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A Comparative Study of Intraradicular *Enterococcus Faecalis* Biofilm Removal
with Three Root Canal Treatment Systems: A Scanning Electron Microscopy
Evaluation

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
in Dentistry at Virginia Commonwealth University

by

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Abstract

A COMPARATIVE STUDY OF INTRARADICULAR ENTEROCOCCUS FAECALIS BIOFILM REMOVAL WITH THREE ROOT CANAL TREATMENT SYSTEMS: A SCANNING ELECTRON MICROSCOPY STUDY

By Cyrus Ardalan, DMD

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University

Virginia Commonwealth University, 2017

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The objective of this study was to evaluate the biofilm removal efficacy of three root canal treatment systems: ProUltra® PiezoFlow™, traditional needle irrigation, and the GentleWave® system in an ex-vivo benchtop study. Twenty-four extracted maxillary and mandibular molars were selected. Teeth were all instrumented to a master apical file size #25 with 4% taper. Teeth were then randomly divided into four experimental groups and two control groups. The root canals were inoculated with a culture of *Enterococcus faecalis* and incubated for five weeks to form a biofilm. Each group was then treated with one of the different root canal treatment systems using 6% sodium hypochlorite (NaOCl) as per the respective manufacturer's recommendation followed by a rinse with water. Following treatment, teeth were decoronated and roots were sectioned longitudinally. Three scanning electron microscope images were taken at the apical level per root half at 5000x magnification. Images were scored by four calibrated examiners blind to group membership using a four-point scoring system (<5% coverage, 5-33%, 34-66%, and >66%). Results were analyzed using mixed model ANOVA. All the experimental

groups were significantly better than the positive control group in removing biofilm. Among the experimental groups, the GentleWave® 15/04 group was significantly better than the other groups. There was no significant difference between the GentleWave® and the ProUltra® PiezoFlow™. Traditional needle irrigation scored the worst in reducing *E. faecalis* biofilm. The GentleWave™ system was as effective at intracanal biofilm removal as the ProUltra® PiezoFlow™ and better than traditional needle irrigation using 6% NaOCl as an irrigant.

Introduction

The elimination of bacteria in the root canal system and the treatment or prevention of apical periodontitis is the primary aim of endodontic therapy (1). Bacteria have been shown to play a major role in both the persistence and emergence of apical periodontitis after root canal therapy has been performed (2). The microflora that exist in apical periodontitis are predominantly facultative anaerobic bacteria. These bacteria are less susceptible to antimicrobial treatment and are more likely to persist following unsuccessful root canal therapy.

The most frequently isolated persistent bacteria in apical periodontitis is *Enterococci faecalis*, and its prevalence has been reported in 32% of teeth with previous root canal therapy and persistent apical periodontitis (3). For bacteria to be found in post endodontic treatment samples, they must resist disinfection procedures and adapt to a strikingly different environment (2). *E. faecalis* appears to be highly resistant to the medications used during root canal therapy and is one of few organisms that is resistant to the antibacterial effects of calcium hydroxide (4). It has also been postulated that a virulence factor of *E. faecalis* in failed endodontically treated teeth may be related to its ability to invade dentinal tubules and adhere to collagen in the presence of human serum (5).

One significant method of resistance *E. faecalis* may undergo is formation of a biofilm. Biofilms, or plaque, are colonies of bacteria embedded in a polysaccharide matrix (5). The ability of *E. faecalis* to form biofilms in root canals of teeth has been shown. These biofilms can enable bacteria to become 1000 times more resistant to phagocytosis, antibodies, and

antimicrobials than non-biofilm producing organisms. Some mechanisms of resistance are an impaired physical penetration of the biofilm matrix, cells within the biofilm antagonizing the effect of antimicrobials, and cells that may change phenotypically (6). Svensater and Bergenholtz proposed a hypothesis for biofilm formation in 2004. They described biofilm formation is likely initiated after organisms invade the pulp chamber. The inflammatory lesion front provides the fluid vehicle for organisms to then travel and attach to the root canal wall (7).

Ricucci et al. were able to identify a high incidence of intraradicular biofilm in both treated and untreated root canals. Biofilms were also significantly associated with periapical lesions and a small percentage of extraradicular biofilms were noted in their study as well (8). A case report by Carr et al. examined a retreatment failure 10 years after endodontic retreatment. They showed microbial communities that existed within the endodontic space for decades after treatment could thrive and prosper with no apparent nutrient source and consist of diverse, multispecies biofilms (9).

Thus, in an infected tooth with apical periodontitis, bacteria may be organized as a biofilm. The persistence of intra-radicular biofilms may be an important factor in post-treatment apical periodontitis. The reduction of this microflora can only be achieved by mechanical dislocation of the biofilm using hand and rotary instrumentation, washing away of the organisms and debris by irrigating with antimicrobial solutions and the use of an intracanal dressing (10).

The main purpose of instrumentation is the mechanical debridement and shaping of the root canal system to create space for delivery of antimicrobial substances (11). However, even with current nickel titanium rotary instrumentation, more than 35% of root canal surface areas can be left untouched (12). Canal walls that are instrumented also produce a smear layer, which can be penetrated by bacteria, and may offer protection to biofilms adhering to root canal walls.

Further, mechanical instrumentation with a chemically inert irrigating solution cannot reduce microorganisms in the root canal successfully (13).

The ideal properties of an irrigant is first and foremost to clean and disinfect the root canal system. The irrigant should not have any adverse effects on dentin or healing ability of the periapical tissues. Ultimately, the irrigant should have the ability to dissolve vital pulp tissue and inactivate endotoxins. In addition, it should be inexpensive, relatively easy to apply and not cause tooth discoloration. The complexity of canal anatomy, presence of a number of dentinal tubules within the roots, invasion of the tubules by microorganisms and formation of a smear layer are all obstacles in removing irritants from the root canal system (13).

Various types of irrigants have been advocated for use in root canal therapy. Sodium hypochlorite appears to be the most ideal root canal irrigant as it has antibacterial properties and the ability to dissolve necrotic tissue and the organic components of the smear layer. Chelators such as EDTA have shown efficiency in removing the smear layer, and in addition may detach biofilms adhering to root canal walls (14). Clegg et al. showed that 6% NaOCl was the only irrigant able to physically remove artificial biofilm and kill bacteria. The higher concentrations of NaOCl were more antibacterial (15). Del Carpio showed that dissolution of biofilms was not only related to the irrigant used, but also dependent on contact time (16).

Syringe irrigation has been used in endodontics since its establishment. The size of the syringe can affect the tactile force needed to irrigate at a certain flow rate. When a clinician depresses the plunger, the pressure inside the syringe barrel is higher than the pressure around the tip of the needle. This is known as a positive pressure technique (17). Sedgely et al. concluded that the mechanical efficacy of an irrigant in reducing intracanal bacteria was

significantly greater when delivered 1mm from the working length compared with 5mm from the working length (18).

Ultimately, syringe irrigation techniques rely on adequate canal enlargement, placement of a fine needle close to working length, and a relatively high flow rate. However, if the needle is placed too close to the end of the root, it is possible to express irrigant into periapical tissues which could result in post operative pain as well as the potential to experience a sodium hypochlorite accident. Clinical studies have shown that syringe irrigation may be unable to remove debris and soft tissue remnants from certain isthmuses and ramifications of molar teeth (19). Recently published randomized control trials using a syringe irrigation technique resulted in a similar radiographic success than a group with ultrasonic activation of irrigation (20). This study suggests that the increased cleaning efficacy of lateral canals and isthmuses may not result in a better treatment outcome.

Ultrasonic irrigation incorporates cavitation and acoustic streaming of the irrigant within a canal to aid in the debridement of the root canal system. Metzler and Montgomery found that passive ultrasonic irrigation (PUI) using NaOCl as an irrigant significantly improved the cleanliness of the isthmuses of mesial roots of mandibular molars in vitro at 1mm and 3mm levels from the apex (21). Some initial difficulties with PUI was that the irrigant needed constant replenishment and this added heavily to clinical treatment time. Thus, new products were created to provide continuous ultrasonic irrigation (CUI).

The Pro Ultra® PiezoFlow™ (Dentsply, Inc, York, PA) is an ultrasonic needle used to facilitate irrigation. The needle is connected to the ultrasonic unit and has a connecting tube, which carries the irrigant from the syringe to the needle. A study by Castelo Baz et al. reported that CUI with the Piezoflow® was more effective than PUI in getting irrigant into lateral canals

(22). However, Howard et al. reported no differences in debris removal with the Piezoflow® over conventional needle irrigation (23).

Recently, a novel device, the GentleWave™ System (Sonendo, Inc, Laguna Hills, CA) has been developed to clean the root canal system. The system is composed of a console and handpiece that delivers treatment solution from the tip of the handpiece into the pulp chamber while excess fluid is simultaneously removed by a vented suction through the handpiece. The treatment protocol uses both sodium hypochlorite and EDTA to create a strong cavitation cloud, which generates a broad spectrum of sound waves within the degassed fluid inside the tooth.

Haapasalo et al. have shown that the tissue dissolution effect of the GentleWave™ system was 8 times greater than that of conventional irrigation systems including the Endovac® and needle irrigation using a simulated tooth model (24). Another study concluded that the GentleWave™ system showed a greater cleaning capacity and reduction in residual debris of mandibular and maxillary molars than those cleaned conventionally (25). A micro-CT study showed complete removal of calcium hydroxide in mandibular molar canals within 90 seconds without the use of any instruments in the canals using the GentleWave™ system (26). A recent prospective clinical study using the GentleWave™ system reported high levels of success after a 12-month follow up (27).

Previous studies have used various irrigation systems to evaluate *E. faecalis* biofilm dissolution and removal. Estrela described a model of biofilm inoculation using single canaled teeth with 60 days of incubation for effective SEM visualization (31). Bhuvra showed that the use of both conventional syringe irrigation and passive ultrasonic irrigation with sodium hypochlorite were effective at removing intraradicular *E. faecalis* biofilms in extracted maxillary anterior teeth (28). This study evaluated biofilm by scanning electron microscopy. Schaudinn

discussed the use of SEM as an invaluable tool for describing biofilms because of its ability to provide a detailed view of surfaces with high resolution and magnification. However, there are limitations as biofilm bacteria can lose their characteristic size and shape as well as being difficult to visualize if they are embedded in a matrix (29). In another study, *E. faecalis* biofilms were grown in root canal systems and treated using both positive and negative pressure irrigation and evaluated by scanning electron microscopy. This study concluded that positive and negative pressure irrigation protocols using 2.5% NaOCl showed a similar capacity to reduce *E. faecalis* in infected root canals, but biofilm was still noted in all image samples (30).

Most biofilm studies have focused on using dentinal slices or extracted single rooted teeth as their biofilm model (16,28). This study will use mesial and distal roots of maxillary and mandibular molars, which can be more difficult to treat because of the curvatures and complex anatomy found in these canal systems. No study to date has compared the GentleWave™ multisonic system to other irrigation systems using this extracted tooth model. The purpose of this study was to compare the effectiveness of the GentleWave™ multisonic system, ProUltra® PiezoFlow®, and conventional needle irrigation on reduction of intraradicular *Enterococcus faecalis* biofilms in extracted molar human teeth using sodium hypochlorite as an irrigant.

Materials and Methods

Twenty-six freshly extracted maxillary and mandibular molar teeth were obtained and stored in phosphate buffered saline until use. Any teeth with decay or fractures below the cemento-enamel junction, internal or external resorption, open apices, or previous root canal therapy were excluded. For all treatment groups, the roots of teeth were firmly secured within a water saturated porous medium to simulate blood-saturated periradicular tissue.

Canal Preparation

Endodontic access was achieved per standard practice of patency, confirmed utilizing a #10K hand file visually extending past the root apex. Working length was defined as 1mm from the clinical apex. The root canals were prepared with #15/.04 and #25/.04 Endosequence rotary files (Brassler USA, Savannah, GA) to the full working length using a step back approach. After completion of canal preparation all samples were treated with the GentleWave system using 3% NaOCl for 5 minutes to provide a baseline for all samples to be free of any tissue remnants. The samples were then submerged in 10mL of PBS and autoclaved for sterility at 121° C for 25 minutes.

Inoculation

Using an inoculation loop, a stock culture of *E. faecalis* (ATCC #19433) was streaked onto a Brain Heart Infusion (BHI) agar plate (Teknova, Hollister, CA). The plate was then incubated at 37 °C for 24 hours. Fifty mL of sterile BHI broth (Teknova, Hollister, CA) was then inoculated with 5 colonies from the 24-hour stock culture plate. The inoculated BHI

broth was then incubated at 37 °C for 4 hours. The inoculated BHI broth was placed in a vortex mixer for 10 seconds to resuspend bacteria within the solution. Using sterile tweezers, the autoclaved molar samples were then placed in 15mL sterile centrifuge tubes (McMaster-Carr, USA).

Using a sterile 30 G Max-i-Probe needle (Dentsply, York, PA) and a 3cc syringe (Medtronic, Minneapolis, MN), the root canals were injected with the bacterial suspension in BHI broth until the canals were filled (approximately 150 µL). The samples were then centrifuged for 5 minutes each at 3500 rpm and this step was repeated twice. The coronal portion of the molar samples were then filled with the bacterial suspension and centrifuged for 5 minutes at 3500 rpm. The media was replenished every 3 days as needed using sterile BHI broth. The incubation period of the samples was five weeks. Care was taken that all samples were handled with utmost sterility.

Testing Procedures

Following incubation of a mature biofilm, the samples were divided randomly into four treatment groups and two control groups listed below:

- A. GentleWave™ system (n=6)
- B. ProUltra PiezoFlow® Active Ultrasonic (n=6)
- C. Conventional Needle Irrigation (n=6)
- D. GentleWave™ system 15/04 (n=2)
- E. Positive control (Biofilm inoculation, no treatment) (n=3)
- F. Negative control (No Biofilm, no treatment) (n=3)

A single operator performed all endodontic treatment procedures. So as to standardize the treatments, care was taken to ensure that the sequence, concentration, exposure of treatment fluids for each tooth would be the same across all treatment groups.

A. GentleWave™ System:

The teeth were treated using the GentleWave system following the manufacturer's recommended procedure. The GentleWave system was used with 3% NaOCl for 5 minutes per tooth followed by sterile water for 15 seconds. The canals were then dried with paper points.

B. ProUltra PiezoFlow® Ultrasonic System:

Irrigation was performed with the ProUltra PiezoFlow system. The ultrasonic irrigation needle was attached to the ultrasonic handpiece. Then, a syringe pump (New Era Pump Systems, Farmingdale, NY) was connected to a 0.5L vial of sodium hypochlorite which was then attached to the Luer-lock connection on the ultrasonic irrigation needle. The flow rate was set to 15 ml per minute.

After completing canal preparation, the needle was trial-fit into the canal and the length at which the needle began to bind against the canal walls was determined. The needle was pulled back approximately 1 mm and the silicon stopper was set to this depth. The power level was set to 5 and 6% NaOCl was used for 1 minute per canal, as per the manufacturer's recommendation. Afterwards, each canal was rinsed with water for 20 seconds using a 30 gauge max-i-probe needle. Small paper points were used to dry the canal.

C. Conventional Needle Irrigation

A 30-gauge needle was placed 2mm short of WL, without binding and moved in an up and down motion while irrigating. The needle was attached to a syringe pump set at 5ml per minute. Six percent NaOCL was delivered for 1 minute per canal followed by 30 seconds of water in

sequence. Paper points were used to dry the canal.

D. GentleWave™ System 15/.04:

The teeth were treated using the GentleWave™ system. The GentleWave™ system was used with 3% NaOCl for 5 minutes per tooth, and sterile water for 15 seconds.

E. Positive control

Treatment teeth in this group were inoculated with biofilm but no irrigation protocol was completed.

F. Negative Control

Teeth in the negative control group did not receive any inoculation or treatment.

After each tooth had been subjected to its allocated irrigation protocol (Table 1), the crown was removed from the tooth using a diamond disc. The roots were then sectioned and split along their long axis using a diamond disc and blade. Next, they were prepared for scanning electron microscopy.

Table 1. Random assignment

<u>Treatment</u>	<u>Chart-Tooth</u>
GentleWave	xx179-3
GentleWave	xx340-18
GentleWave	xx463-3
GentleWave	xx576-18
GentleWave	xx593-3
GentleWave	xx805-30
GentleWave 15 0.04	xx804-32
GentleWave 15 0.04	xx952-15
ProUltra/ Piezo Flow	xx052-14
ProUltra/ Piezo Flow	xx211-18
ProUltra/ Piezo Flow	xx265-2
ProUltra/ Piezo Flow	xx304-18
ProUltra/ Piezo Flow	xx405-14
ProUltra/ Piezo Flow	xx596-15
Needle Irrigation	xx009-31
Needle Irrigation	xx028-15
Needle Irrigation	xx266-15
Needle Irrigation	xx694-02
Needle Irrigation	xx856-30
Needle Irrigation	xx966-3
Negative Control	xx960-14
Negative Control	xx961-2
Negative Control	xx963-15
Positive Control	xx076-3
Positive Control	xx679-03
Positive Control	xx965-2

Scanning Electron Microscopy Preparation

The root samples were dehydrated by serial dehydration in graded ethanol with the following dilutions in distilled water: 50% ethanol, 70% ethanol, 80% ethanol, and 100% ethanol. The roots were then sputter coated with gold palladium prior to imaging. All roots were imaged with a Hitachi TM3030 scanning electron microscope. All images were acquired in the apical 1.5-2.5mm of the root at 50x, 200x and 5000x. Three images of each root half were taken

at 5000x unless it was not feasible due to splitting or excessive splitting debris. SEM and image selection were performed in a blinded fashion.

Image preparation

After roots were sectioned, each root had aspects labeled as “Side 1” and “Side 2”. An SEM image at 5000x magnification was taken at three locations labeled “X1”, “X2”, or “X3”.

Table 2 shows the number of usable images available for each tooth and root. Note that not all roots produced the planned 6 images. In addition, note that two roots were randomly chosen to be assessed multiple times—these correspond to the count=4 in the table. These replicate samples were chosen to assess intra-rater repeatability.

Table 2. Number of images per tooth and root

Chart-Tooth	Root	Side 1			Side 2		
		X1	X2	X3	X1	X2	X3
<u>GentleWave</u>							
xx179-3	DIS	1	1	1	1	1	1
xx179-3	MB1	1	1	1	1	1	1
xx179-3	MB2	1	1		1		1
xx340-18	DIS Apical				1	1	1
xx340-18	ML MB,MB Apical	1	1	1	1	1	1
xx340-18	ML MB,ML Apical	1	1	1	1	1	1
xx463-3	DB	1	1	1			
xx463-3	MB	1	1	1			
xx463-3	MB2	1	1	1	1	1	1
xx576-18	DIS Apical	1	1	1	1	1	1
xx576-18	MB ML,MB Apical	1	1	1	1	1	1
xx576-18	MB ML,ML Apical	1	1	1	1	1	1
xx593-3	MB	1	1				
xx805-30	DIS DB Apical	1	4	1	1	1	4
xx805-30	DIS DL Apical	1	1	1	1	1	1
<u>GentleWave 15 0.04</u>							
xx804-32	DIS	1	1	4	1	1	4
xx804-32	MB ML,MB	1	1	1	1	1	1
xx804-32	MB ML,ML	1	1	1	1	1	1
xx952-15	DIS	1	1	1			
xx952-15	MB	1	1	1	1	1	1

Chart-Tooth	Root	Side 1			Side 2		
		X1	X2	X3	X1	X2	X3
		ProUltra/ Piezo Flow					
xx052-14	DIS	1	1	1	1	1	1
xx052-14	MB	1	1	1	1	1	1
xx211-18	DIS	4	1	1	4	1	1
xx211-18	MB	1	1	1			
xx211-18	MB ML,MB				1	1	1
xx211-18	MB ML,ML	1	1	1	1	1	1
xx265-2	DB Apical	1	1	1	1	1	1
xx265-2	MB Apical	1	1	1	1	1	1
xx304-18	DIS	1	1	1	1	1	1
xx304-18	MB ML MERGE	1	1	1	1	1	1
xx405-14	DB	1	1	1			
xx405-14	MB	1	1	1	1	1	1
xx596-15	DB	1	4	4			
		Needle Irrigation					
xx009-31	DIS	1	1	1	1	1	1
xx009-31	MB ML,MB	1	1	1	1	1	1
xx009-31	MB ML,ML	1	1	1			
xx028-15	DB Apical	1	1	1	1	1	1
xx028-15	MB Apical	1	4	4			
xx266-15	DIS				1	1	1
xx266-15	MB Apical	1	1	1	1	1	1
xx694-02	DB	1	1	1	1	1	1
xx694-02	MB	1	1	1	1	1	1
xx856-30	DIS DB Apical	1	1	1	1	1	1
xx856-30	DIS DL Apical	1	1	1	1	1	1
xx856-30	MB ML,MB Apical	1	1	1	1	1	1
xx856-30	MB ML,ML Apical	1	1	1	1	1	1
xx966-3	DIS Apical	4	4	1	1	1	1
xx966-3	MB Apical				1	1	1
		Negative Control					
xx960-14	MB Apical	1	4	1	1	1	4
xx961-2	DB	1	1	1	1	1	1
xx961-2	MB	1	4	4	1	1	1
xx963-15	DIS Apical	1	1	1	1	1	1
		Positive Control					
xx076-3	DB Apical	1	1	1	1	1	1
xx679-03	DB Apical	1	1	1	4	1	4
xx965-2	MB	4	4	1	1	1	1

Data Acquisition

Four examiners were calibrated using a series of images obtained from a database created during preliminary studies. A number of different images representing each score were used to ensure that the examiners were exposed to slight variations in the appearance of the biofilm. A calibration test was completed by the examiners to confirm a high level of agreement.

Counting the 60 replicate images, there were 348 images available for assessment. In order to reduce the cognitive load on the raters, it was decided that each rater would evaluate one-third of the images on three separate occasions. The images were randomly assigned to one of three blocks in a manner to equalize the number of treatment groups, sides, and x-aspects (see Table 3). The replicate images were also assigned so that an SEM was repeated, twice in one block and repeated in each of the other two blocks.

Table 3. Assignment of images to one of three blocks

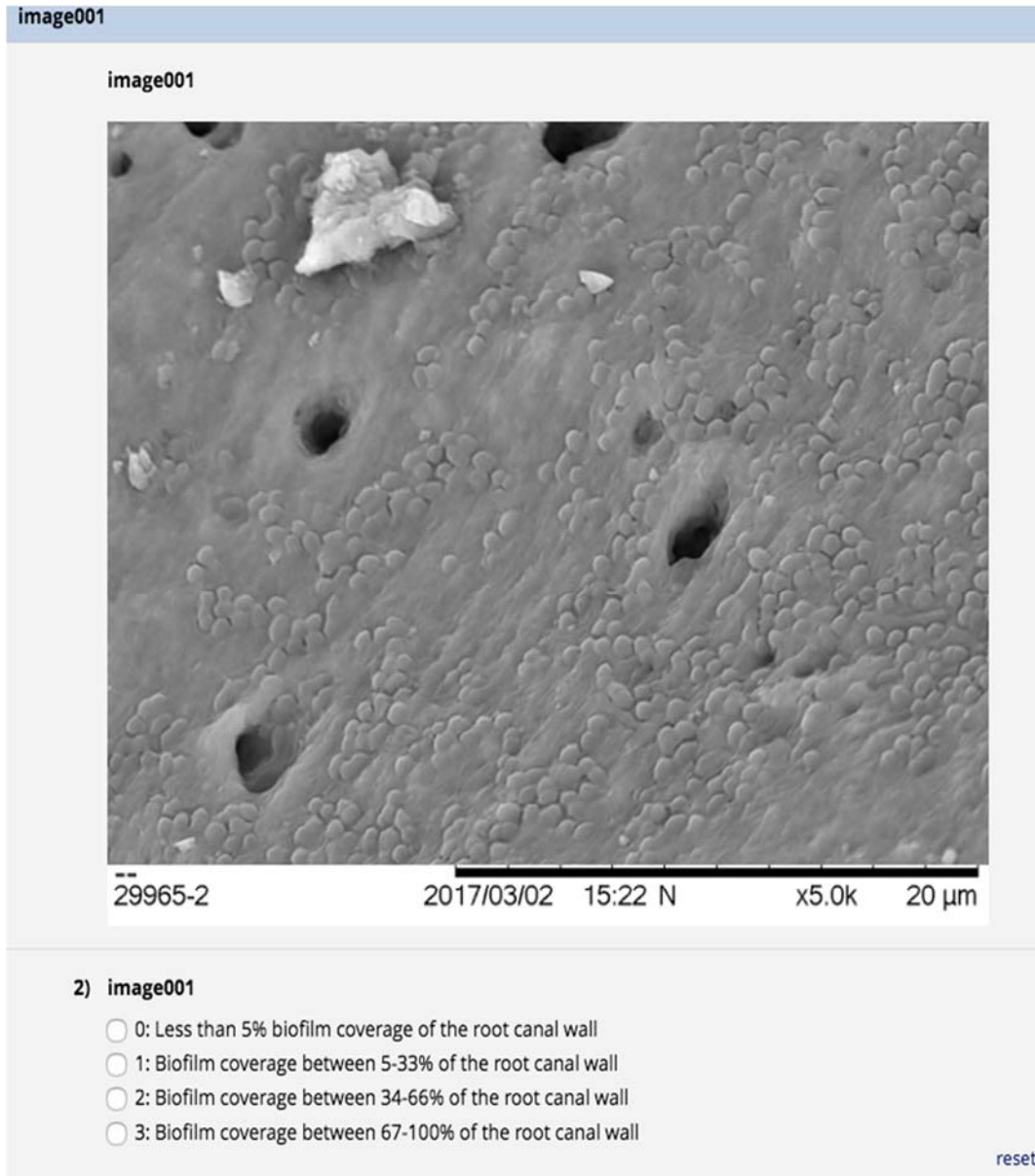
Characteristic	Random Block		
	1	2	3
Treatment			
GentleWave	28	26	27
GentleWave 15 0.04	11	11	11
Needle Irrigation	30	32	28
ProUltra/ Piezo Flow	28	26	24
Negative Control	11	12	13
Positive Control	9	11	10
Side			
Side 1	68	66	59
Side 2	49	52	54
X			
X1	38	25	49
X2	38	57	22
X3	41	36	42
Total	117	118	113

The images were cropped to exclude the image data: after which they were numbered from 1 to

348. Using a random number sequence generator, all of the images in a block were randomly ordered, with the exception that in each block the first two images were of controls—one negative control and one positive control.

A single SEM image was shown via a REDCap® survey and evaluators were asked to score the image using a 4 point scoring system adapted from Bhuva (28). For example, see Figure 1.

Figure 1. Redcap Survey Question



Statistical Analysis

Differences between the five groups were assessed using a repeated-measures mixed-model ANOVA that took into account the random assignment of images into blocks for assessment purposes, the rater and position differences. Inter and intra-examiner agreements were assessed by the chance-corrected Kappa index of agreement.

Results

Each of four raters scored the 348 images independently. Table 4 shows the number ratings for each of the four rating categories and summarized the average rating using the mean and standard deviation of the ratings of the respective images. Nominally, the GentleWave 15/0.04 had the lowest average rating and the needle irrigation had the highest average rating. It is comforting to observe that the raters largely rated the Negative Control images as 0 and the Positive Control images as 3, although these were not the only rating produced in these controls. It is also apparent that the four raters had different average ratings. Raters A and C more commonly gave low ratings and raters B and D gave high ratings more often.

Table 4. Overall rating summary

Treatment	Rating				total	Score	
	0	1	2	3		Mean	Std Dev
GentleWave	214	54	22	34	324	0.617	1.002
GentleWave 15 0.04	103	10	4	15	132	0.477	1.000
ProUltra/ Piezo Flow	174	73	26	39	312	0.776	1.046
Needle Irrigation	143	45	42	130	360	1.442	1.330
Controls							
Negative Control	104	31	5	4	144	0.368	0.687
Positive Control	3	7	41	69	120	2.467	0.721
Rater							
A	249	33	10	56	348	0.635	1.122
B	117	72	51	108	348	1.431	1.242
C	282	6	25	35	348	0.463	0.999
D	93	109	54	92	348	1.417	1.145

The control images were constructed so that the “correct” rating for a Negative Control image was 0. The raters were trained to be calibrated to these standards but there remains evidence of rater differences (Table 5). Rater A appears to match best with the expectations. Rater B often

gave non-zero scores to the negative control images and gave a rating of 3 to the positive control images somewhat more than half the time. Rater C got all the negative control images correct but was clearly reticent to assign ratings of 3, even to the positive control images. Rater D rated the negative control images correctly less than half the time but was more nearly correct on the positive images. All this indicates a potential bias between the raters.

Table 5. Rater differences on the control images

Rater	Rating				total	Score	
	0	1	2	3		Mean	Std Dev
Negative Control							
A	34	2	0	0	36	0.056	0.232
B	21	13	0	2	36	0.528	0.774
C	36	0	0	0	36	0.000	0.000
D	13	16	5	2	36	0.889	0.854
Positive Control							
A	1	1	3	25	30	2.733	0.691
B	1	3	10	16	30	2.367	0.809
C	1	1	19	9	30	2.200	0.664
D	0	2	9	19	30	2.567	0.626

All four raters assessed every image, and so it's possible to compare the agreement of the ratings. The full description of each pair of the four raters is given in the Appendix, Table 6, and the level of agreement is summarized in Table 6. All of the Kappa agreement scores were significantly above chance agreement ($P < .001$). Raters A and C had the highest level of agreement—81% exact agreement and a chance-corrected Kappa agreement of 53%. Raters C and D had the lowest level of agreement.

Table 6. Summary of between rater agreements

Comparisons	Agreement	
	Exact	Kappa
A v. B	46.6%	22.0%
A v. C	81.0%	52.6%
A v. D	44.5%	24.2%
B v. C	45.7%	20.4%
B v. D	53.4%	37.1%
C v. D	39.1%	17.7%

There were 4 positive control images and 4 negative control images that were repeatedly assessed—there were four occasions where these duplicate images were assessed. Accordingly, the within-rater agreement may be described by counting the number of times the same image was rated with an identical rating. Table 8 in the Appendix shows each rater’s assessment of these duplicate images. The results are summarized as follows: Rater A and C gave identical ratings on all 8 images 88% of the time, and rater B gave identical ratings 75% of the time. For each of the 8 duplicate images, rater D never gave the same rating across the four occasions where he was shown the same image. The negative control images seemed somewhat easier to assess identically, as this occurred in 69% of these images whereas an identical assessment occurred in 56% of the positive control images.

In summary, the raters each exhibited a different mean level and varied somewhat in their agreement with the other raters and with themselves. The possibility of these differences were anticipated and were taken into account in the analysis.

Analysis of the primary aim

The primary aim of the study was to compare the rating of biofilm coverage between the 4 treatment groups. The analysis of this aim was accomplished using a repeated-measures mixed-model ANOVA. The following factors were included in the model: Treatment, Random block (1, 2, or 3), Position of the image (Side 1 or 2, and X1-X3), and Rater (A, B, C, or D). Each Chart-

Tooth-Root was treated as independent and the six positions of the image were treated as a repeated (correlated) assessment. Table 7 shows that, after adjusting for Rater, Block, and Position differences, there were significant differences between the Treatment groups. The least-squares mean rating is shown with its 95% confidence interval. Differences between the means were identified by Tukey's LSD multiple comparison procedure. Those LS Means sharing the same letter were not significantly different. The superscript letters for the Treatment effect show that Needle Irrigation is significantly better than the Positive Control and worse than all other groups. The ProUltra® Piezeoflow™ and GentleWave™ groups were not different from one another. The Negative control is significantly better than all other treatments except the GentleWave™15/0.04.

Table 7. Group differences

Effect	LS Mean *	95% CI	P-value
Treatment			<.0001
Positive Control	2.56 ^a	(2.41 to 2.71)	
Needle Irrigation	1.55 ^b	(1.47 to 1.64)	
ProUltra/ Piezo Flow	0.77 ^c	(0.67 to 0.86)	
GentleWave	0.70 ^c	(0.61 to 0.79)	
GentleWave 15 0.04	0.65 ^{cd}	(0.50 to 0.80)	
Negative Control	0.44 ^d	(0.30 to 0.57)	
Rater			<.0001
B	1.56 ^a	(1.47 to 1.64)	
D	1.54 ^a	(1.45 to 1.63)	
A	0.76 ^b	(0.67 to 0.85)	
C	0.59 ^c	(0.50 to 0.67)	
Random block			<.0001
1	1.30 ^a	(1.23 to 1.38)	
3	1.03 ^b	(0.95 to 1.11)	
2	1.00 ^b	(0.92 to 1.08)	
Position			0.0381
Side 2 X1	1.25 ^a	(1.14 to 1.37)	
Side 2 X3	1.15 ^{ab}	(1.04 to 1.25)	
Side 2 X2	1.11 ^{ab}	(0.99 to 1.23)	
Side 1 X3	1.08 ^{ab}	(0.98 to 1.19)	
Side 1 X2	1.08 ^{ab}	(0.98 to 1.18)	
Side 1 X1	1.00 ^b	(0.89 to 1.10)	

* Significant differences identified by Tukey's LSD multiple comparison procedure. Groups sharing the same superscript letter are not significantly different ($P < .05$)

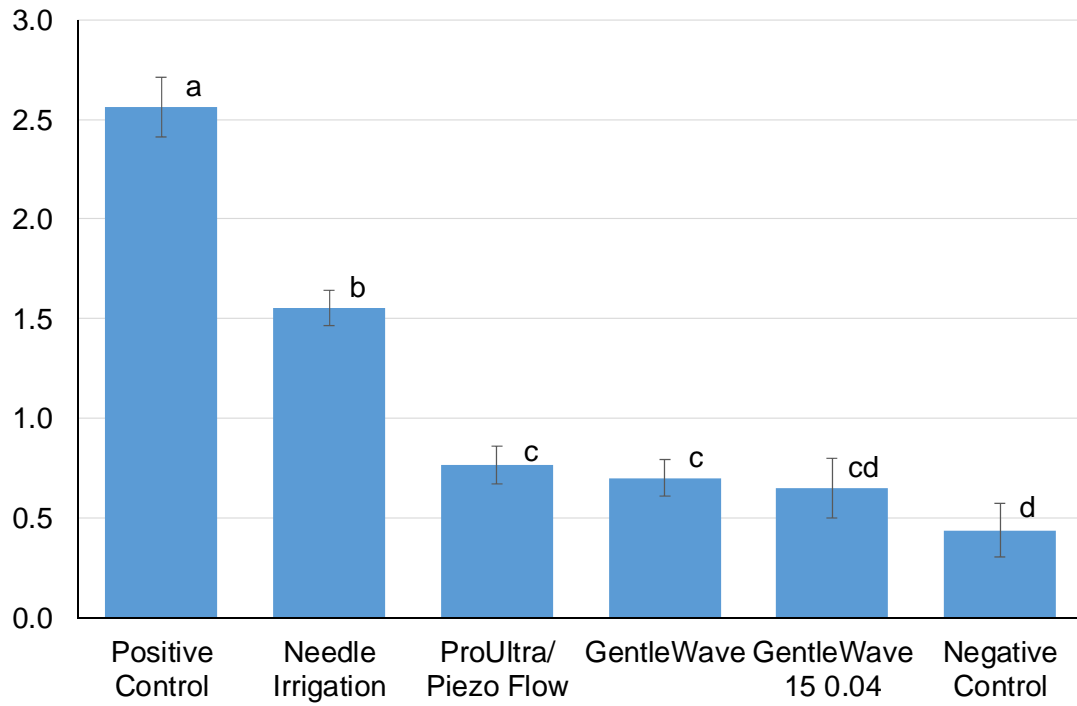


Figure 2. Treatment group differences

Discussion

This was an ex-vivo study that examined the efficacy of biofilm removal in extracted teeth using 3 different irrigation systems: standard syringe irrigation using a 30g needle, continuous ultrasonic irrigation (CUI) with the ProUltra® Piezoflow™ and a new irrigation system, the GentleWave™. The syringe irrigation and CUI both used 6% NaOCl and the GentleWave™ system used 3% NaOCl as the choice of irrigant. The study used the mesial and distal roots of extracted molars with *E. faecalis* biofilm formation on the root walls. The teeth were treated with each of the irrigation systems and then the remaining biofilm was evaluated in the apical third of the roots. Scanning electron microscopy (SEM) was used to evaluate the biofilm formation and effects of the irrigation systems similar to studies by Clegg and Bhuva (15,28). Four raters then scored the percentage of biofilm for 348 SEM images using a REDCap® survey.

This study design used extracted human molar teeth for the study model. According to Estrela, an adequate human root canal with variations and complexity reflects the best environment for a biofilm study (31). Previous studies have used 3D models, membrane filters, dentinal slices, and single rooted teeth as vectors for biofilm formation (5,10,15,16,28). The use of mesial and distal roots of maxillary and mandibular molars increases the difficulty for both biofilm formations ex-vivo as well as effective irrigation due to the anatomical complexities of molar teeth. In addition, this study design focused only on the apical third of these teeth, where ramifications and lateral canals are mostly located (1,11).

Table 4 details the raters overall scoring summary. Overall, the Gentlewave™ system had 83% of images with less than 33% biofilm coverage, the ProUltra® Piezoflow™ had 79% with

less than 33% biofilm coverage, and needle irrigation had 52% with less than 33% biofilm coverage. Raters A and C tended to rate lower scores for biofilm coverage. These raters were also more experienced with viewing SEM images and may have been better able to delineate biofilm versus dentin or debris. Raters B and D tended to have higher scores, which may have been due to less experience in viewing SEM images.

Table 5 shows rater differences on control sample images. Ultimately, if biofilm inoculation was covering a majority of the walls of the positive controls, raters should have scored a “3” for these images. However, from the table we can gather that only 58% of positive controls were scored a “3” and 34% were scored as a “2”. Thus, raters established that 92% of positive controls had greater than 33% biofilm coverage but, only 58% had greater than 66% biofilm coverage. From this data we can infer that biofilm inoculation was more challenging to form on walls in the apical third of molar teeth.

Previous biofilm studies have shown that coronal and middle thirds of canals were covered more heavily with biofilm and more easily removed after irrigation (28,31). Several studies have shown that it takes a considerable amount of time for biofilm formation to occur. This study inoculated molars with biofilm for a period of 5 weeks (35 days). Estrela et al. suggested that mature *E. faecalis* biofilm on human root dentin may need 60 days to develop under low oxygen and nutrient rich environment. They believed it would allow for a satisfactory colonization time and viable for antimicrobial strategies (31). It is likely that a longer biofilm incubation period may have given more scores of “3” for positive controls. Greater wall coverage could have resulted in more accurate scoring of the SEM images and better rater agreement.

This study used scanning electron microscopy (SEM) for evaluation of biofilm in the apical third in molar teeth. Schaudinn discussed that SEM is a useful imaging approach for identifying bacterial biofilms in their dental habitat. However, he stated that most biofilms are embedded in a thick layer of extracellular matrix that prevents a clear identification of individual bacteria by SEM. Biofilms can also lose their characteristic shape which can make them difficult to visualize (29). In addition, splitting of teeth results in the accumulation of dentinal debris. This debris could possibly be interpreted as biofilm in certain images. Although raters were shown multiple images to be able to differ between the two, it is possible that identification could be challenging. SEM images were taken at 5000x magnification. A lower magnification may have given a better sense of biofilm coverage in the apical third. Another visualization approach is the use of confocal laser microscopy in combination with fluorescence which can enable the visualization of matrix embedded biofilms (29).

Some of the SEM images showed atypical dentin structure. Possible reasons for this may be dehydration occurring during instrumentation. All teeth were stored in PBS, but they were not in any solution when teeth were instrumented and possibly long term handling may have led to changes within the dentinal structure. It is also not known if any of the SEM preparation could have disturbed biofilm on the root walls after teeth were split. Any changes to the root structure could have influenced SEM scoring.

In this study, negative controls without biofilm inoculation should have a “correct” rating of 0. However, Table 1 shows that 39/144 negative control images were scored higher than 0. A possible reason for this may be that the raters were not equally calibrated. The calibration exercise consisted of a presentation that showed SEM images with a range of no coverage to complete dentinal wall coverage. This was followed by scorers rating 15 images on their own.

For any images where there was a discrepancy, those images were reviewed and discussed in terms of what a reasonable score for the image would be. The calibration may not have adequately prepared raters for the scoring of 348 images. Rater fatigue was to be helped by separating the surveys into 3 blocks, but if a rater took all 3 blocks simultaneously then fatigue could be an issue.

One solution for better calibration could have been to have raters complete a single survey block and evaluate the agreement between raters. Then, all raters could have discussed their scoring protocol and been re-calibrated as a group to have a better consistent agreement. After re-calibration raters would have completed additional survey blocks.

Table 6 shows the data for between rater agreements. The two raters who had the greatest agreement, A and C, also had the most experience in viewing SEM images of biofilm. This shows that experience of viewing many of these images was important in rating more consistently with one another. Table 9 in the appendix describes the within rater agreements on duplicate images. One aspect of this study was that only control images were used as duplicate images, thus, raters should have a more consistent agreement for negative and positive controls.

Table 9 reveals that when raters were shown images more than once, generally most raters agreed with themselves. But, if they were to score differently, the score was usually within 1 level of scoring. For instance, if a positive control was scored a “3” on one occasion, it may be scored a “2” on another occasion. This may infer that if biofilm coverage was near 66% then it may be difficult for all raters to agree whether that score was a 2 or a 3. It is of note that rater D was shown a negative control 4 times and gave it 3 different scores when repeated. This shows a poor intra-rater agreement on the part of rater D. It is also of interest that rater D was

least experienced in rating biofilm images. Rater D also may have scored the images more quickly and this could have led to a poorer agreement.

Within the limitations of this study, it was shown that the GentleWave™ system was as effective as the ProUltra® Piezoflow™ ultrasonic irrigation system in removing intracanal *E. faecalis* biofilm in maxillary and mandibular molar teeth using 3% NaOCl and 6% NaOCl respectively. Syringe irrigation was less effective at removing biofilm using 6% NaOCl. No system was able to completely remove all biofilm according to the raters. This study differs from the findings of Bhuva et al. that concluded conventional syringe irrigation and passive sonic irrigation with NaOCl was completely effective at removing *E. faecalis* biofilm (28). The Bhuva study only used single rooted maxillary anterior teeth which do not possess the same anatomical challenges in cleaning. Their study also evaluated the root apices at coronal, middle, and apical areas.

Enterococcus faecalis can adapt to environmental changes after endodontic therapy and remain a pathogen in the root canal system, making elimination difficult. In the present study, none of the irrigation systems completely eradicated *E. faecalis* biofilms from the root canals (30). These findings are in accordance with previous studies, which showed microbial persistence after the use of irrigants in infected root canals (18,30,32).

Unlike other studies, this study incorporated more challenging root canal systems of molars where efficacy of biofilm removal may be more difficult. Adding additional irrigants such as EDTA or higher concentrations of NaOCl may also have proven to be more effective at biofilm removal. Additional calibration of raters may have also led to a greater agreement between raters. The use of additional microscopy or possibly software that could identify biofilm may have been useful to account for human error and bias. Further studies should be undertaken

using different evaluation measures to investigate biofilm removal and how it may effect the success of root canal treatment.

In conclusion, the GentleWave™ system and ProUltra® Piezoflow™ ultrasonic irrigation systems were most effective in removing intracanal *E. faecalis* biofilm in this model. Syringe irrigation was much less effective in biofilm removal. No system was able to completely remove all biofilm according to the raters.

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Appendices

Appendix A: REDCap survey, block 1

First block of Images

Please complete the survey below.

Thank you!

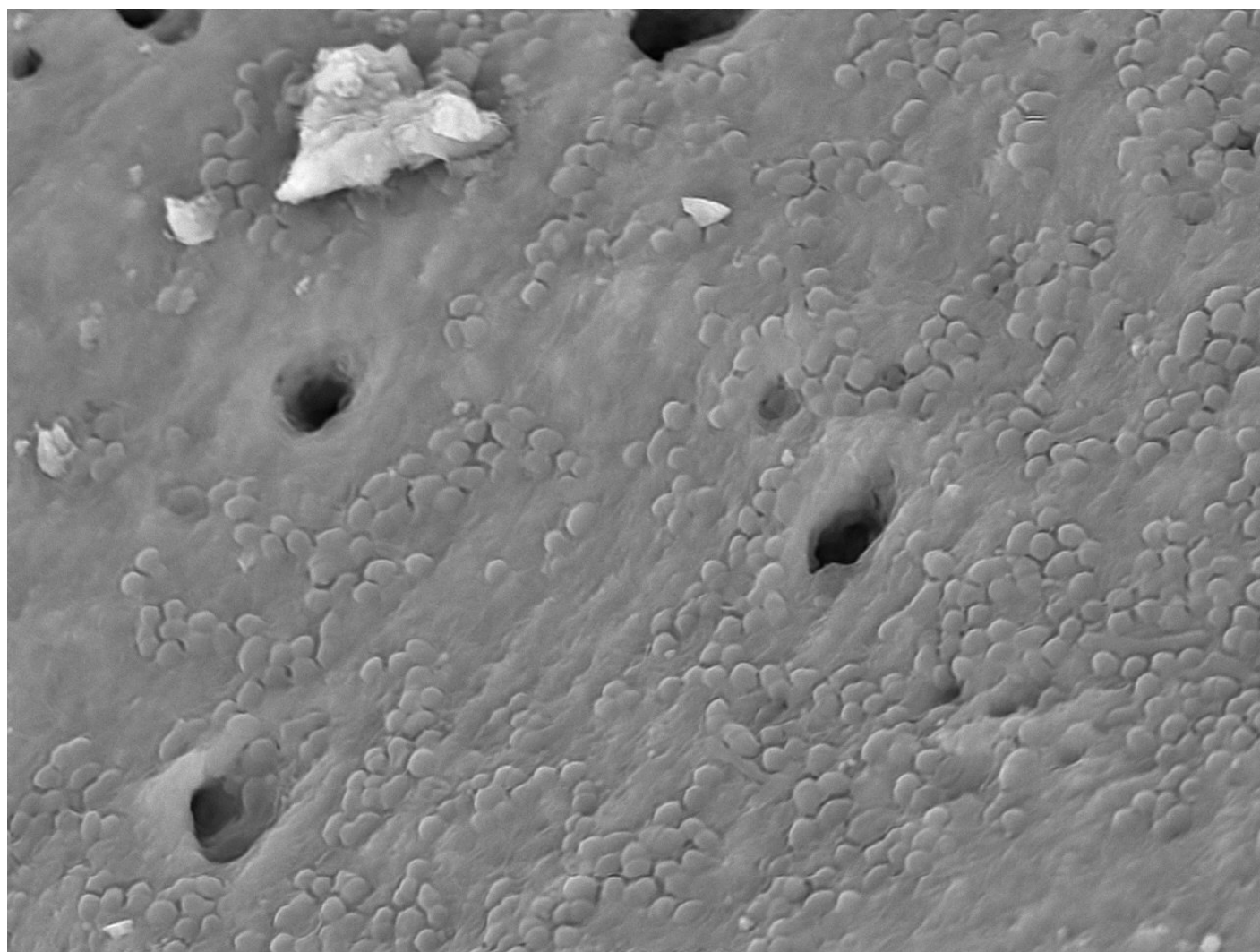
Identify rater

1) Who is rating these images?

- Garry Myers
- Vaughn Mayo
- Todd Kitten
- Cyrus Ardalan

image001

image001



29965-2

2017/03/02 15:22 N

x5.0k

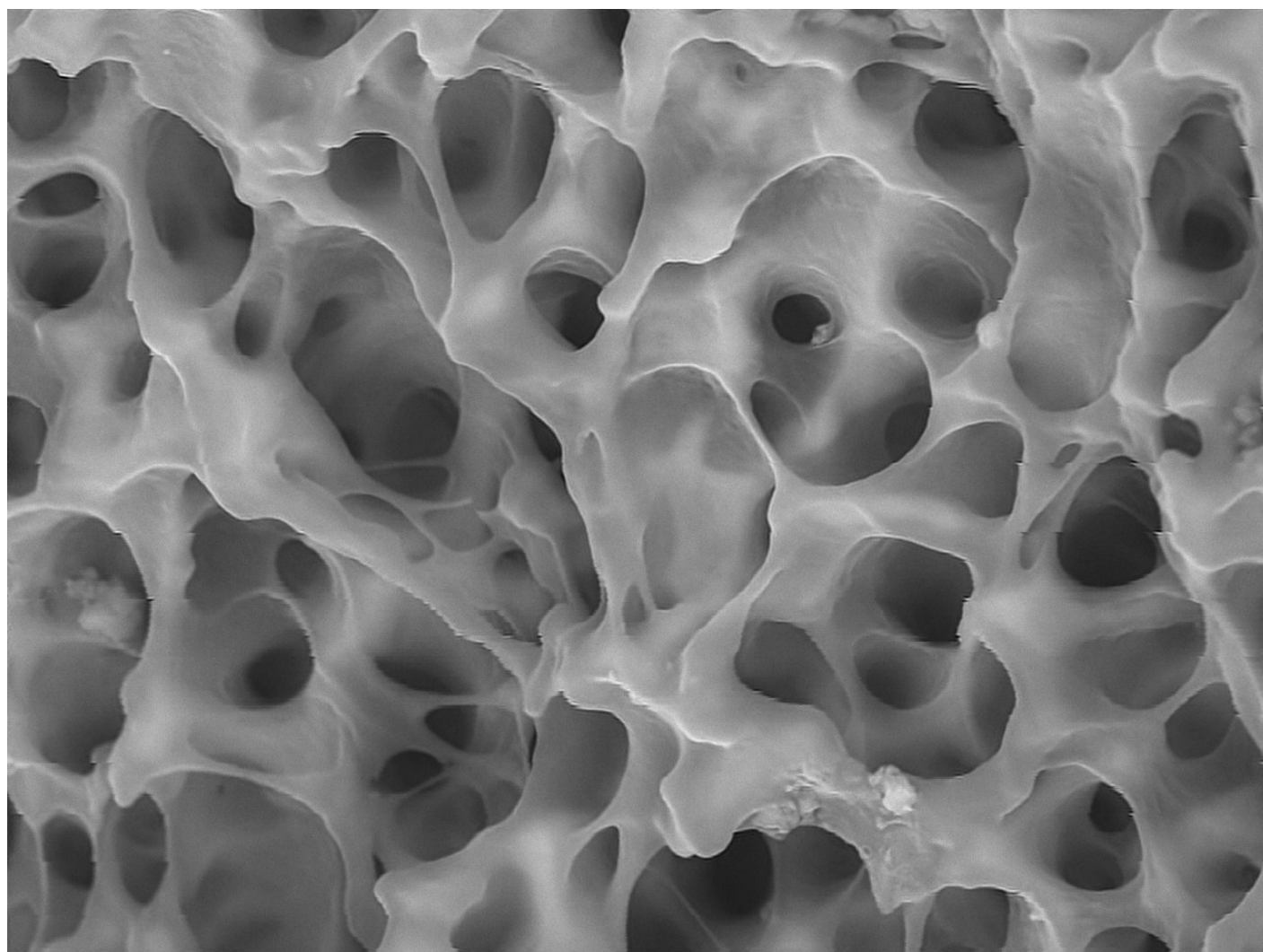
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2) image001

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image002

image002



29960-14

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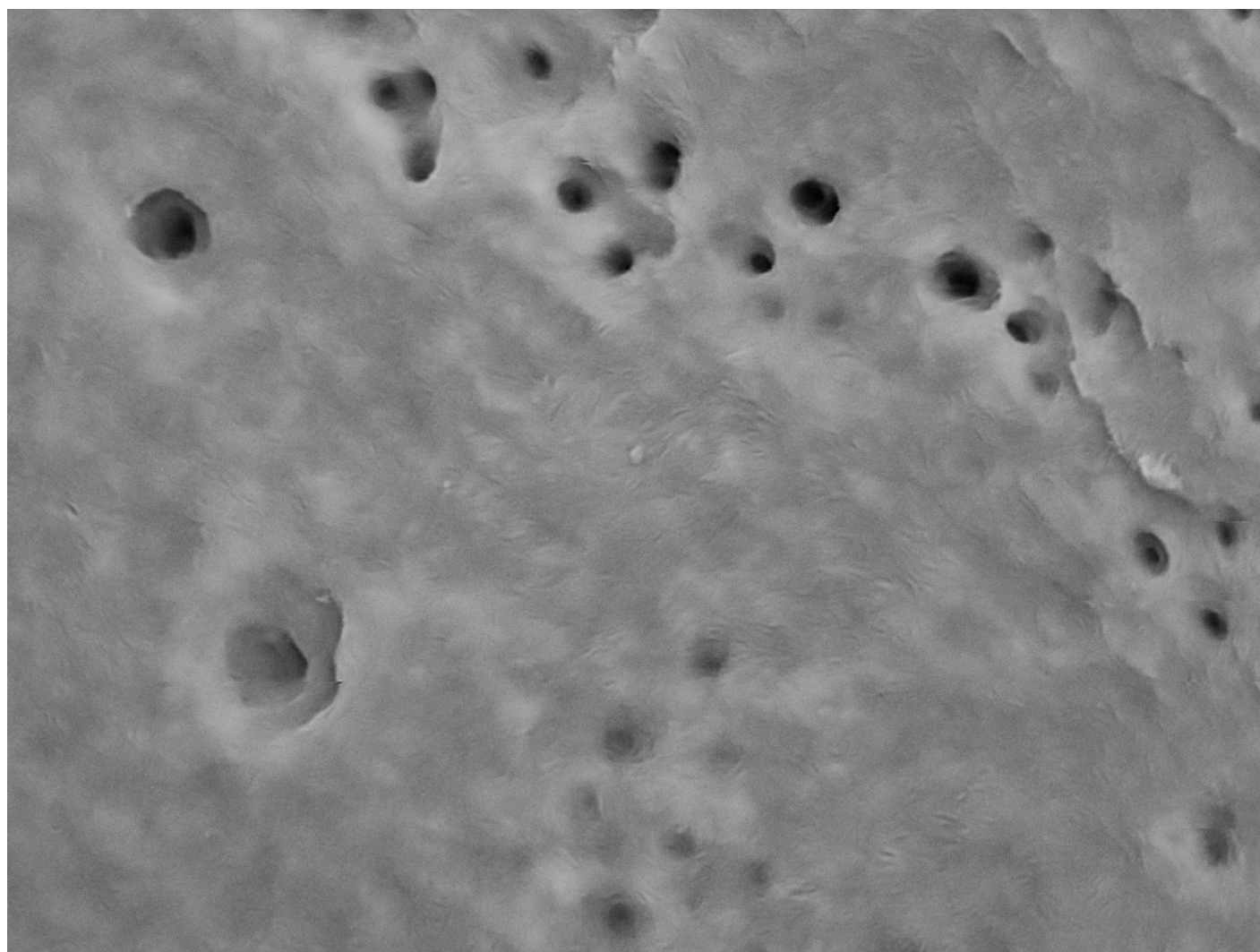
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3) image002

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image003

image003



29340-18

2017/03/03 09:55 N

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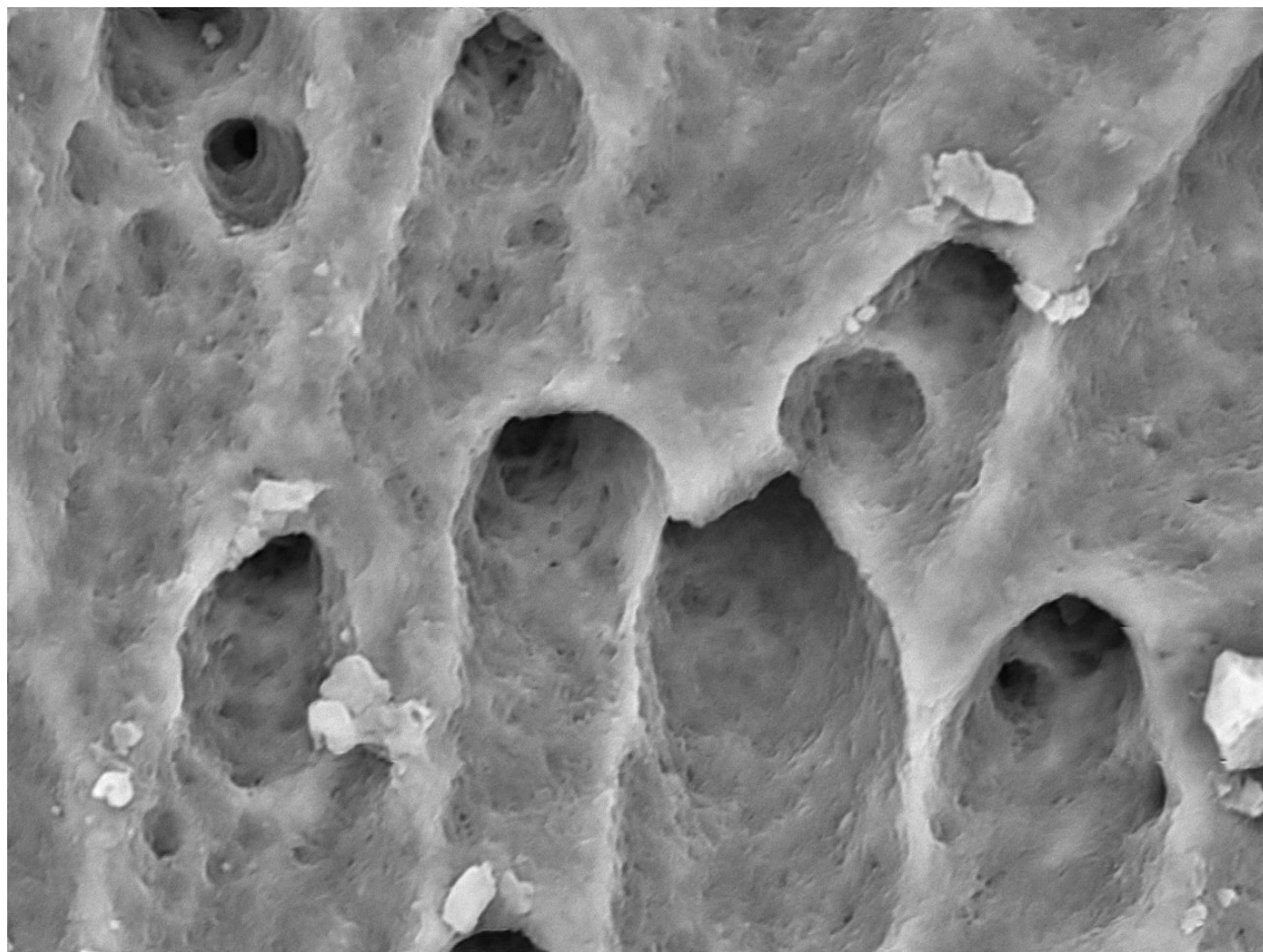
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4) image003

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image004

image004



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2017/03/03 16:03 N

x5.0k

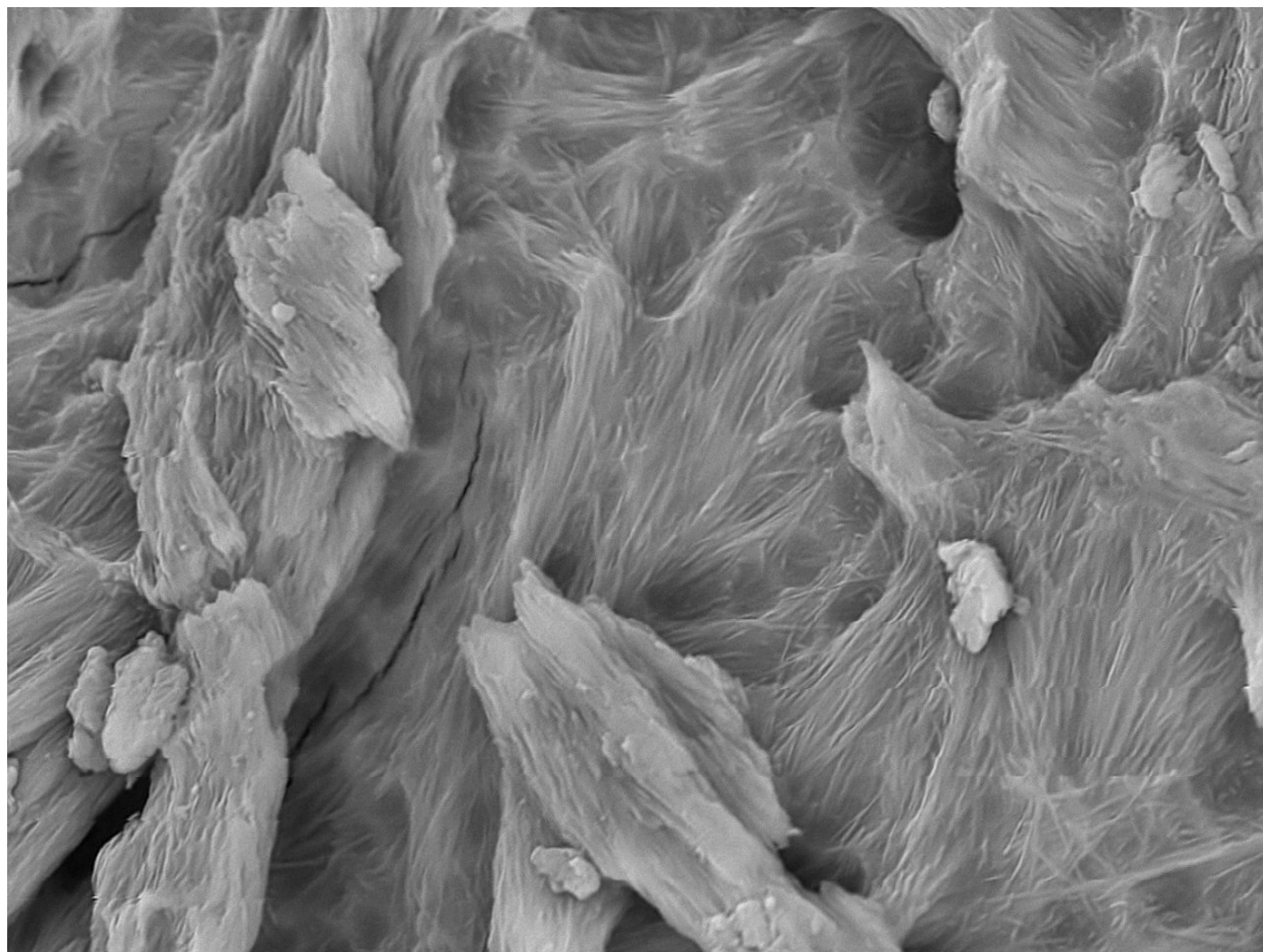
20 μ m

5) image004

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image005

image005



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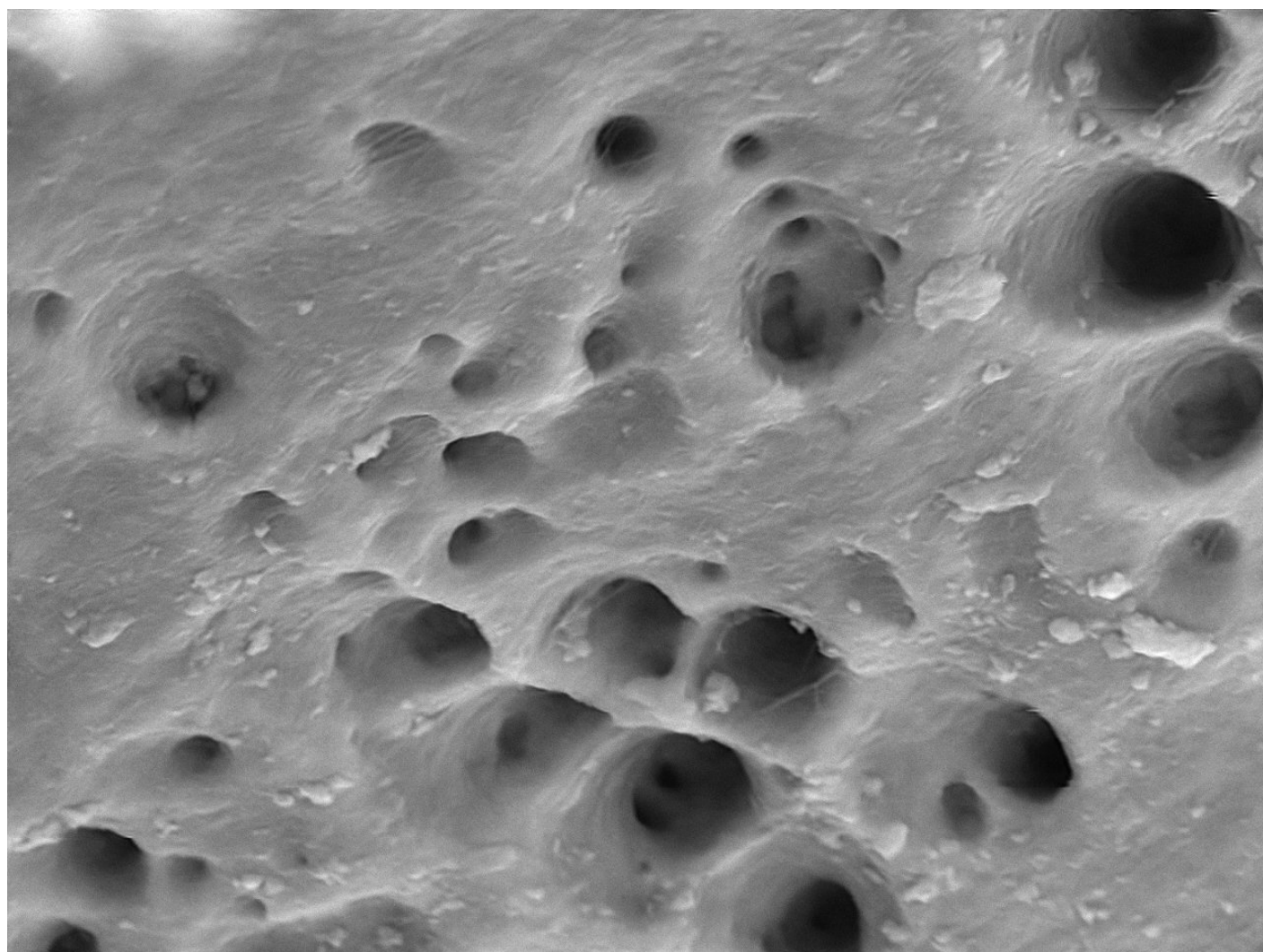
x5.0k 20 μ m

6) image005

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image006

image006



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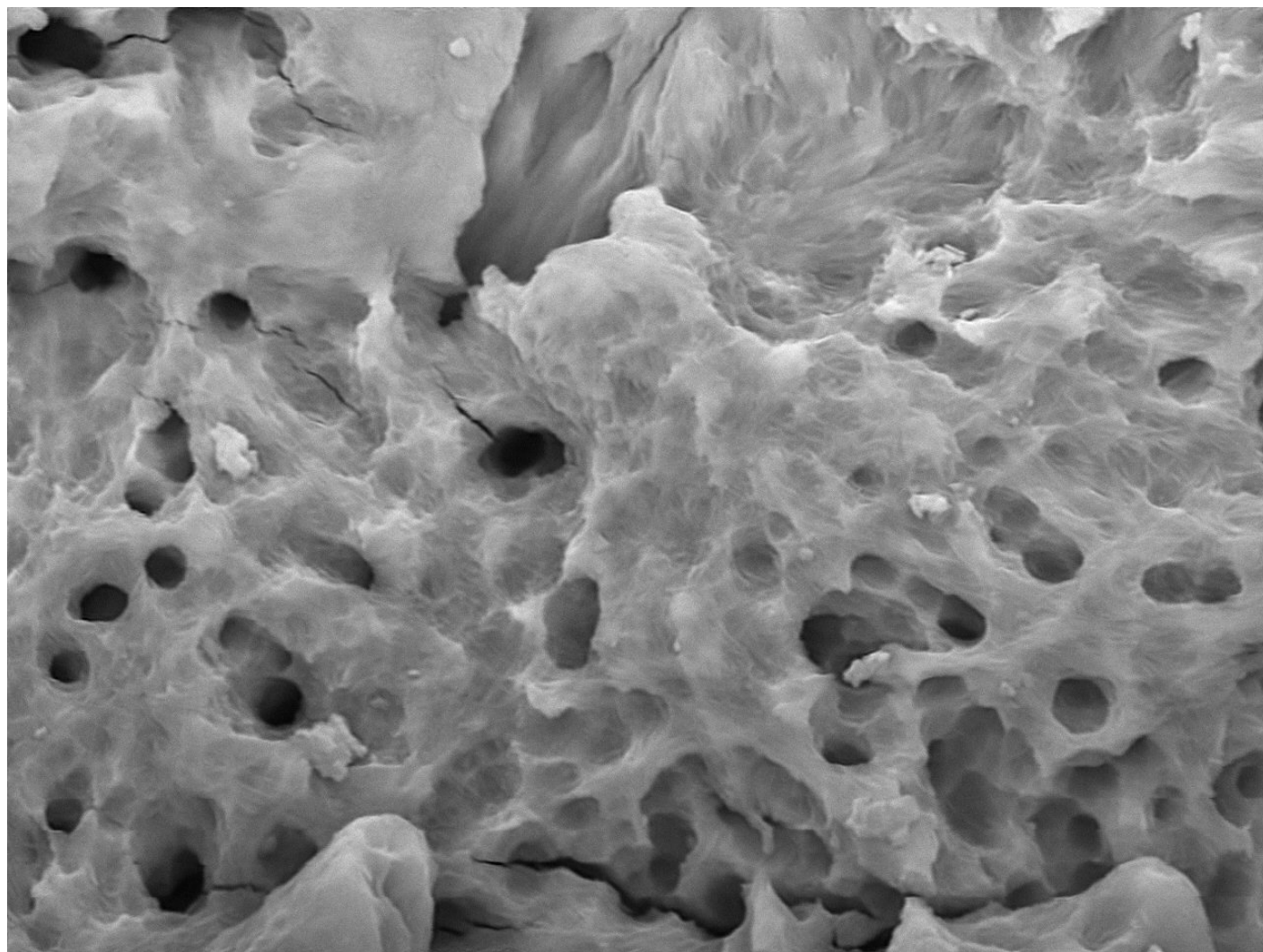
x5.0k 20 μ m

7) image006

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image007

image007



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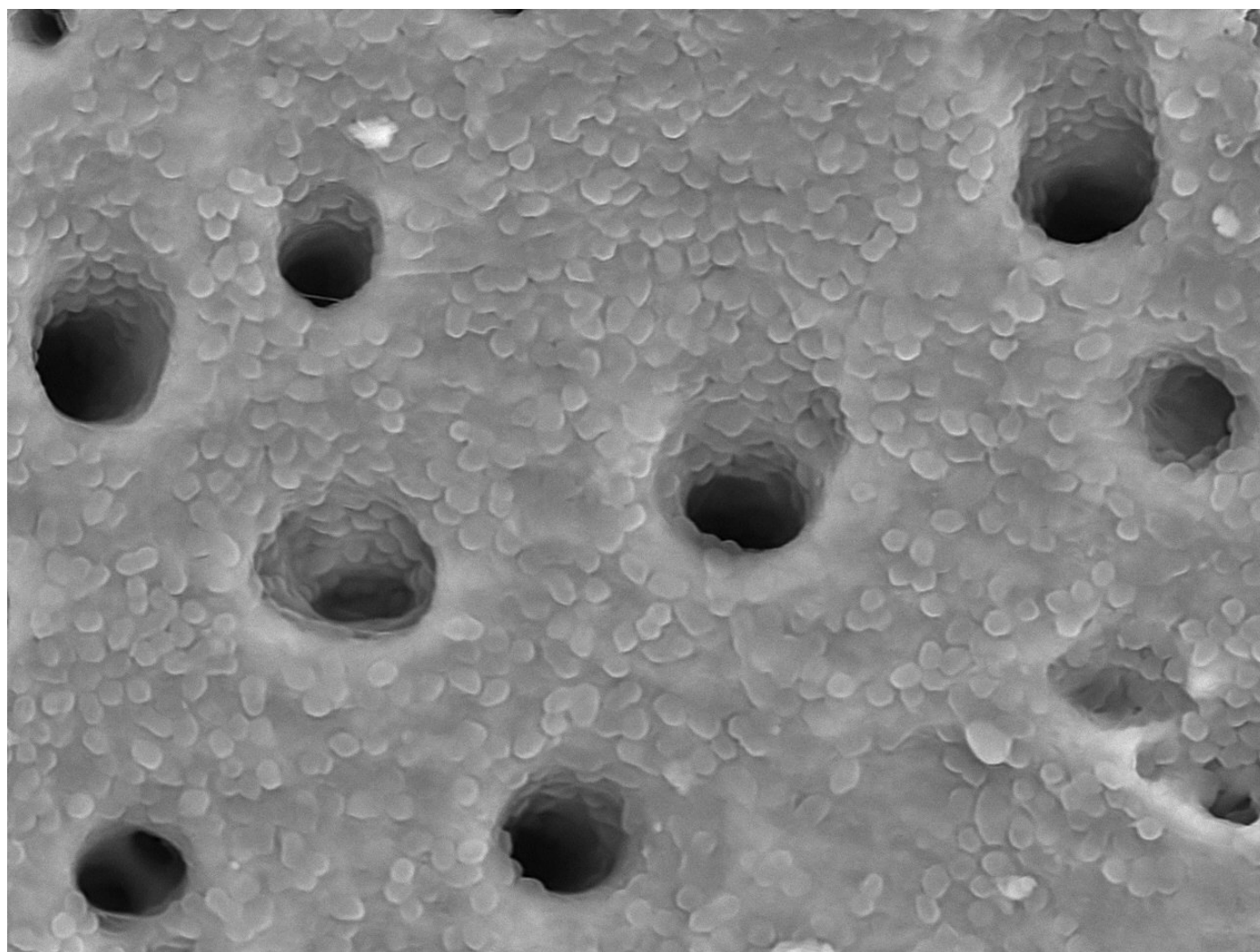
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8) image007

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image008

image008



29679-3

2017/02/24 15:22 N

x5.0k 20 μm

9) image008

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image009

image009



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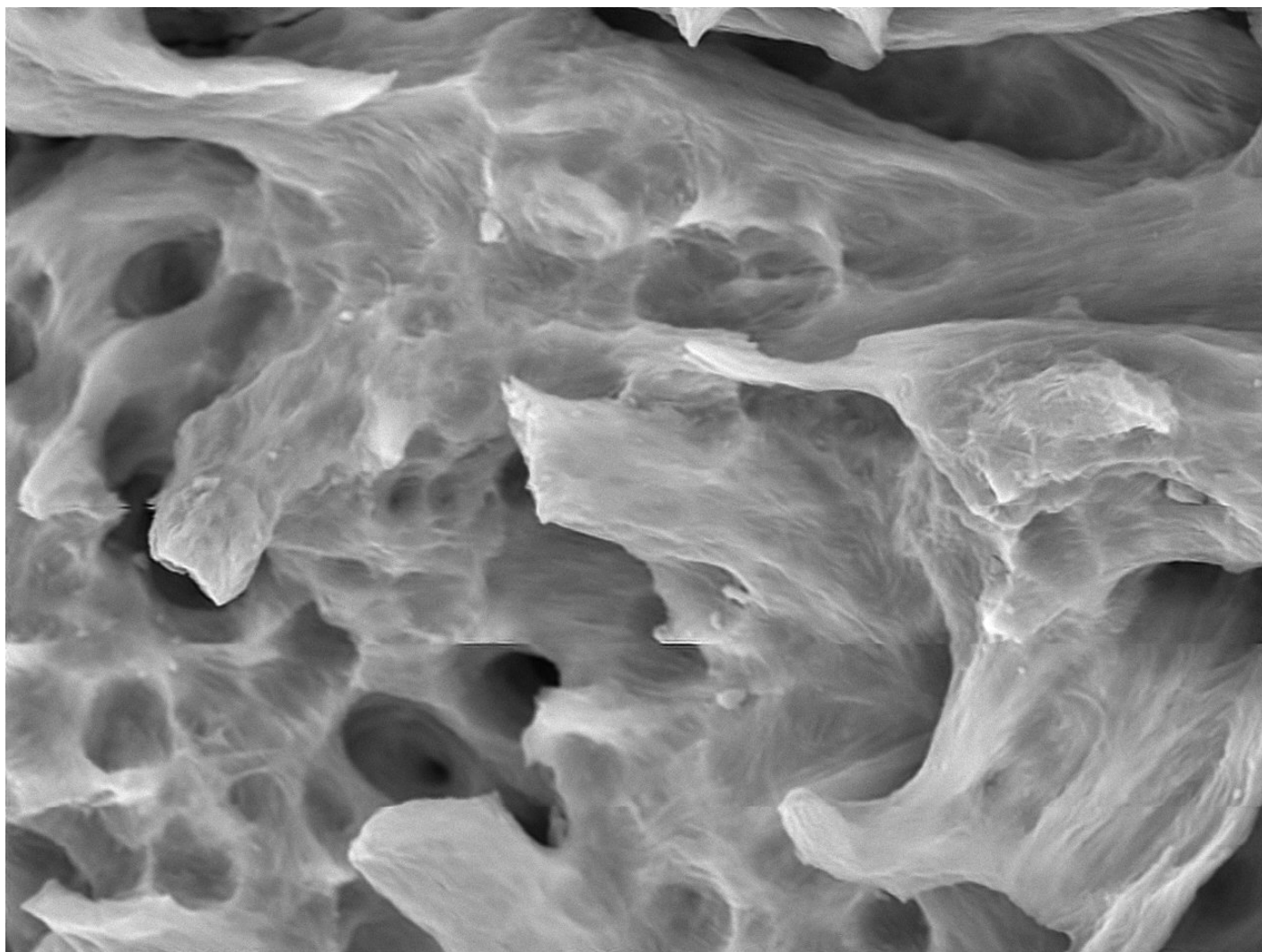
20 µm

10) image009

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image010

image010



29265-2

2017/02/27 11:51 N

x5.0k

20 μ m

11) image010

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image011

image011



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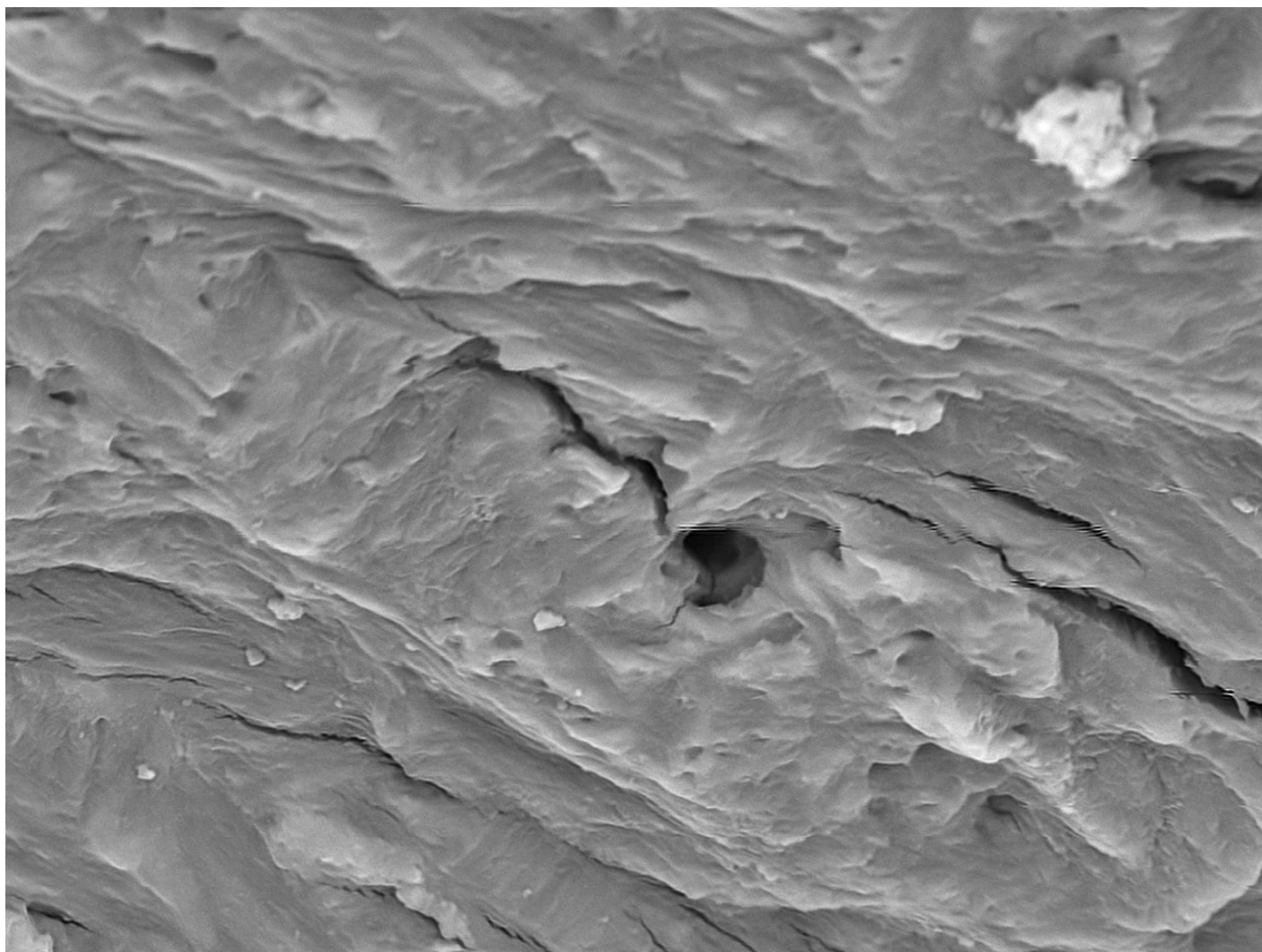
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12) image011

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image012

image012



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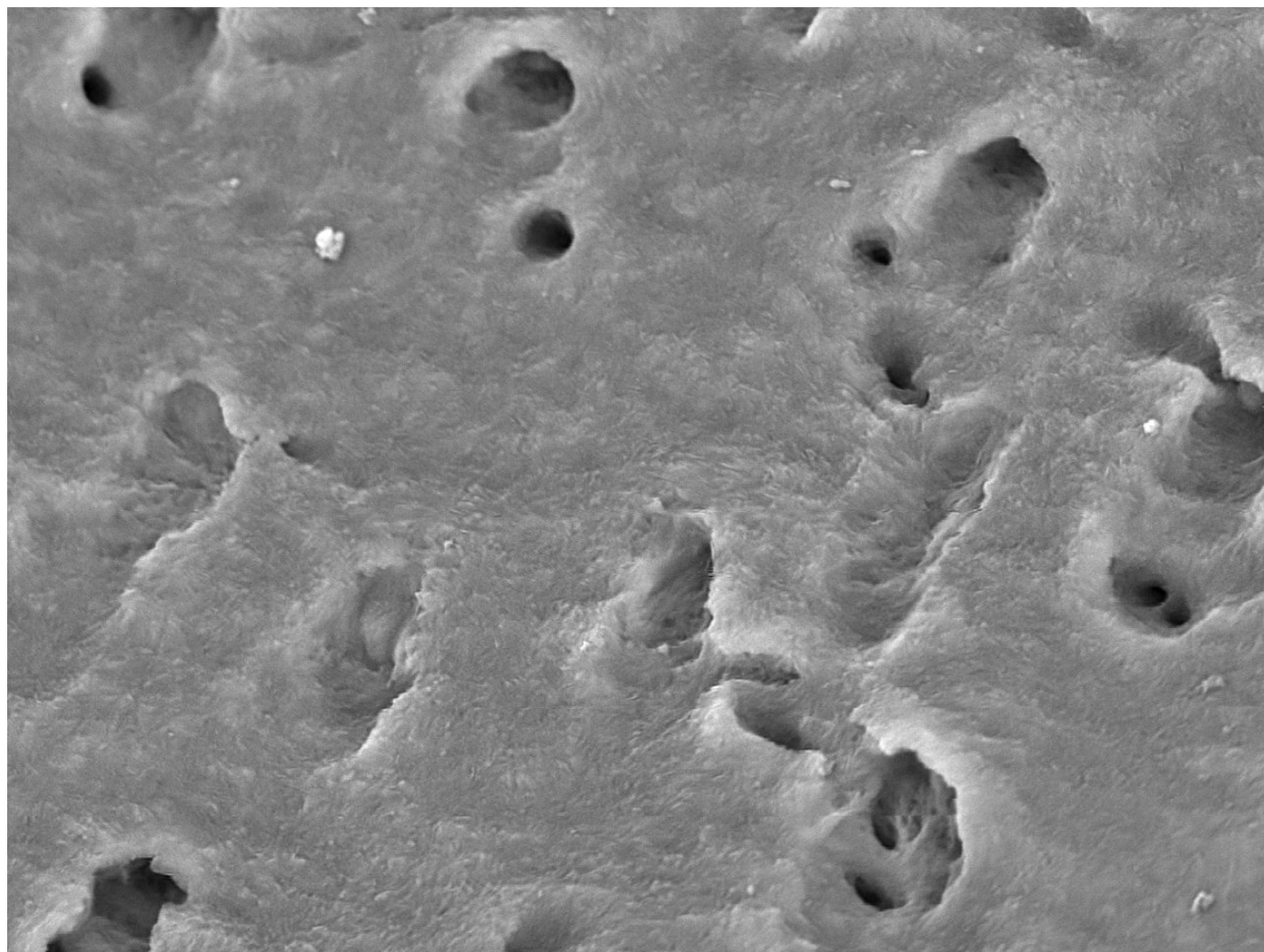
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13) image012

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image013

image013



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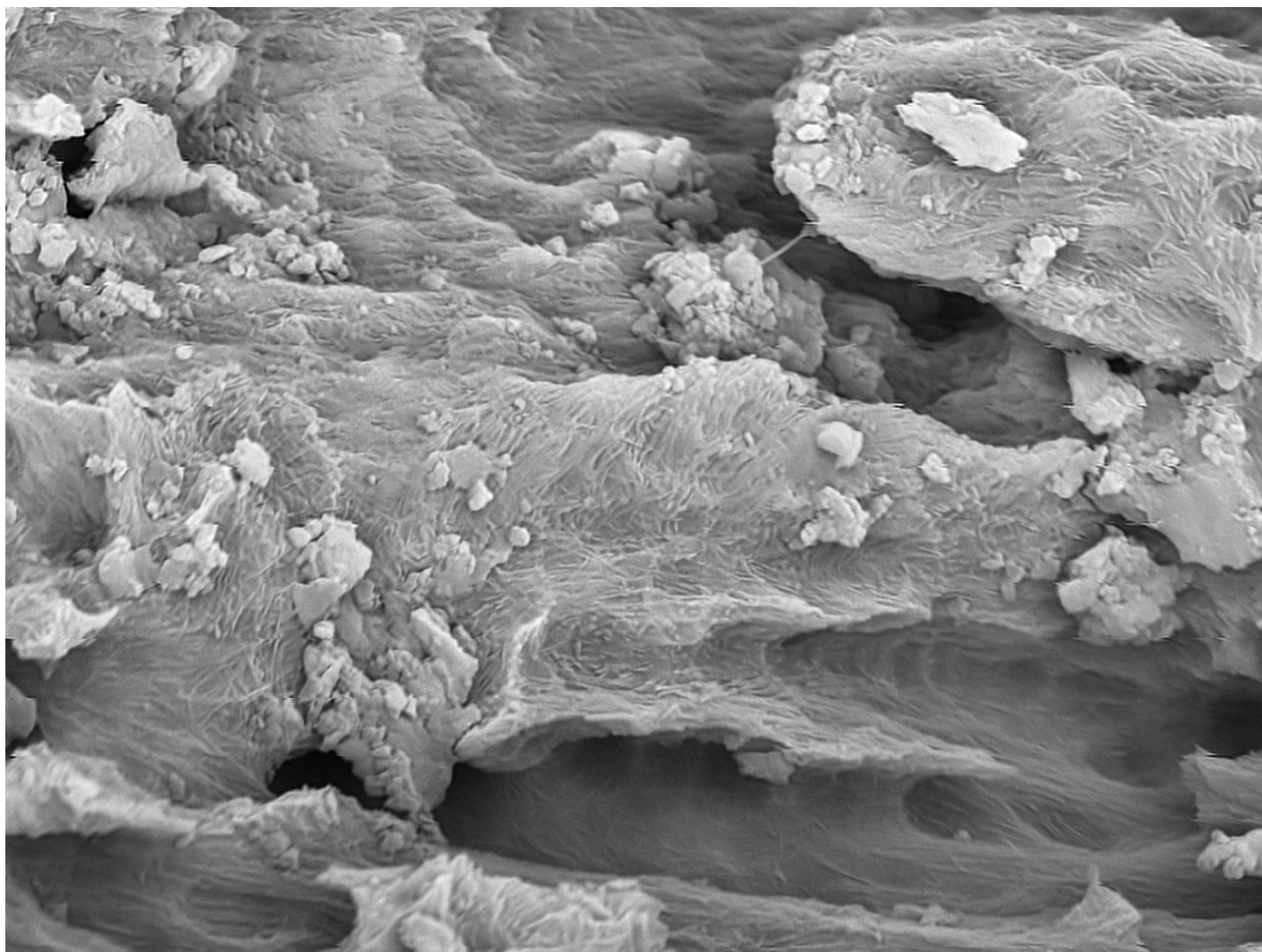
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14) image013

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image014

image014



29211-18

2017/03/03 16:20 N

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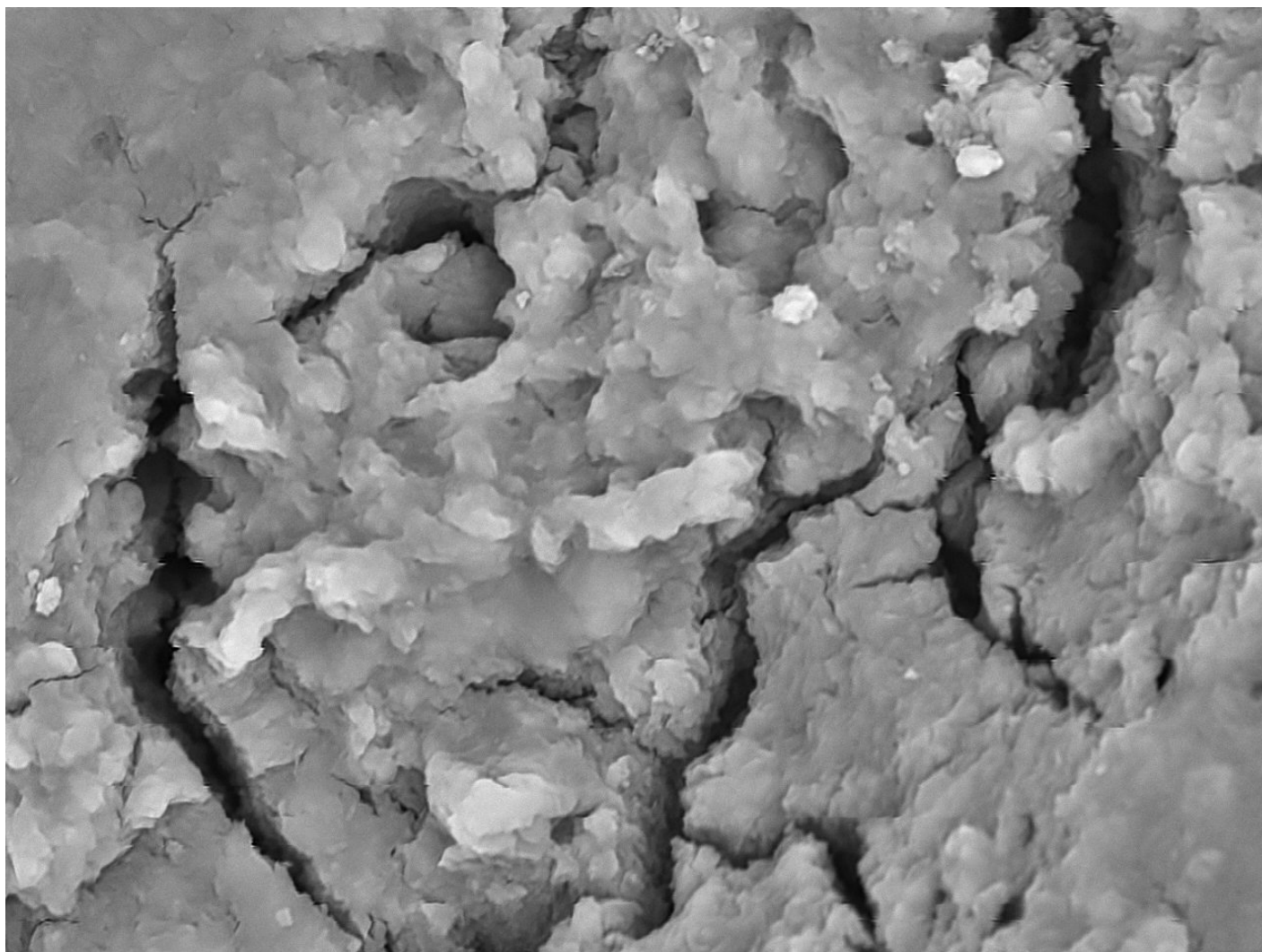
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15) image014

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image015

image015



29052-14

2017/02/28 18:01 N

x5.0k

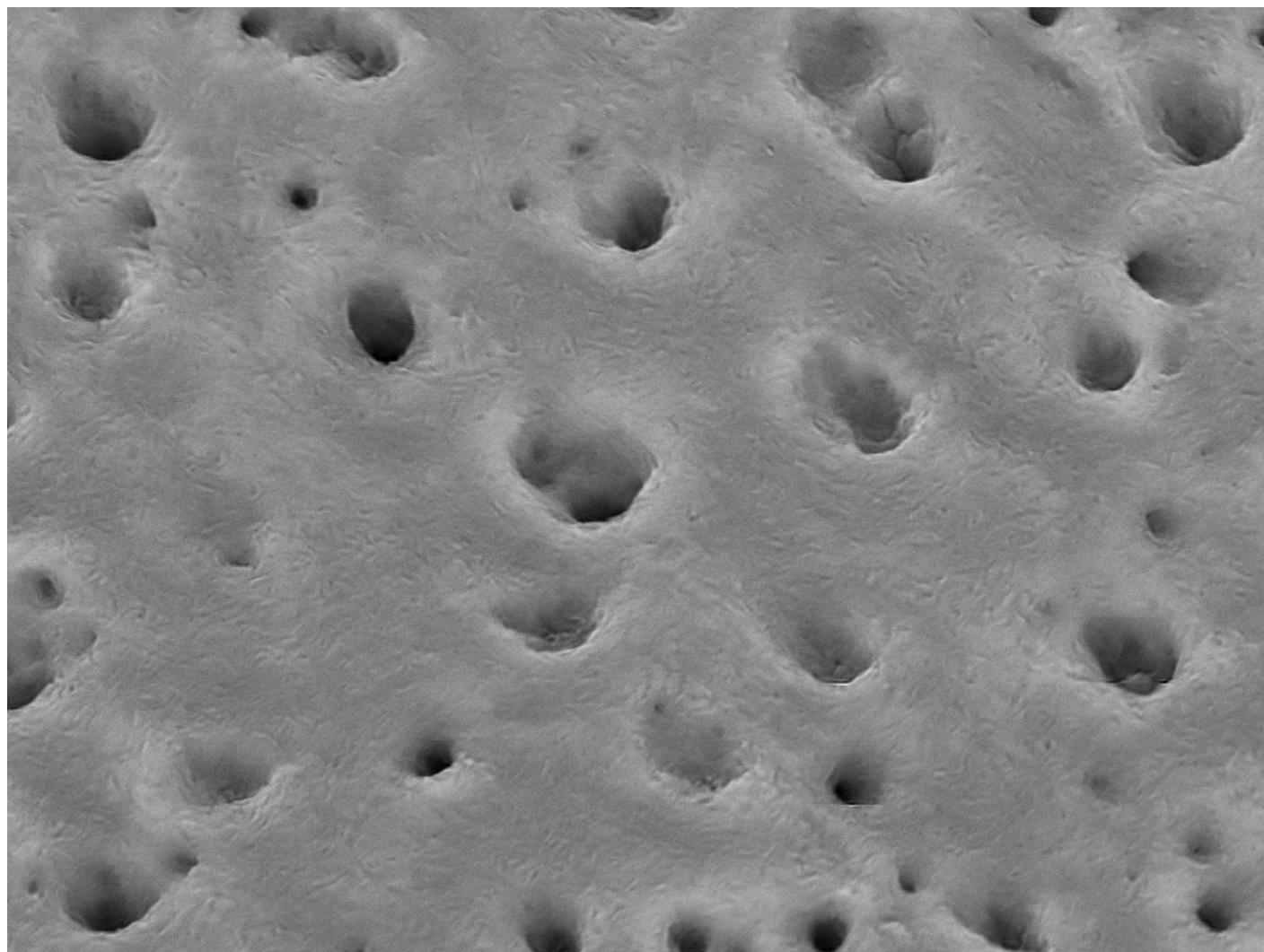
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16) image015

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- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image016

image016



29340-18

2017/03/03 09:39 N

x5.0k

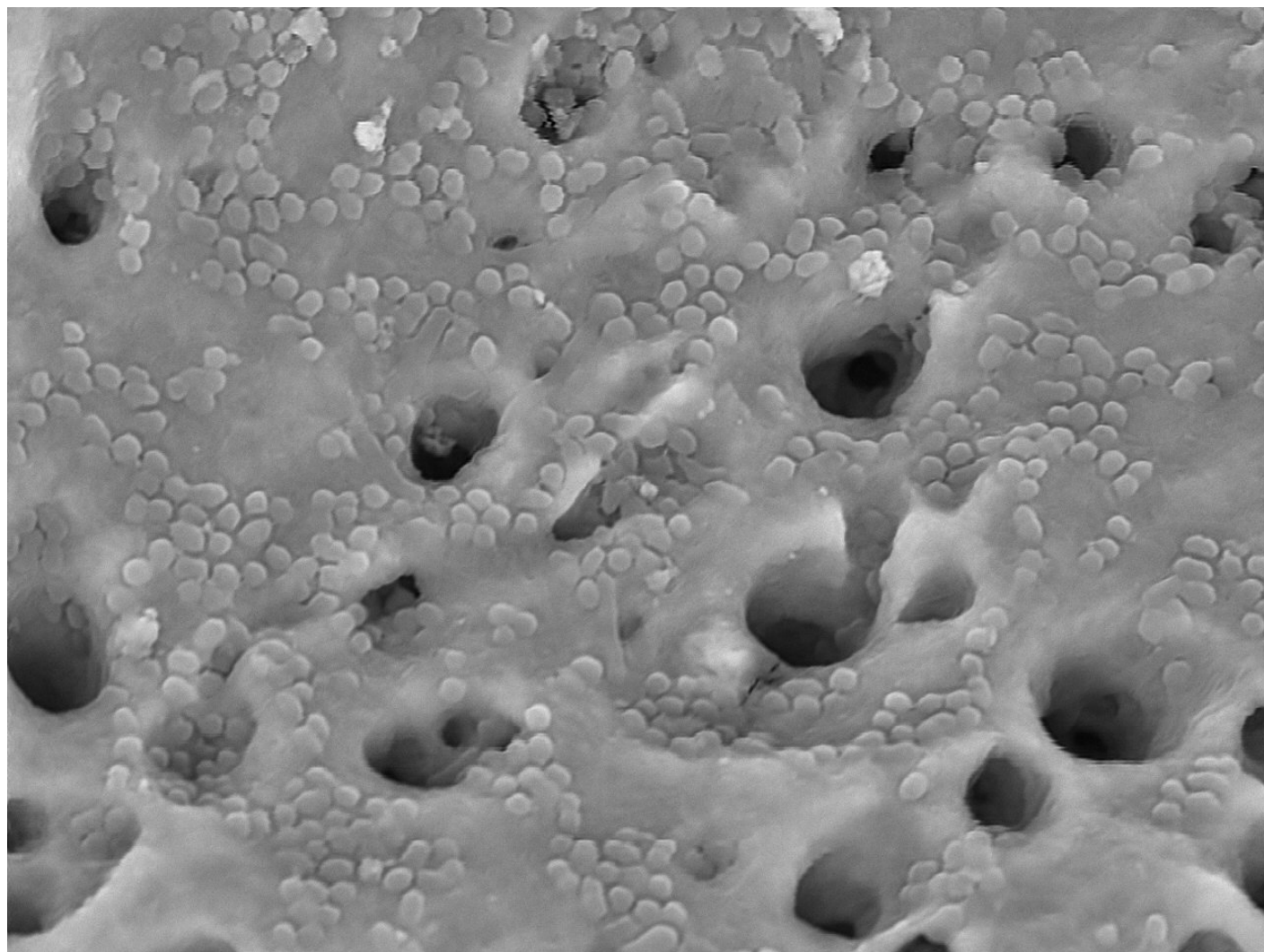
20 μm

17) image016

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image017

image017



29965-2

2017/03/02 15:25 N

x5.0k

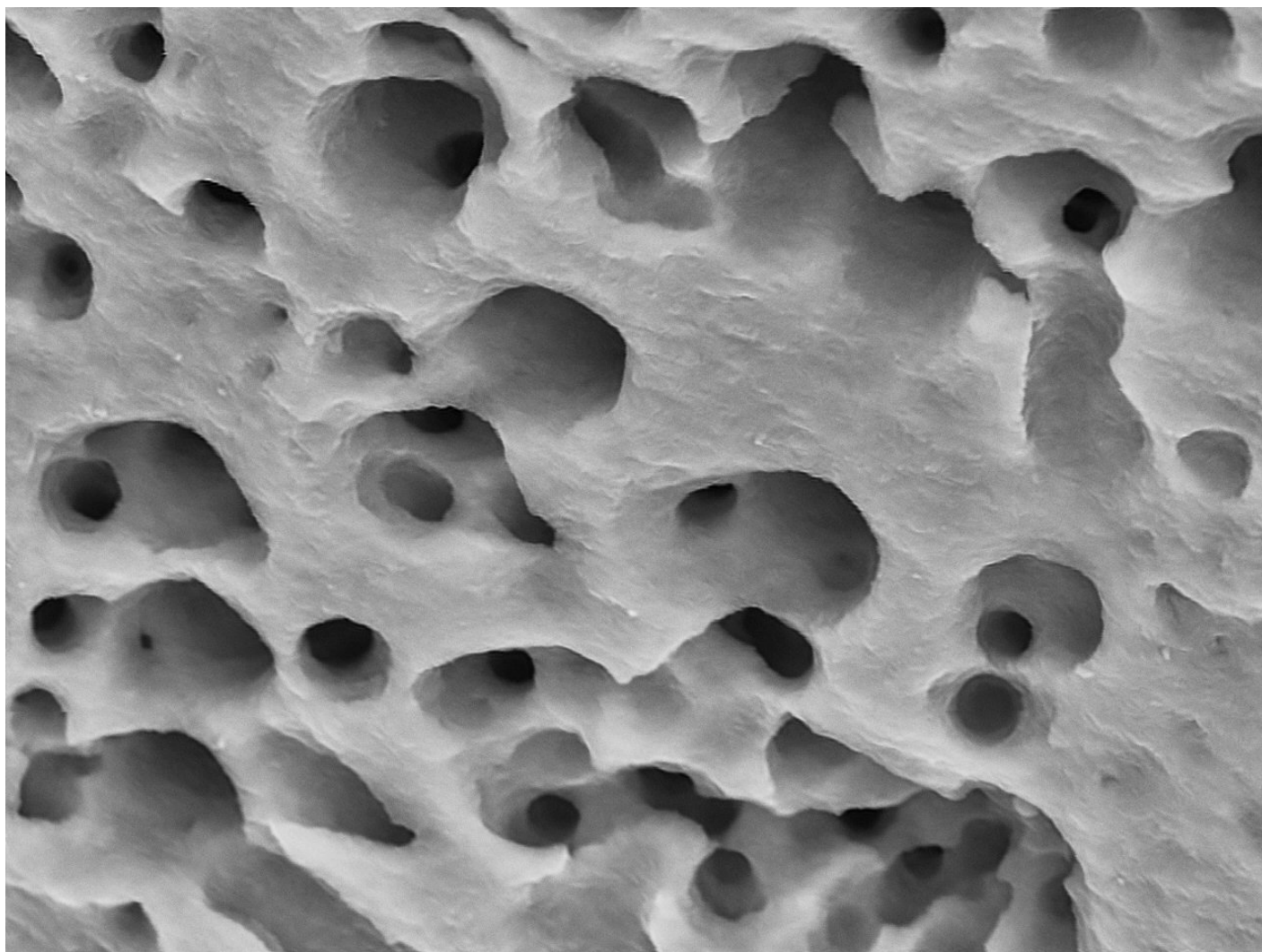
20 μ m

18) image017

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image018

image018



29963-15

2017/03/01 14:17 N

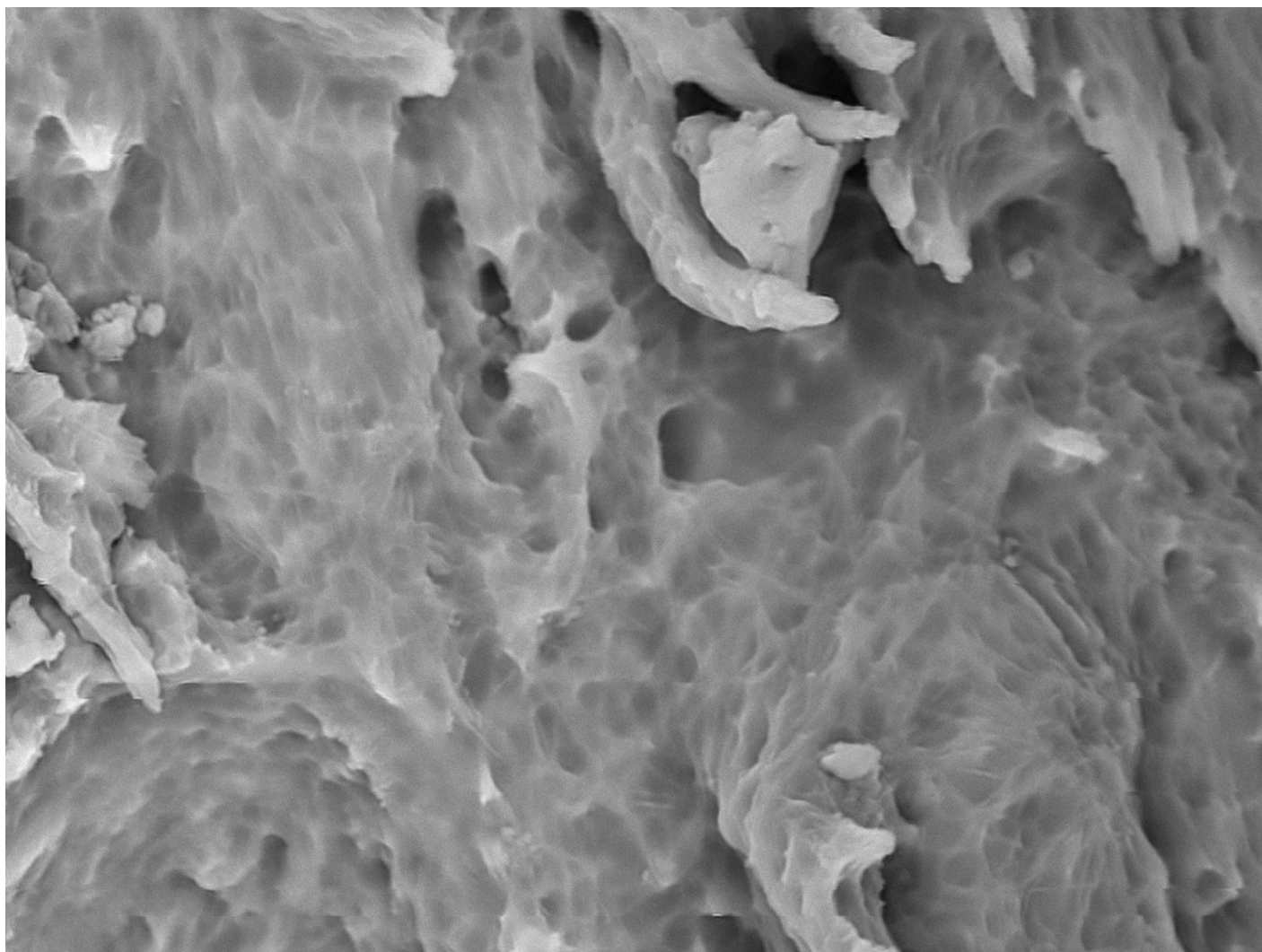
x5.0k 20 μ m

19) image018

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image019

image019



29028-15

2017/03/04 15:32 N

x5.0k

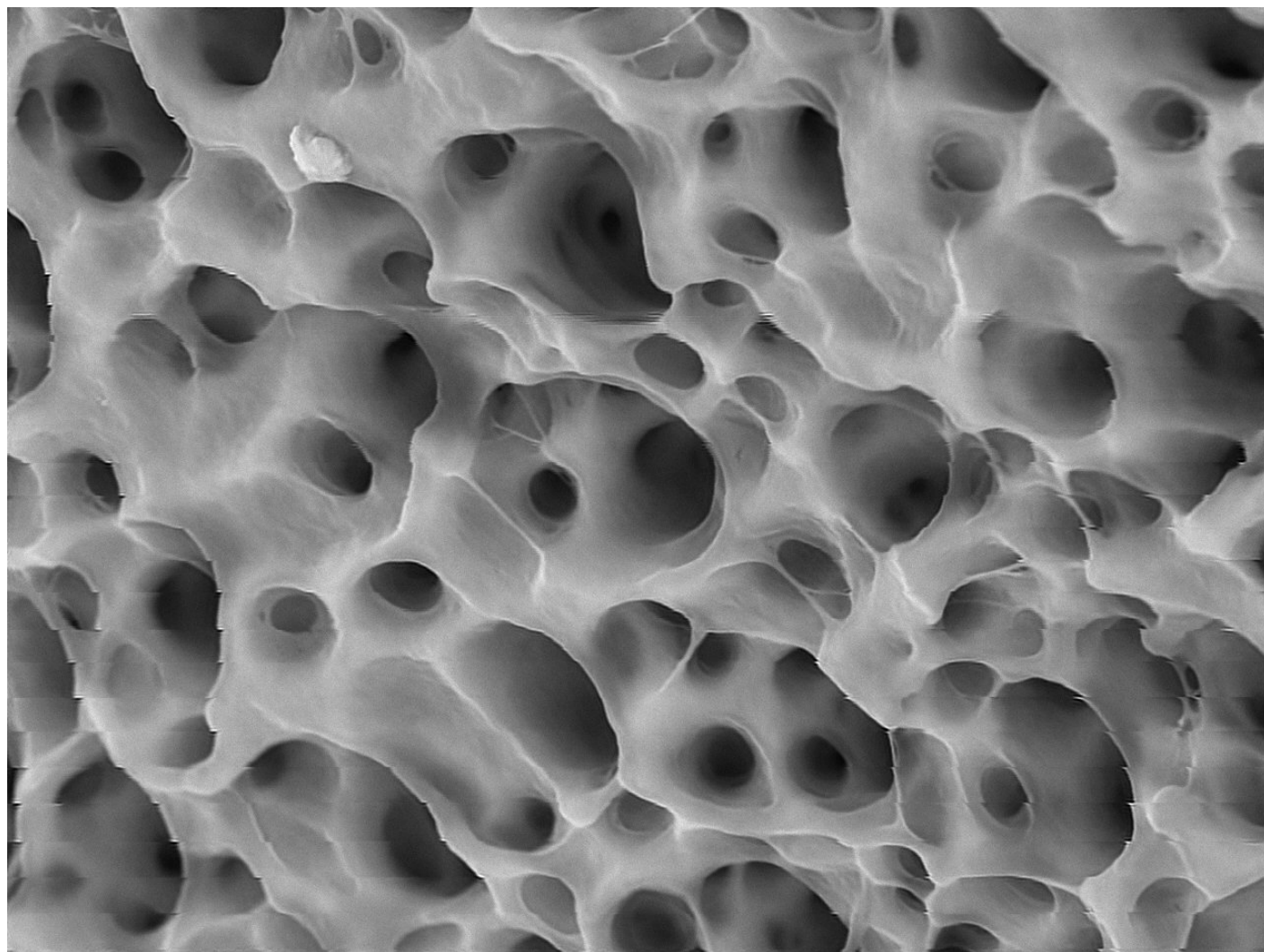
20 μ m

20) image019

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image020

image020



29961-2

2017/03/01 14:47 N

x5.0k

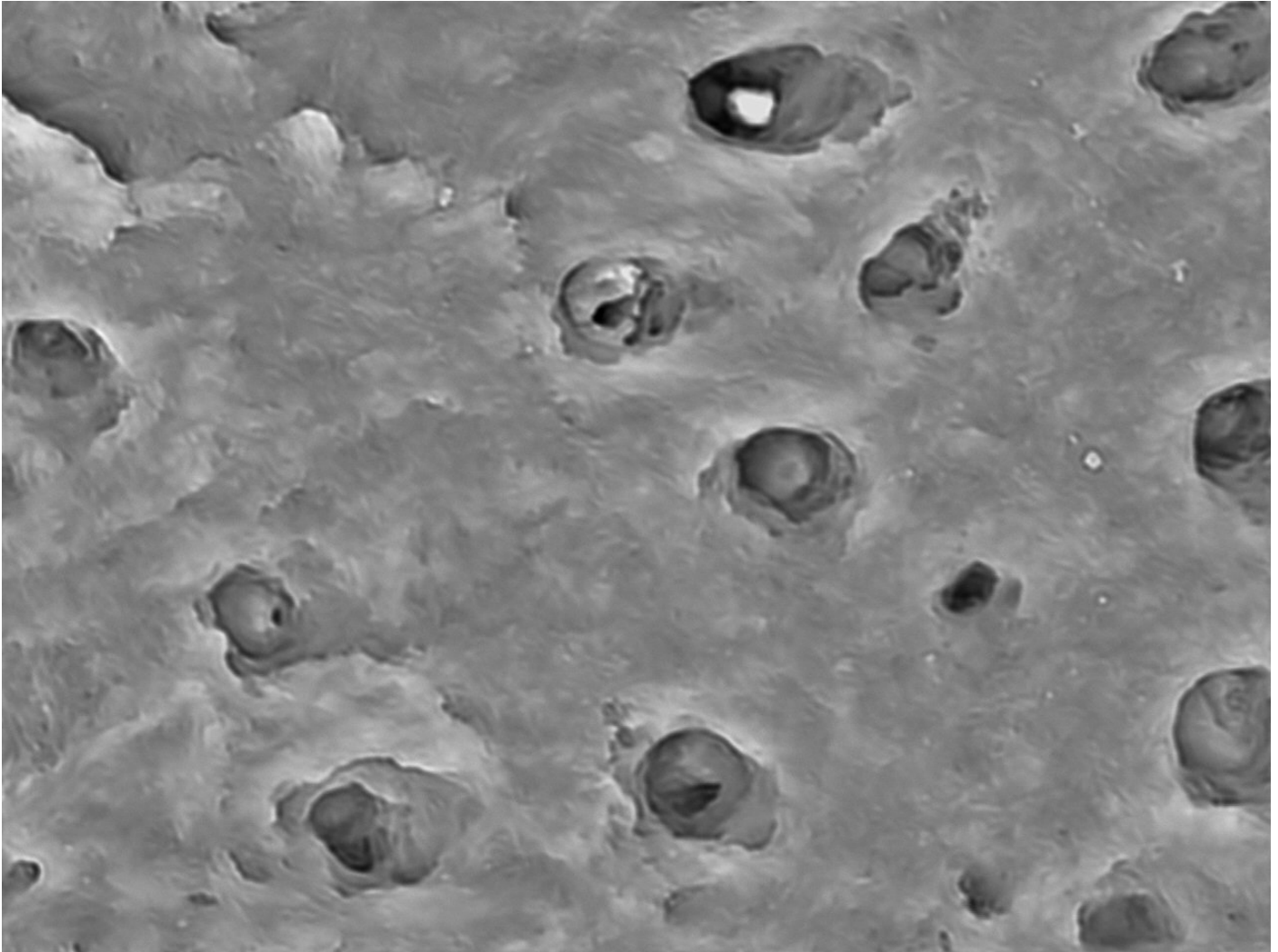
20 μ m

21) image020

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image021

image021



29009-31

2017/03/08 14:38 H

x5.0k

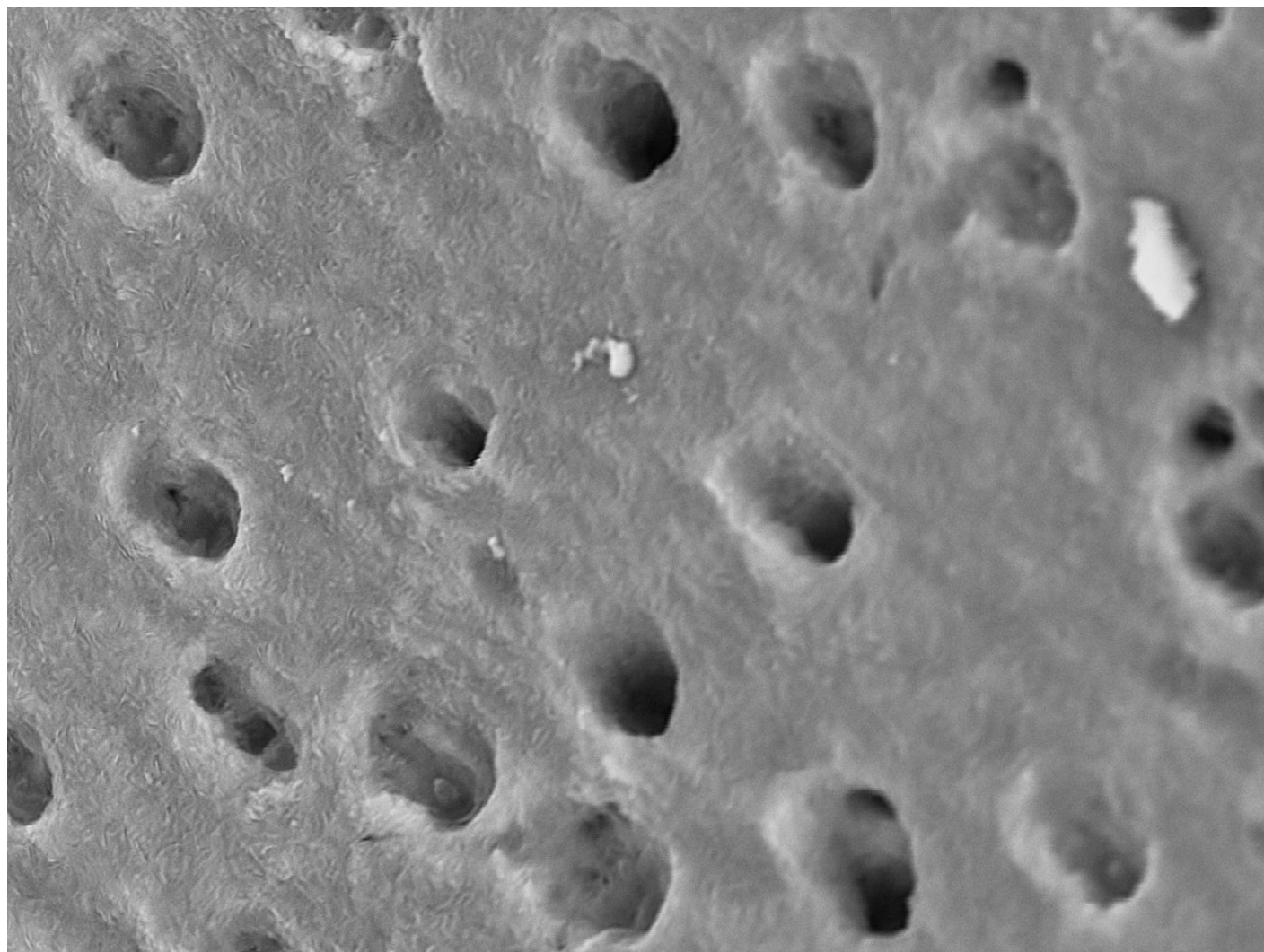
20 μm

22) image021

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image022

image022



29340-18

2017/03/03 10:35 N

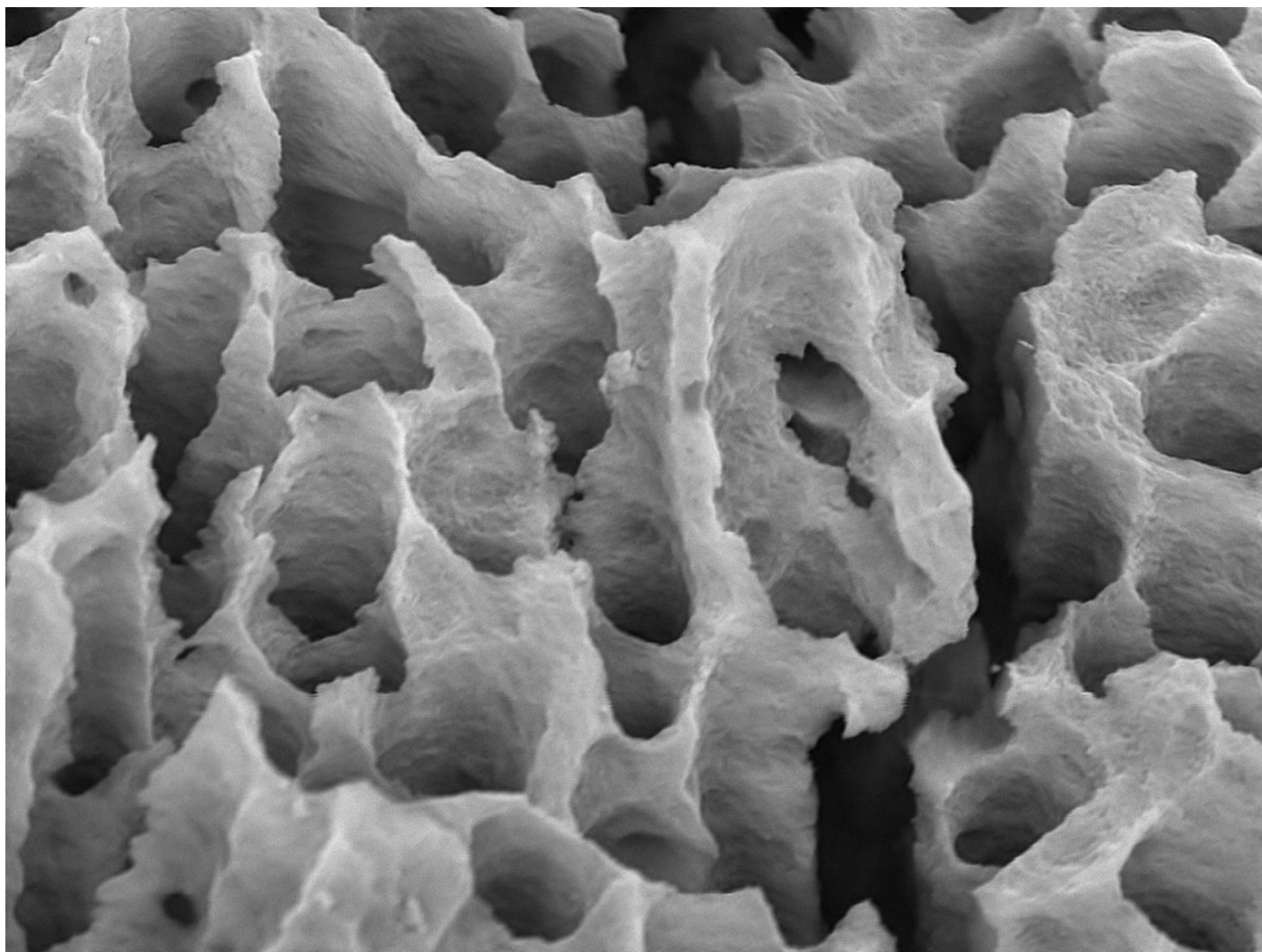
x5.0k 20 μ m

23) image022

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image023

image023



29340-18

2017/03/03 10:27 N

x5.0k

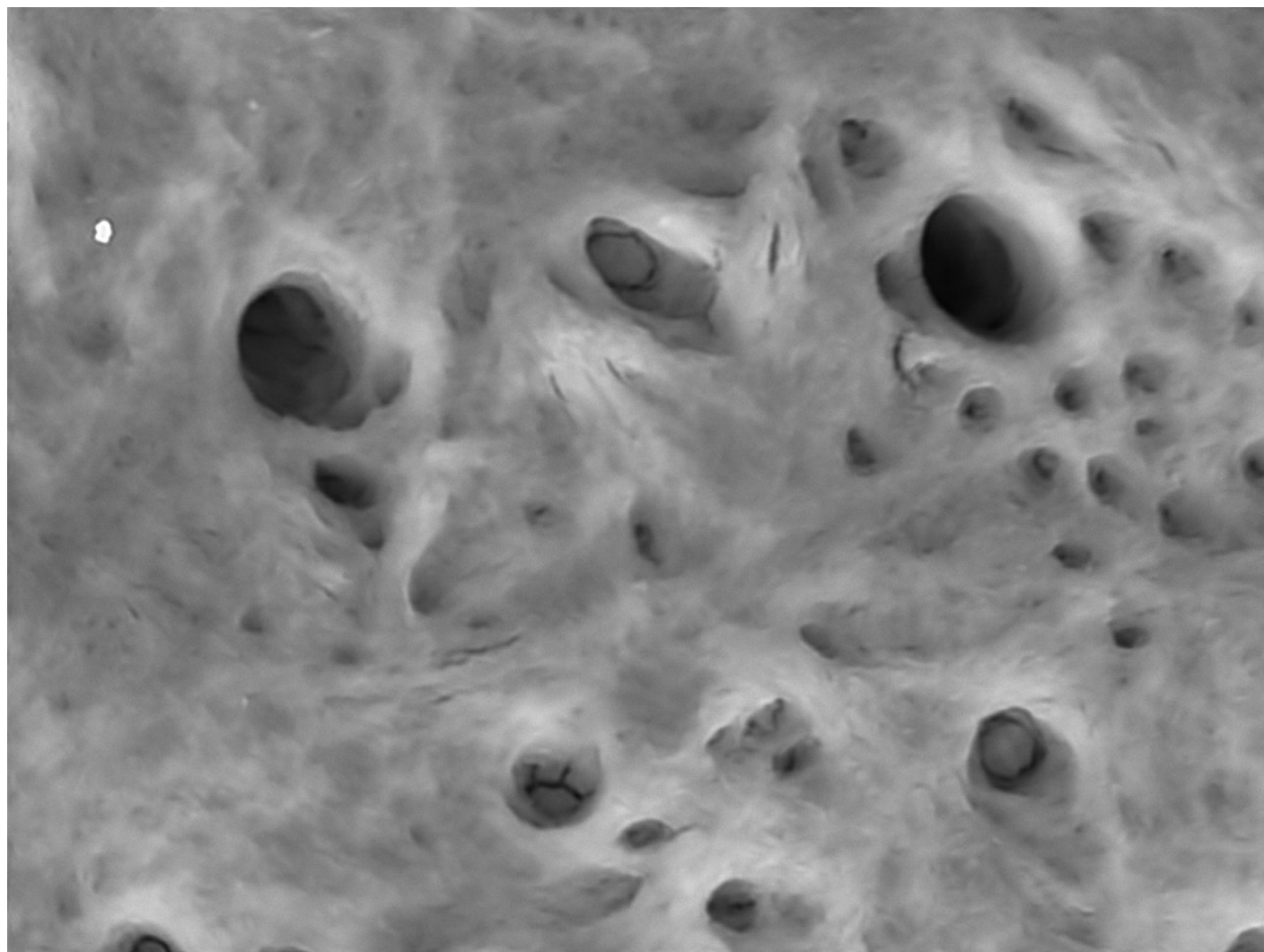
20 μm

24) image023

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image024

image024



29009-31

2017/03/08 15:05 H

x5.0k

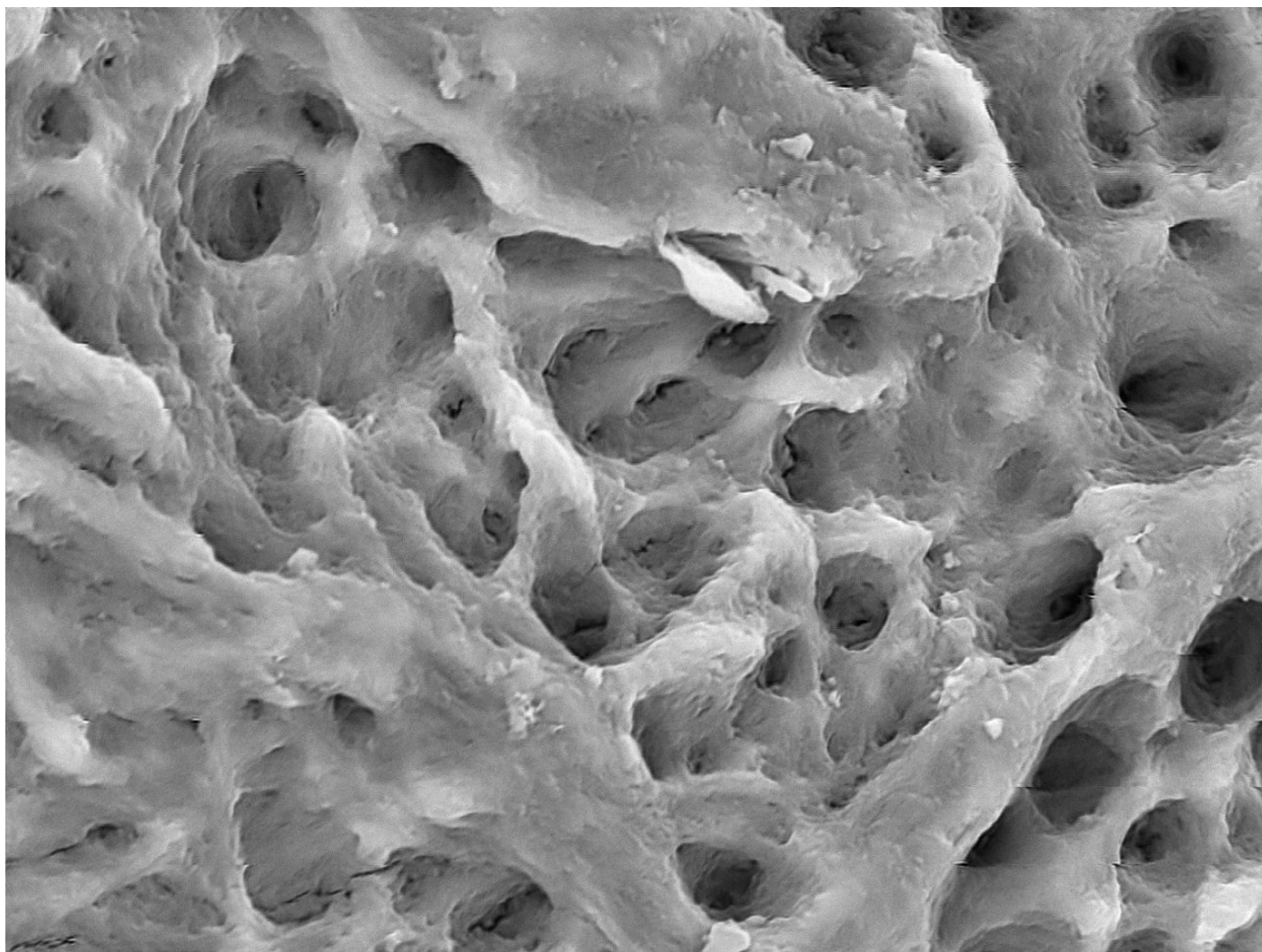
20 μ m

25) image024

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image025

image025



29211-18

2017/03/03 16:01 N

x5.0k

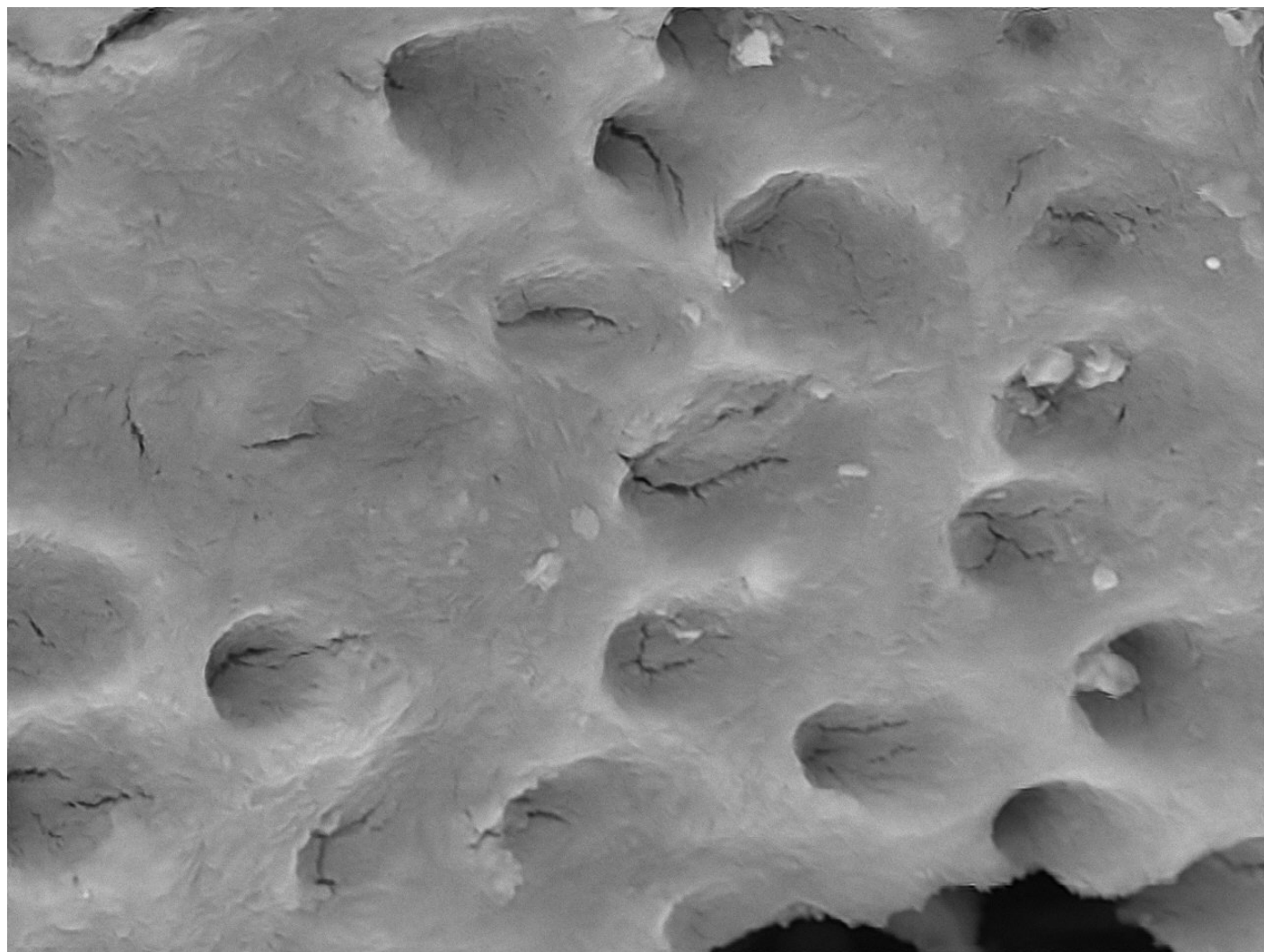
20 μ m

26) image025

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image026

image026



29179-3

2017/03/03 14:28 N

x5.0k

20 μ m

27) image026

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image027

image027



29009-31

2017/03/08 14:57 H

x5.0k

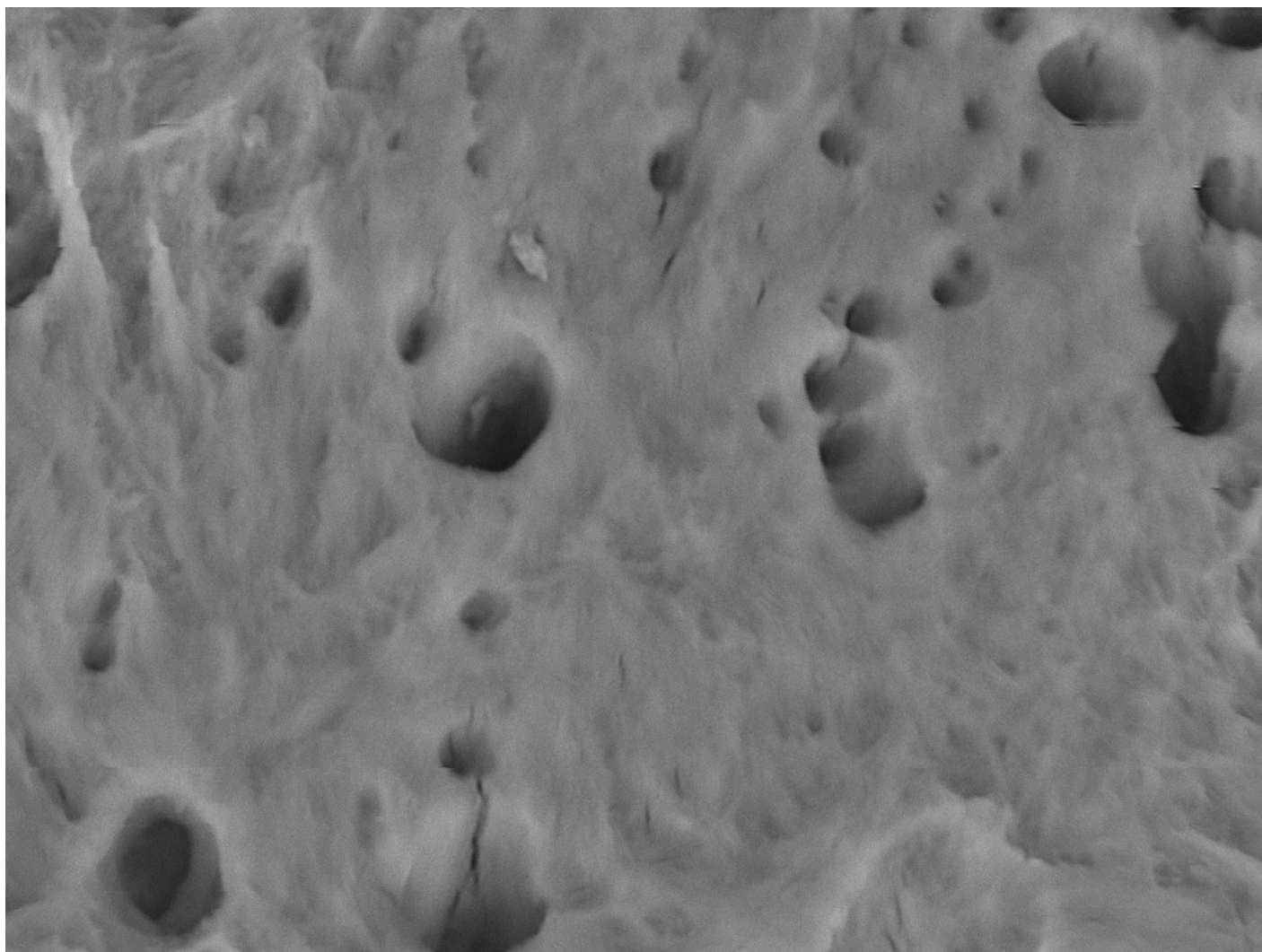
20 μm

28) image027

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image028

image028



29009-31

2017/03/06 09:04 N

x5.0k

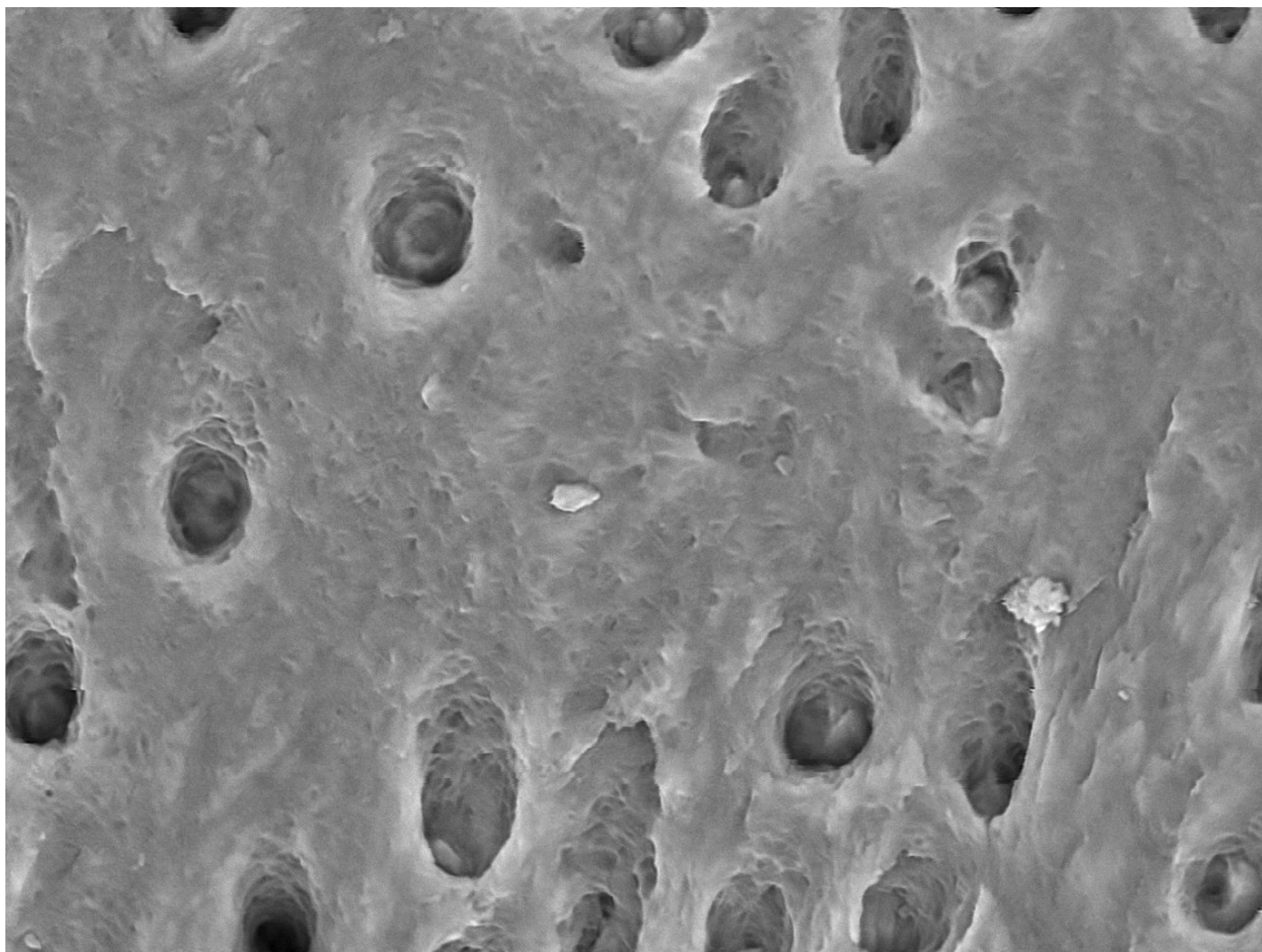
20 μ m

29) image028

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image029

image029



29179-3

2017/03/03 11:48 N

x5.0k

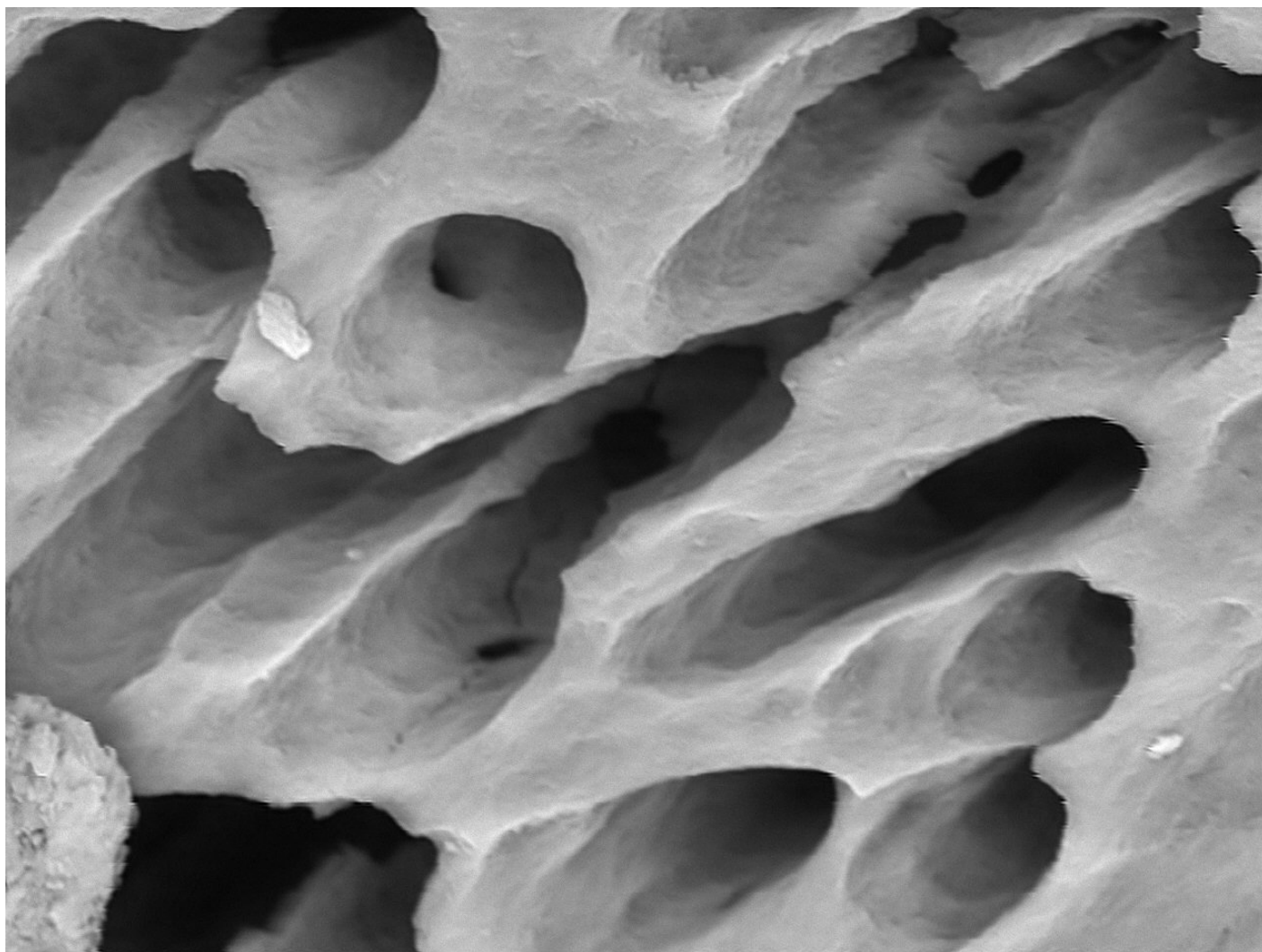
20 μm

30) image029

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image030

image030



29576-18

2017/03/01 11:24 N

x5.0k

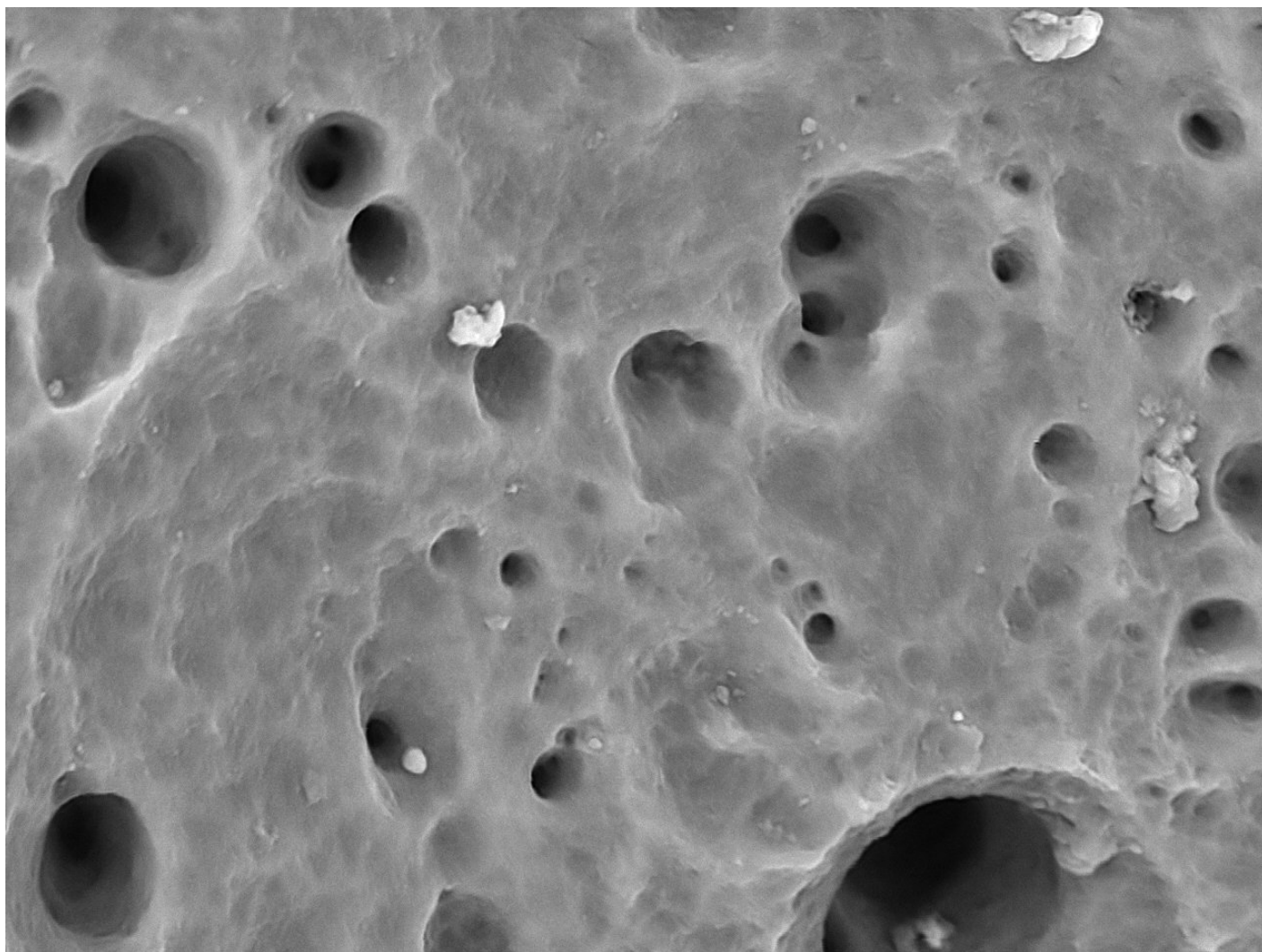
20 μ m

31) image030

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image031

image031



29211-18

2017/03/03 16:15 N

x5.0k

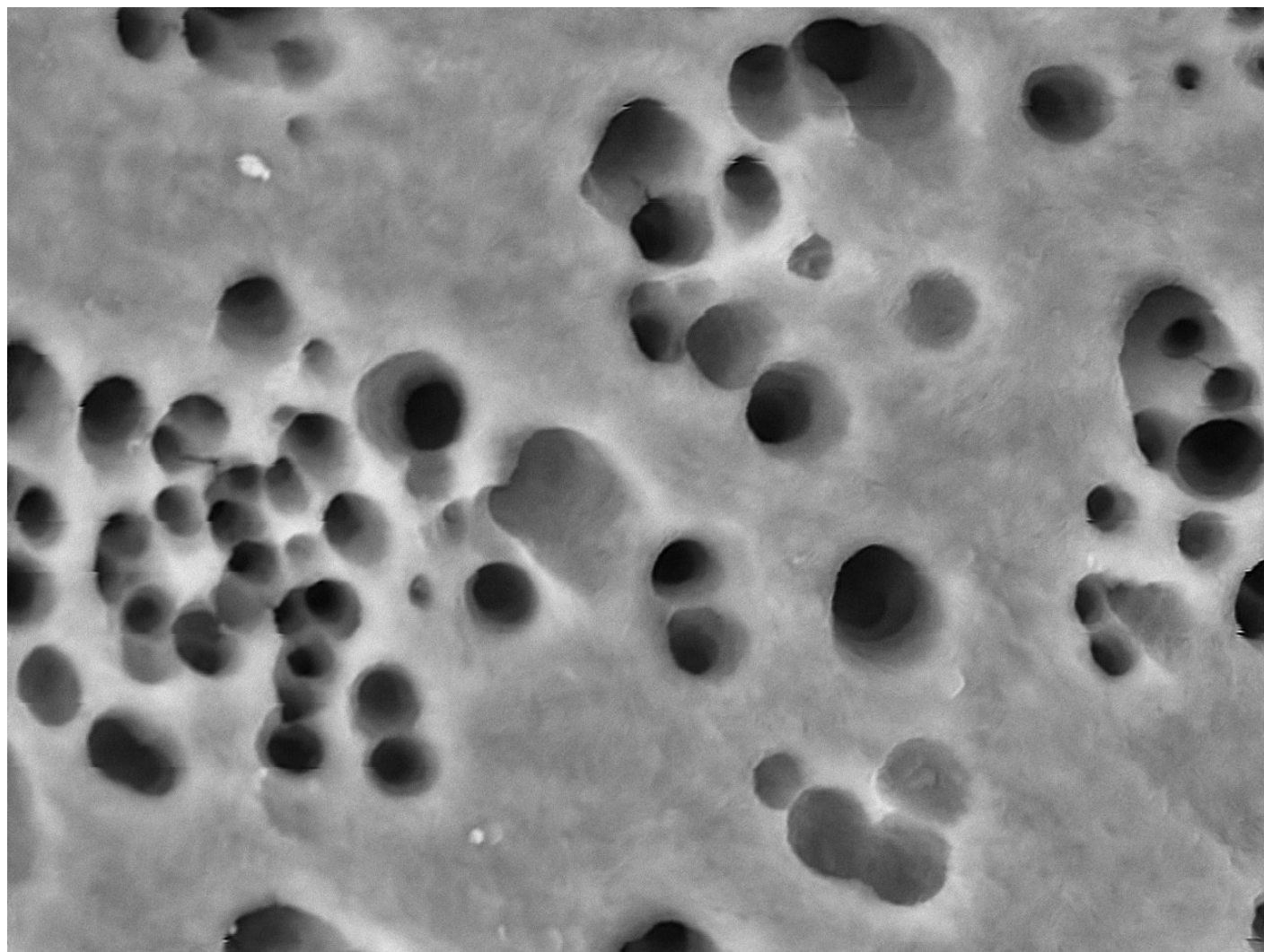
20 μm

32) image031

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image032

image032



29009-31

2017/03/06 09:10 N

x5.0k

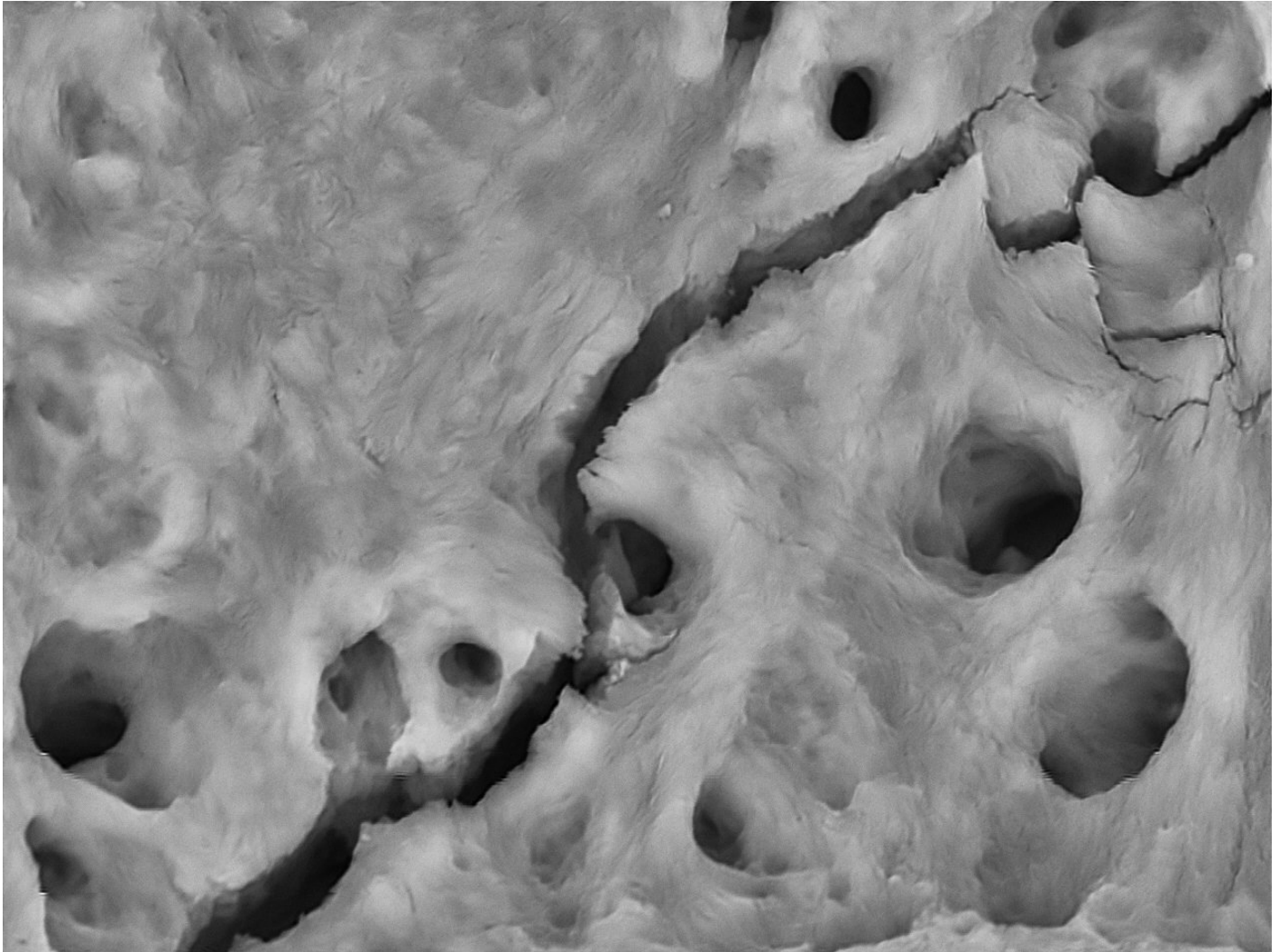
20 μ m

33) image032

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image033

image033



29576-18

2017/03/01 12:06 N

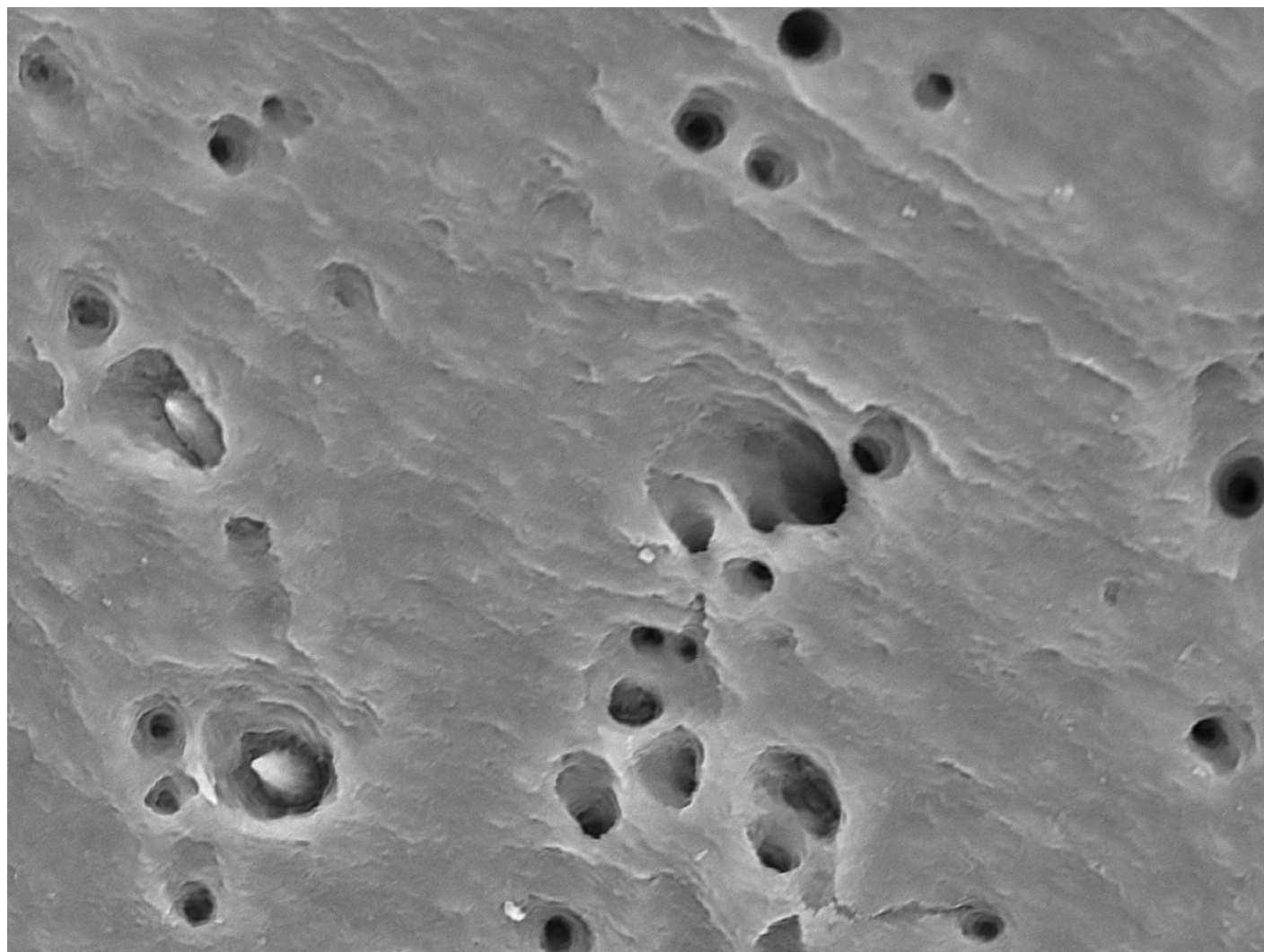
x5.0k 20 μm

34) image033

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image034

image034



29211-18

2017/03/04 13:53 N

x5.0k

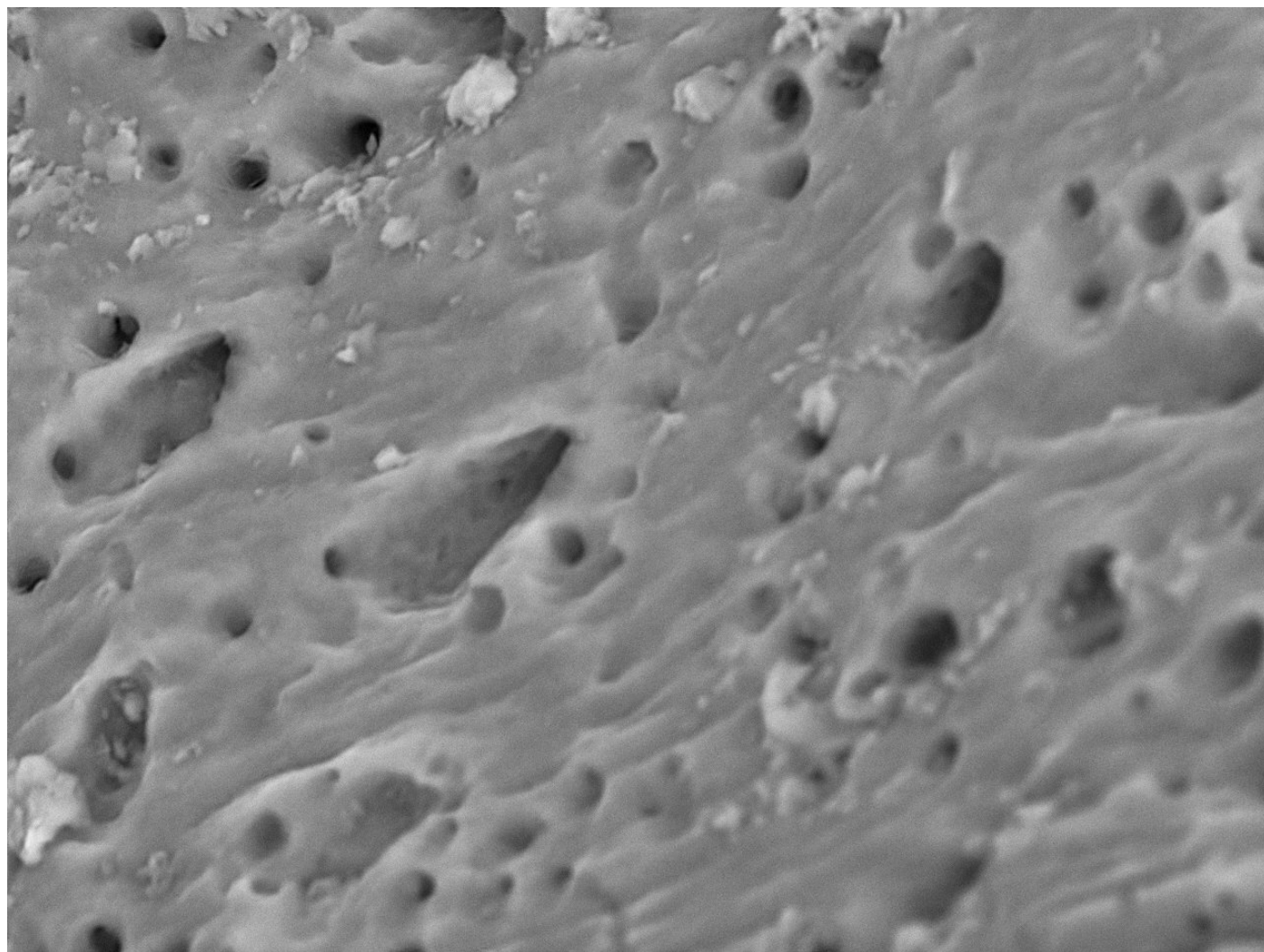
20 μm

35) image034

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image035

image035



29694-2

2017/02/28 16:07 N

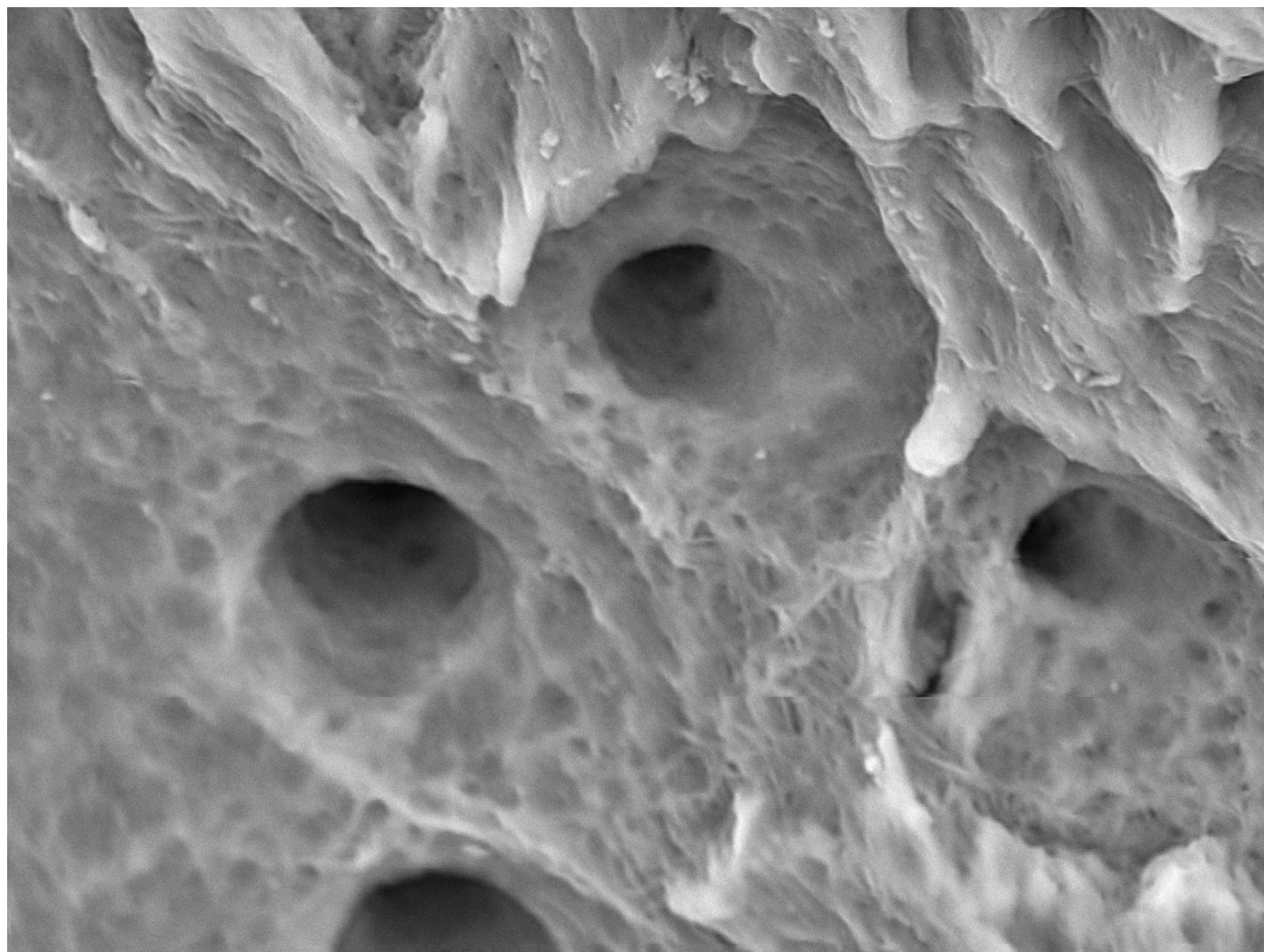
x5.0k 20 μm

36) image035

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image036

image036



29211-18

2017/03/03 14:58 N

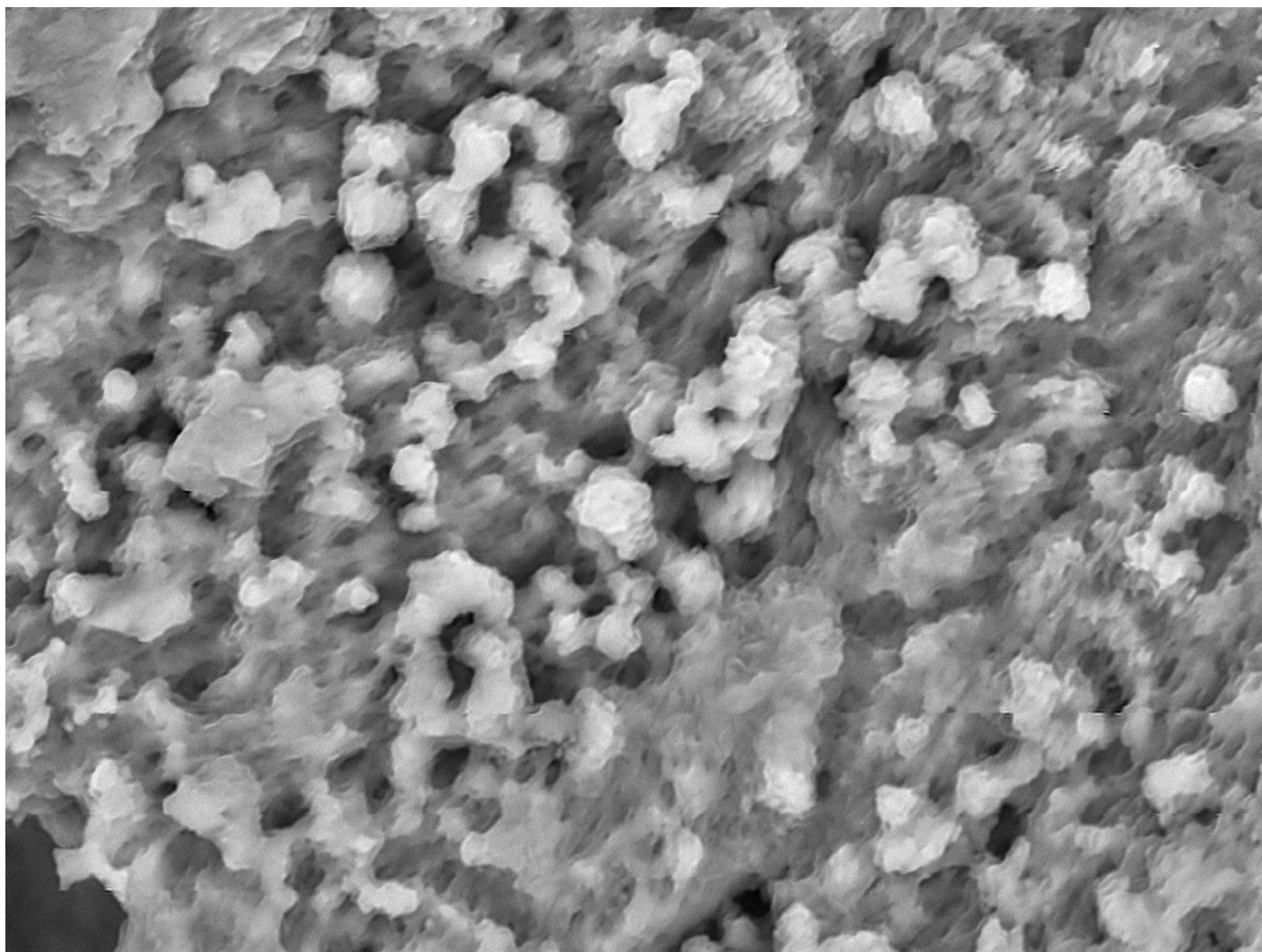
x5.0k 20 μm

37) image036

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image037

image037



29679-3

2017/02/27 16:15 N

x5.0k

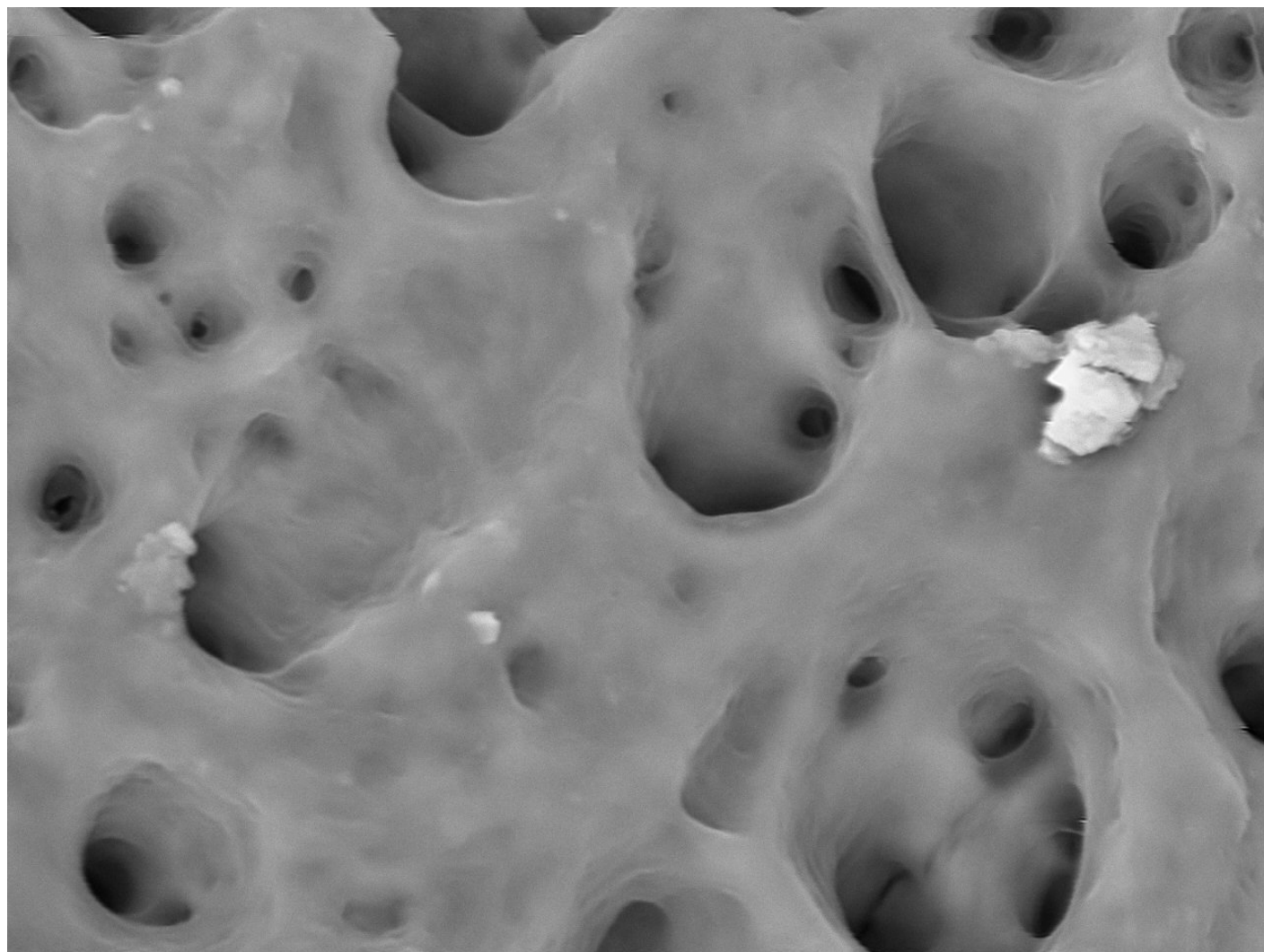
20 μ m

38) image037

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image038

image038



29963-15

2017/03/01 10:09 N

x5.0k

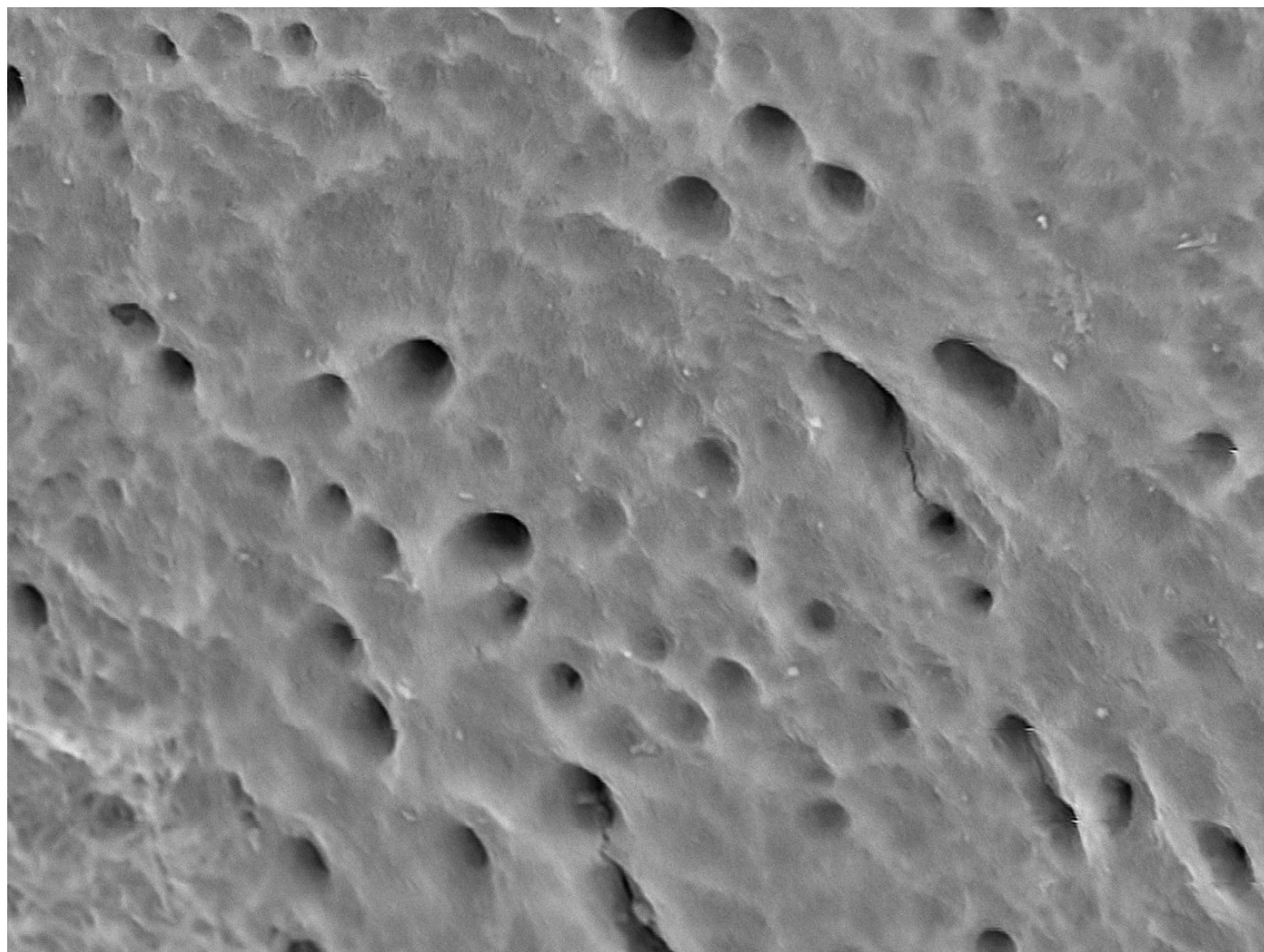
20 μ m

39) image038

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image039

image039



29211-18

2017/03/03 14:57 N

x5.0k

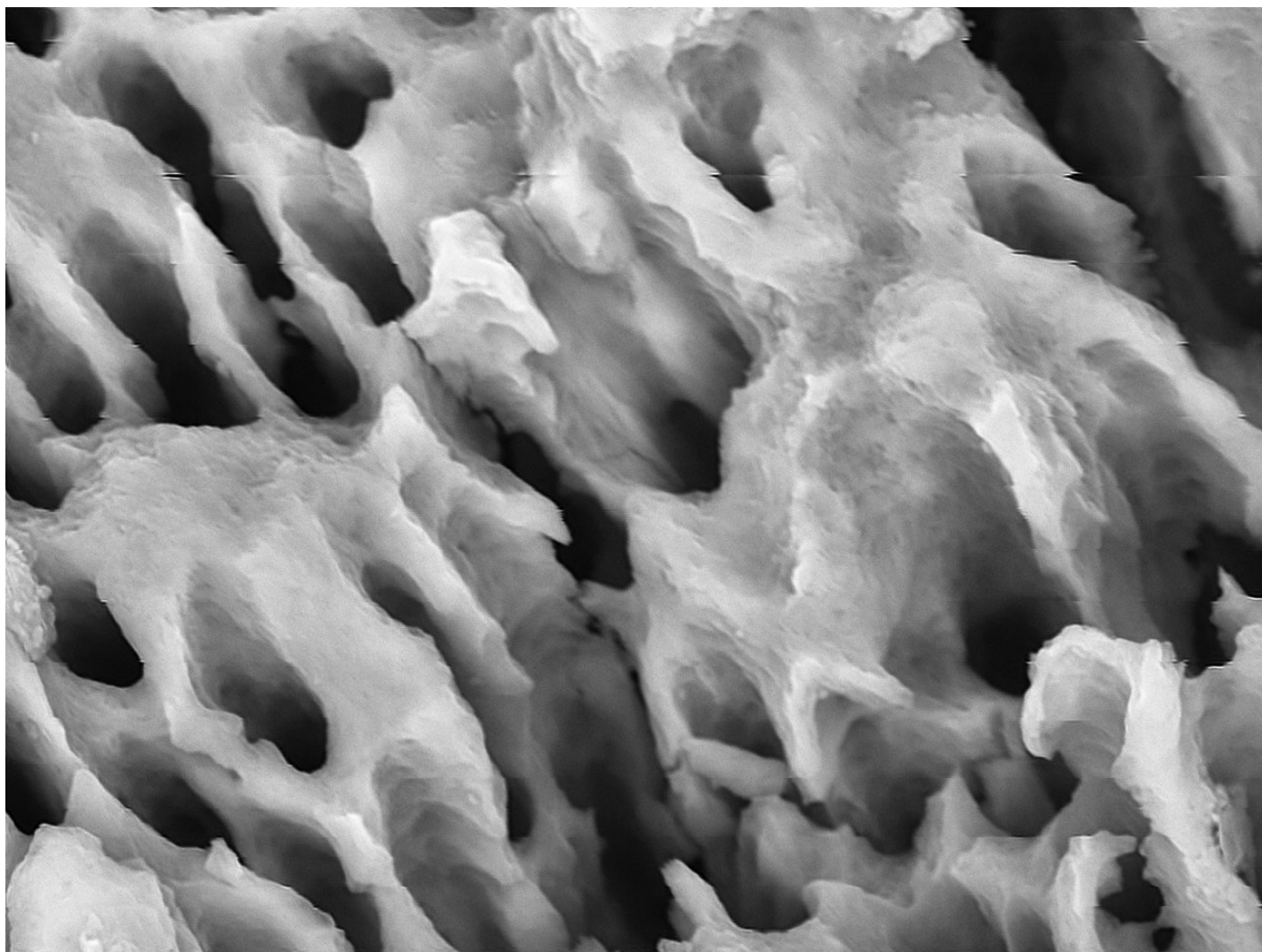
20 μm

40) image039

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image040

image040



29576-18

2017/03/01 12:04 N

x5.0k

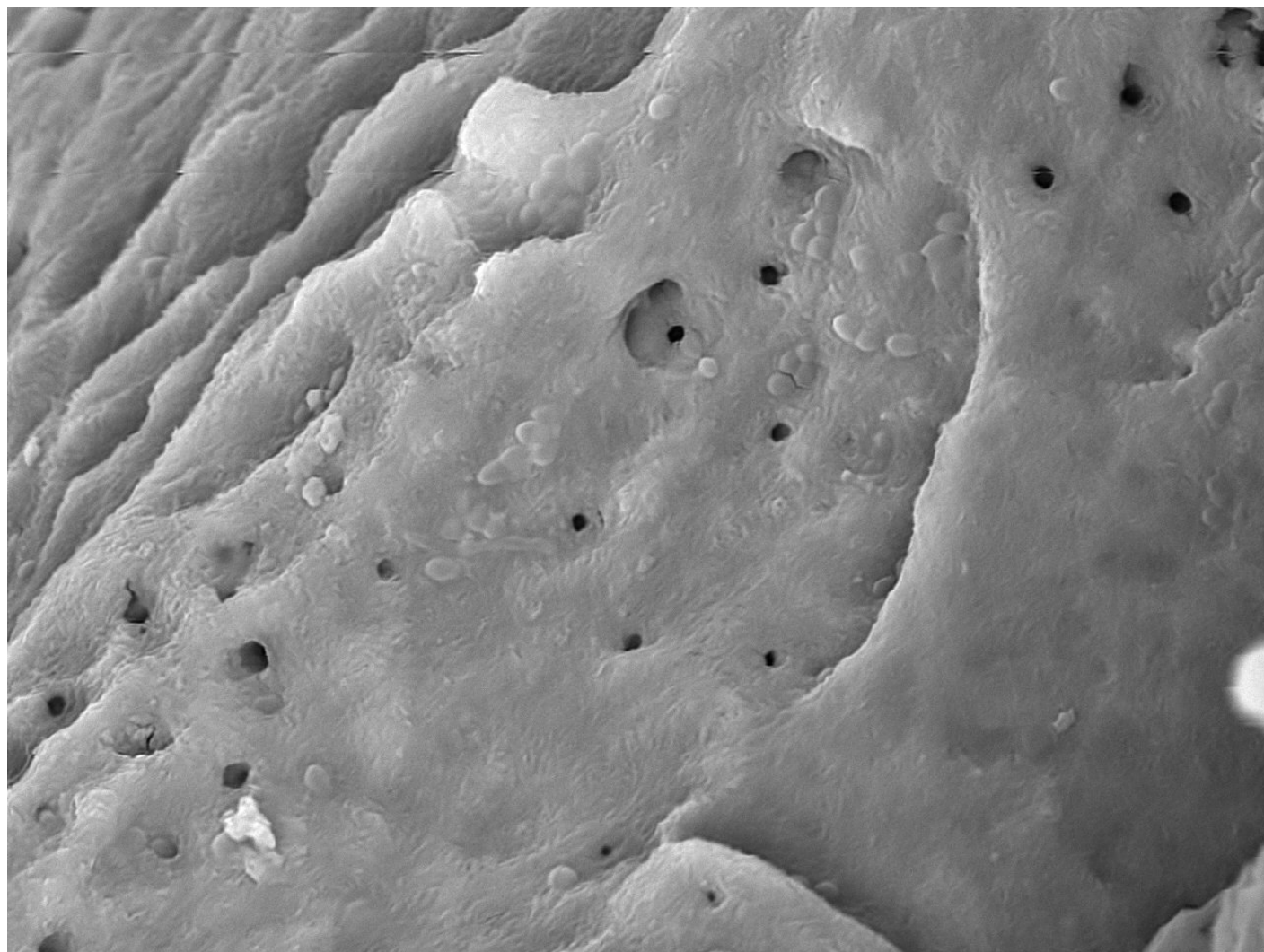
20 μ m

41) image040

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image041

image041



29679-3

2017/02/27 16:34 N

x5.0k

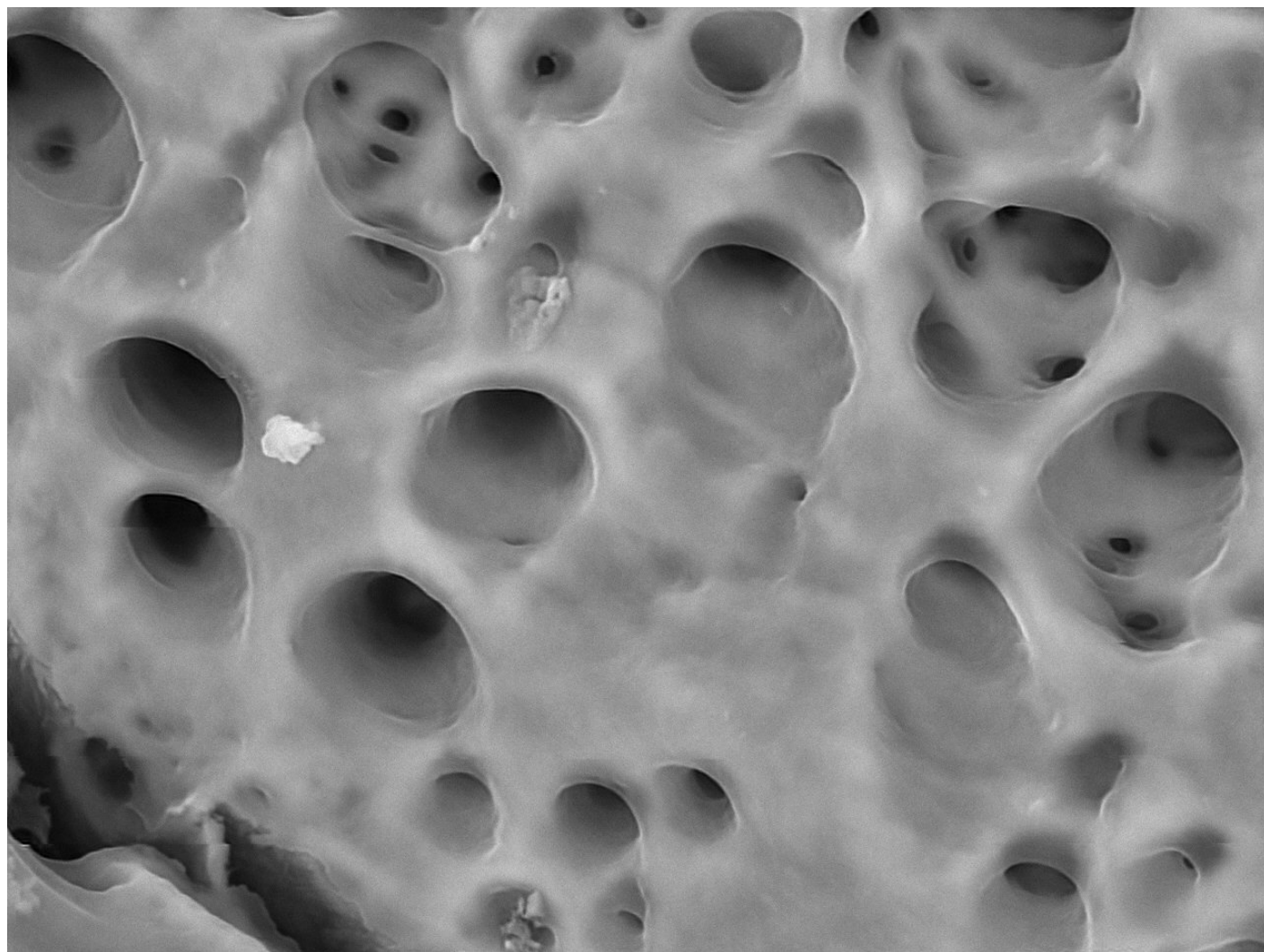
20 μ m

42) image041

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image042

image042



29961-2

2017/03/01 14:49 N

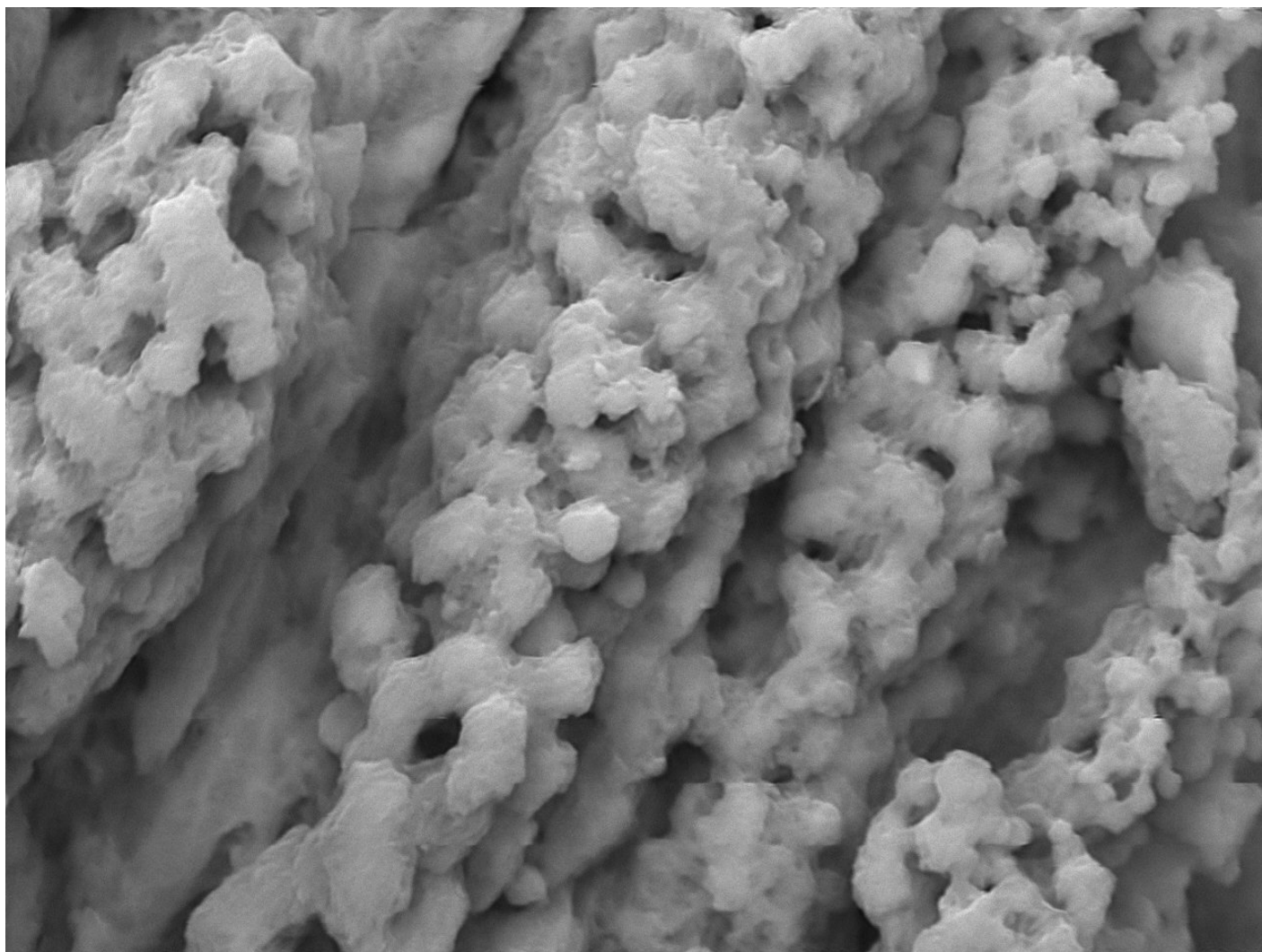
x5.0k 20 μm

43) image042

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image043

image043



29679-3

2017/02/27 16:24 N

x5.0k

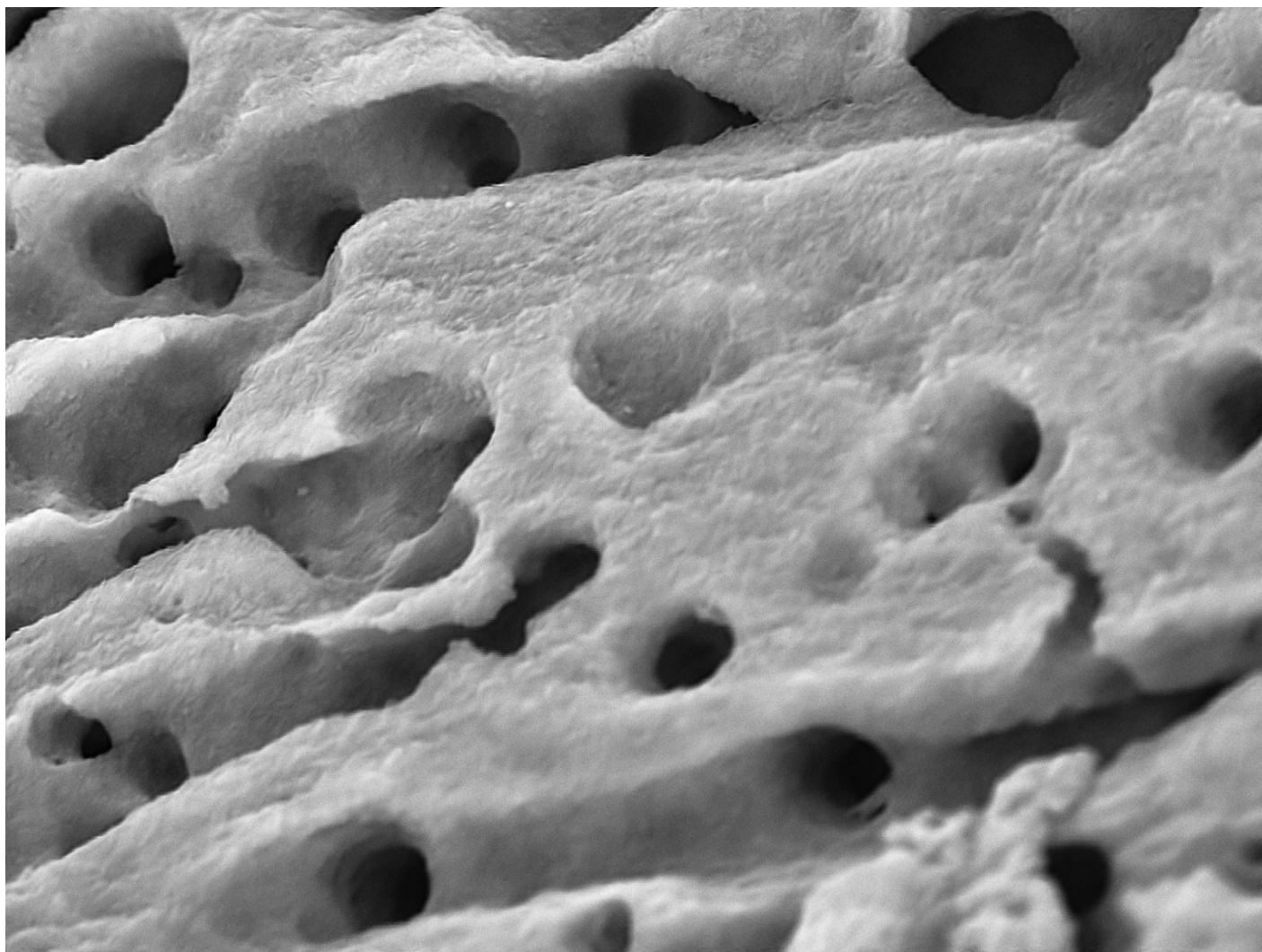
20 μ m

44) image043

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image044

image044



29211-18

2017/03/03 15:52 N

x5.0k

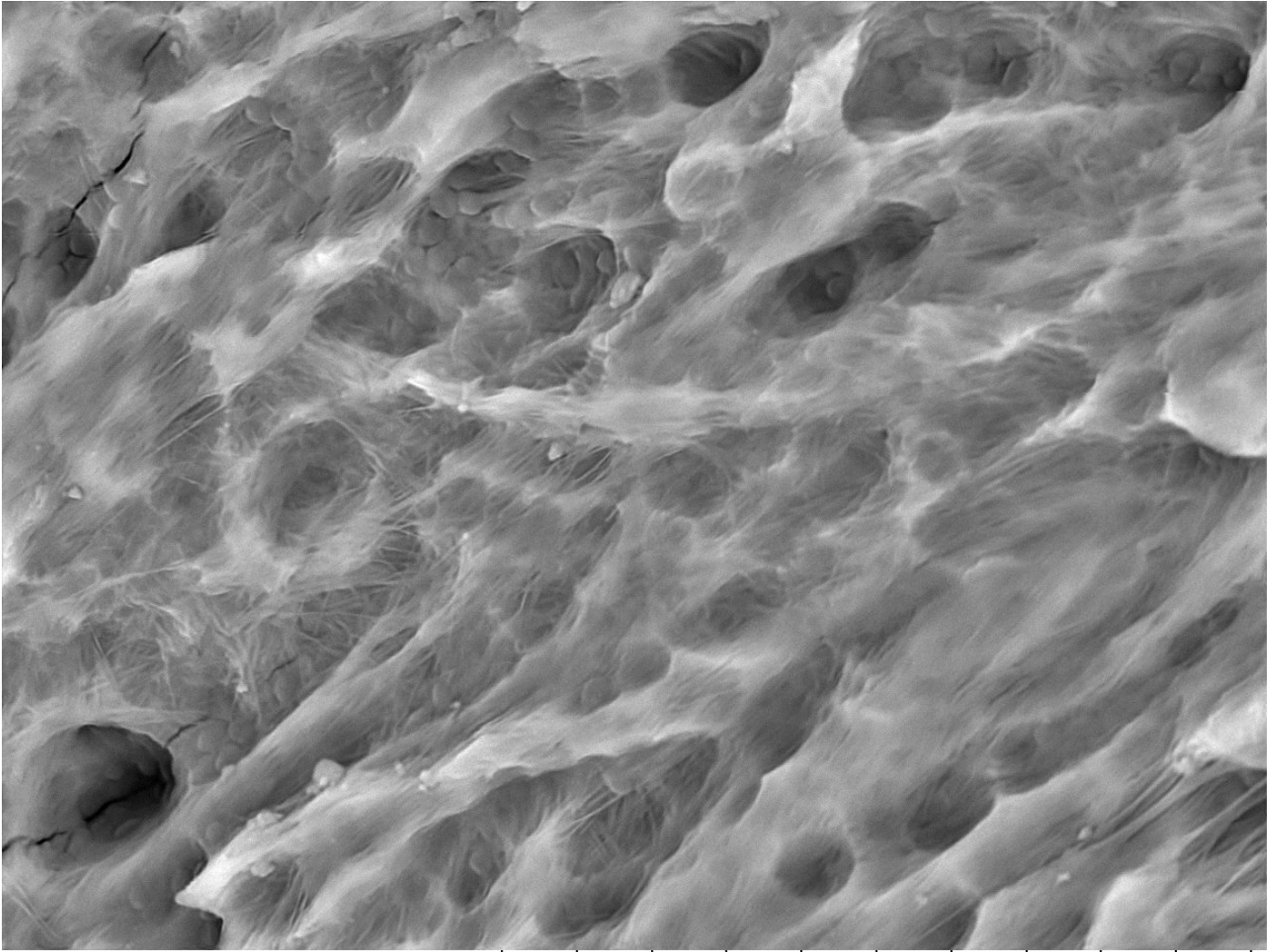
20 μ m

45) image044

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image045

image045



29694-2

2017/02/28 16:34 N

x5.0k

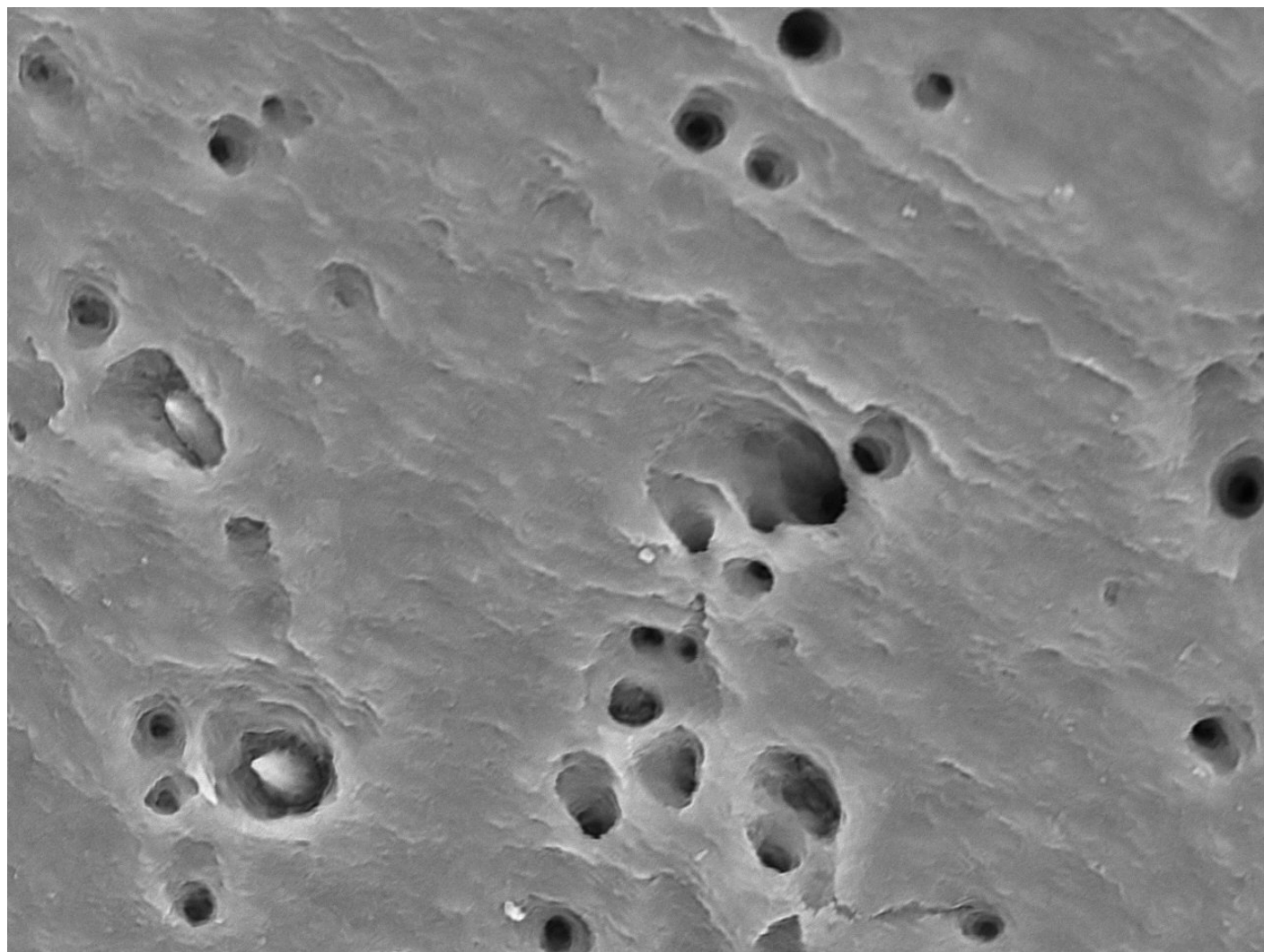
20 μ m

46) image045

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image046

image046



29211-18

2017/03/04 13:53 N

x5.0k

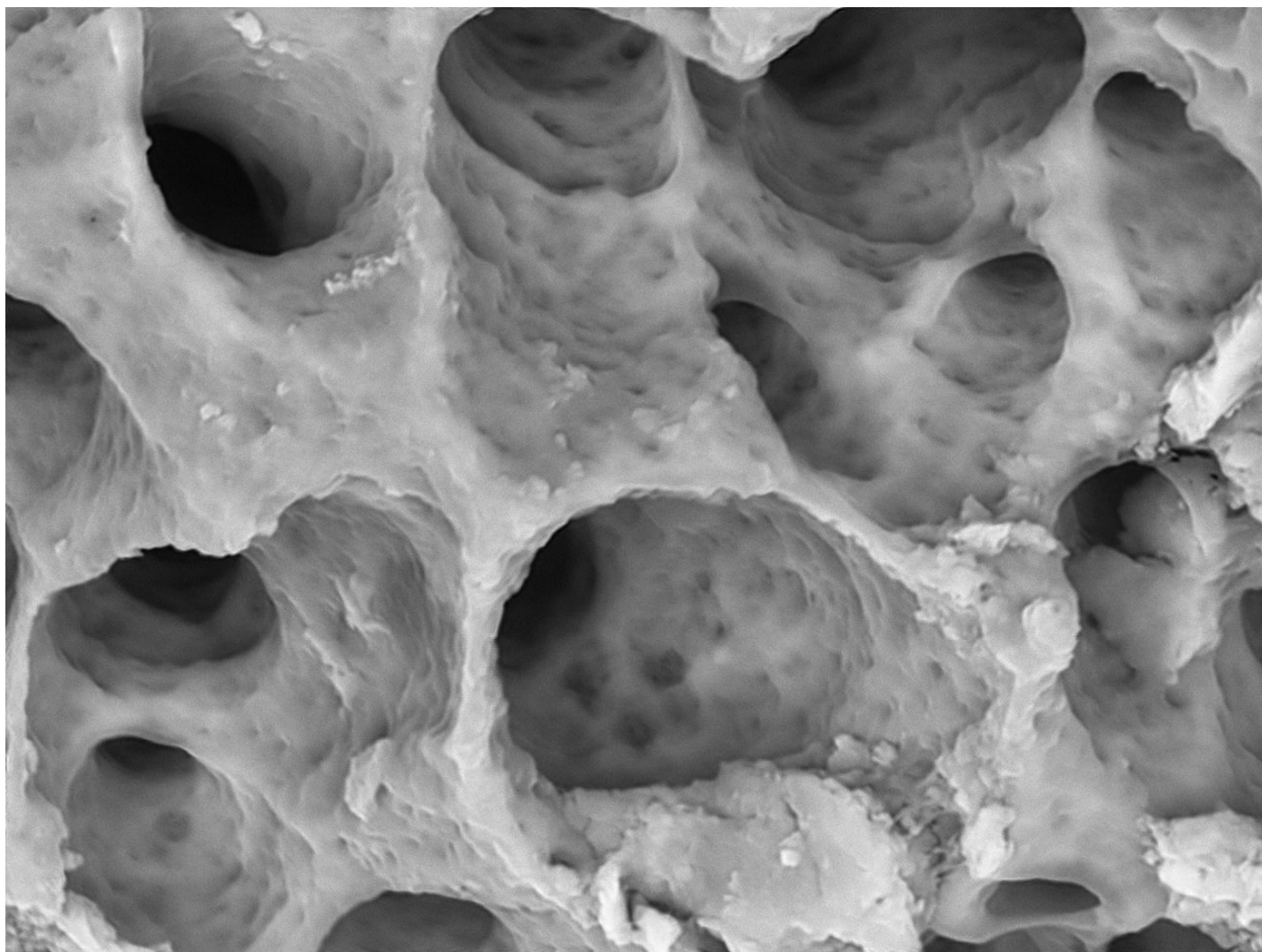
20 μ m

47) image046

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image047

image047



29009-31

2017/03/08 10:32 N

x5.0k

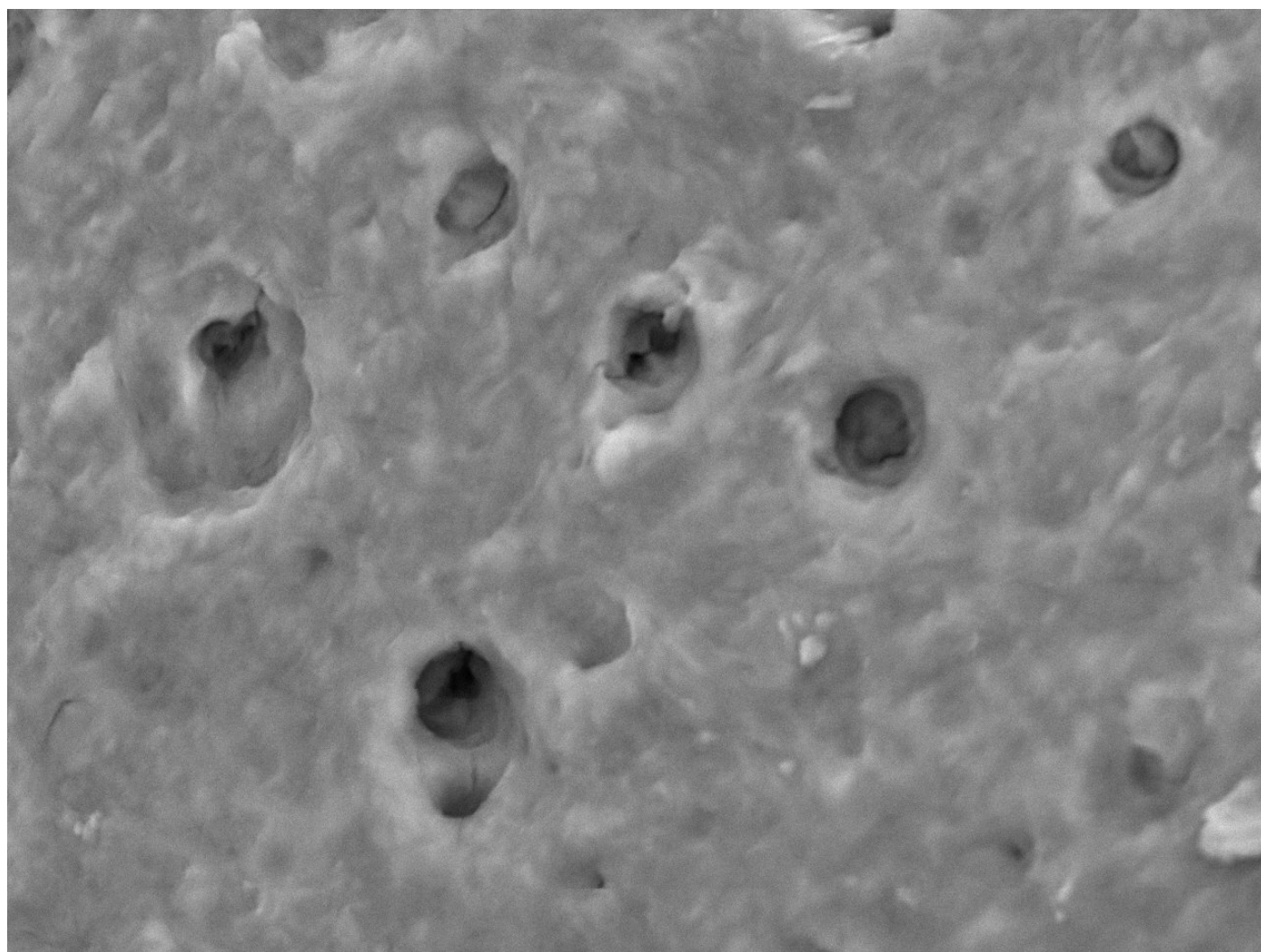
20 μ m

48) image047

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image048

image048



29211-18

2017/03/04 14:18 N

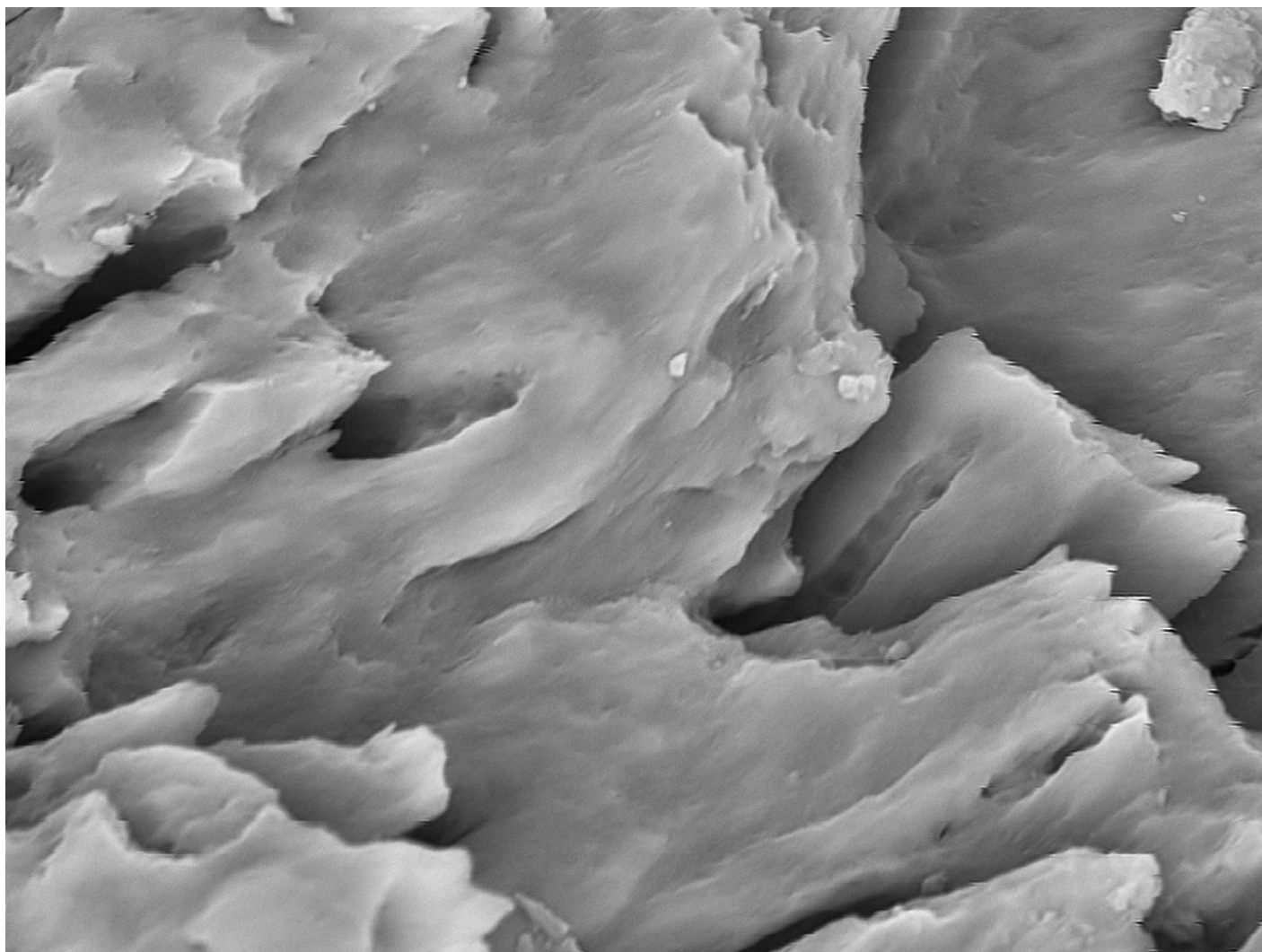
x5.0k 20 μ m

49) image048

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image049

image049



29576-18

2017/03/01 11:43 N

x5.0k

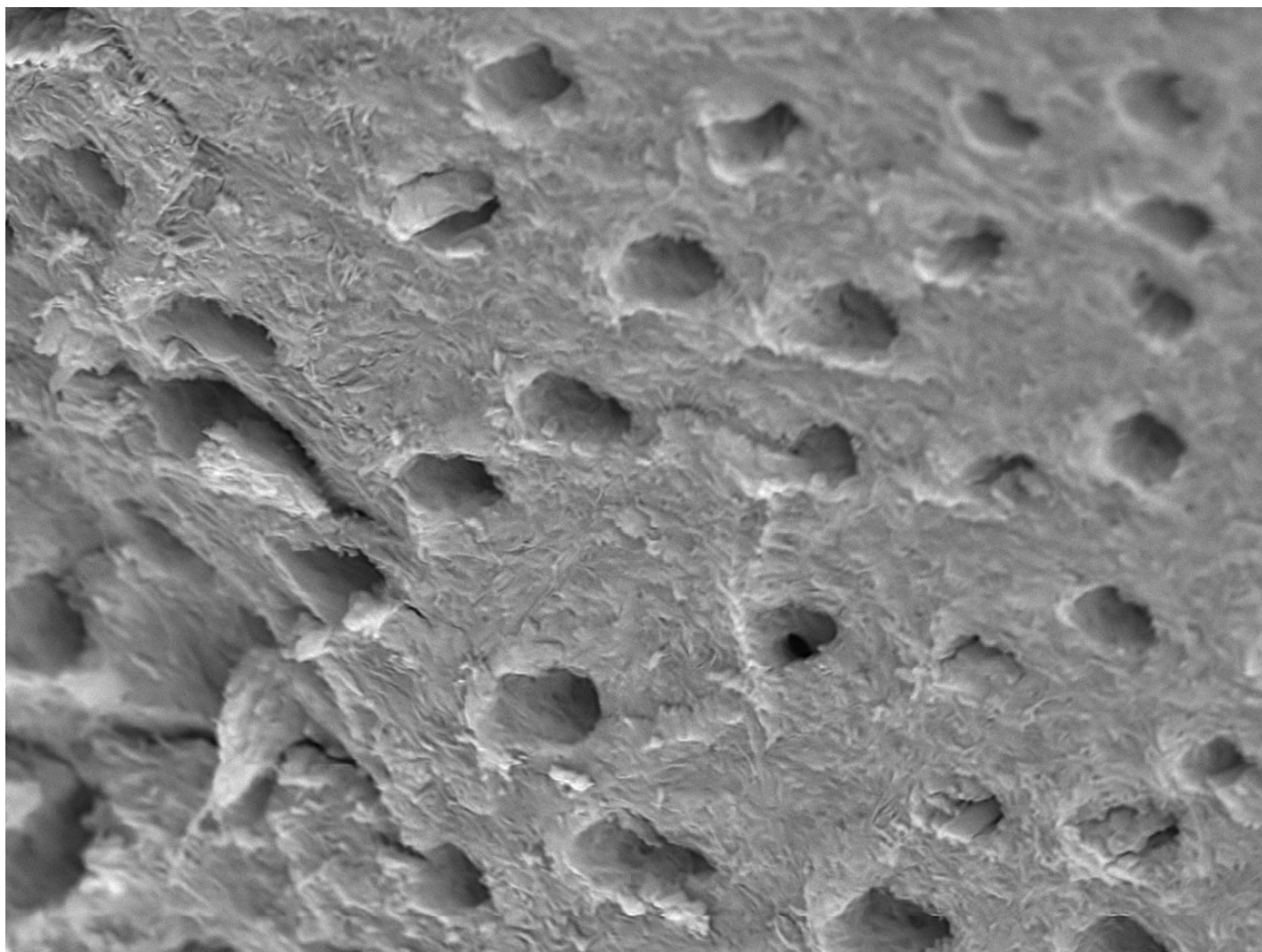
20 μ m

50) image049

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image050

image050



29565-15

2017/02/28 15:32 N

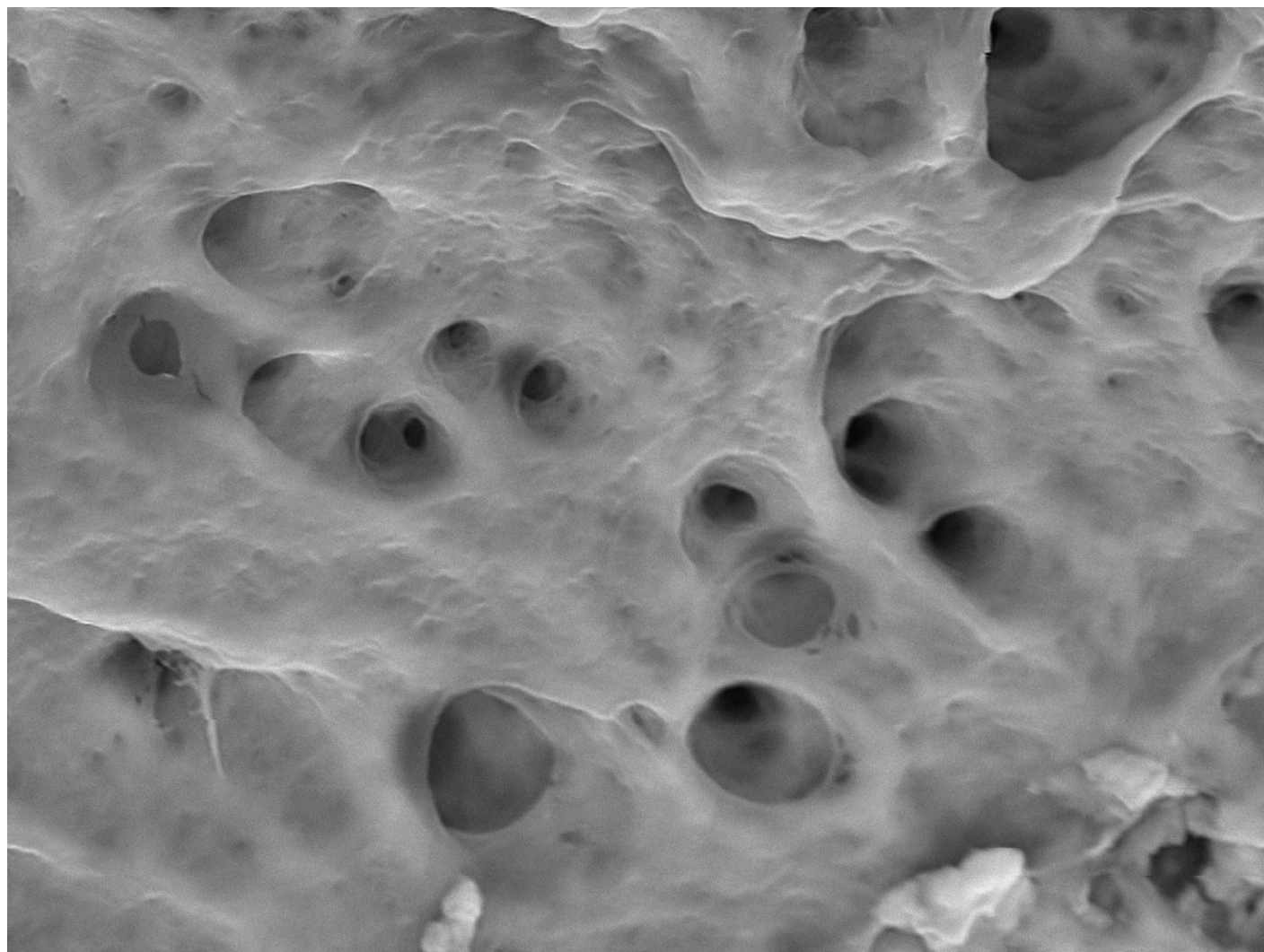
x5.0k 20 μm

51) image050

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image051

image051



29961-2

2017/03/01 14:56 N

x5.0k

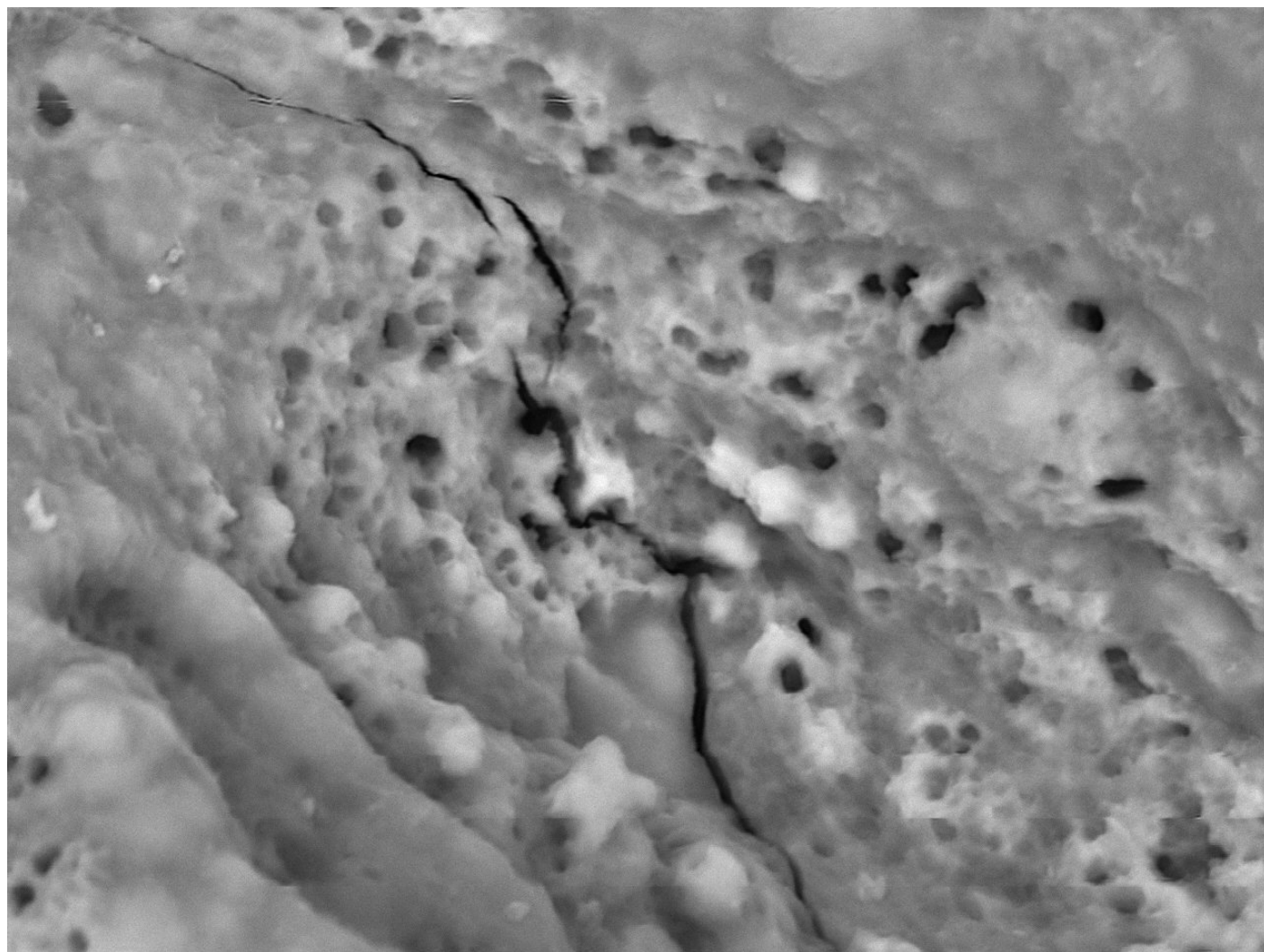
20 μ m

52) image051

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image052

image052



29679-3

2017/02/27 16:06 N

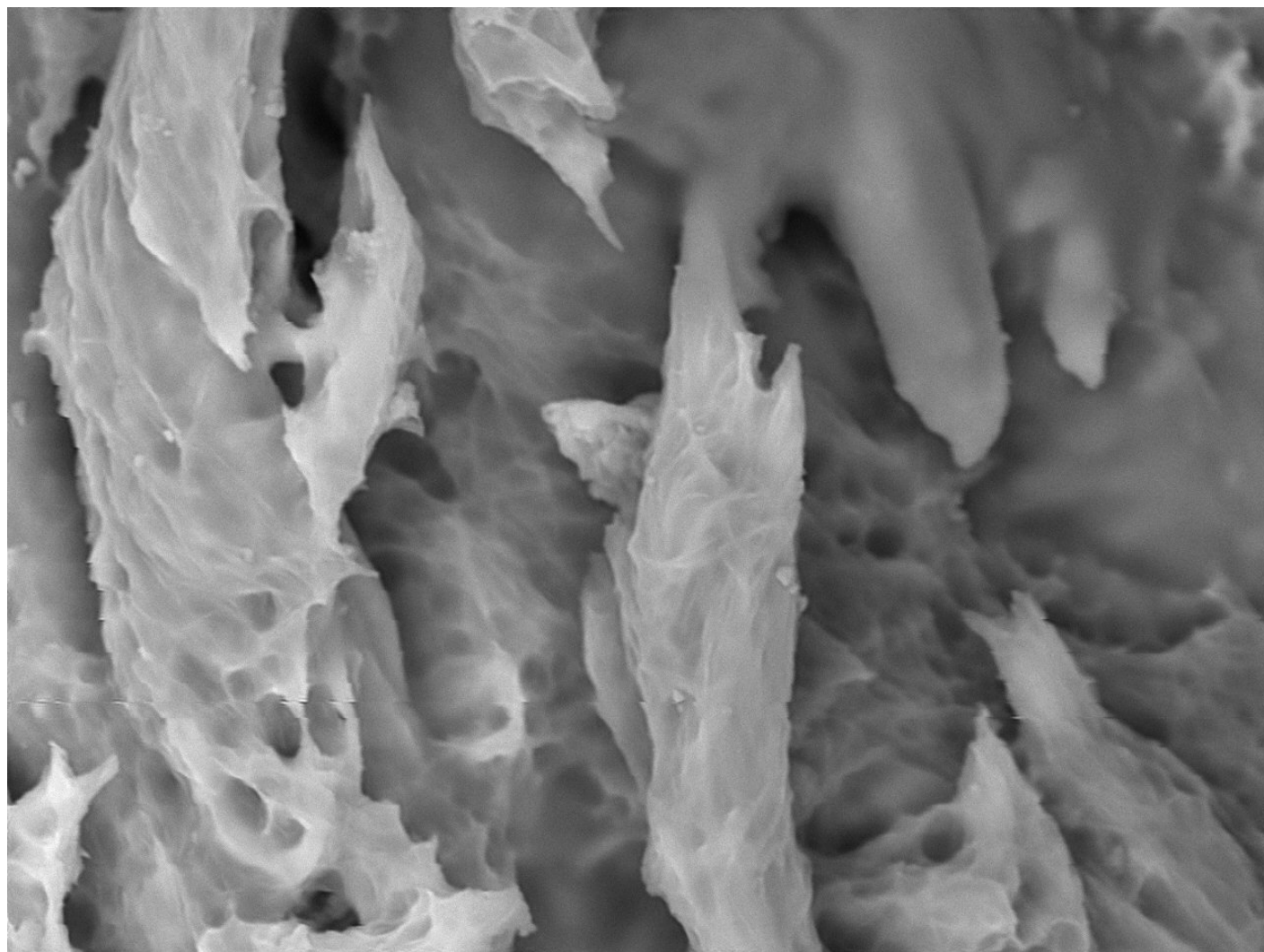
x5.0k 20 μm

53) image052

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image053

image053



29028-15

2017/03/04 15:29 N

x5.0k

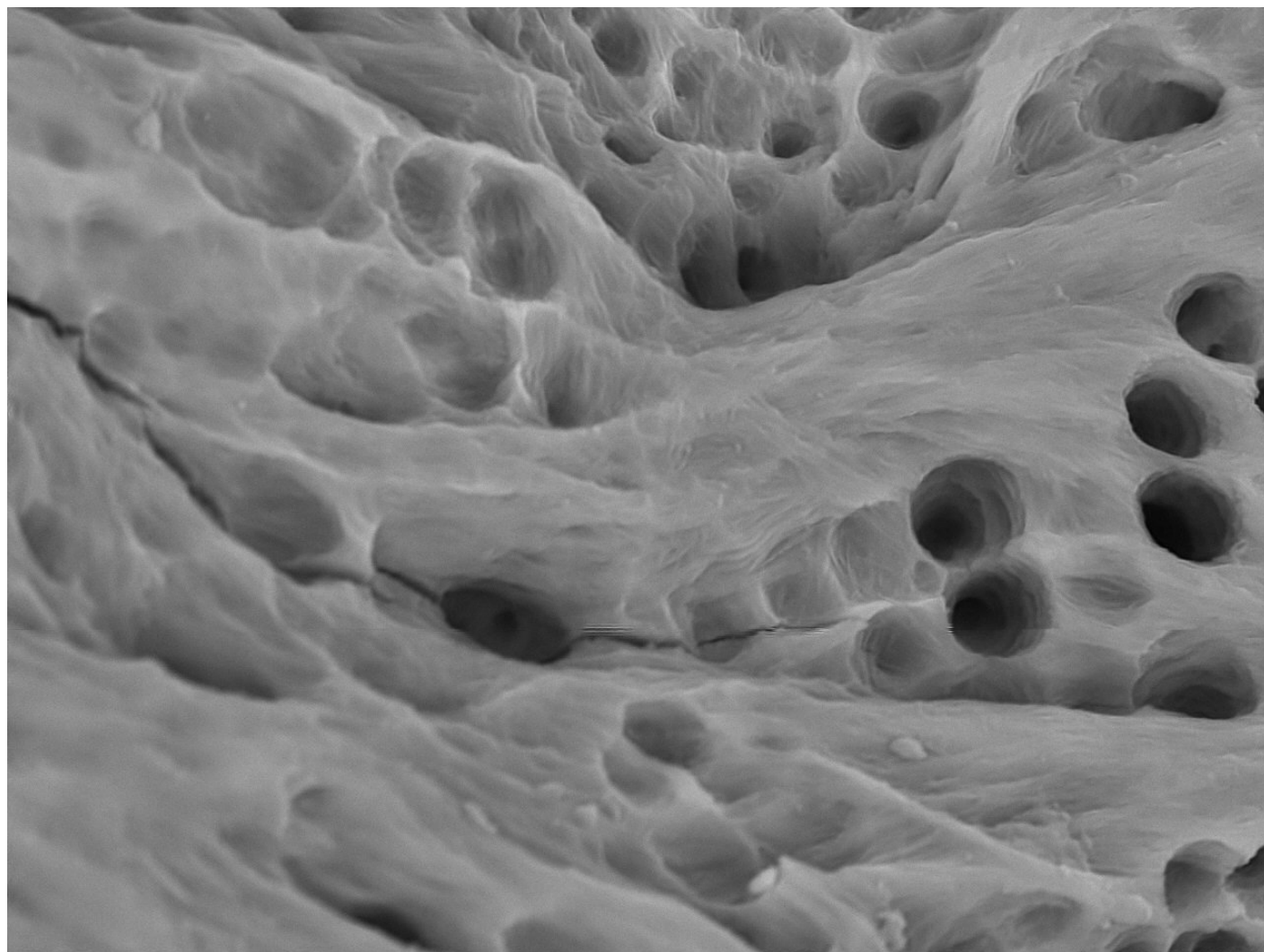
20 μ m

54) image053

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image054

image054



29265-2

2017/02/27 11:38 N

x5.0k

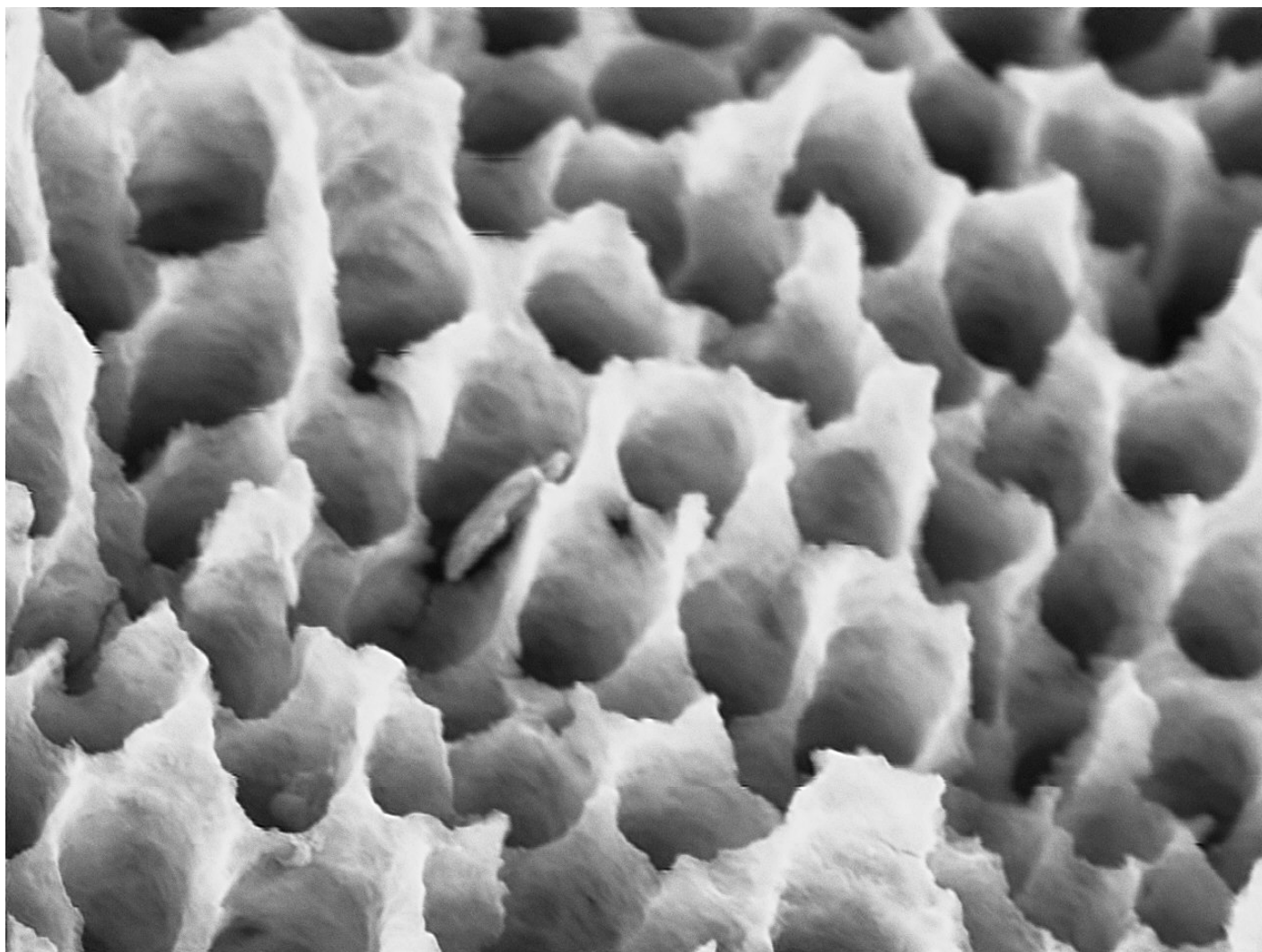
20 μ m

55) image054

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image055

image055



29340-18

2017/03/03 10:21 N

x5.0k

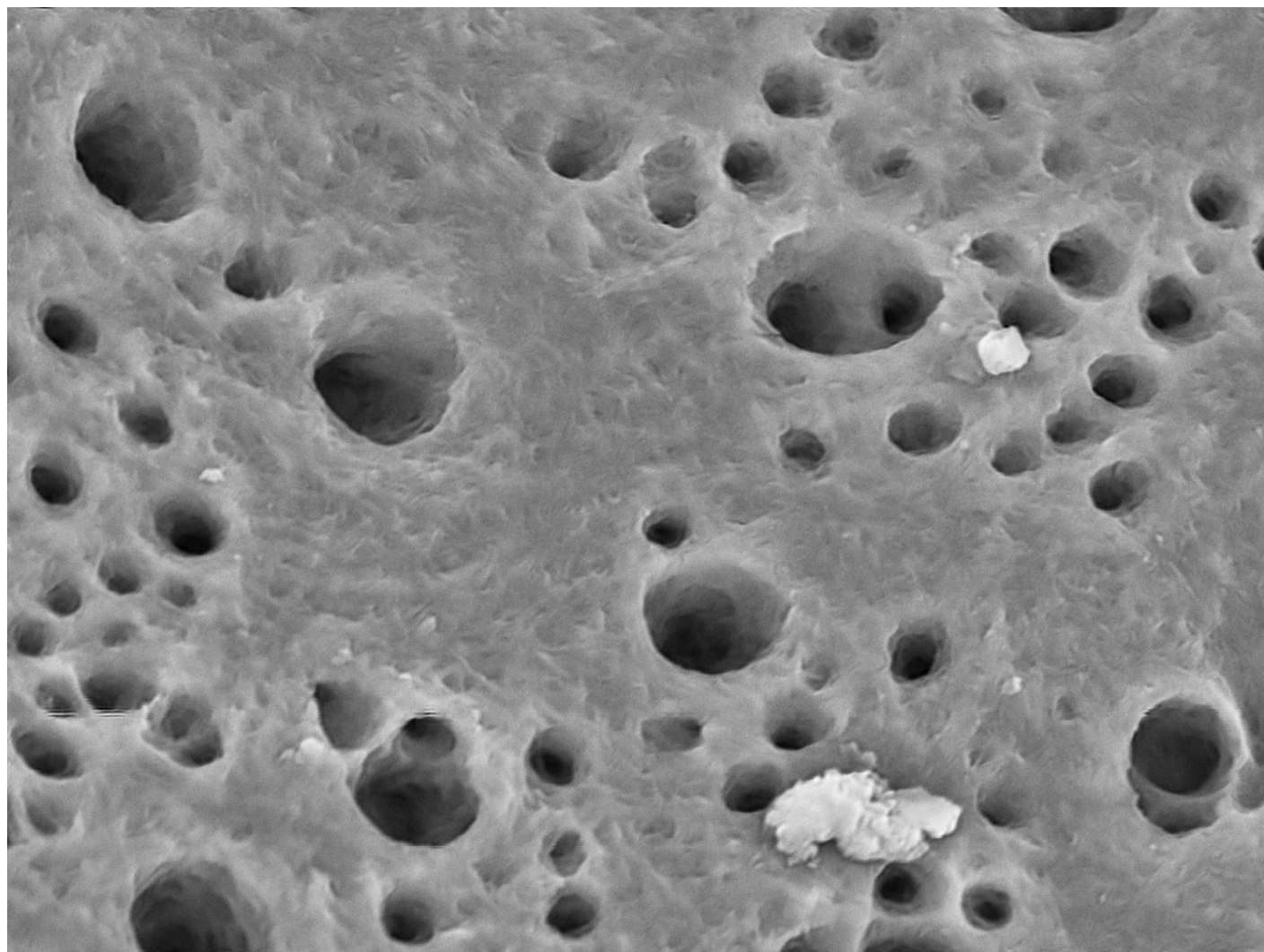
20 μ m

56) image055

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image056

image056



29265-2

2017/02/27 11:00 N

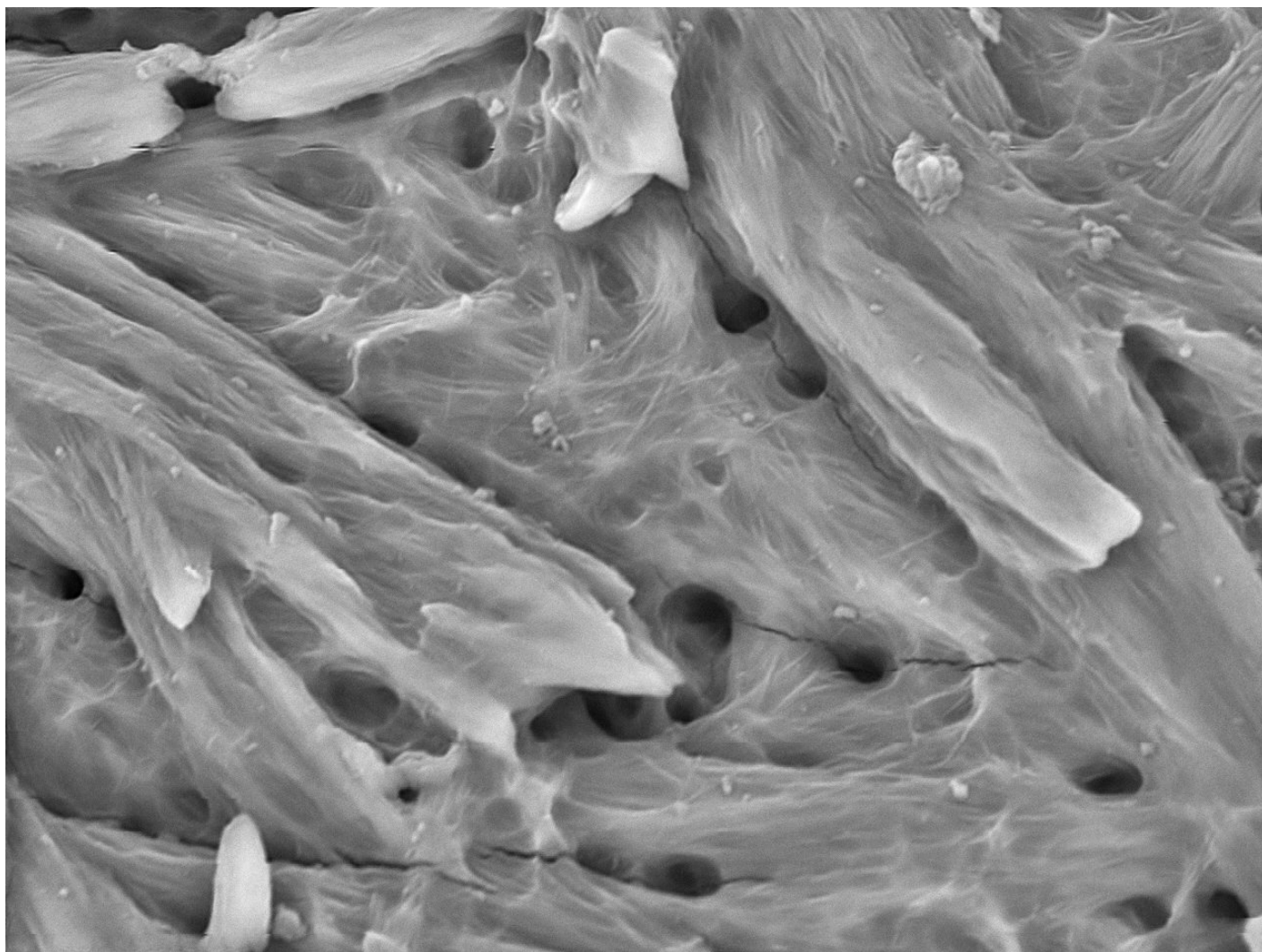
x5.0k 20 μm

57) image056

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image057

image057



29679-3

2017/02/27 15:47 N

x5.0k

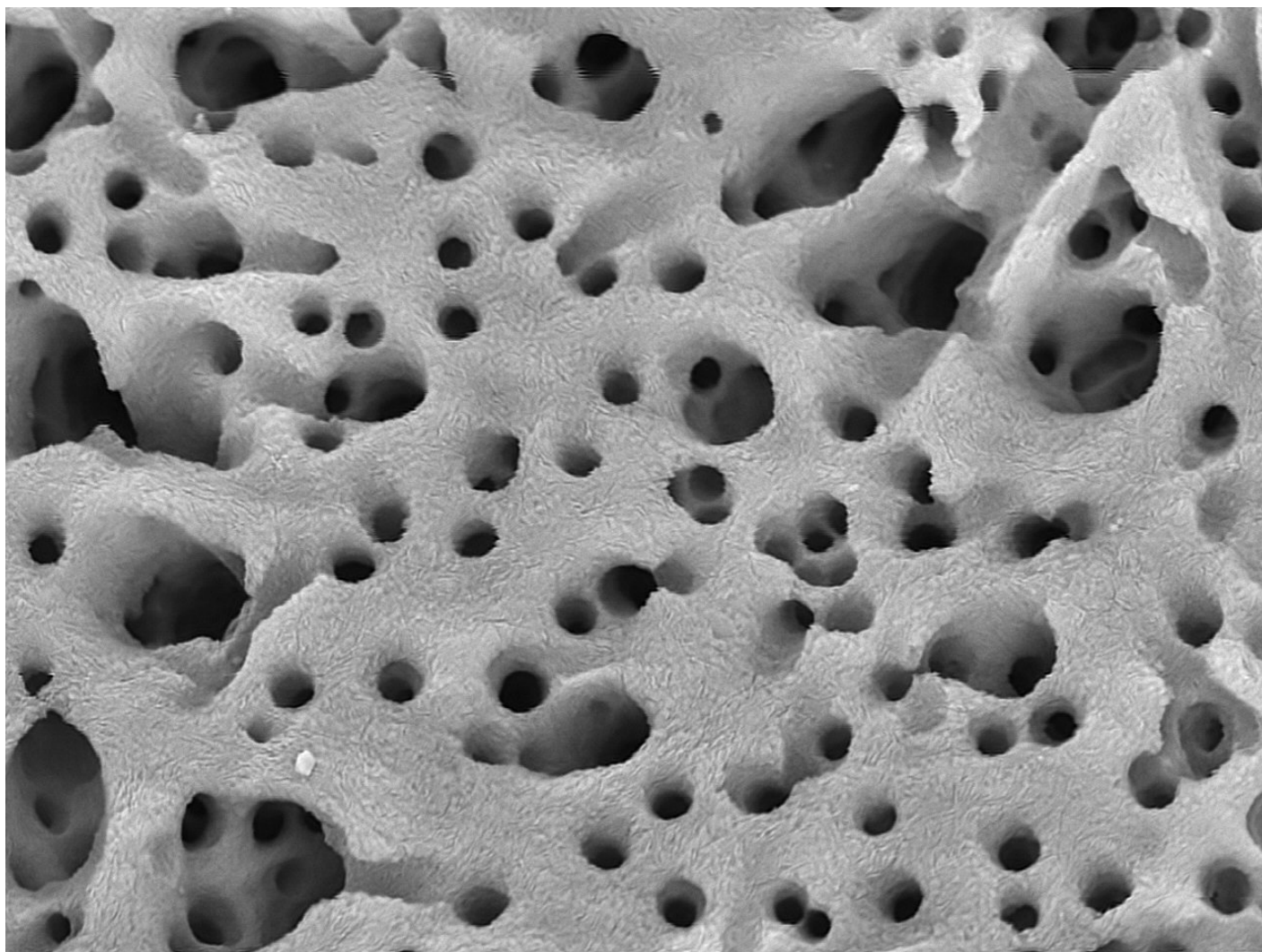
20 µm

58) image057

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image058

image058



29179-3

2017/03/03 14:19 N

x5.0k

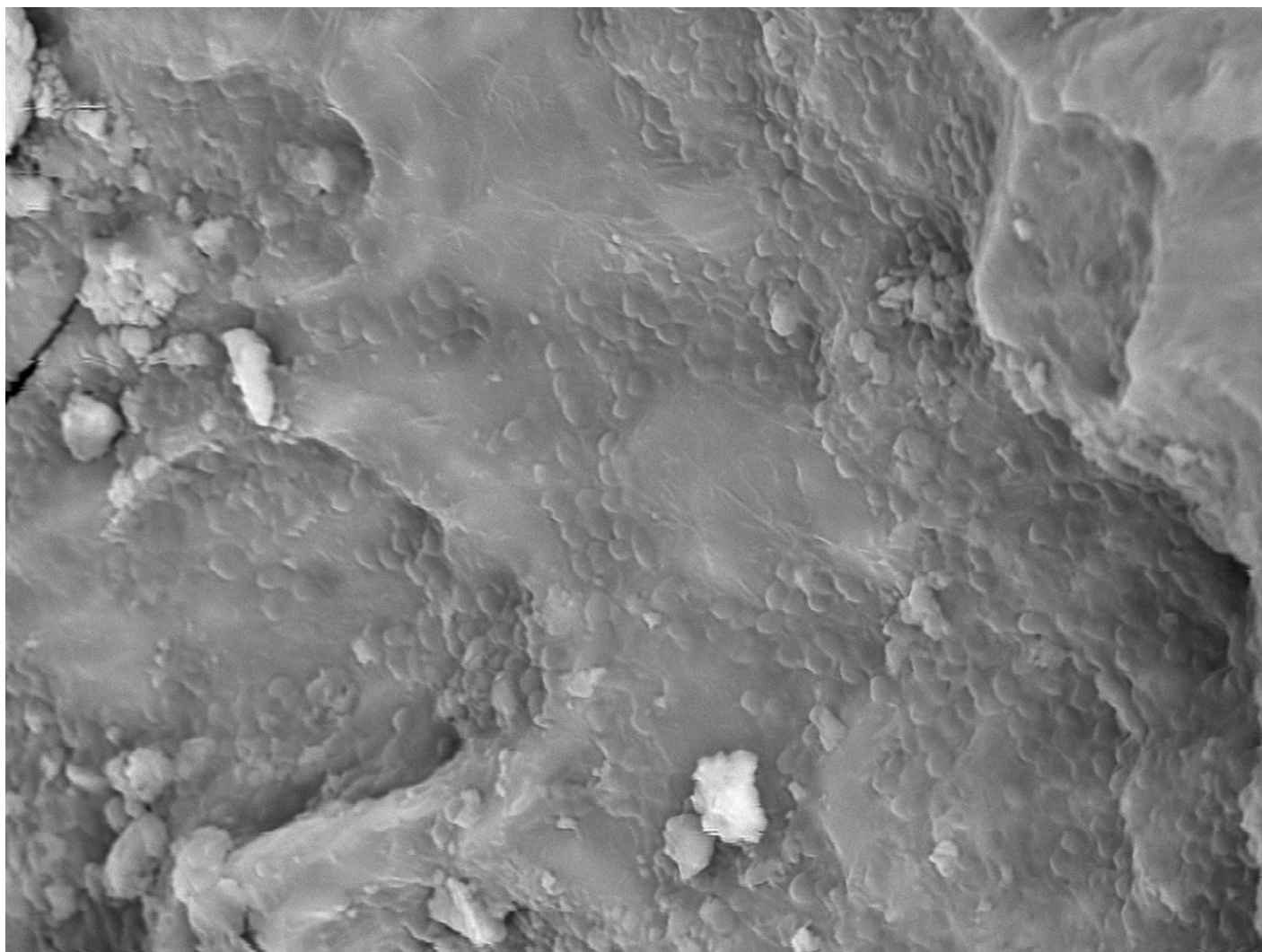
20 μ m

59) image058

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image059

image059



29052-14

2017/02/28 17:41 N

x5.0k

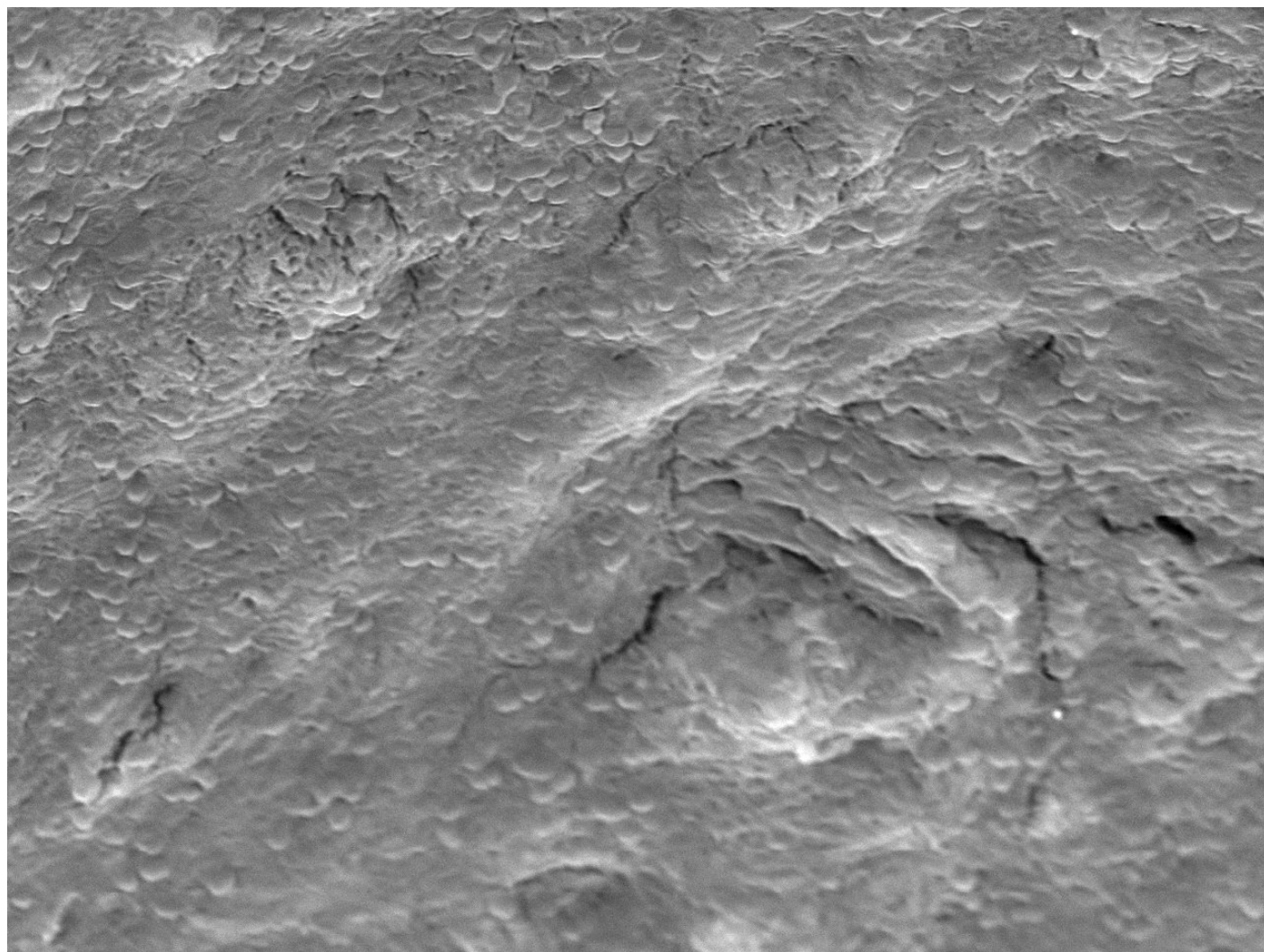
20 μ m

60) image059

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image060

image060



29965-2

2017/03/02 17:33 N

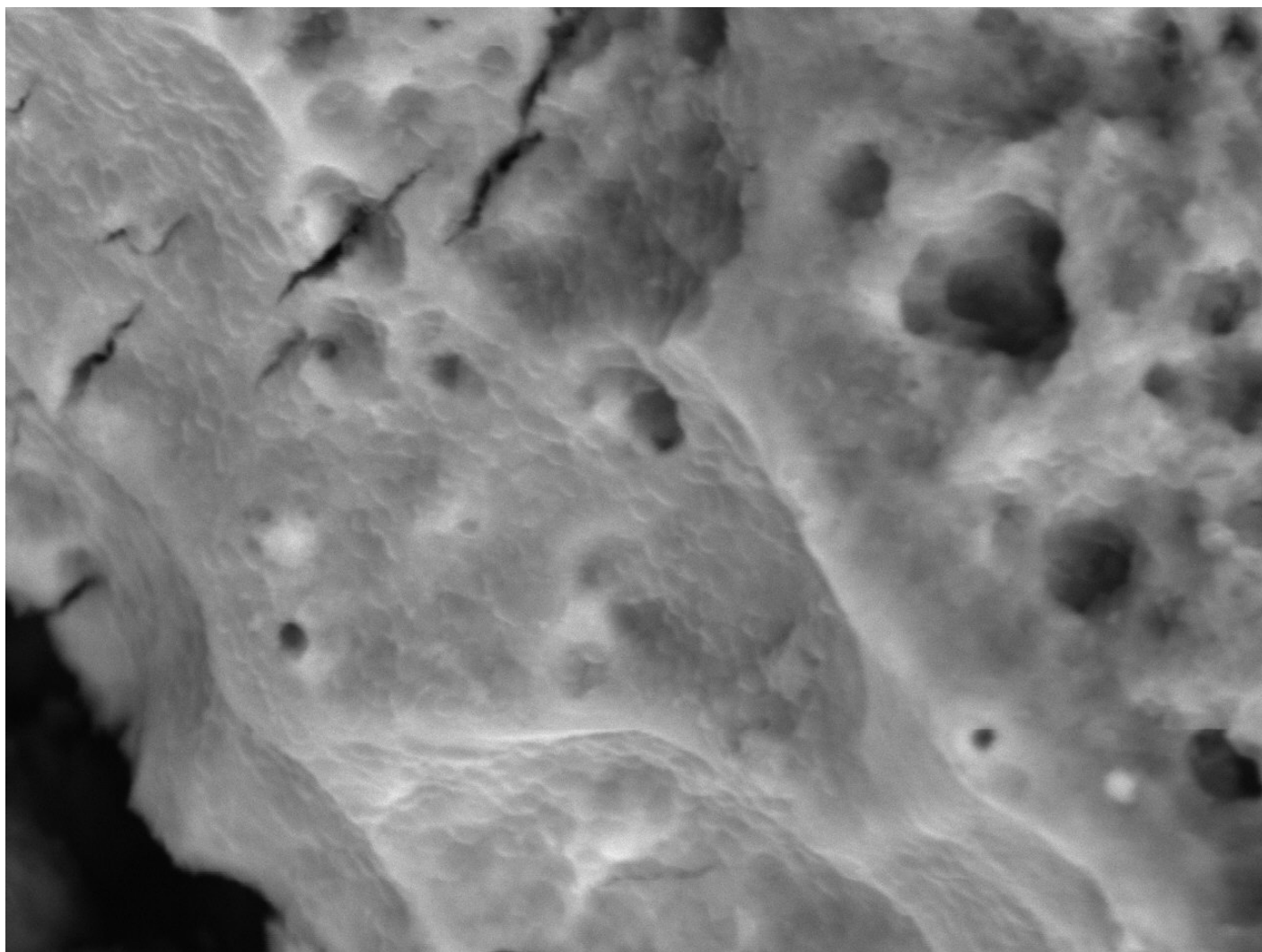
x5.0k 20 μ m

61) image060

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image061

image061



29856-30

2017/02/22 12:04 H

x5.0k

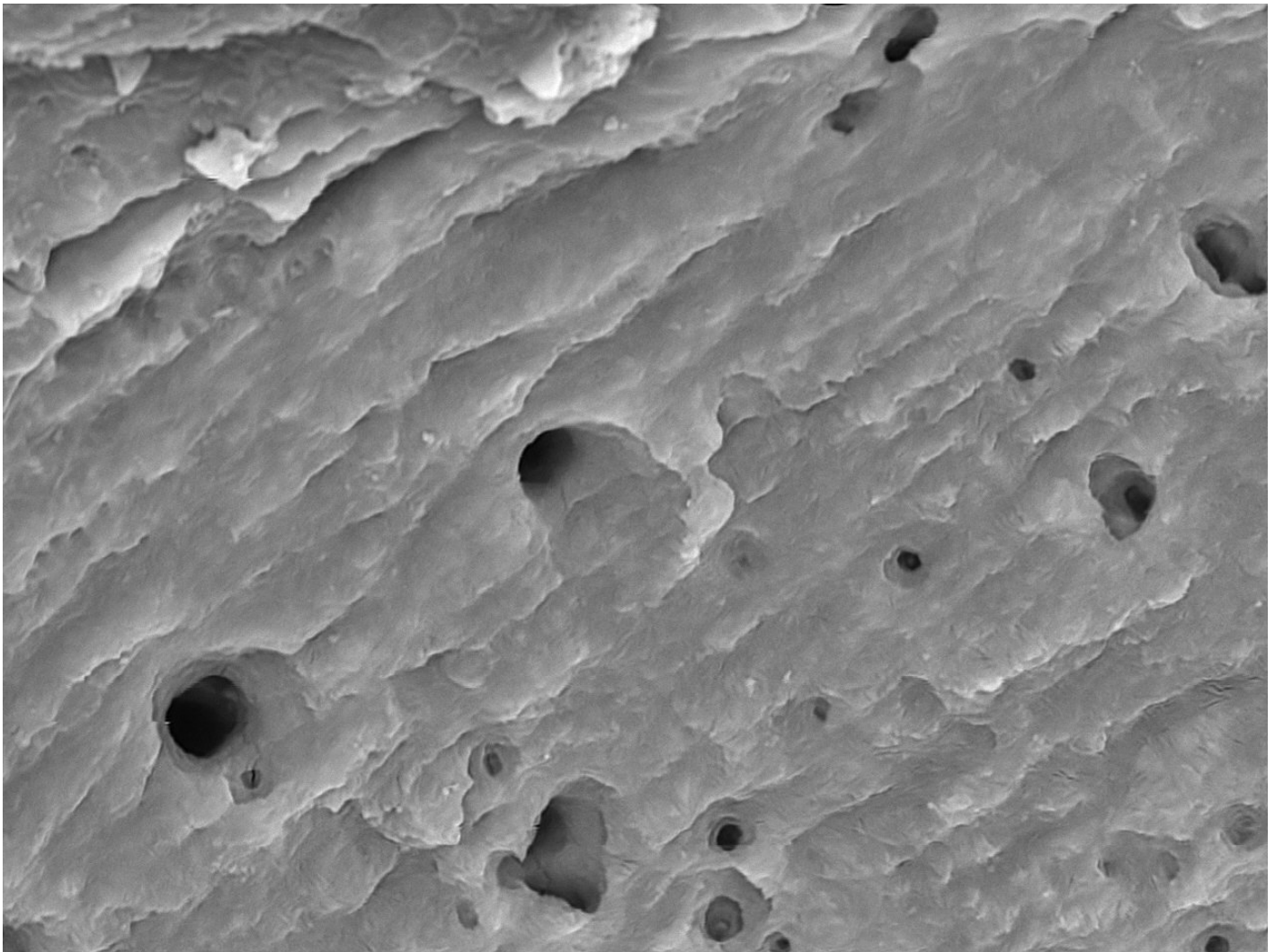
20 μ m

62) image061

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image062

image062



29052-14

2017/02/28 18:02 N

x5.0k

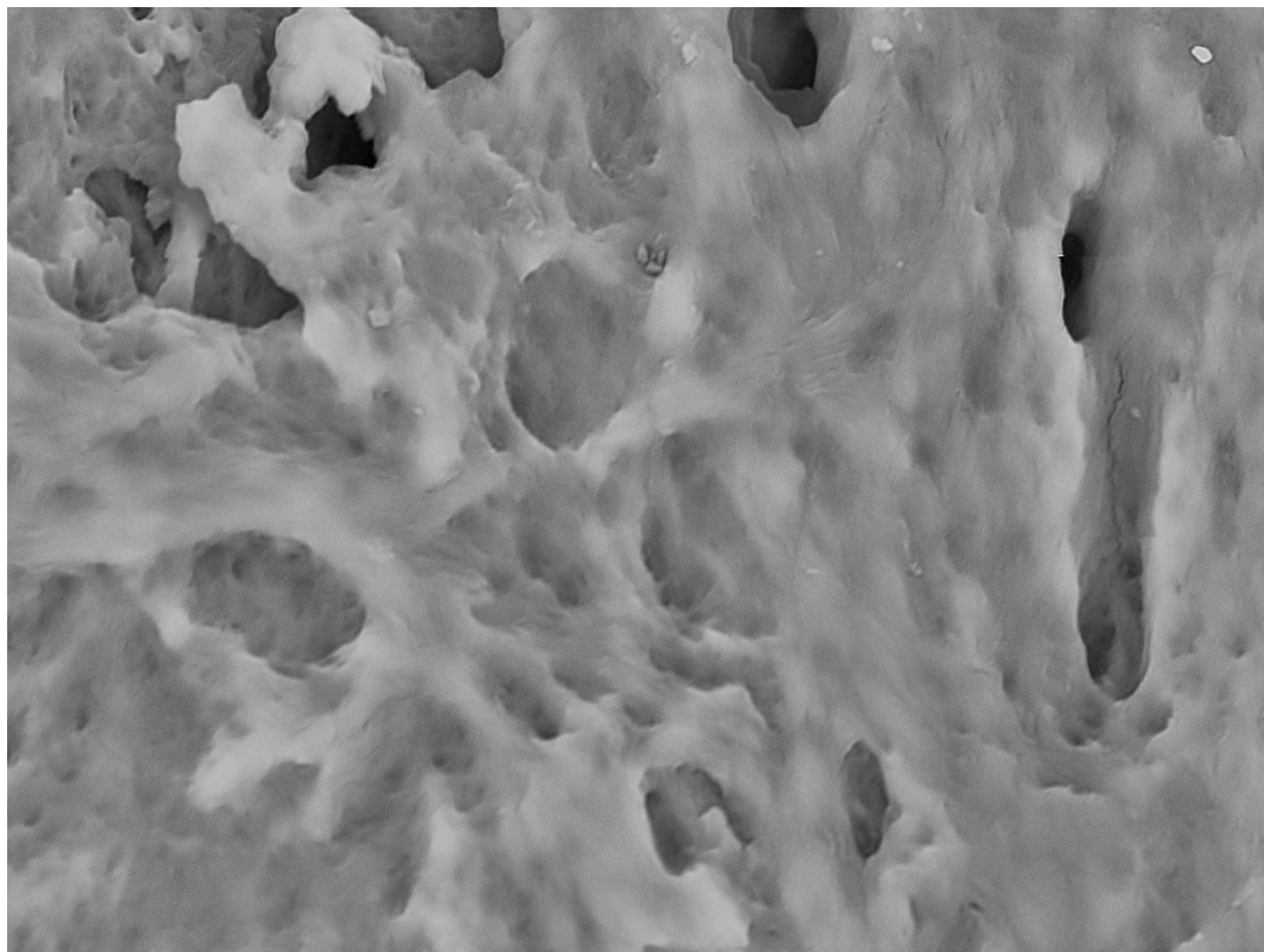
20 μm

63) image062

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image063

image063



29576-18

2017/03/01 12:01 N

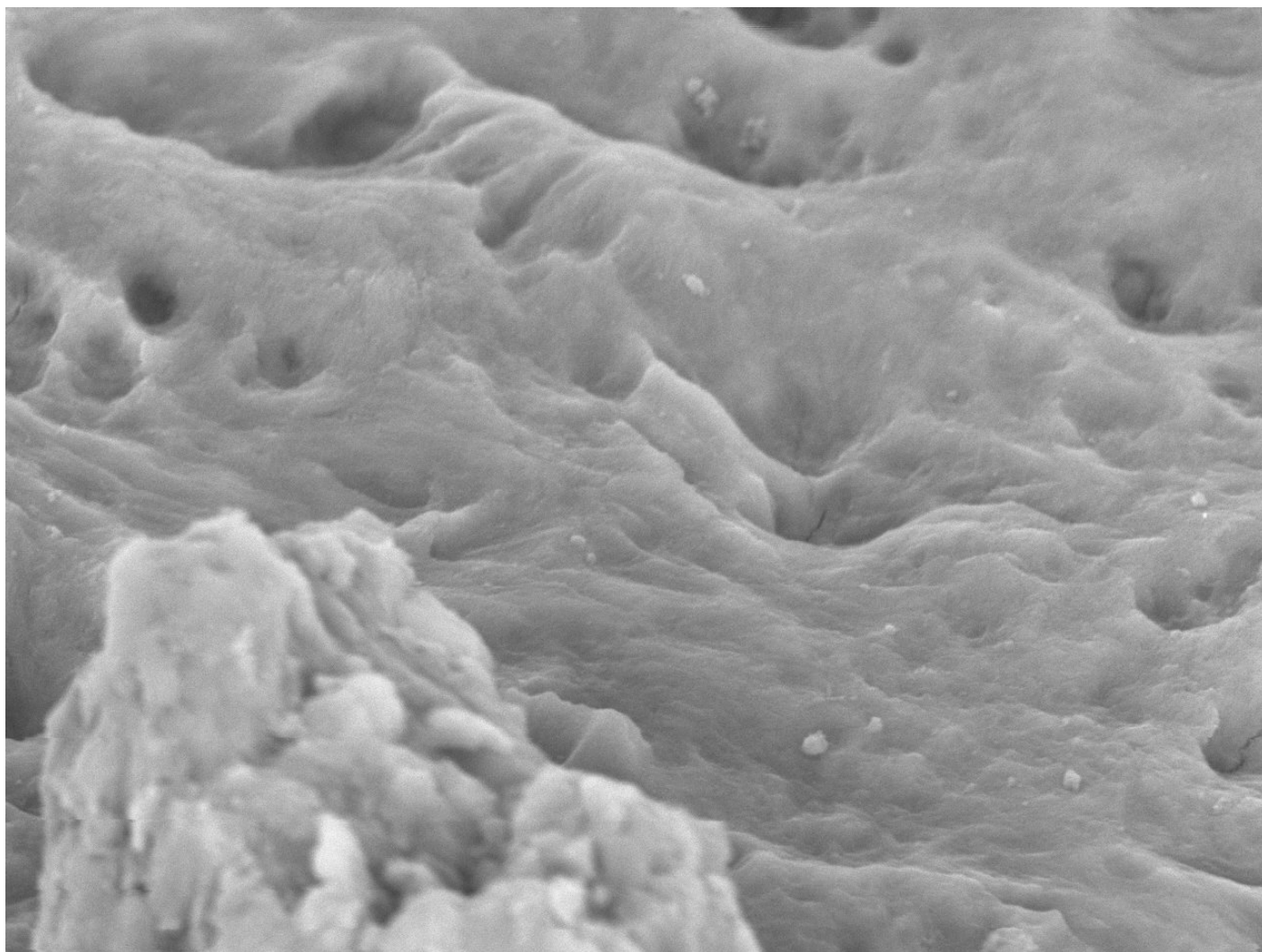
x5.0k 20 μm

64) image063

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image064

image064



29952-15

2017/02/22 15:21 N

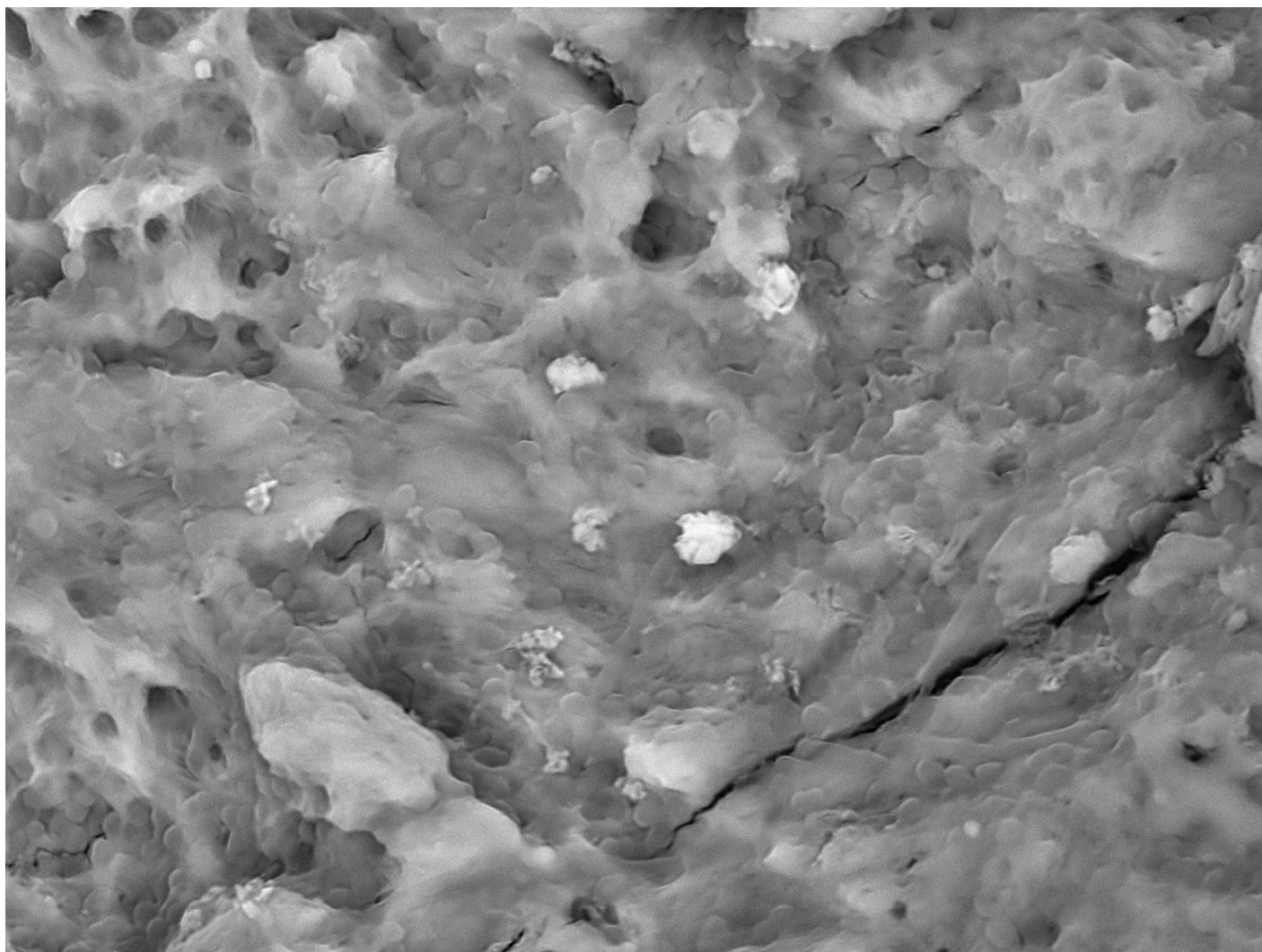
x5.0k 20 μ m

65) image064

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image065

image065



29856-30

2017/02/22 10:22 N

x5.0k

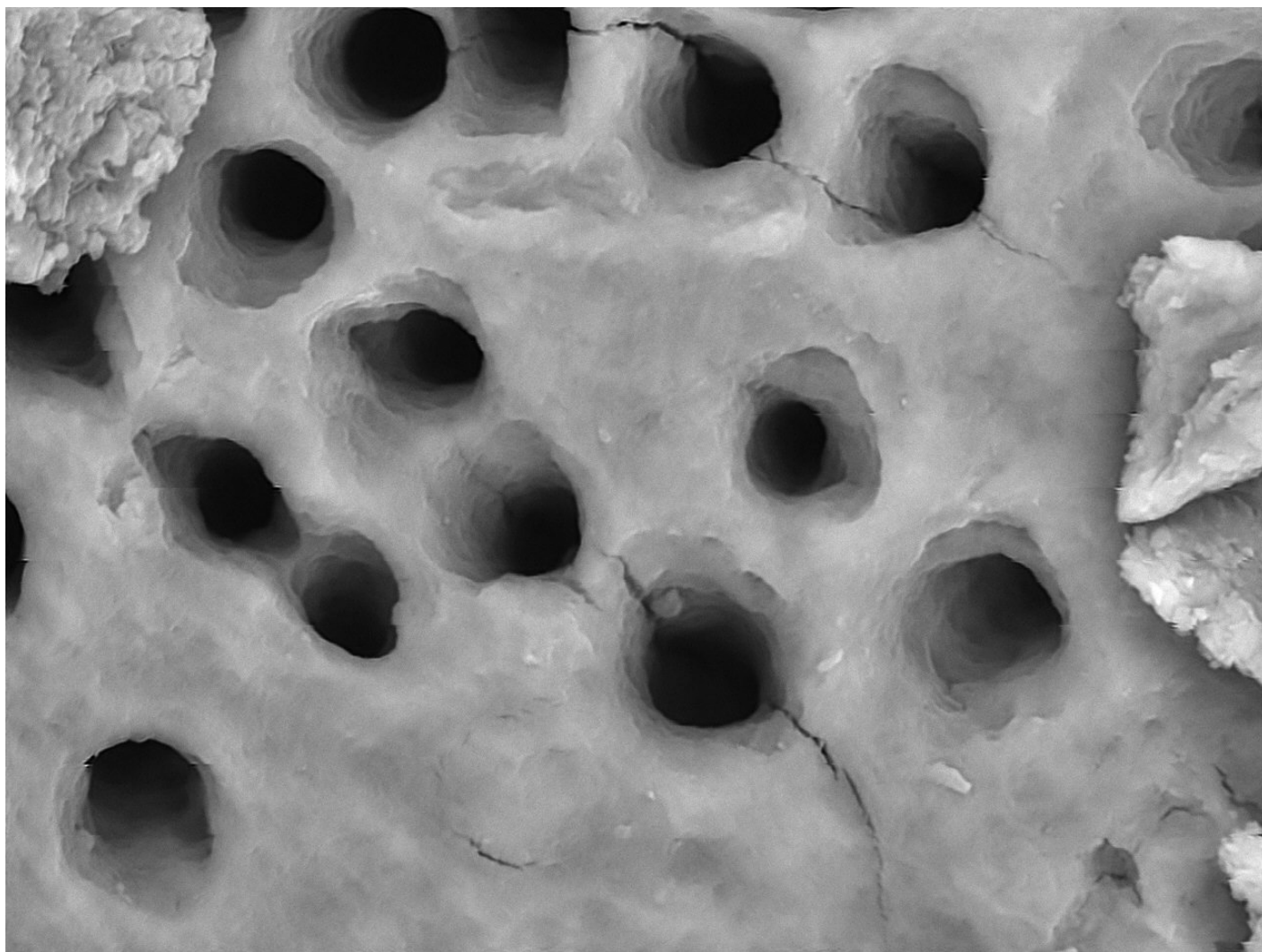
20 μ m

66) image065

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image066

image066



29565-15

2017/02/28 15:31 N

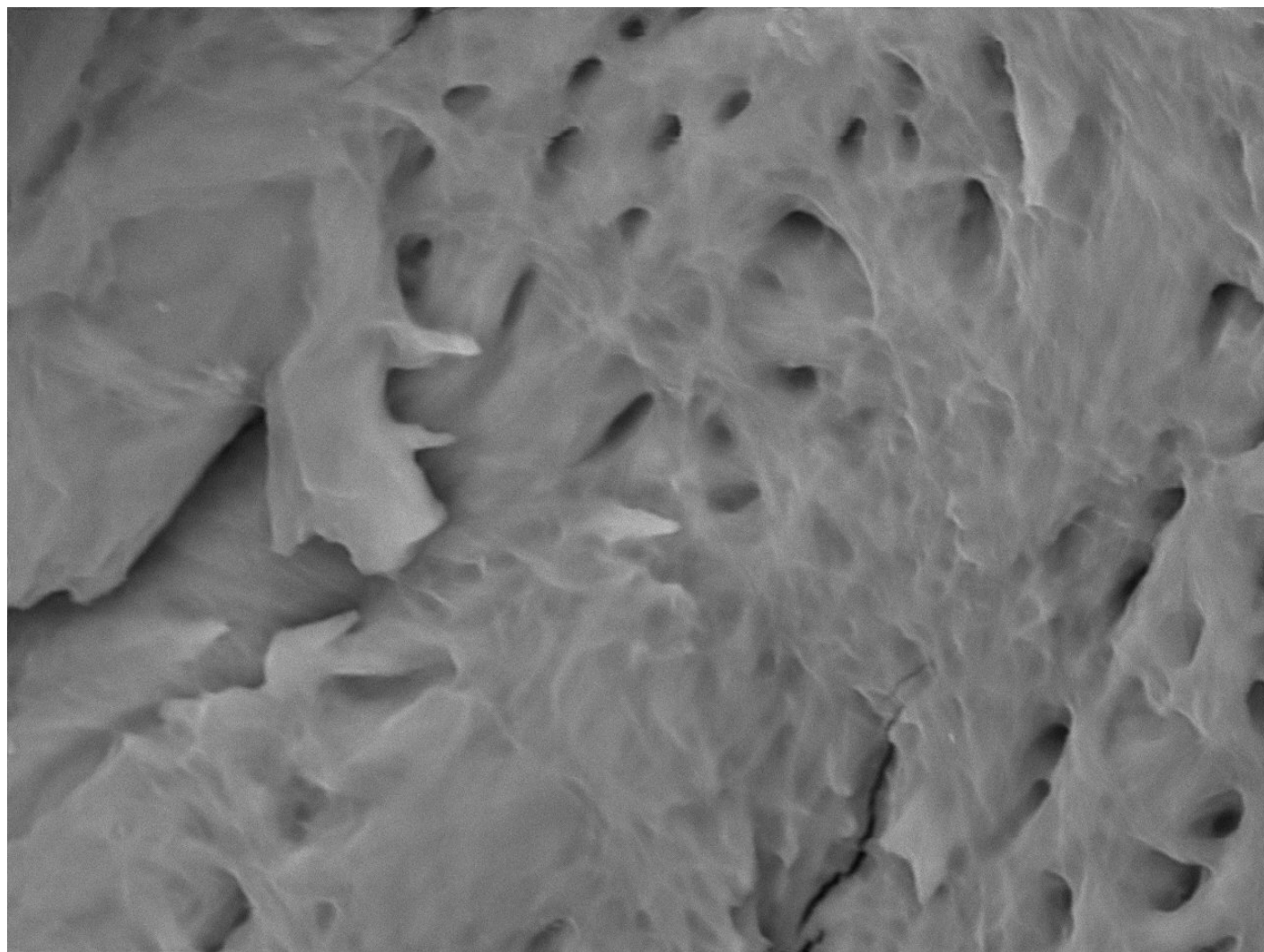
x5.0k 20 μ m

67) image066

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image067

image067



29593-3

2017/02/27 12:08 N

x5.0k

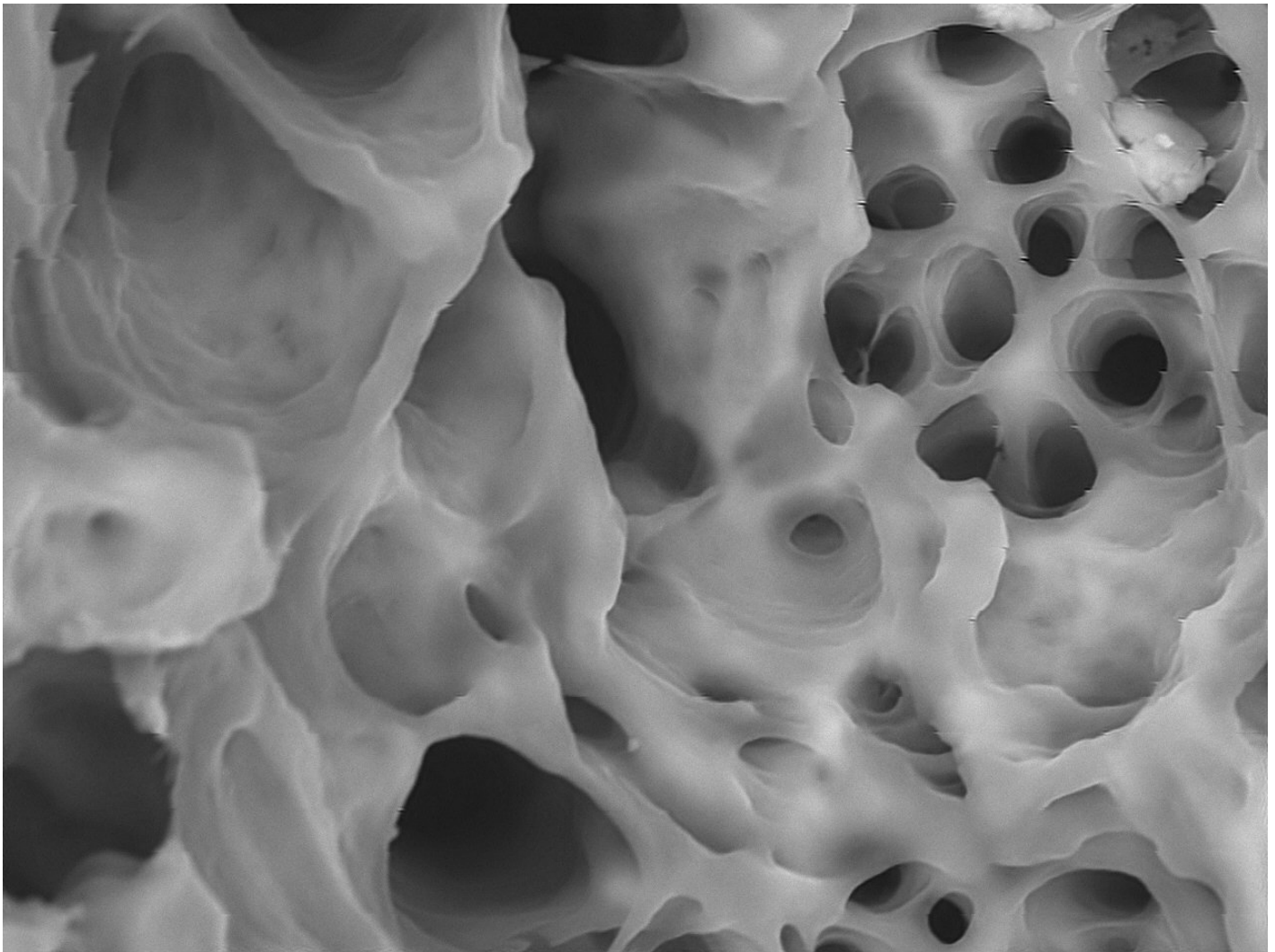
20 μ m

68) image067

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image068

image068



29960-14

2017/03/01 10:38 N

x5.0k

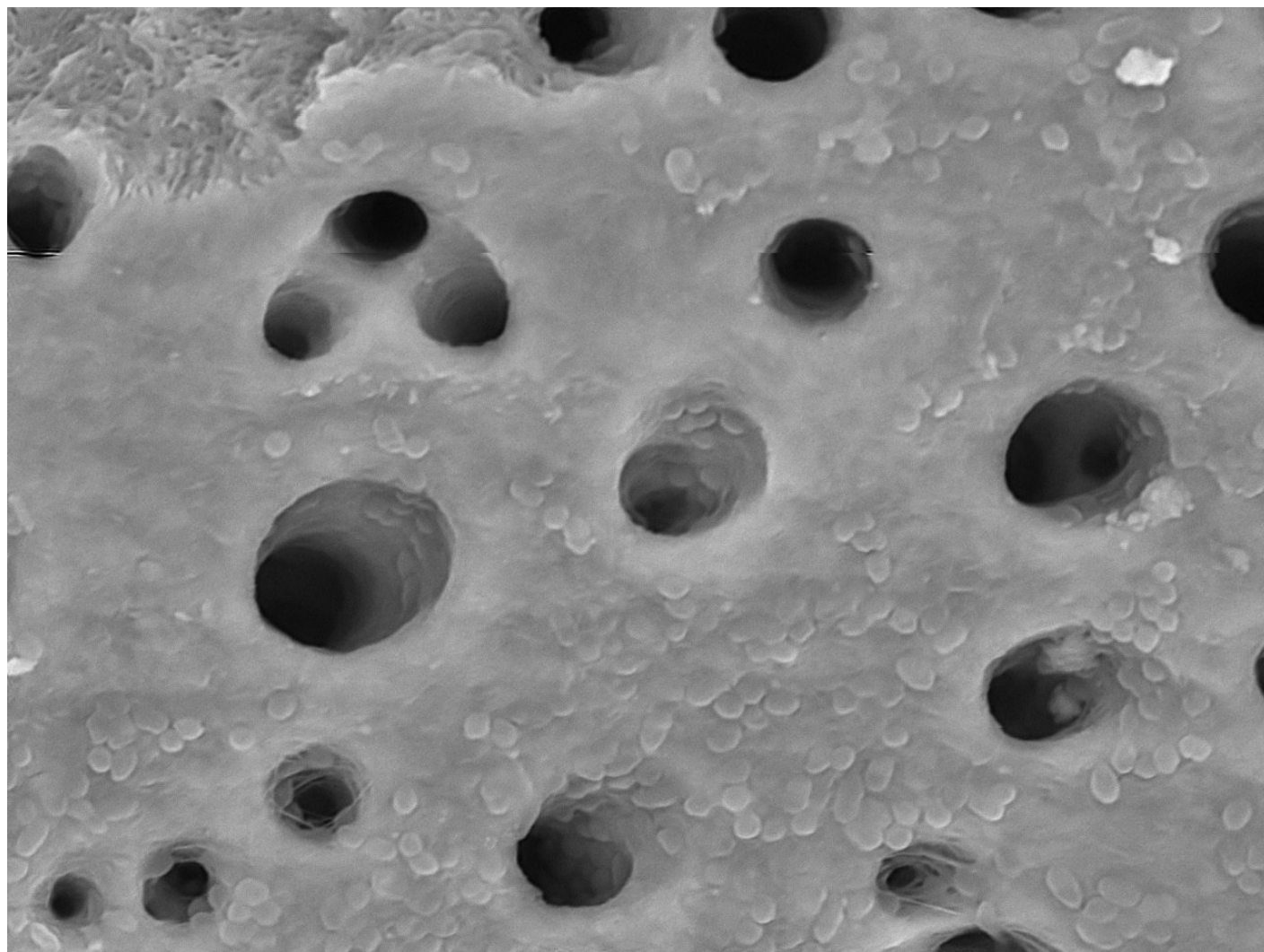
20 μ m

69) image068

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image069

image069



29679-3

2017/02/24 15:04 N

x5.0k

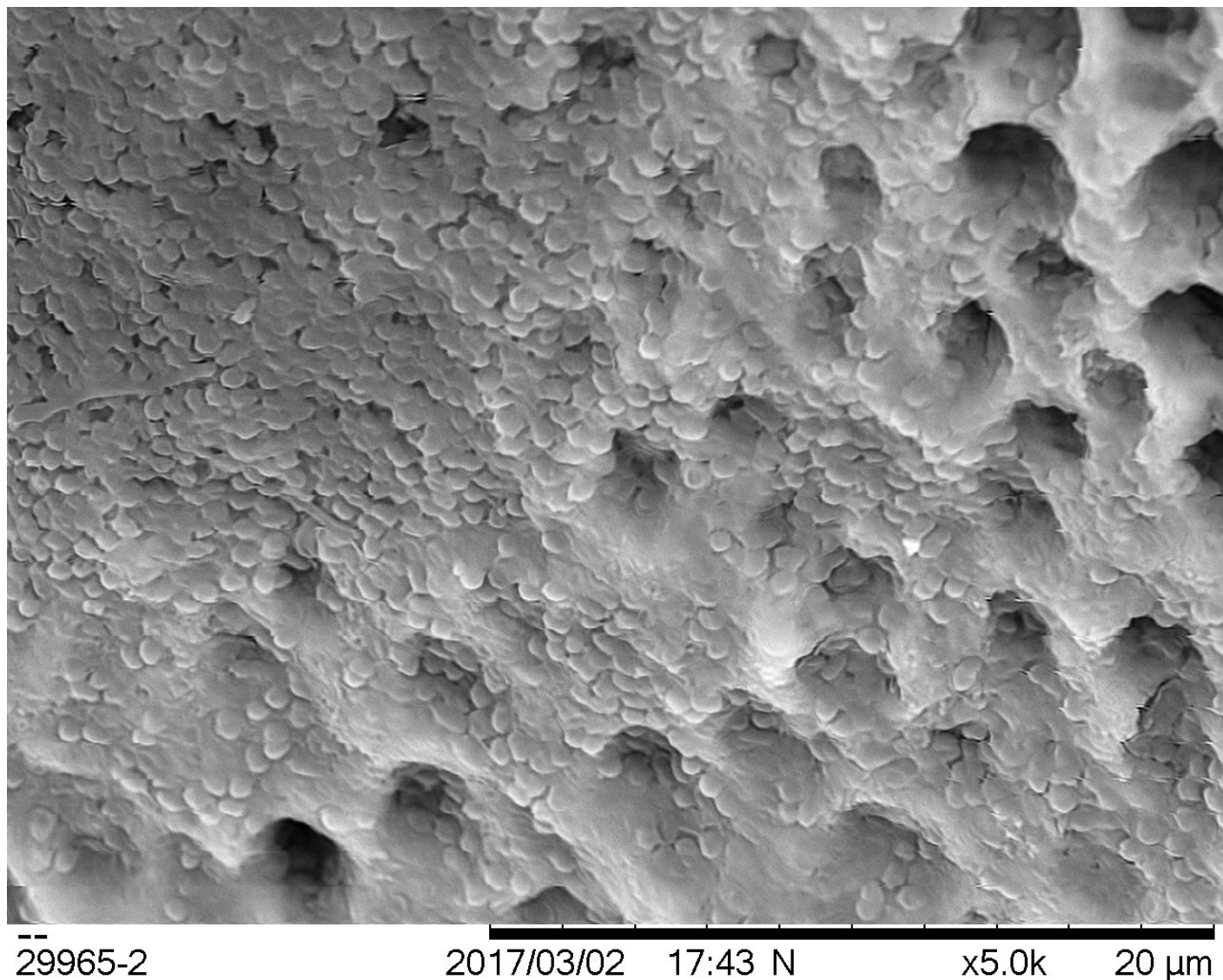
20 μ m

70) image069

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image070

image070

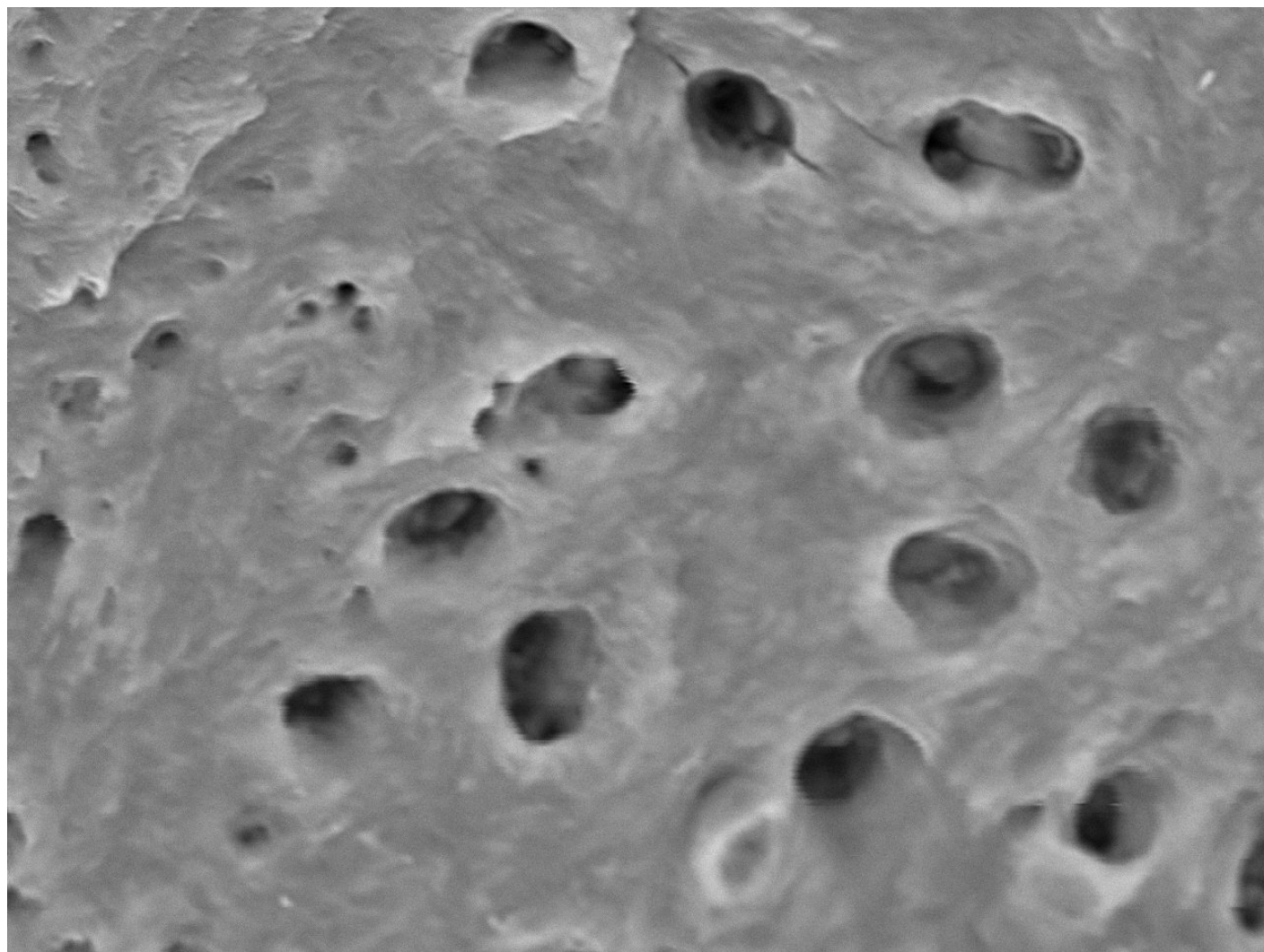


71) image070

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image071

image071



29179-3

2017/03/03 11:45 N

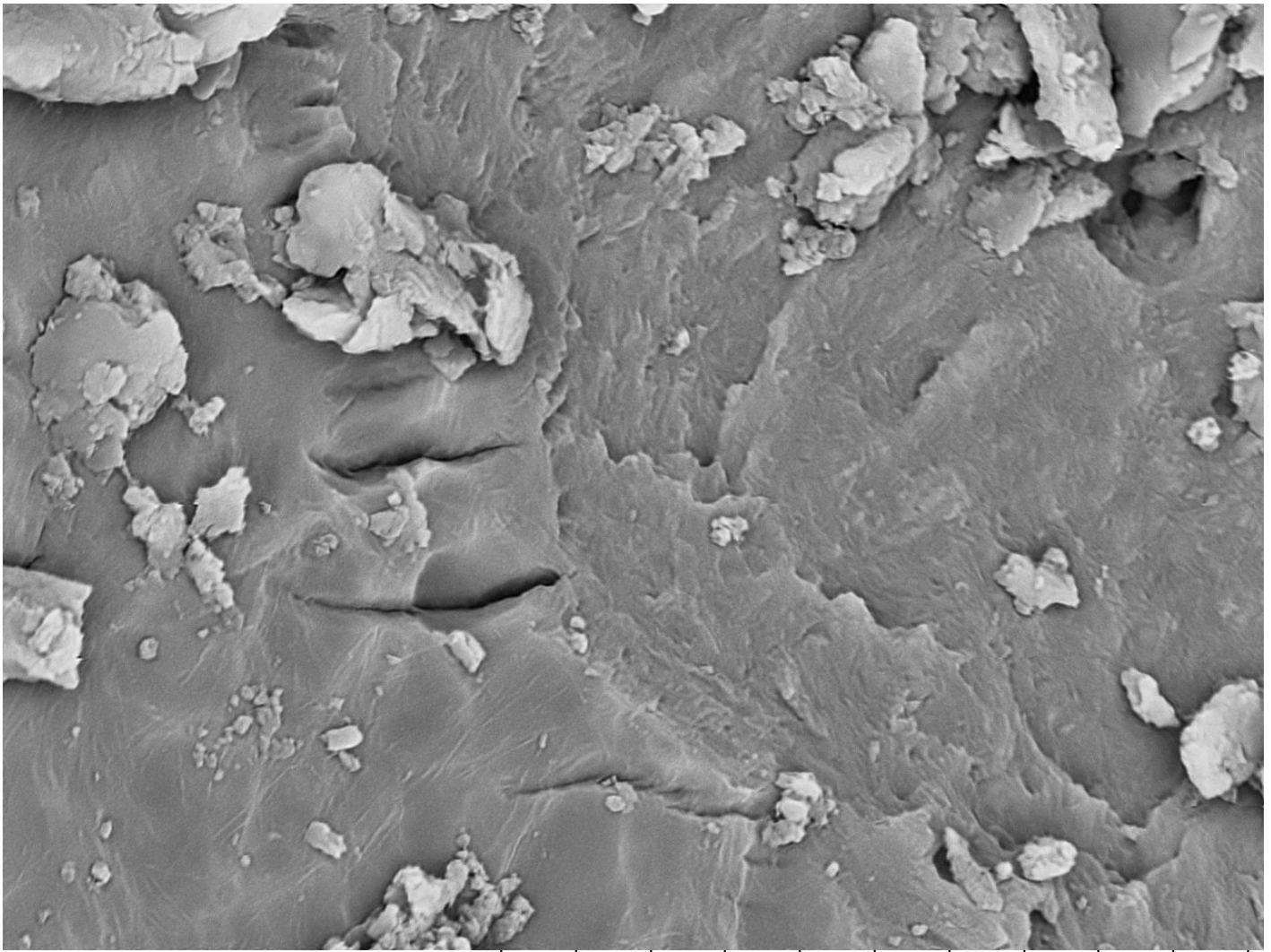
x5.0k 20 μm

72) image071

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image072

image072



29211-18

2017/03/03 16:21 N

x5.0k

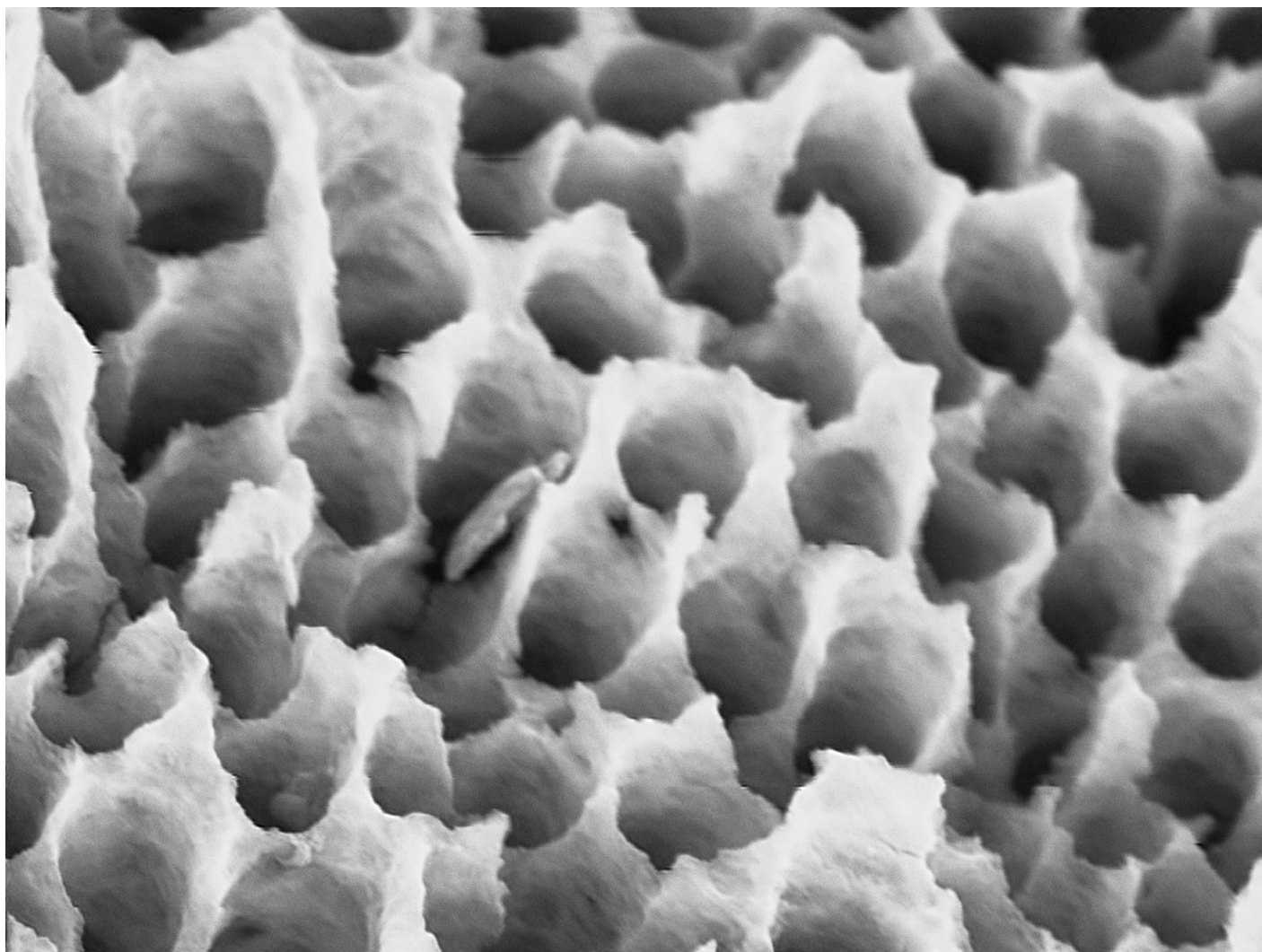
20 μ m

73) image072

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image073

image073



29340-18

2017/03/03 10:21 N

x5.0k

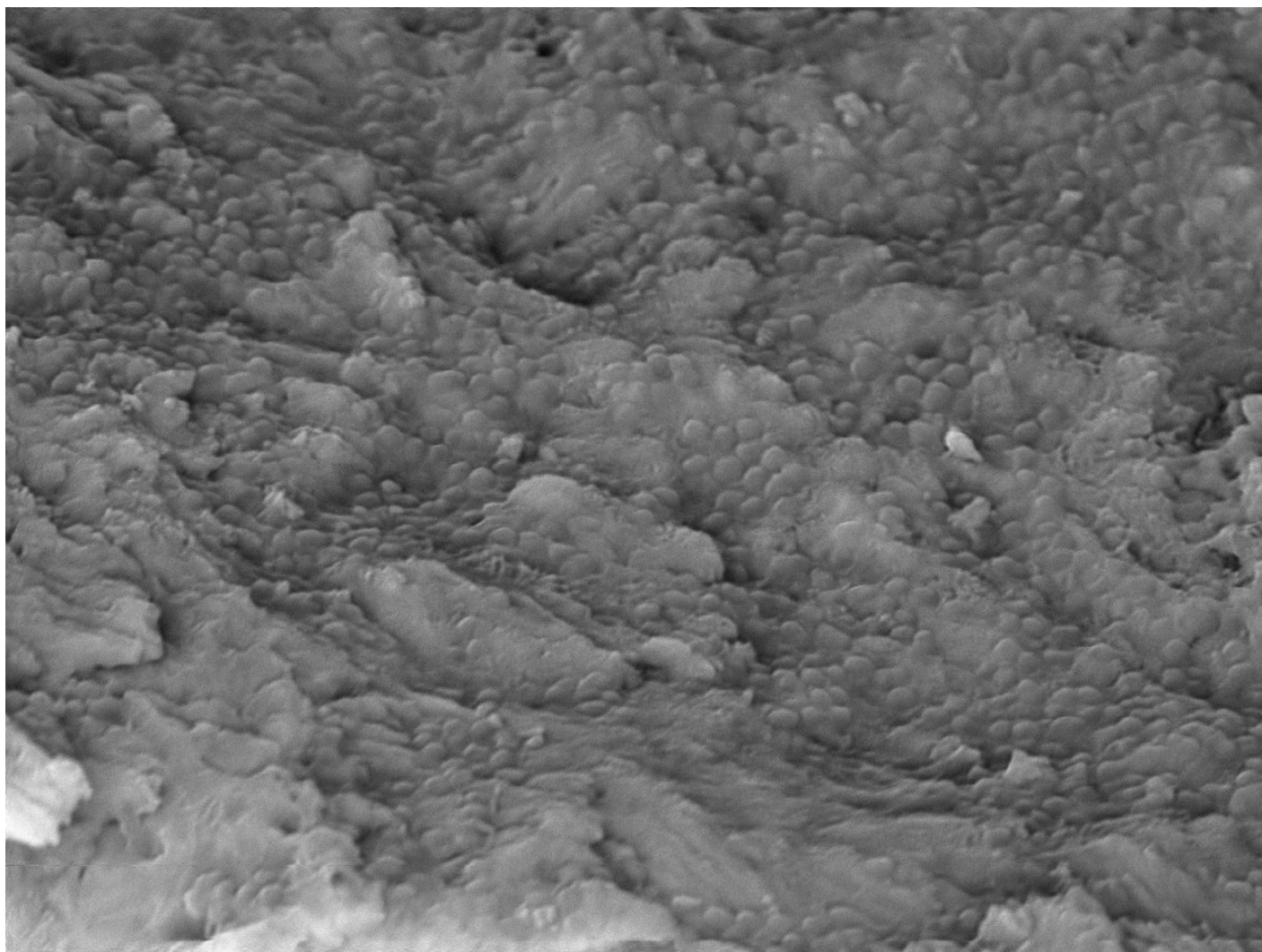
20 μ m

74) image073

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image074

image074



29266-15

2017/03/04 14:35 N

x5.0k

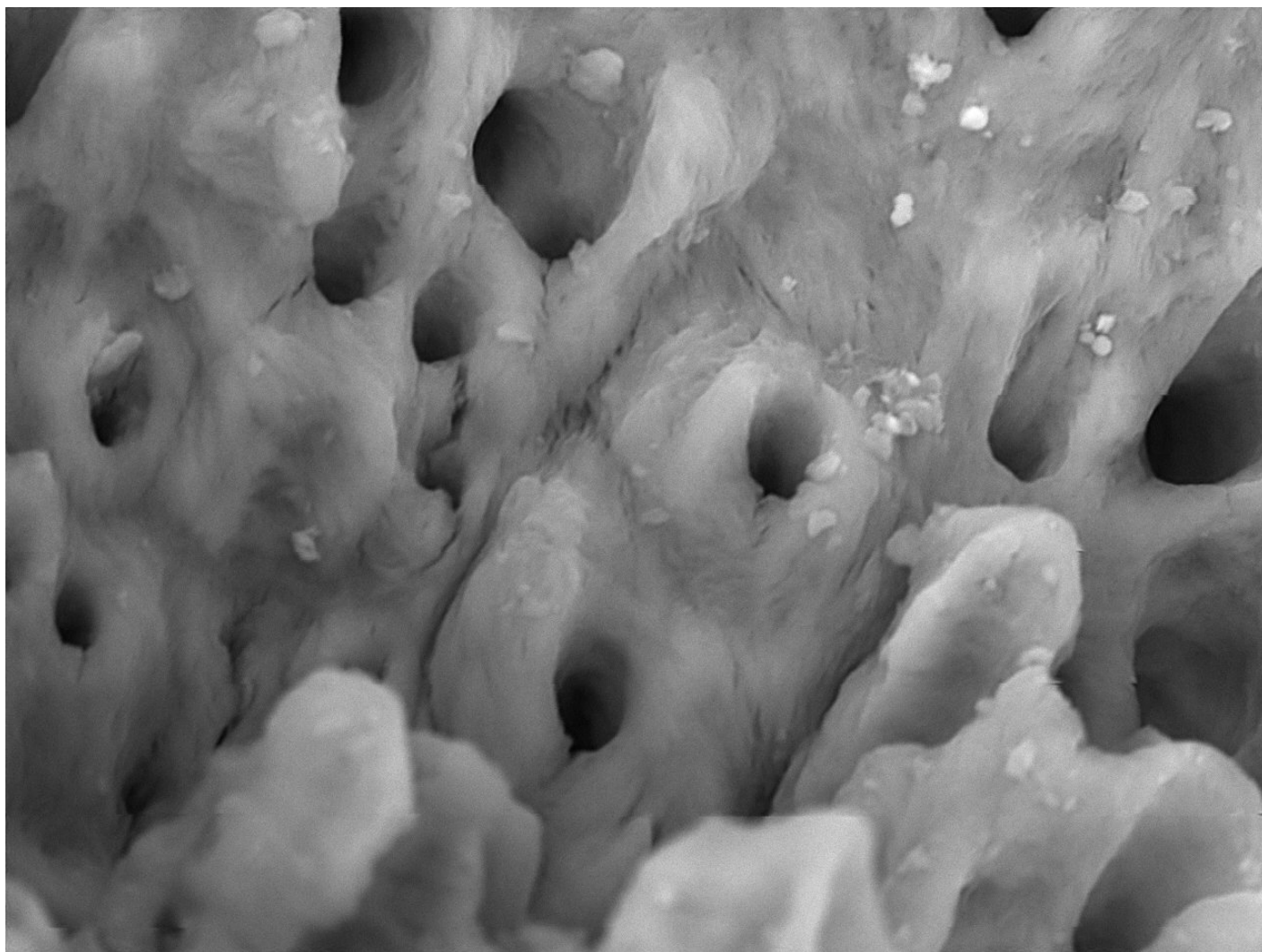
20 μ m

75) image074

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image075

image075



29179-3

2017/03/03 12:05 N

x5.0k

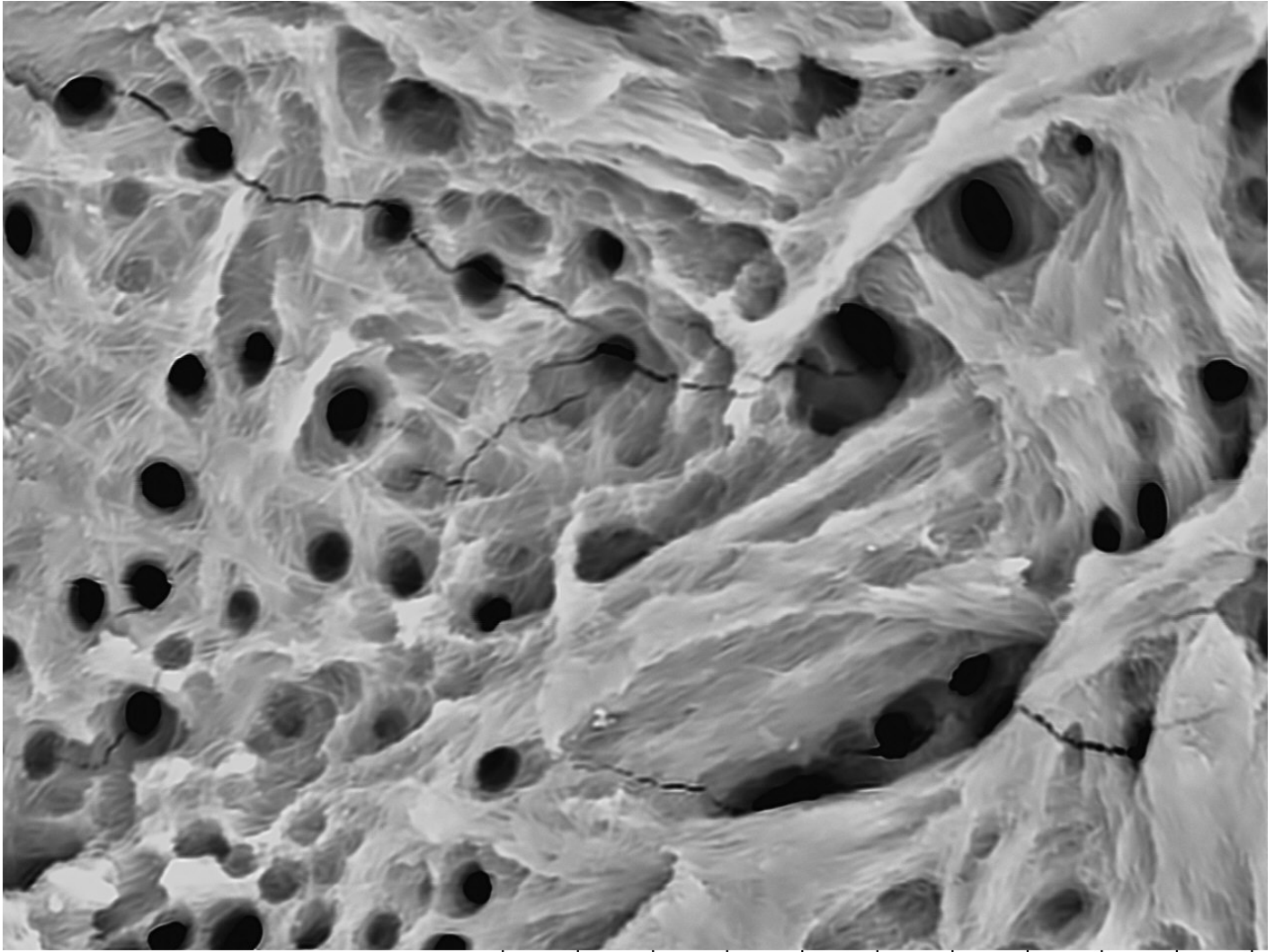
20 μ m

76) image075

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image076

image076



29805-30

2017/03/09 14:37 H

x5.0k

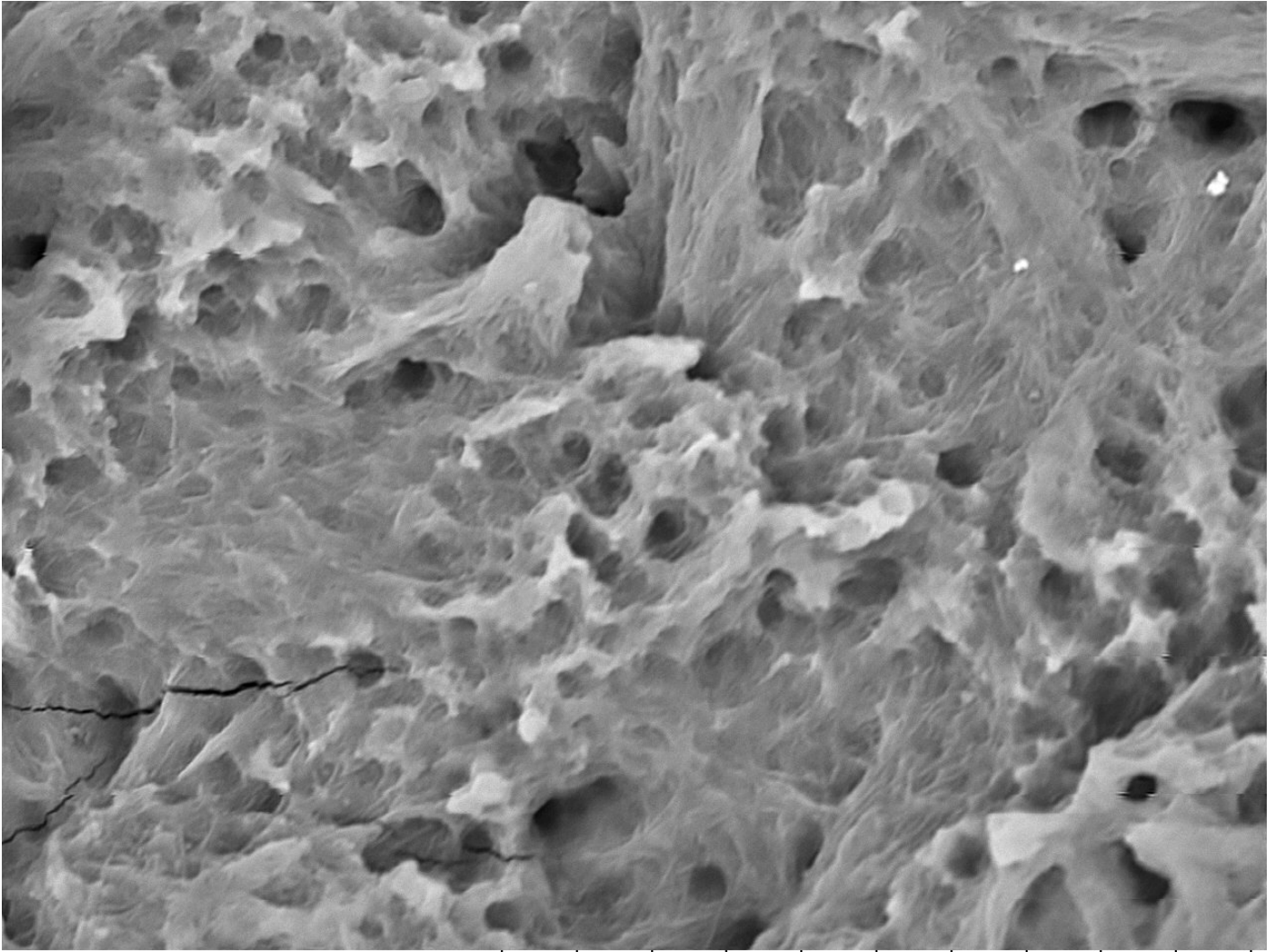
20 μ m

77) image076

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image077

image077



29028-15

2017/03/04 15:38 N

x5.0k

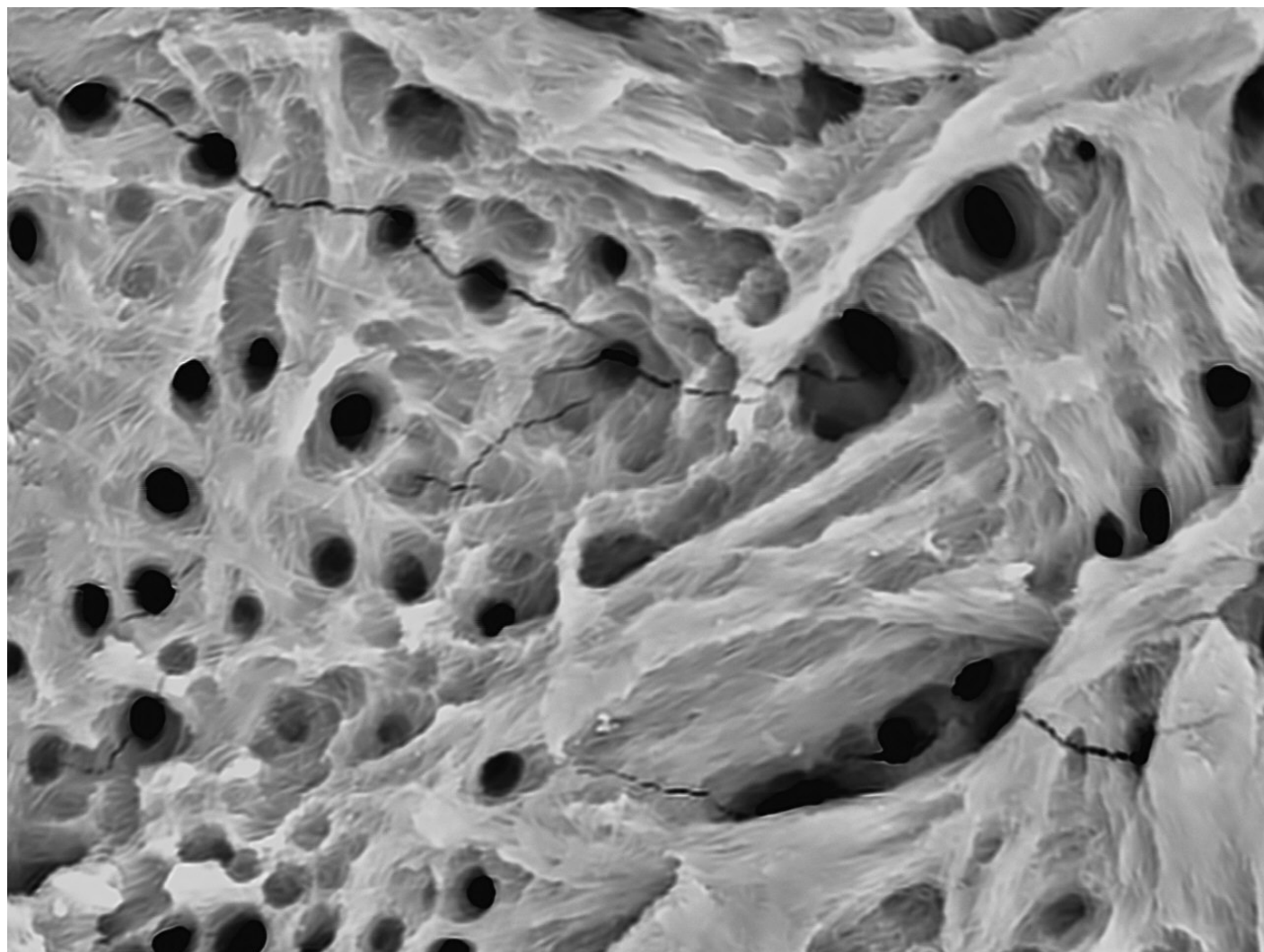
20 μ m

78) image077

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image078

image078



29805-30

2017/03/09 14:37 H

x5.0k

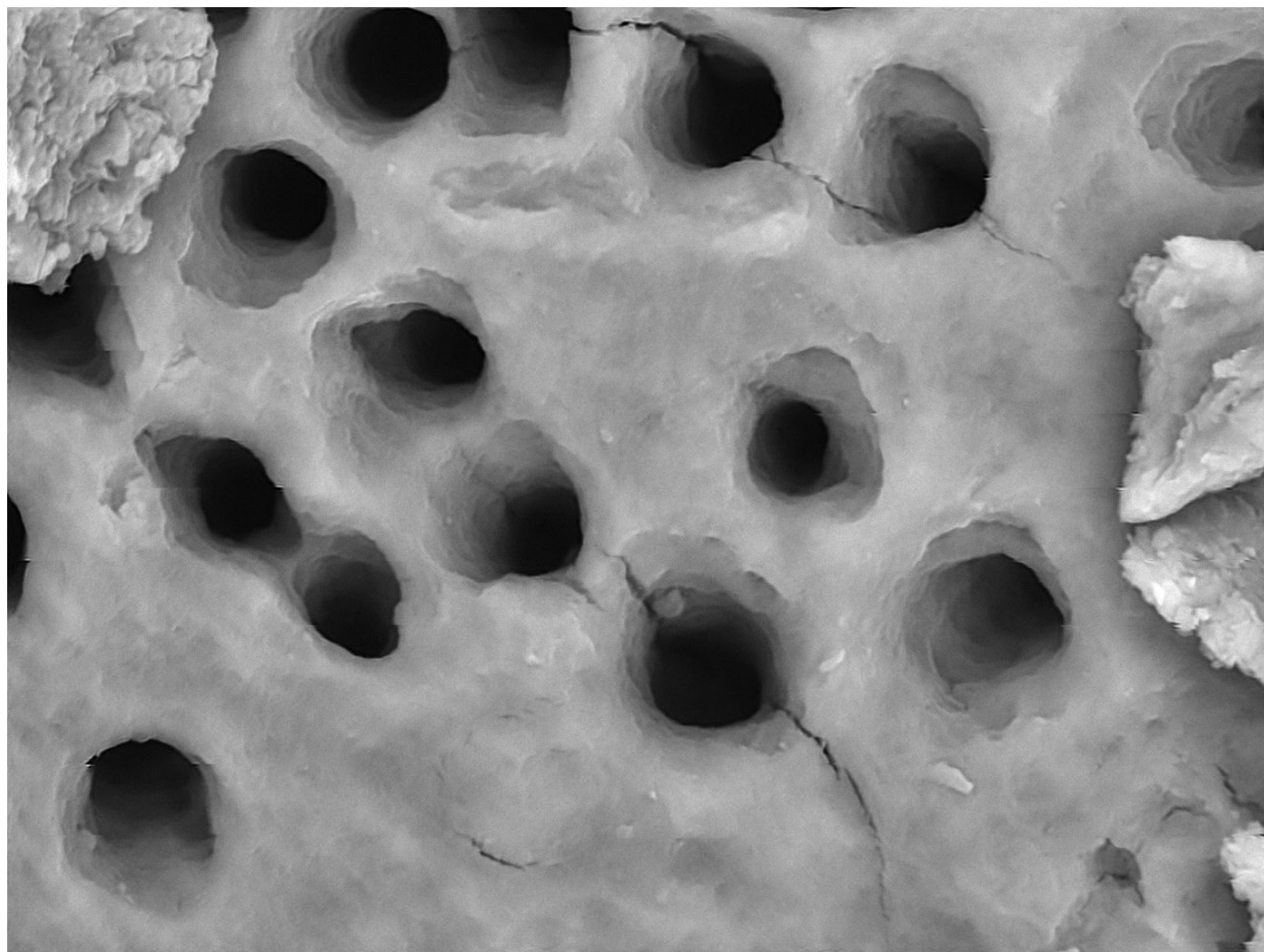
20 μ m

79) image078

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image079

image079



29565-15

2017/02/28 15:31 N

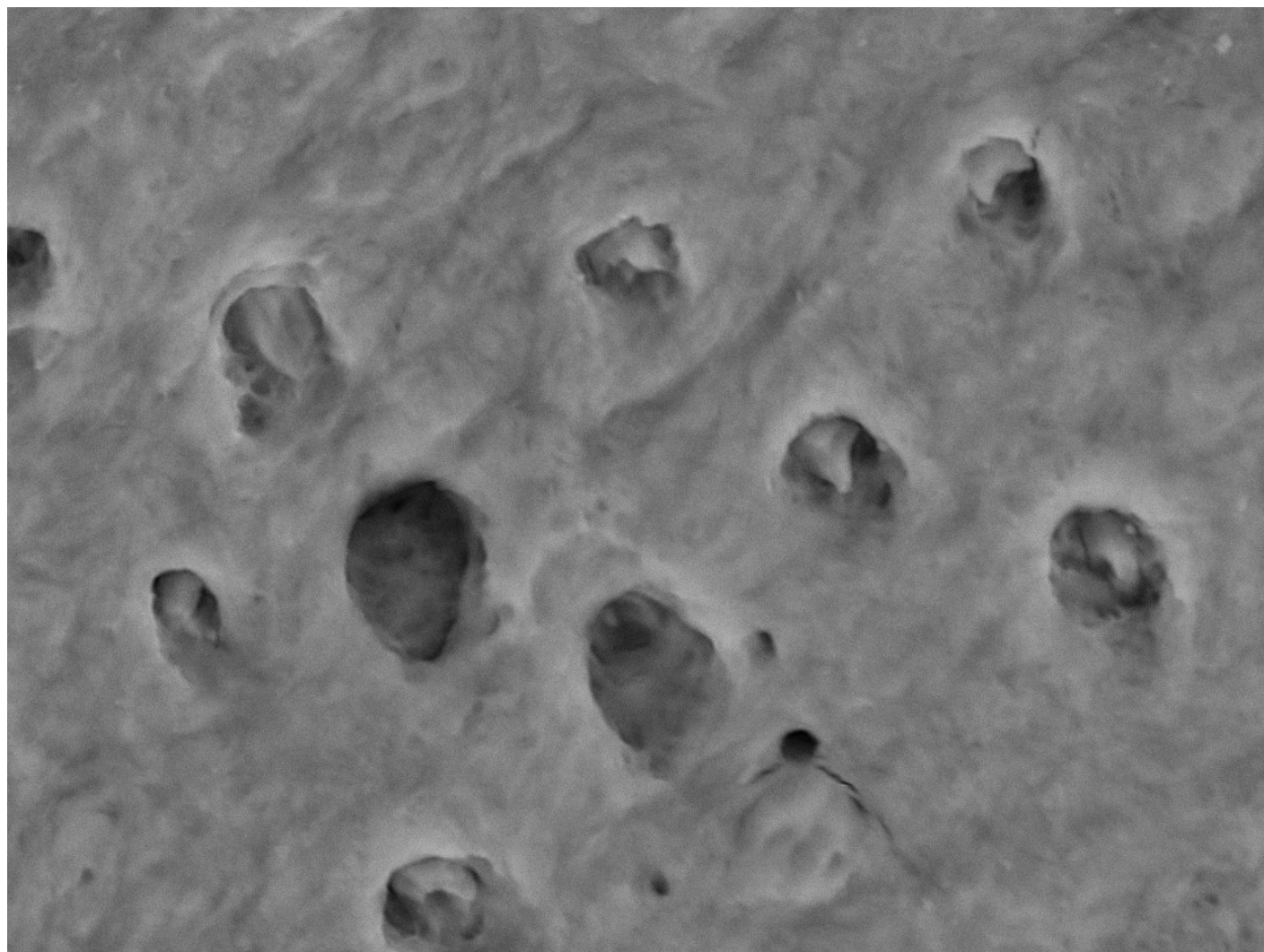
x5.0k 20 μ m

80) image079

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image080

image080



29211-18

2017/03/04 14:03 N

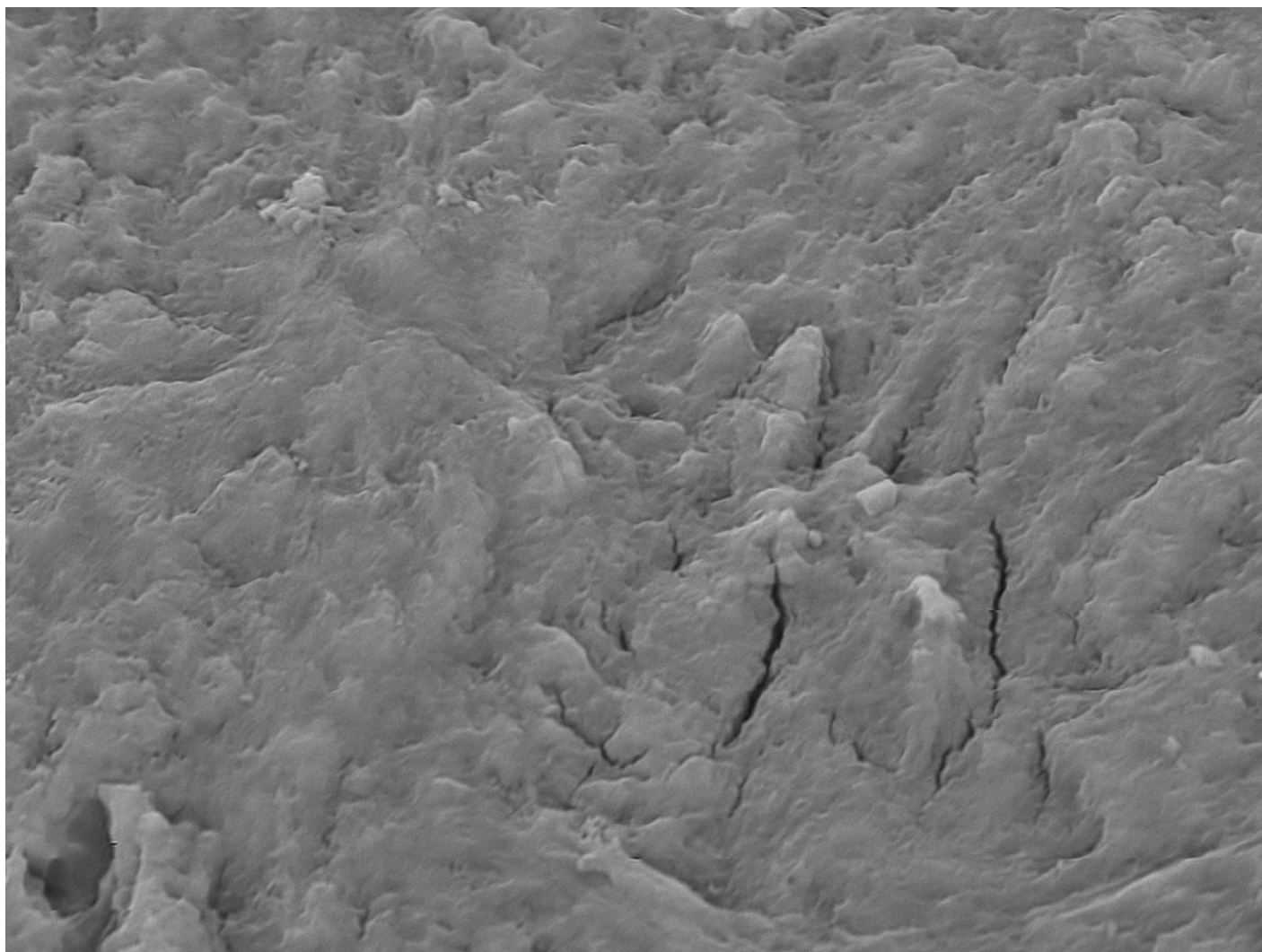
x5.0k 20 μm

81) image080

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image081

image081



29028-15

2017/03/04 15:44 N

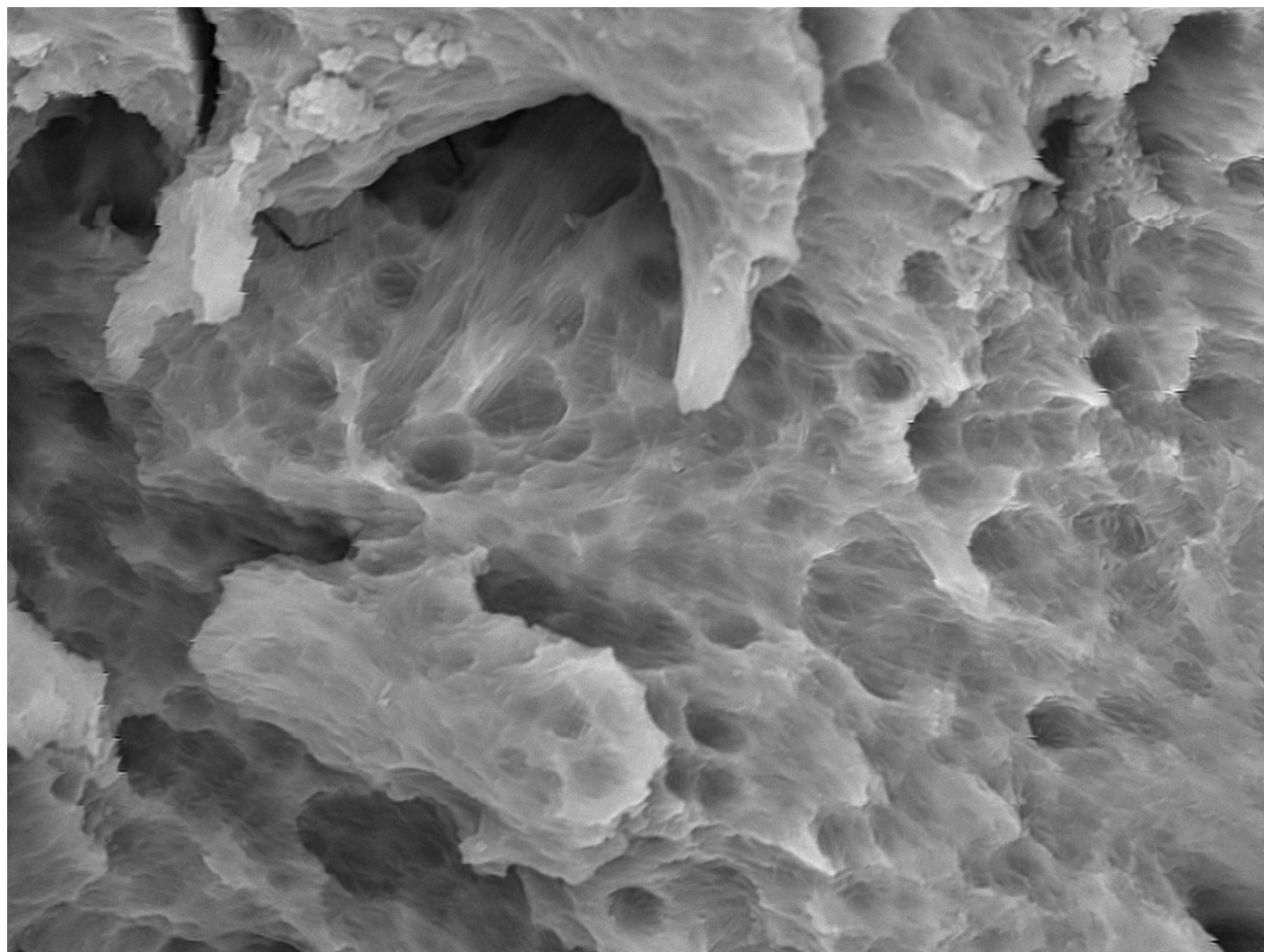
x5.0k 20 μ m

82) image081

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image082

image082



29211-18

2017/03/03 16:32 N

x5.0k

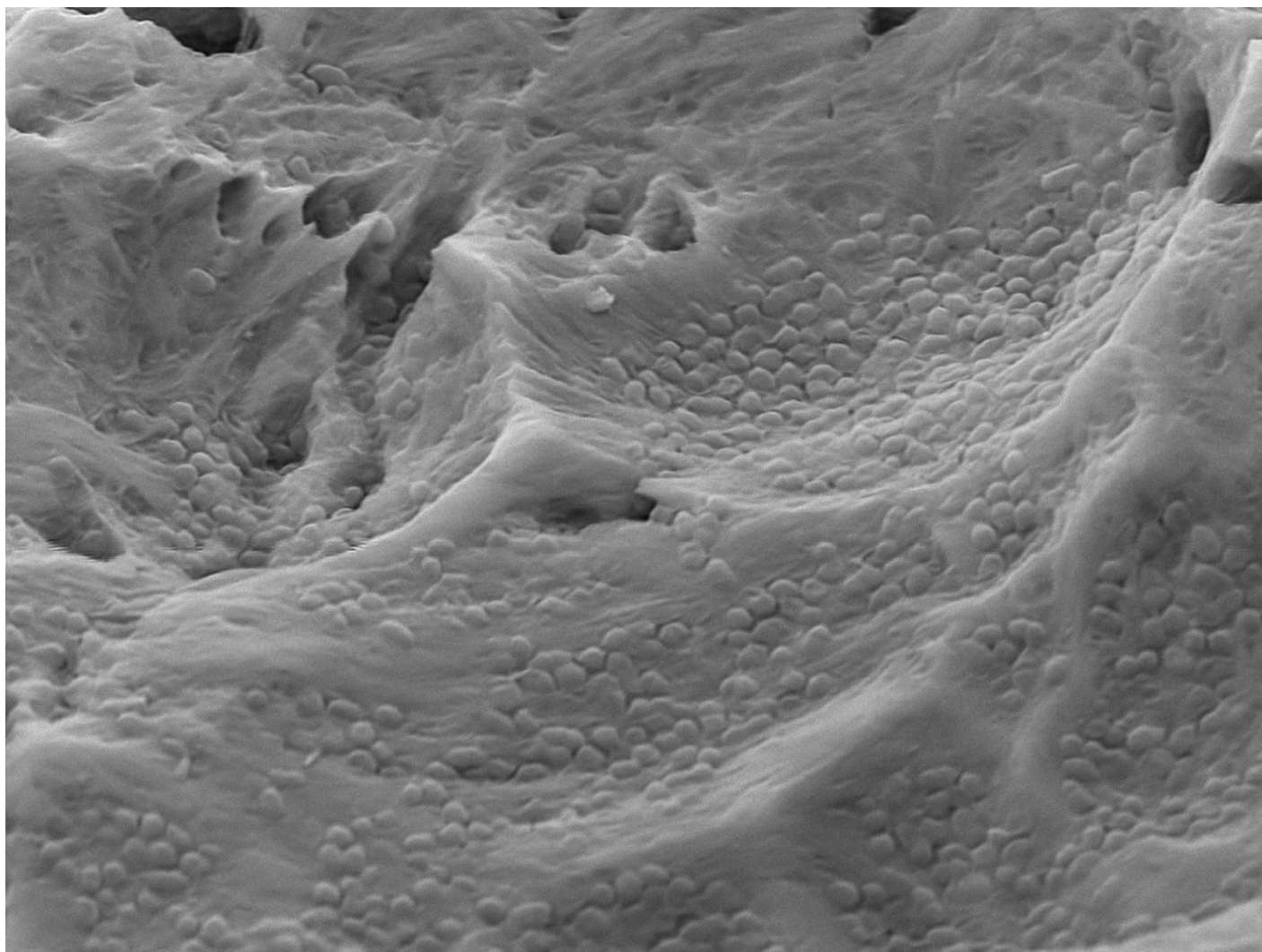
20 μ m

83) image082

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image083

image083



29679-3

2017/02/27 10:04 N

x5.0k

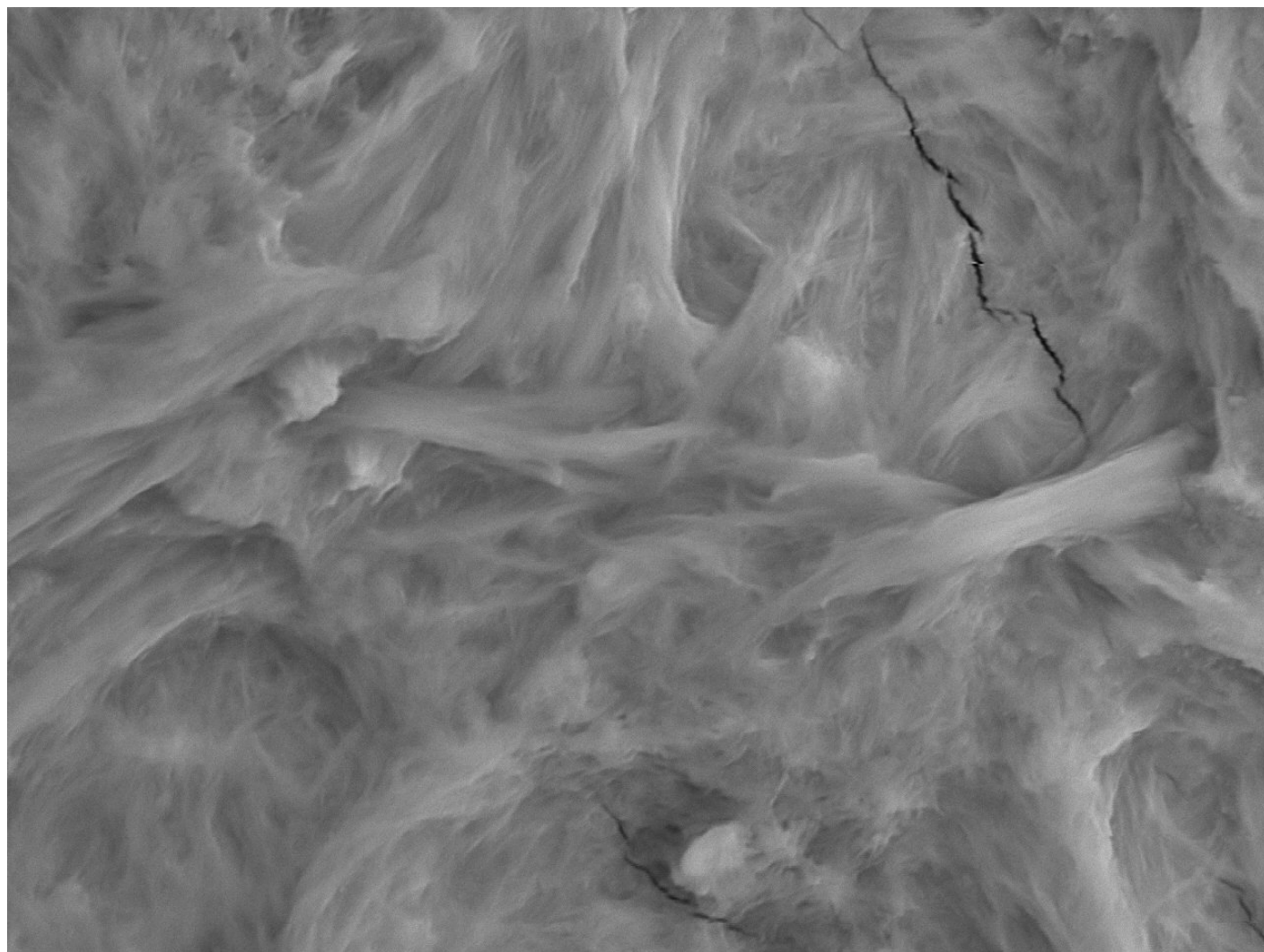
20 μm

84) image083

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image084

image084



29028-15

2017/03/04 15:31 N

x5.0k

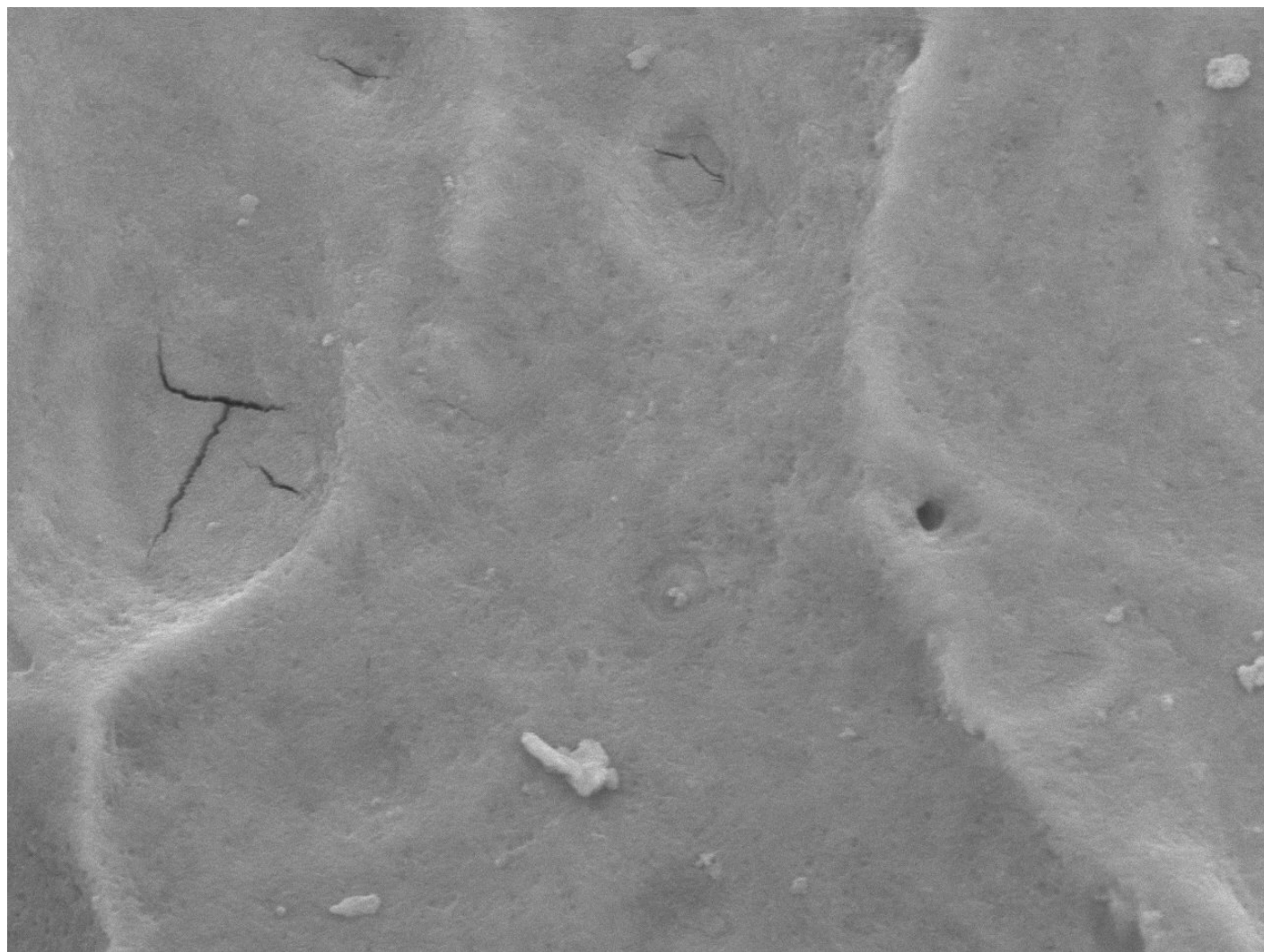
20 μm

85) image084

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image085

image085



29952-15

2017/02/22 16:05 N

x5.0k

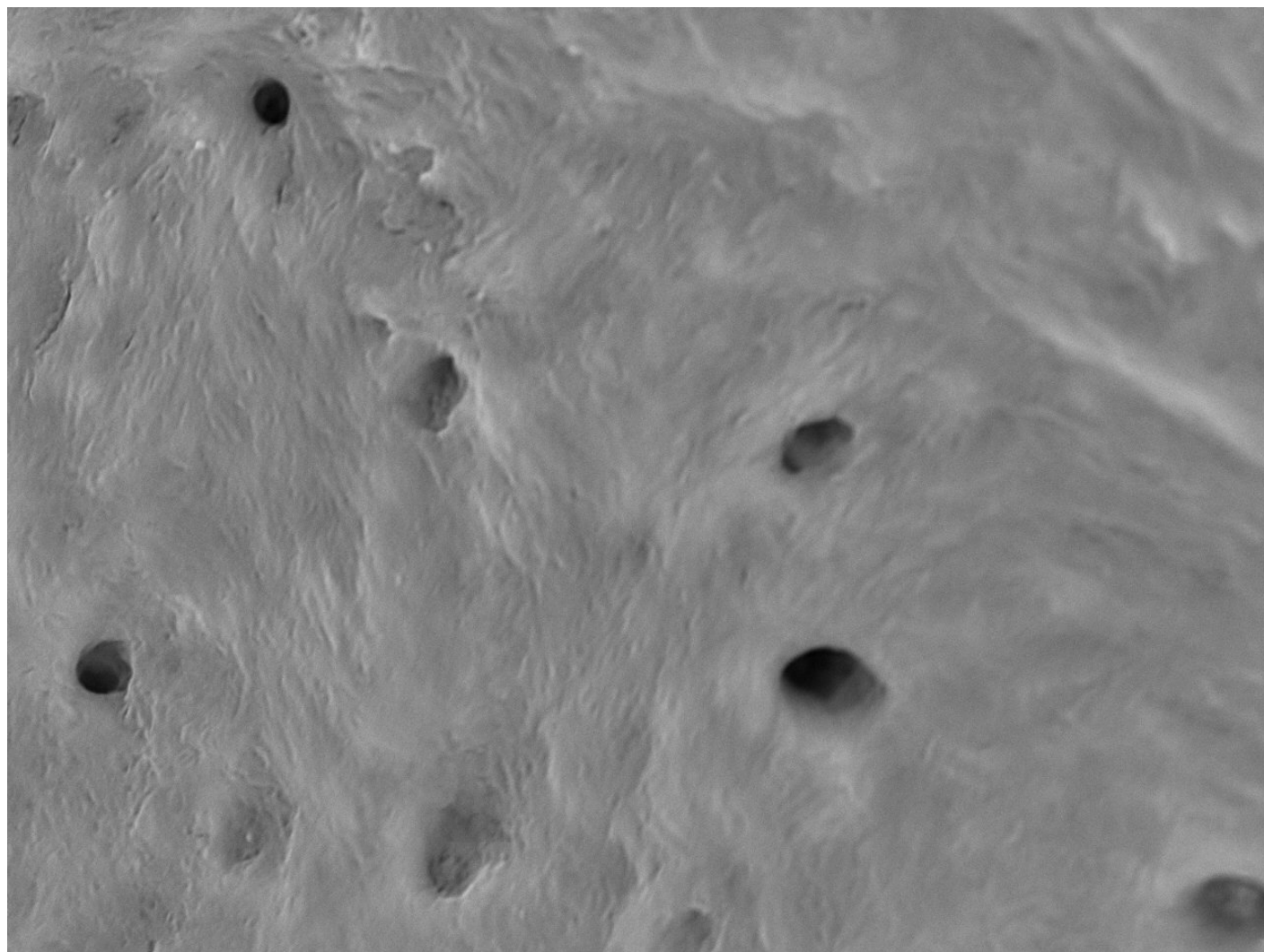
20 μ m

86) image085

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image086

image086



29340-18

2017/03/03 09:46 N

x5.0k

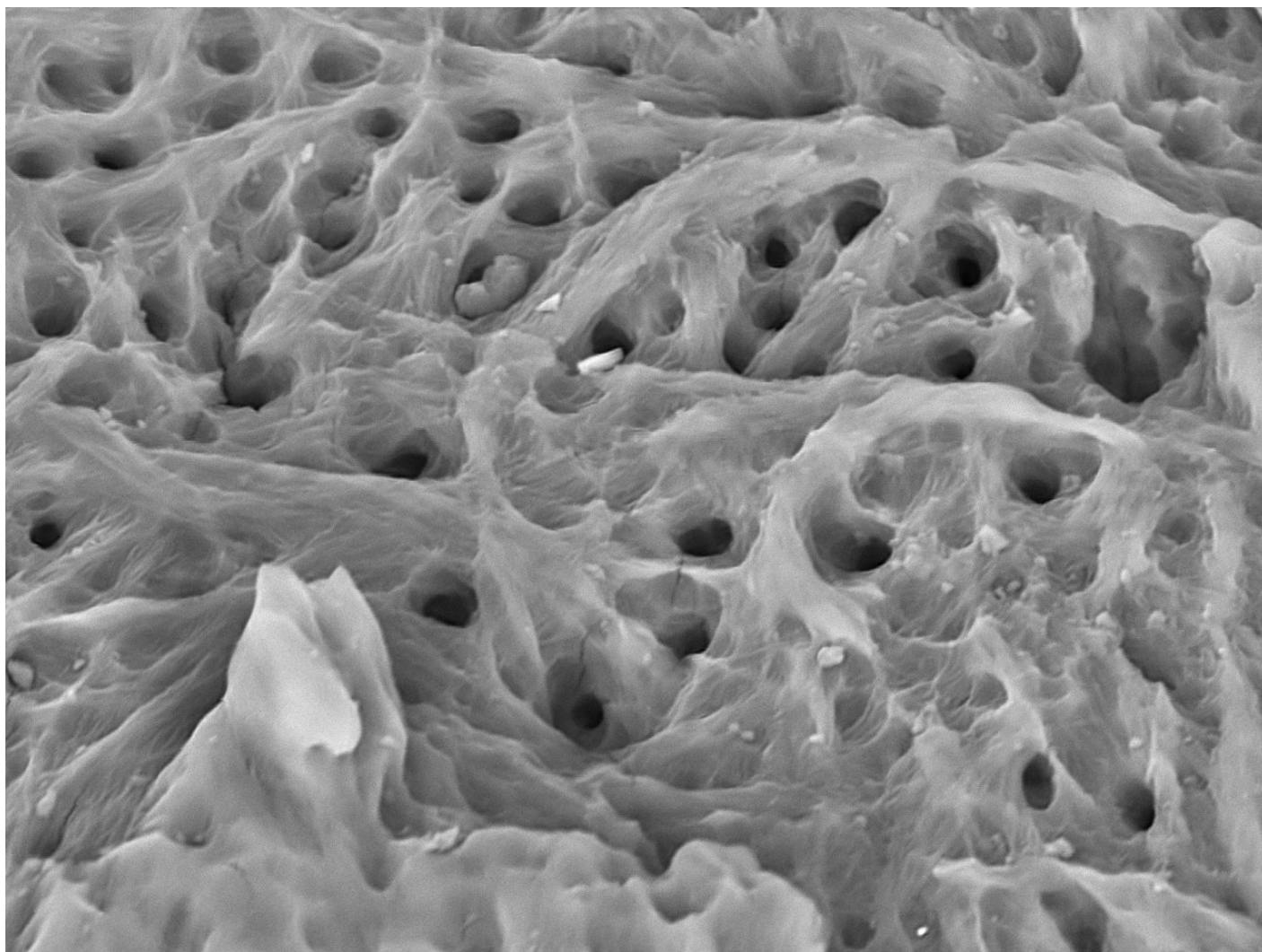
20 μ m

87) image086

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image087

image087



29679-3

2017/02/27 15:46 N

x5.0k

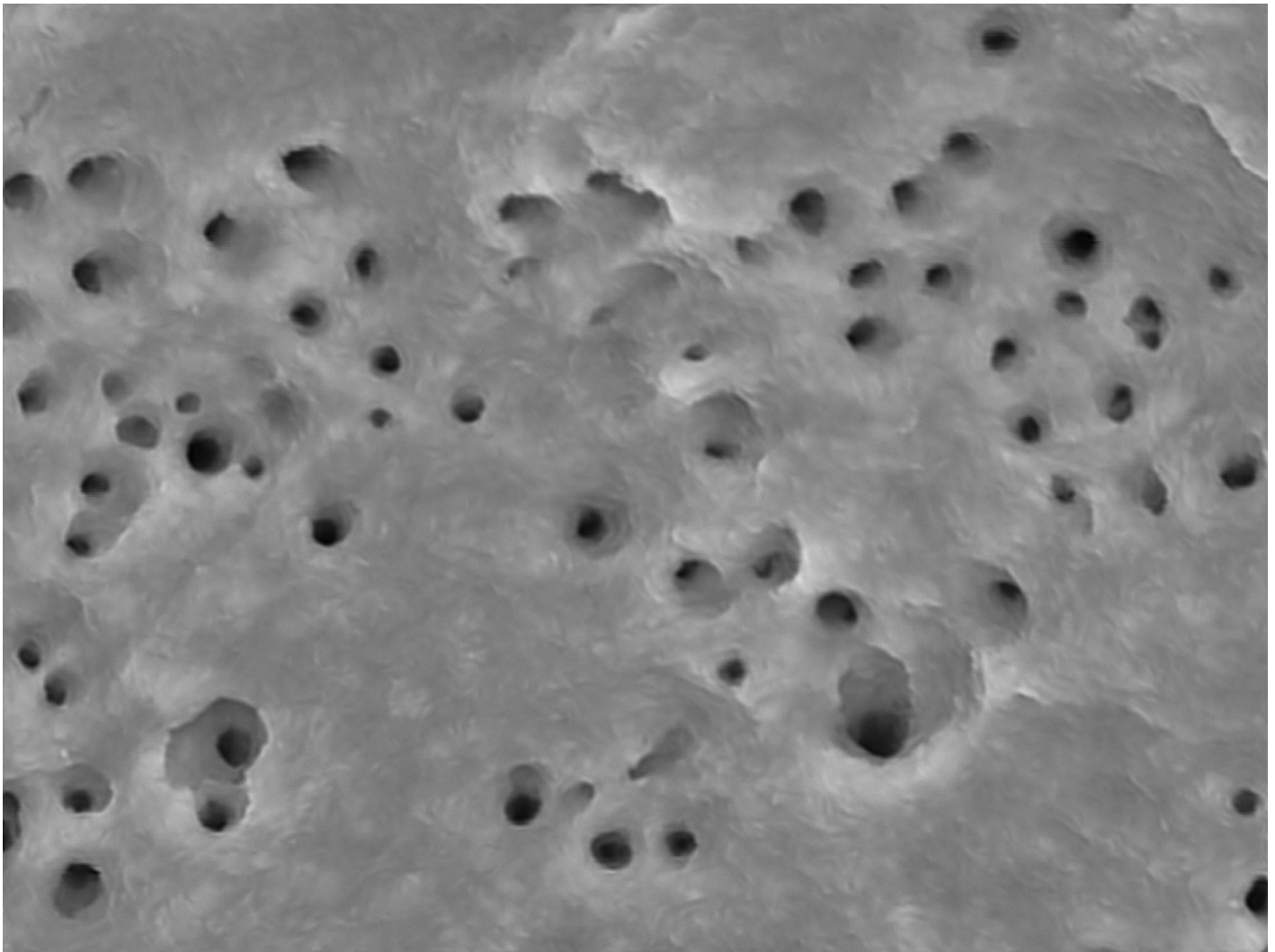
20 μ m

88) image087

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image088

image088



29805-30

2017/03/09 14:51 H

x5.0k

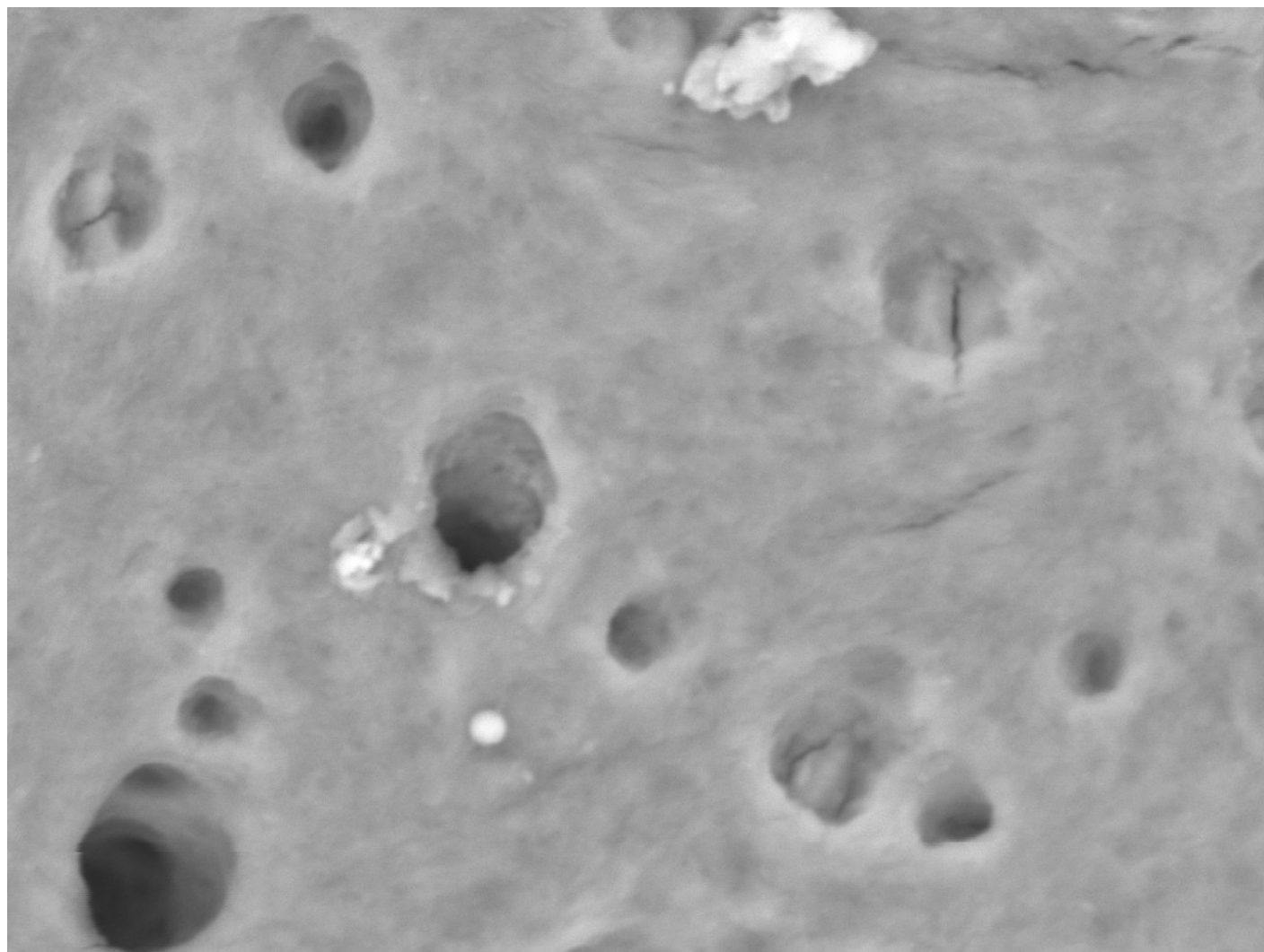
20 μ m

89) image088

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image089

image089



29856-30

2017/02/22 11:55 H

x5.0k

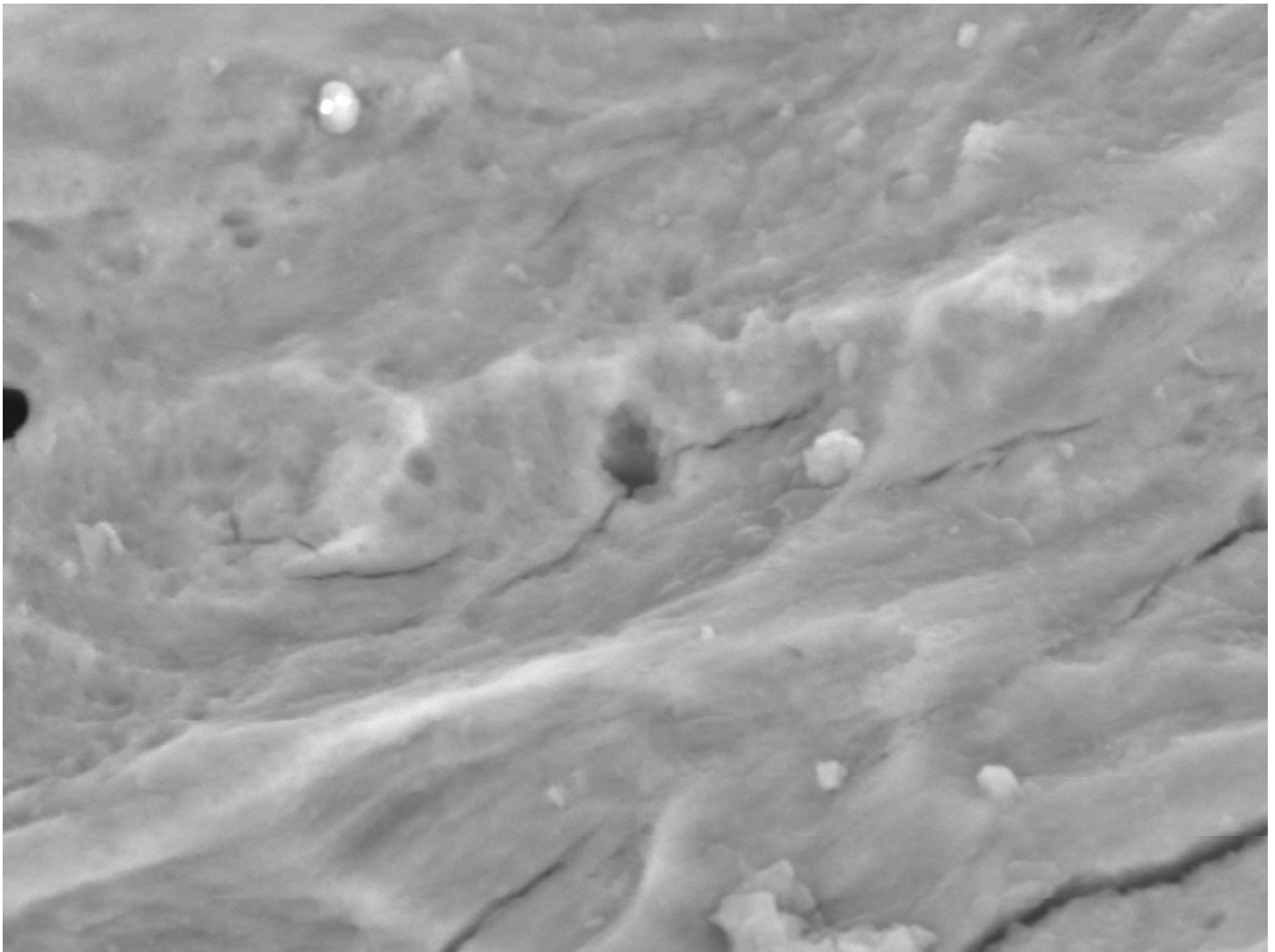
20 μ m

90) image089

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image090

image090



29856-30

2017/02/22 11:48 H

x5.0k

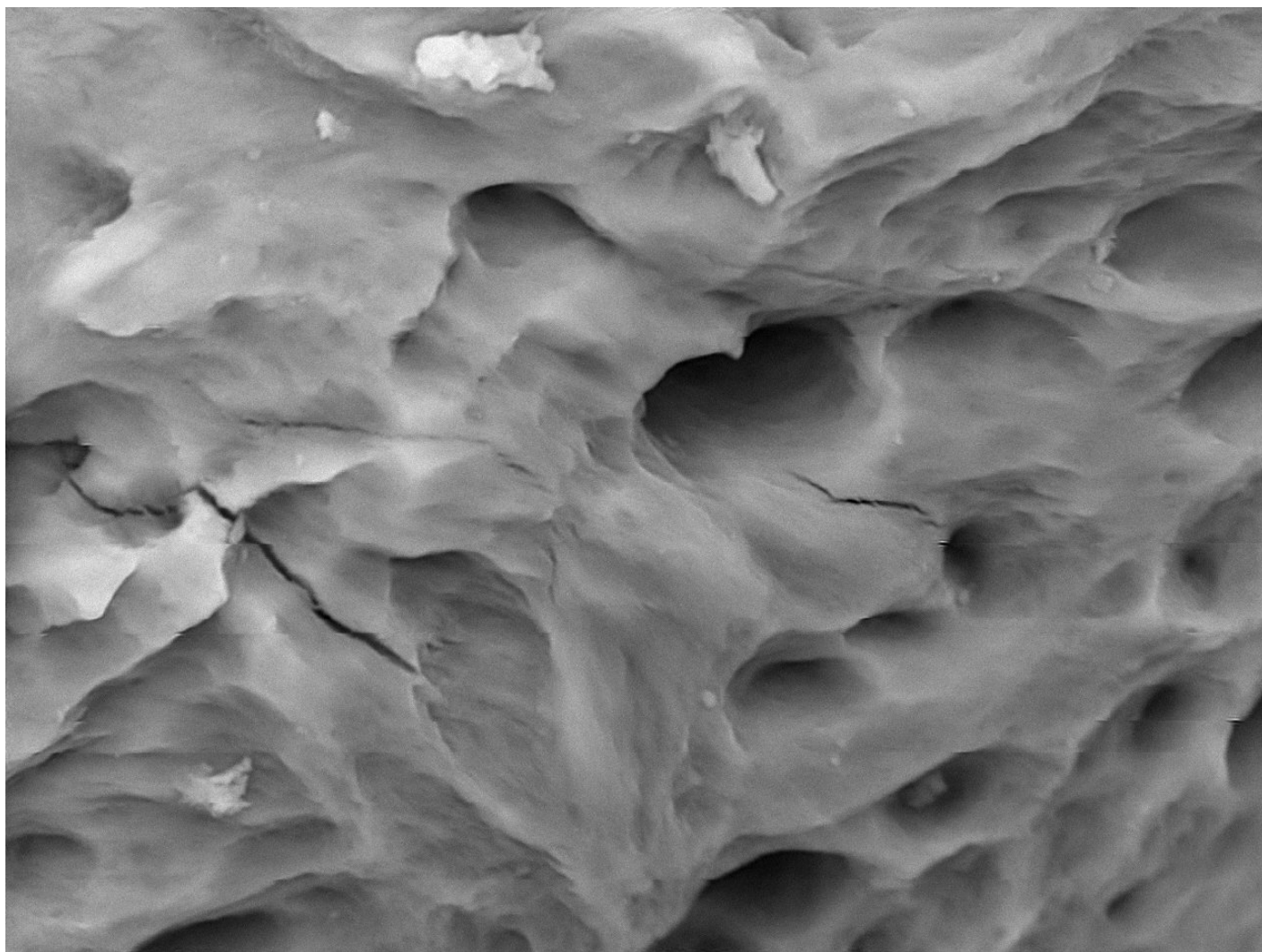
20 μ m

91) image090

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image091

image091



29576-18

2017/03/01 11:34 N

x5.0k

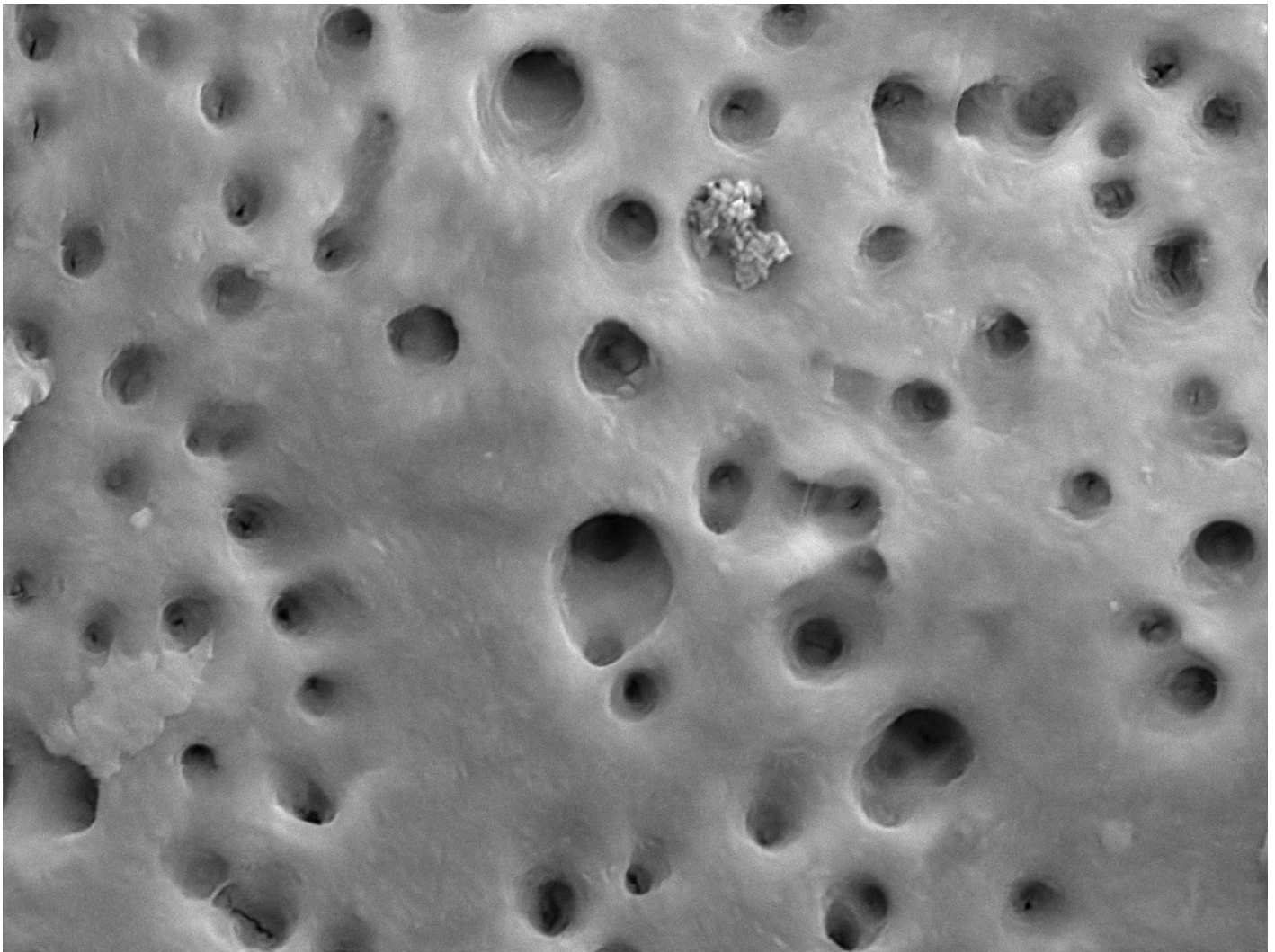
20 μ m

92) image091

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image092

image092



29961-2

2017/03/01 14:29 N

x5.0k

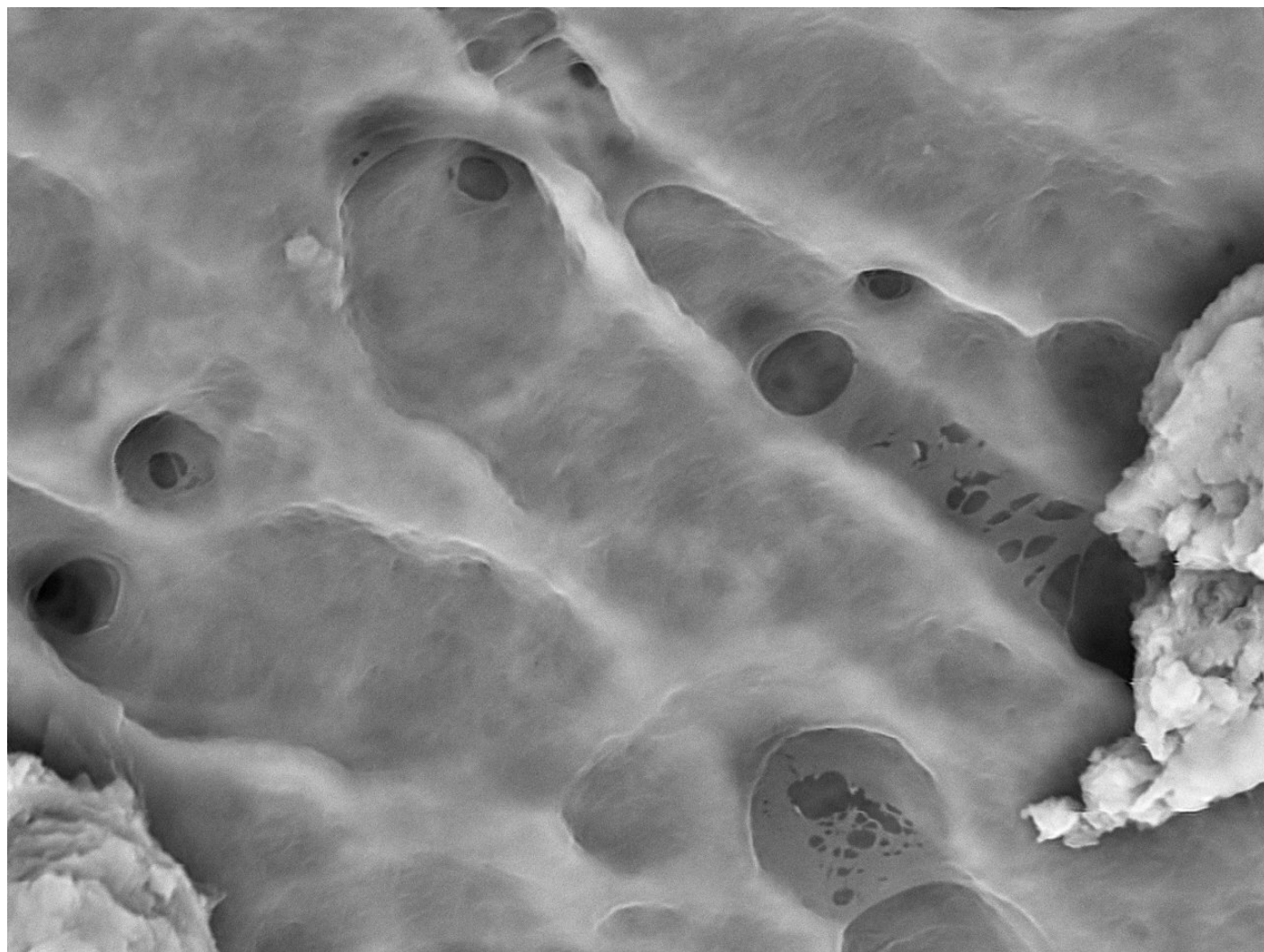
20 μm

93) image092

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image093

image093



29961-2

2017/03/01 14:55 N

x5.0k

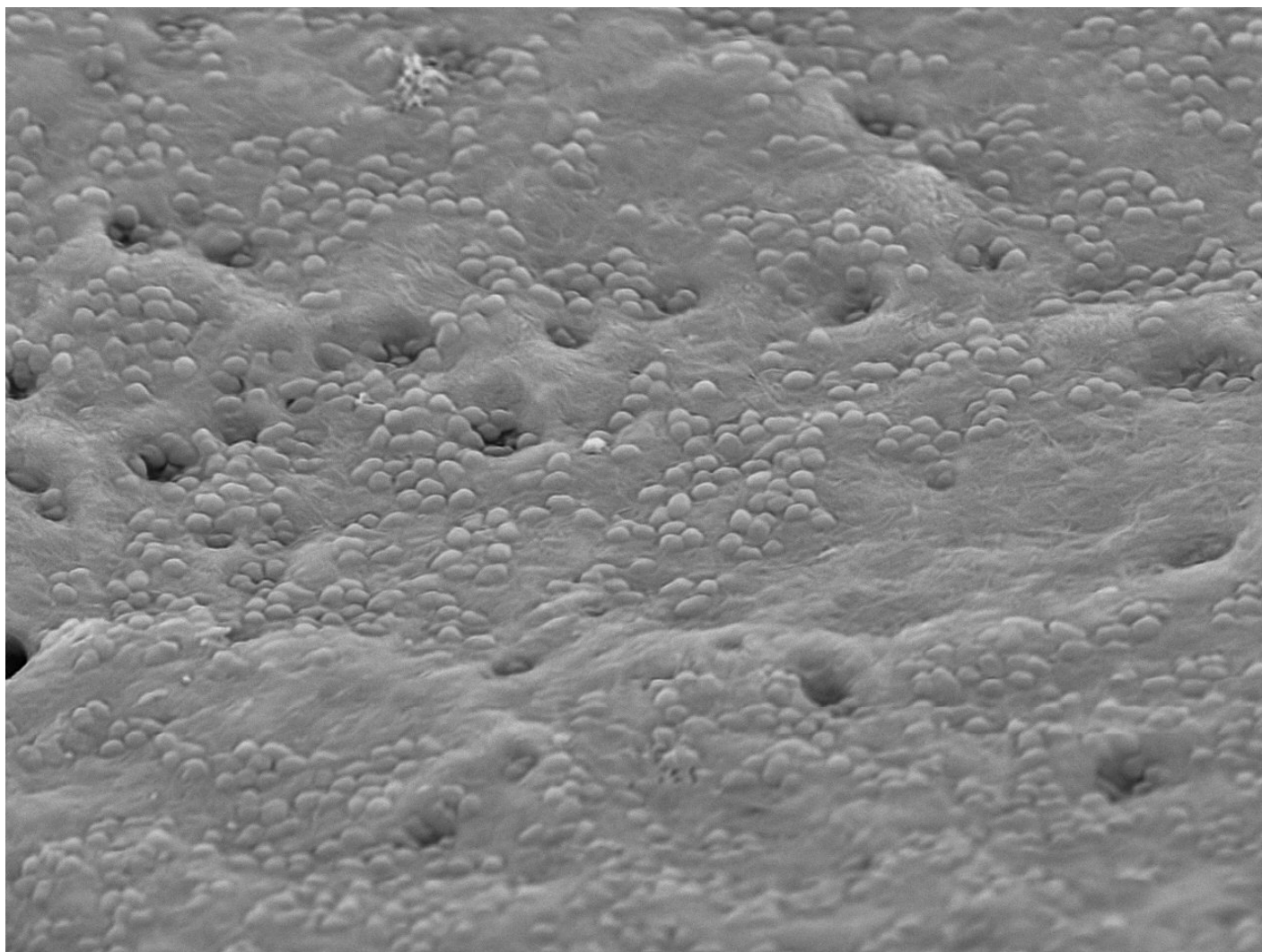
20 μm

94) image093

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image094

image094



29266-15

2017/03/04 15:06 N

x5.0k

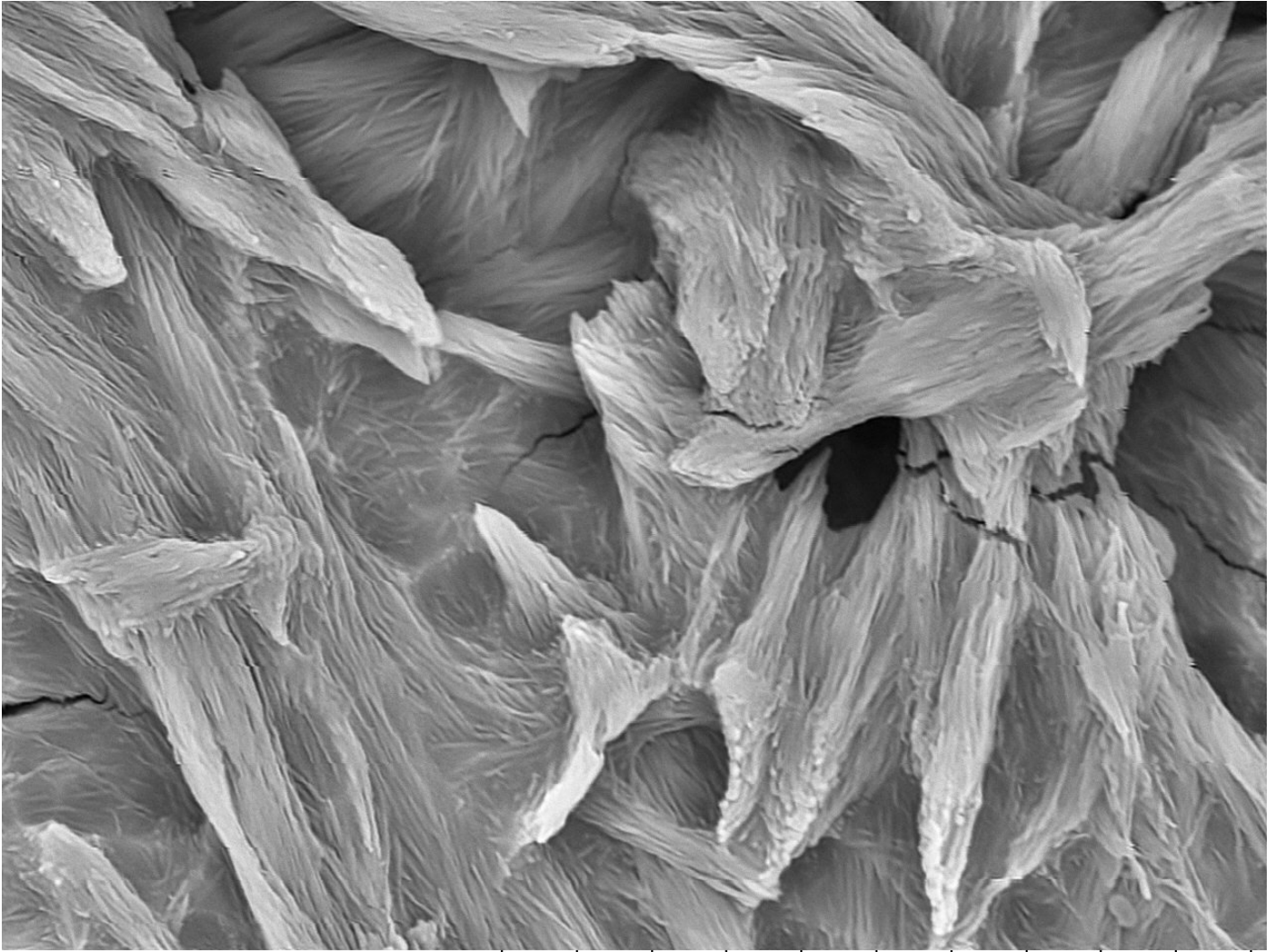
20 μ m

95) image094

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image095

image095



29052-14

2017/02/28 18:14 N

x5.0k

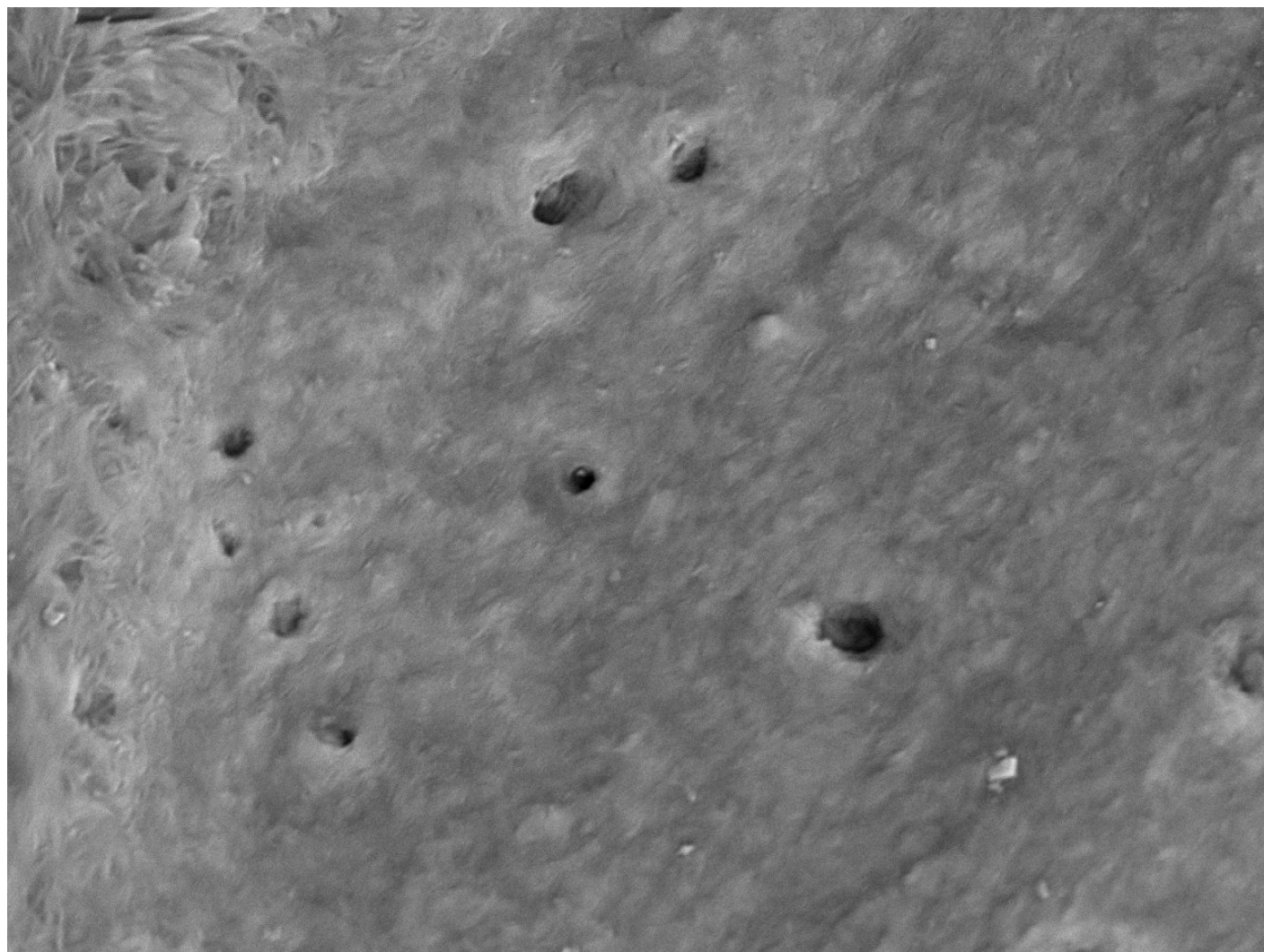
20 μ m

96) image095

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image096

image096



29052-14

2017/02/28 18:23 N

x5.0k

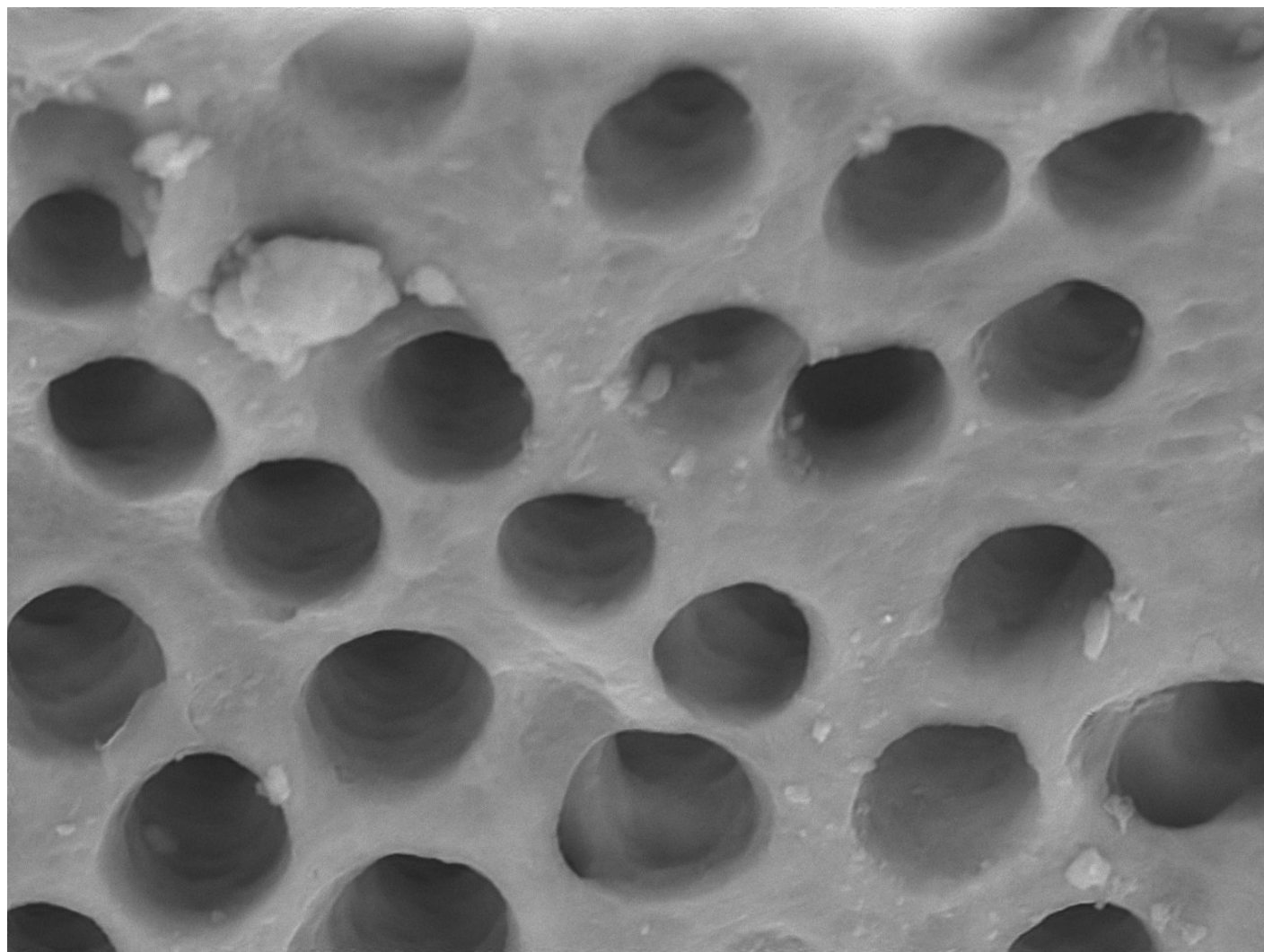
20 μ m

97) image096

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image097

image097



29265-2

2017/02/27 11:24 N

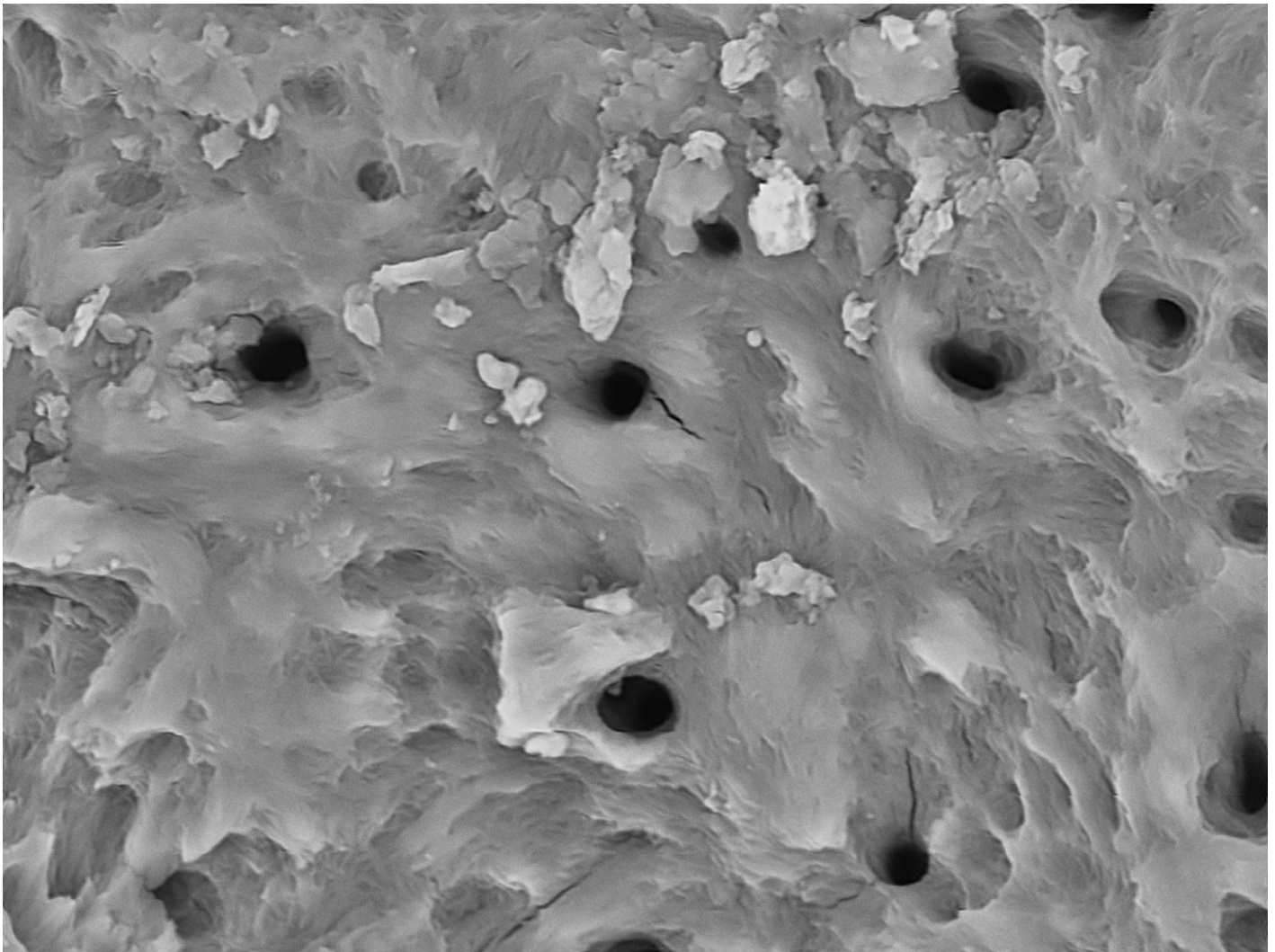
x5.0k 20 μm

98) image097

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image098

image098



29463-3

2017/02/27 14:48 N

x5.0k

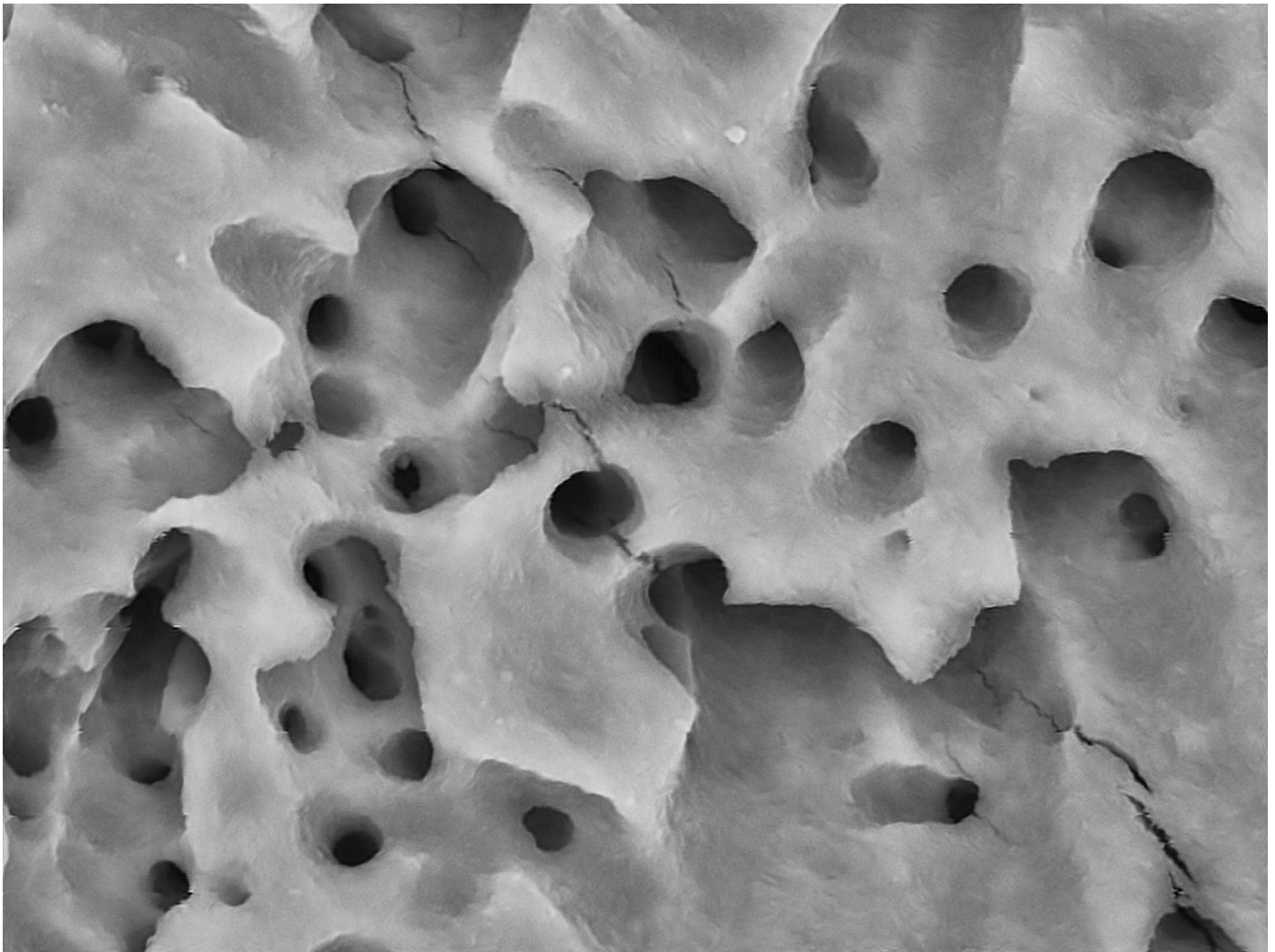
20 µm

99) image098

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image099

image099



29963-15

2017/03/01 14:16 N

x5.0k

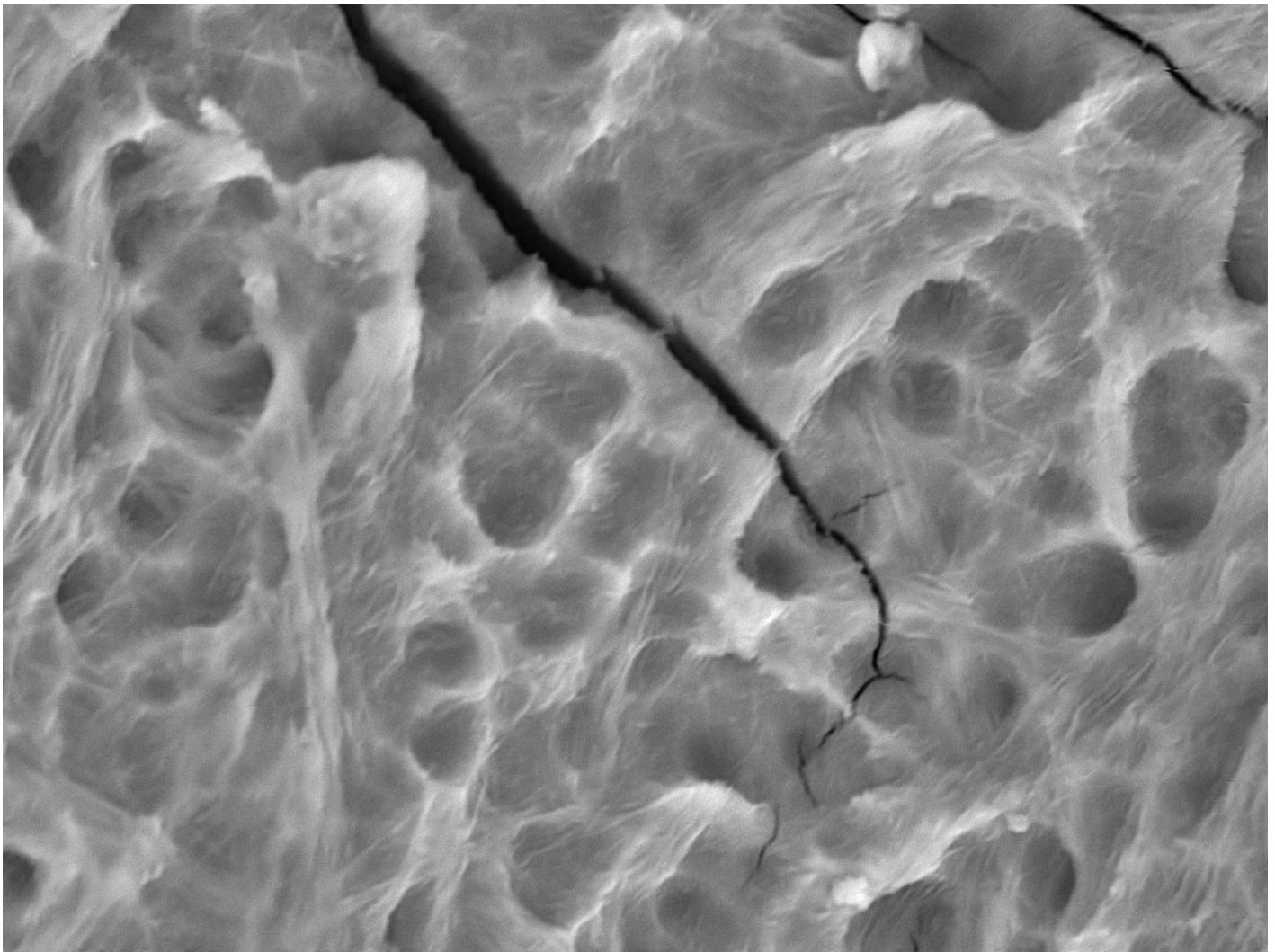
20 μm

100) image099

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image100

image100



29052-14

2017/02/28 18:19 N

x5.0k

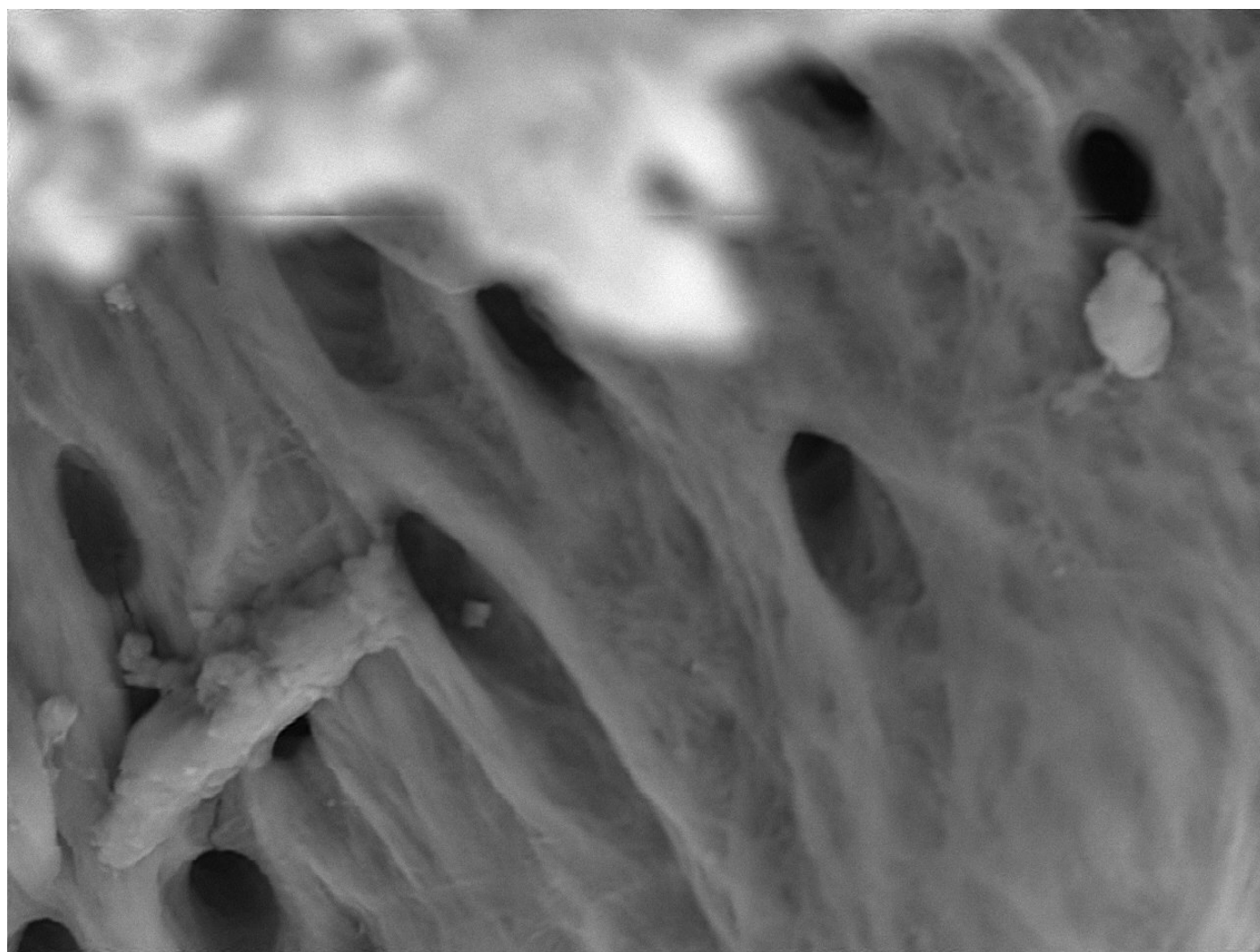
20 μ m

101) image100

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image101

image101



29179-3

2017/03/03 11:52 N

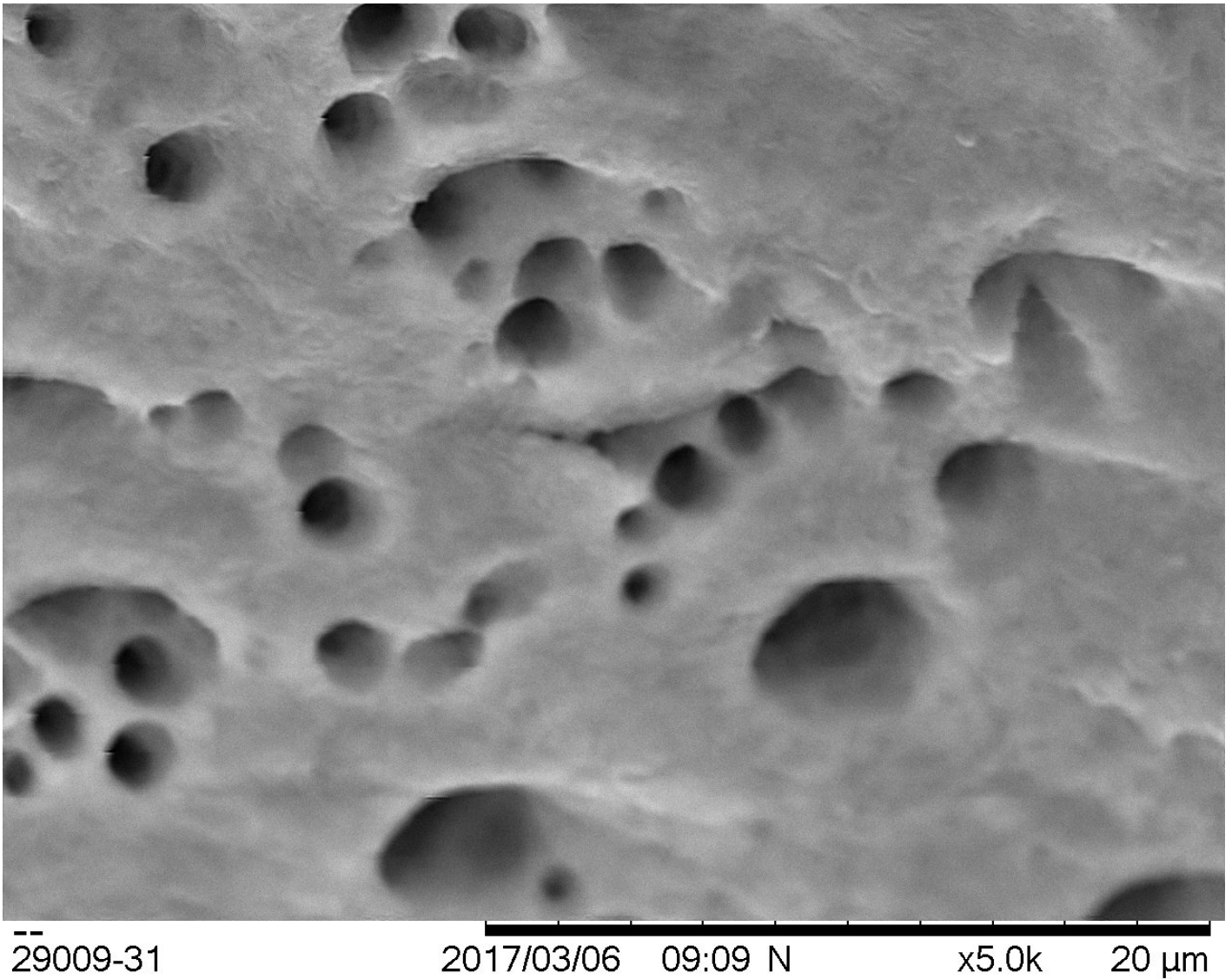
x5.0k 20 μ m

102) image101

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image102

image102

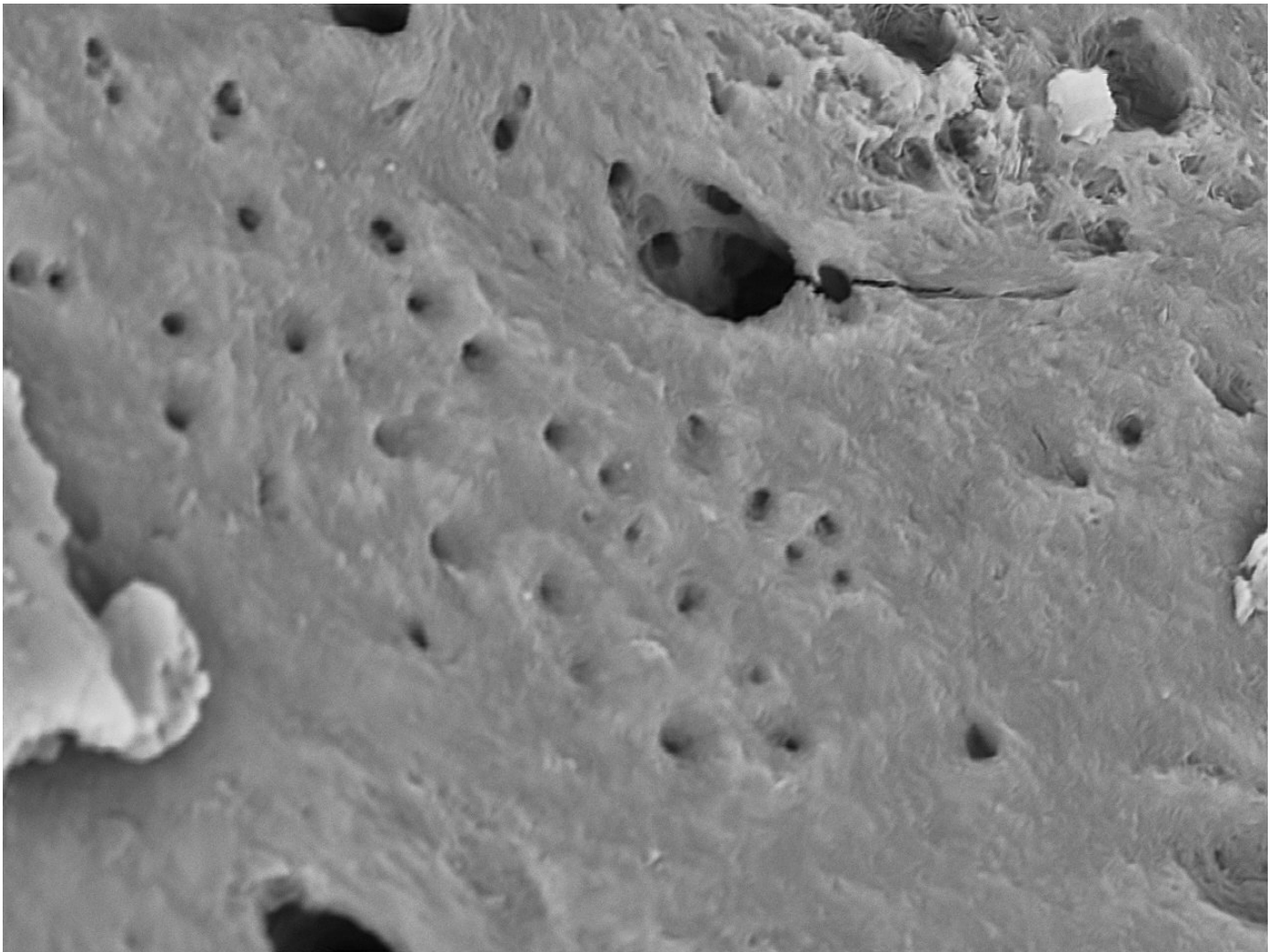


103) image102

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image103

image103



29009-31

2017/03/06 10:05 N

x5.0k

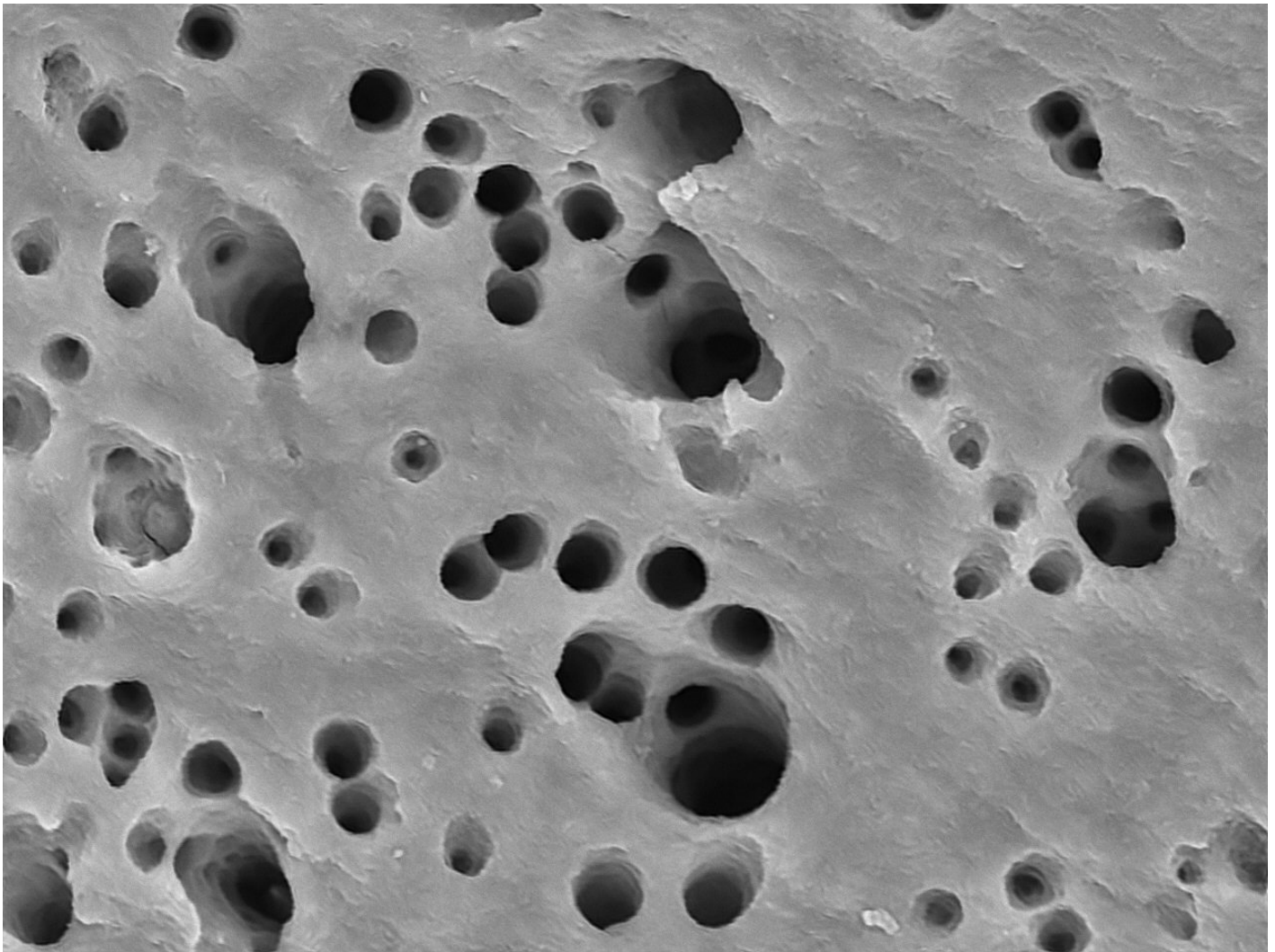
20 μ m

104) image103

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image104

image104



29211-18

2017/03/04 13:55 N

x5.0k

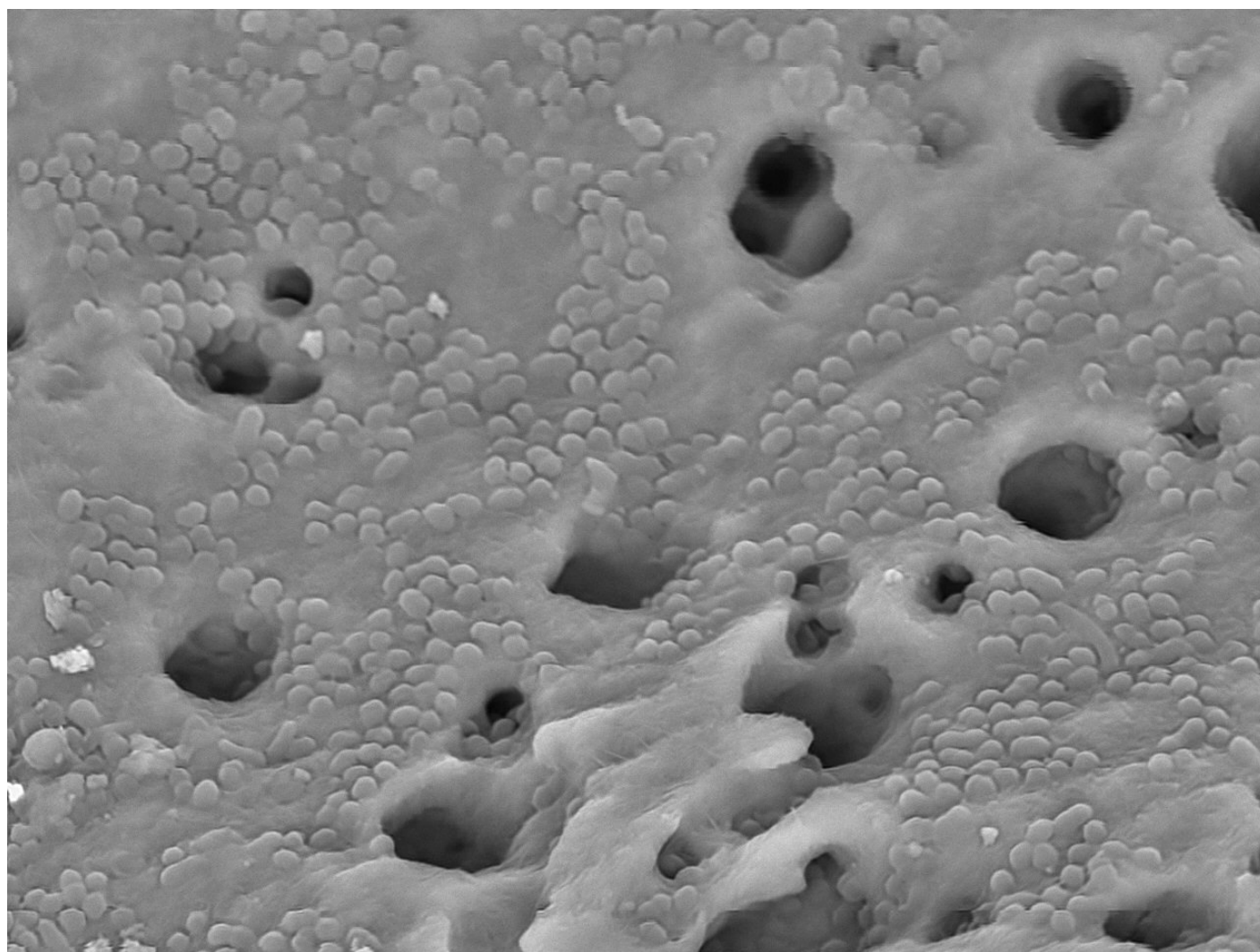
20 μm

105) image104

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image105

image105



29965-2

2017/03/02 15:27 N

x5.0k

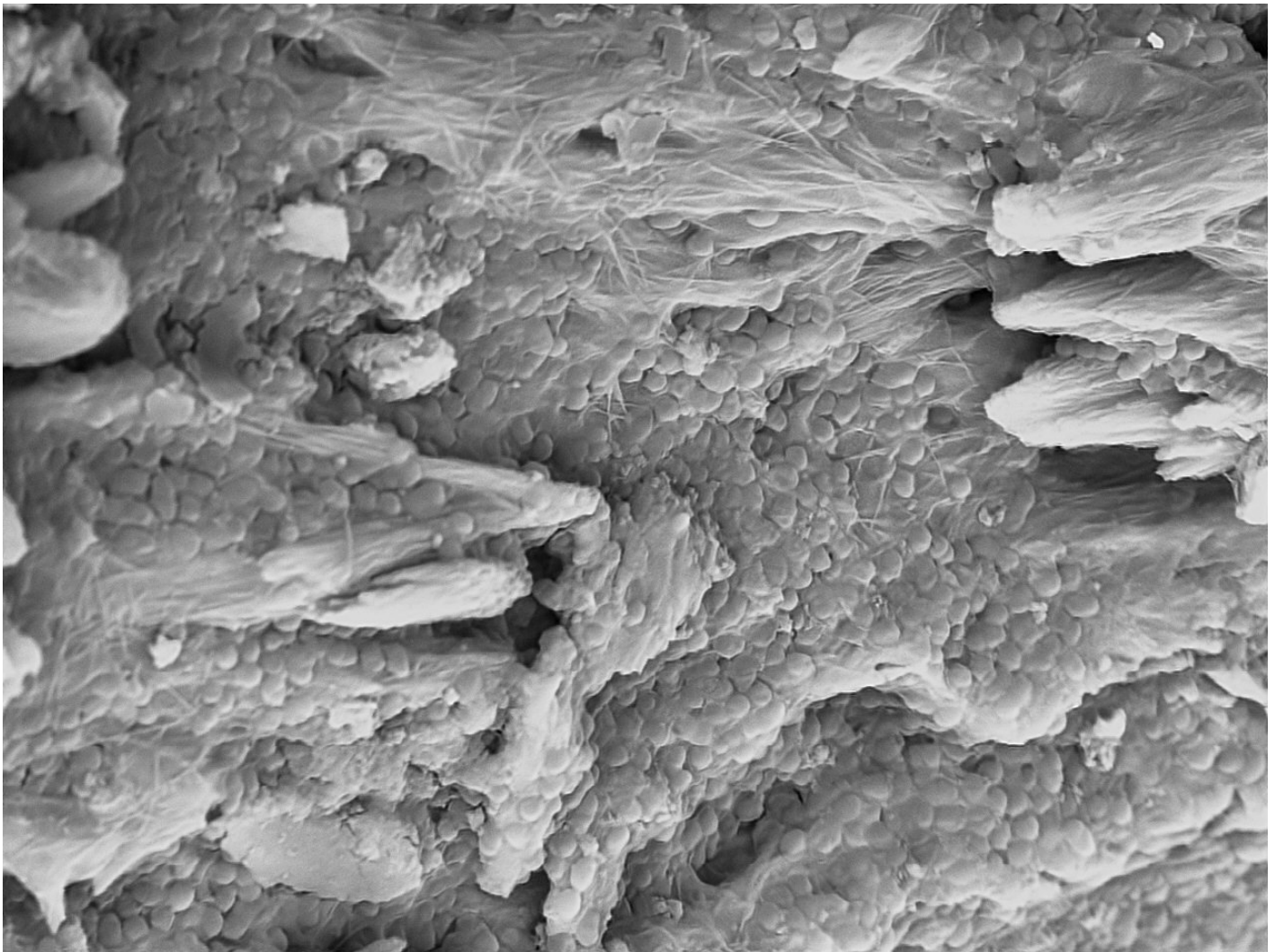
20 µm

106) image105

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image106

image106



29266-15

2017/03/04 14:44 N

x5.0k

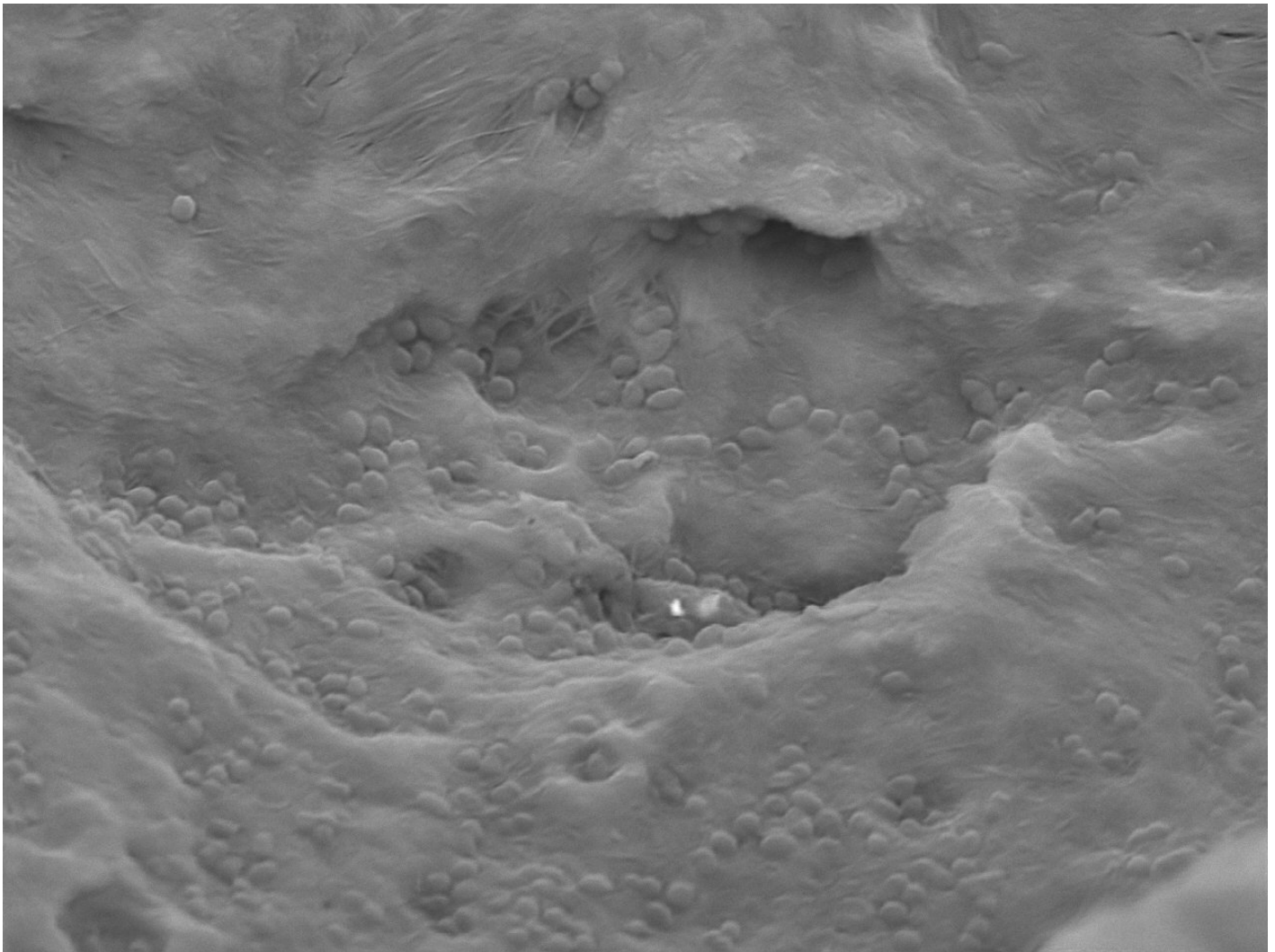
20 μ m

107) image106

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image107

image107



29679-3

2017/02/27 09:45 N

x5.0k

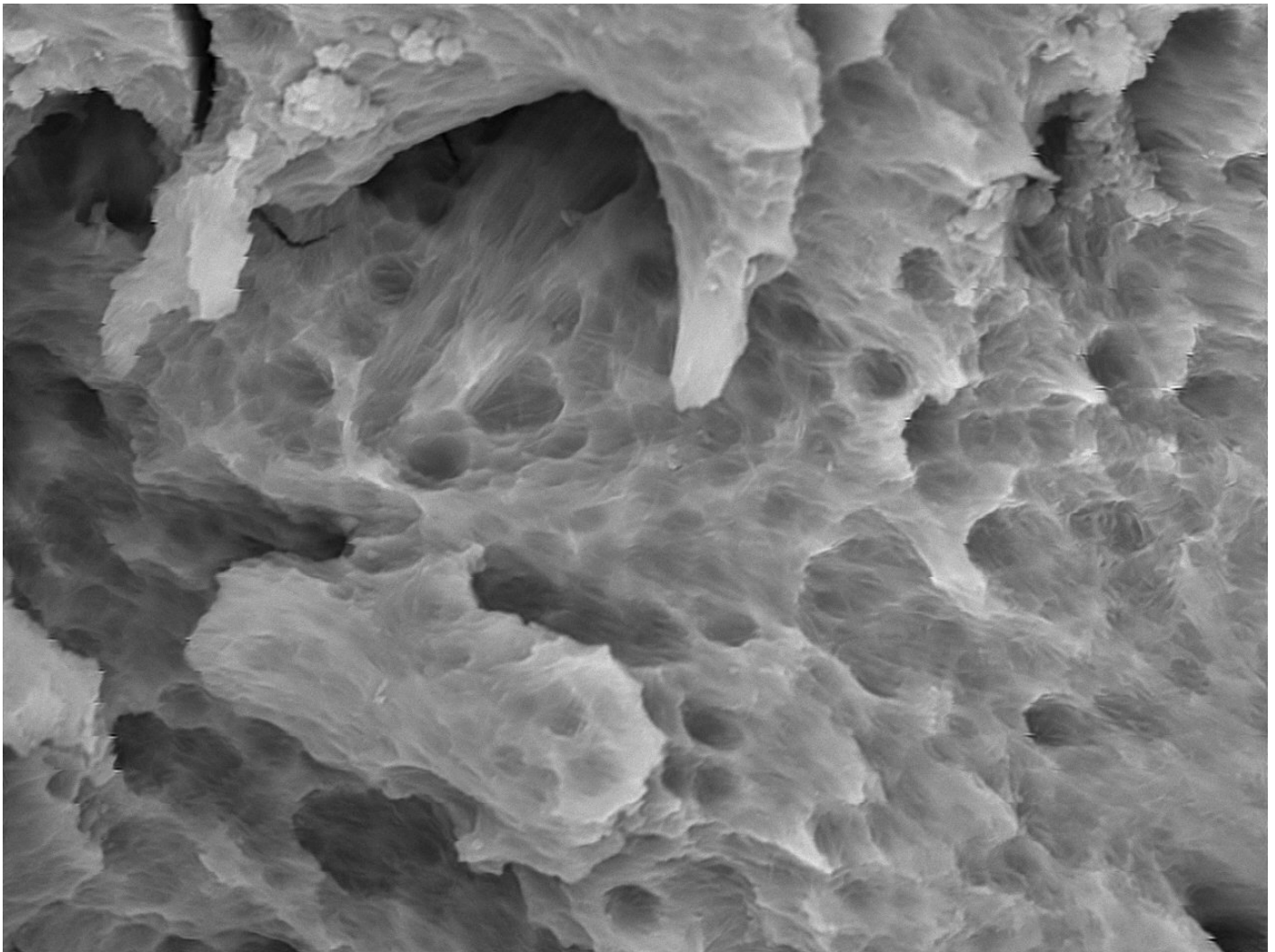
20 μ m

108) image107

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image108

image108



29211-18

2017/03/03 16:32 N

x5.0k

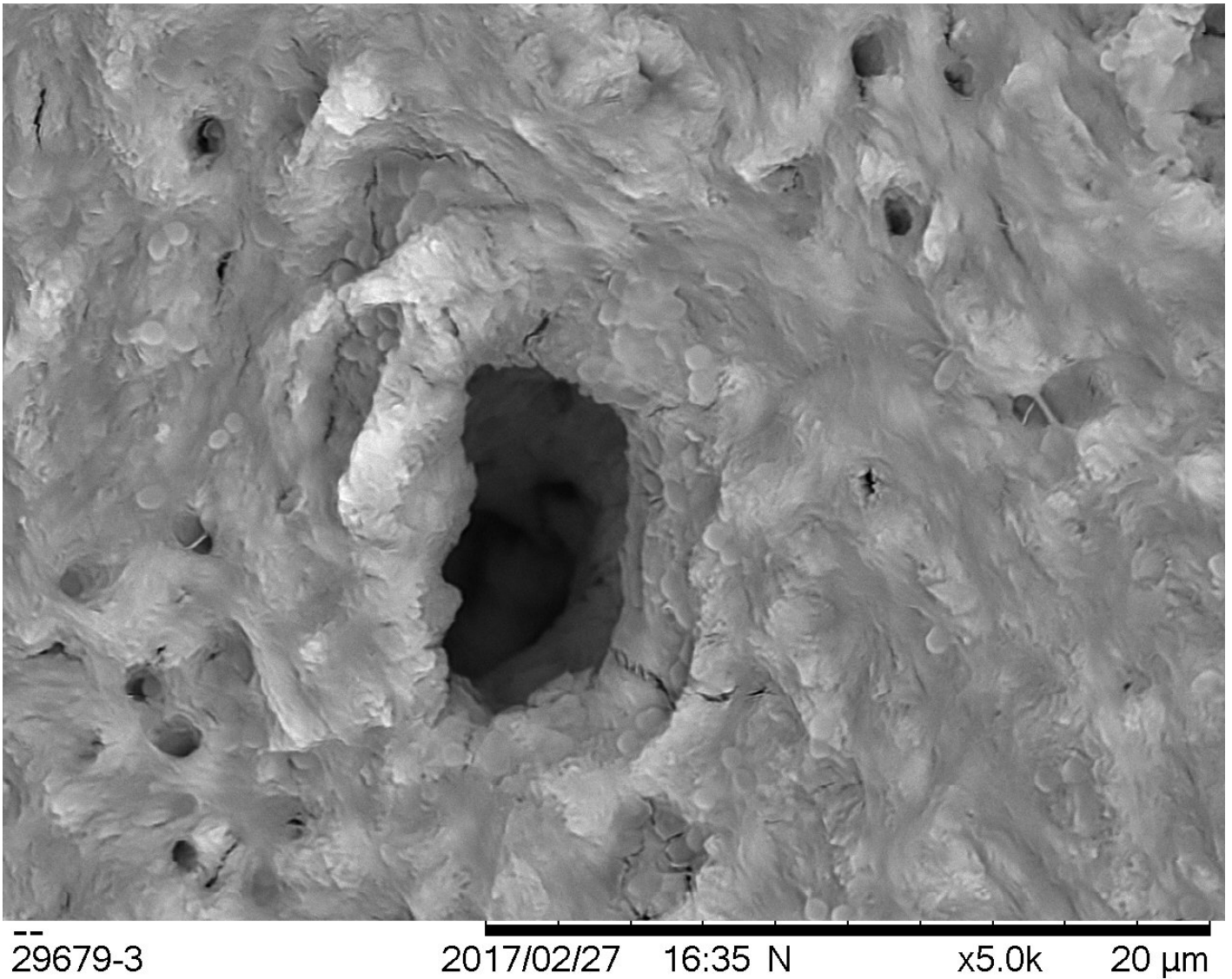
20 μ m

109) image108

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image109

image109

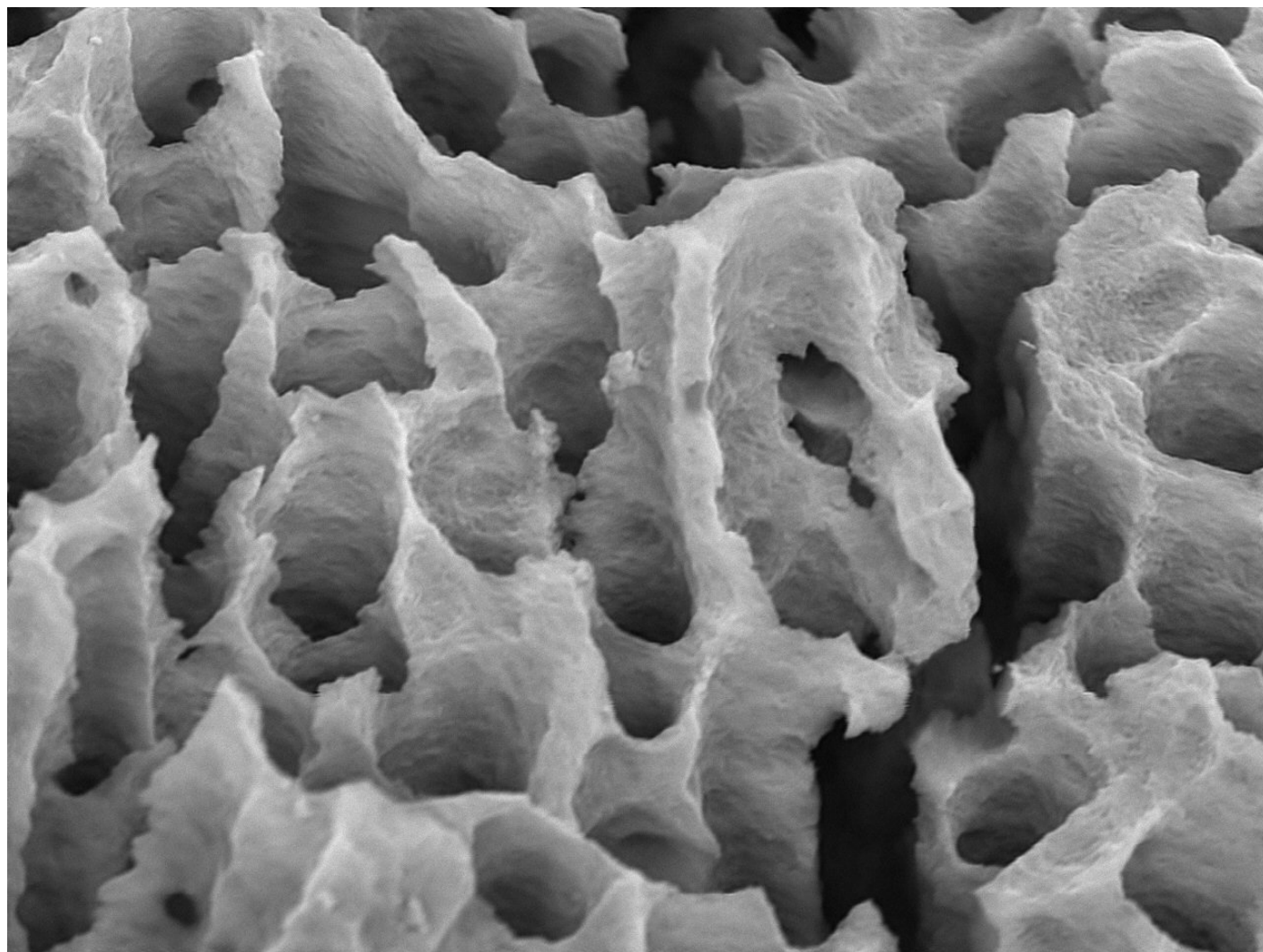


110) image109

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image110

image110



29340-18

2017/03/03 10:27 N

x5.0k

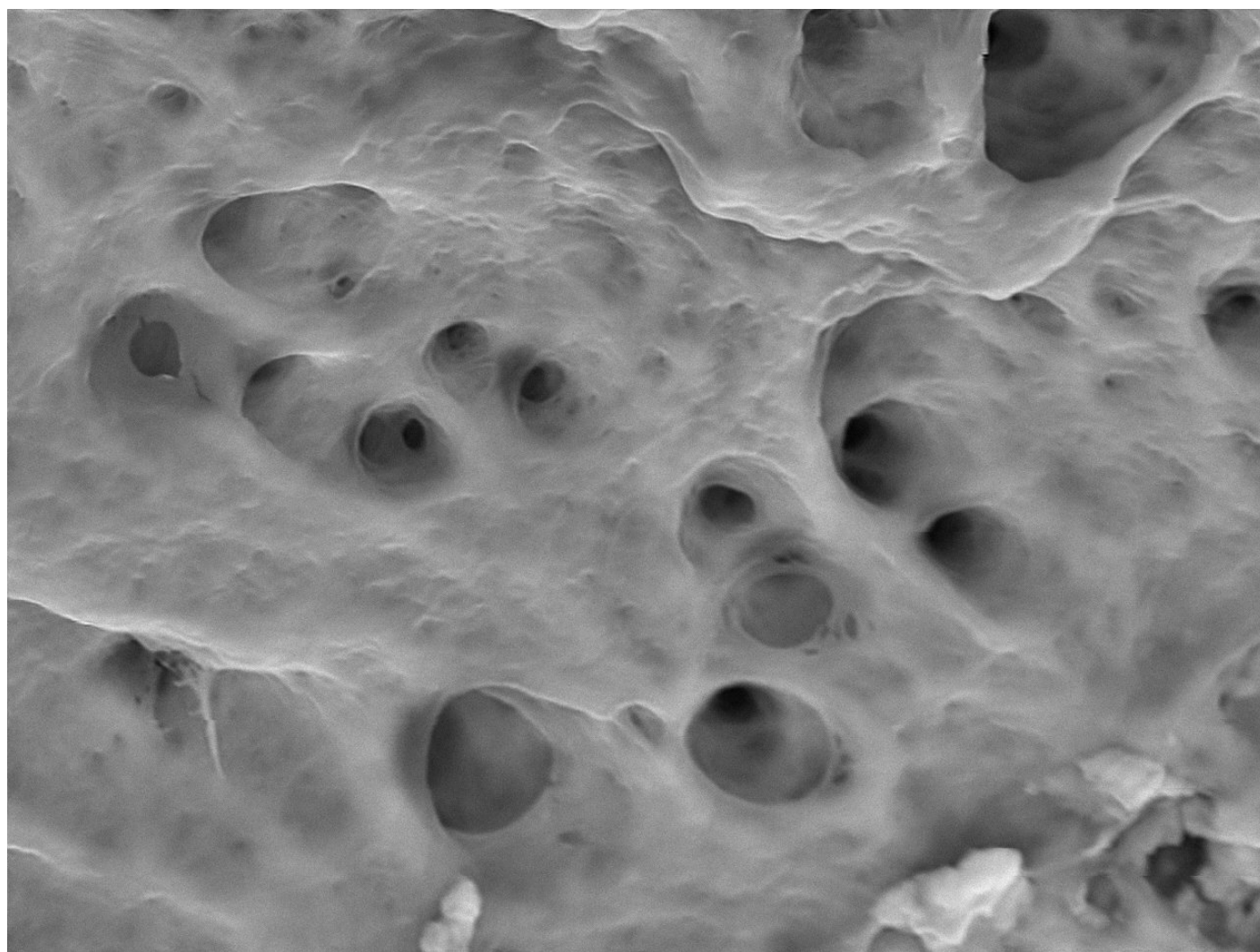
20 μm

111) image110

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image111

image111



29961-2

2017/03/01 14:56 N

x5.0k

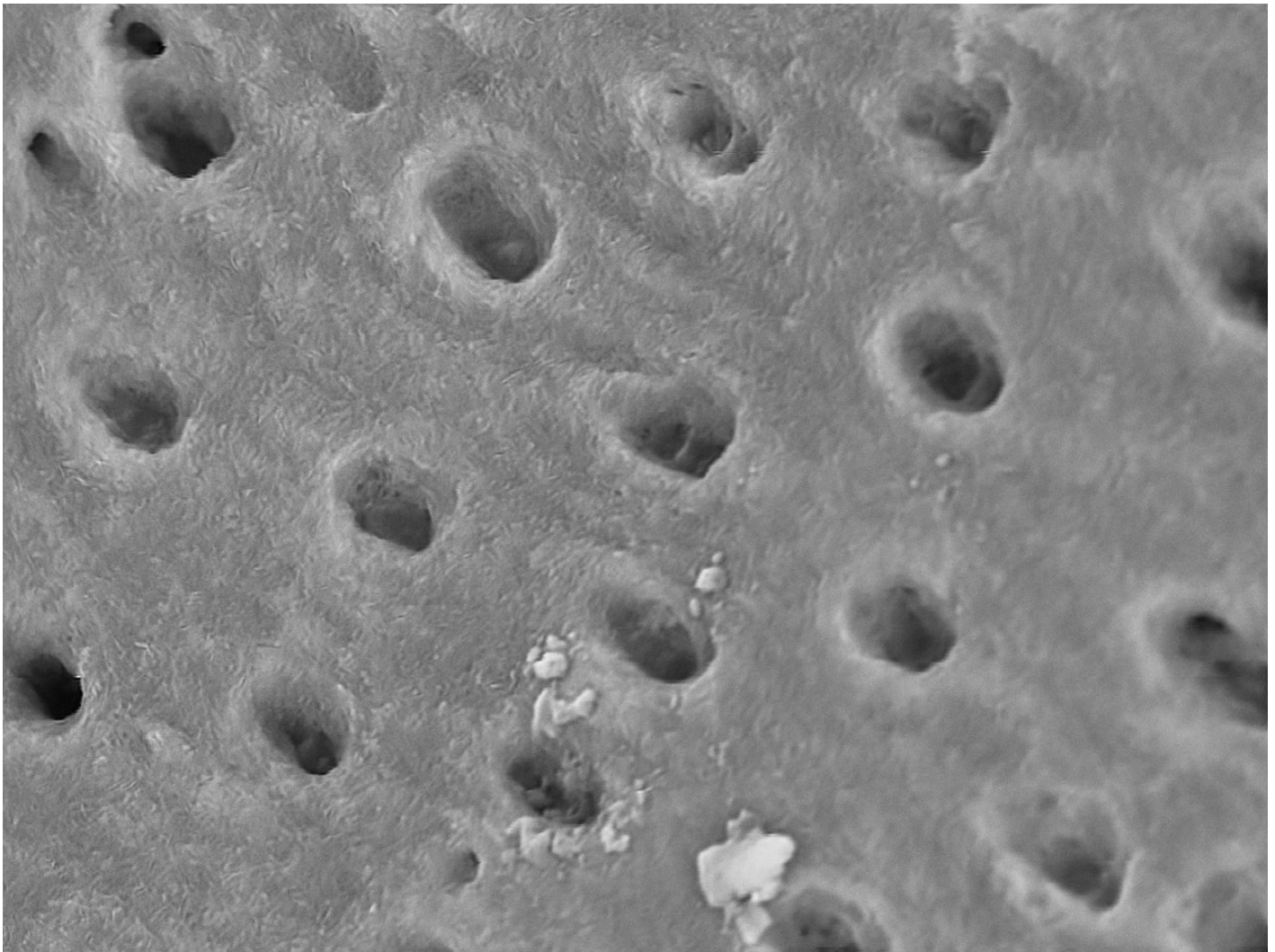
20 μ m

112) image111

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image112

image112



29340-18

2017/03/03 10:36 N

x5.0k

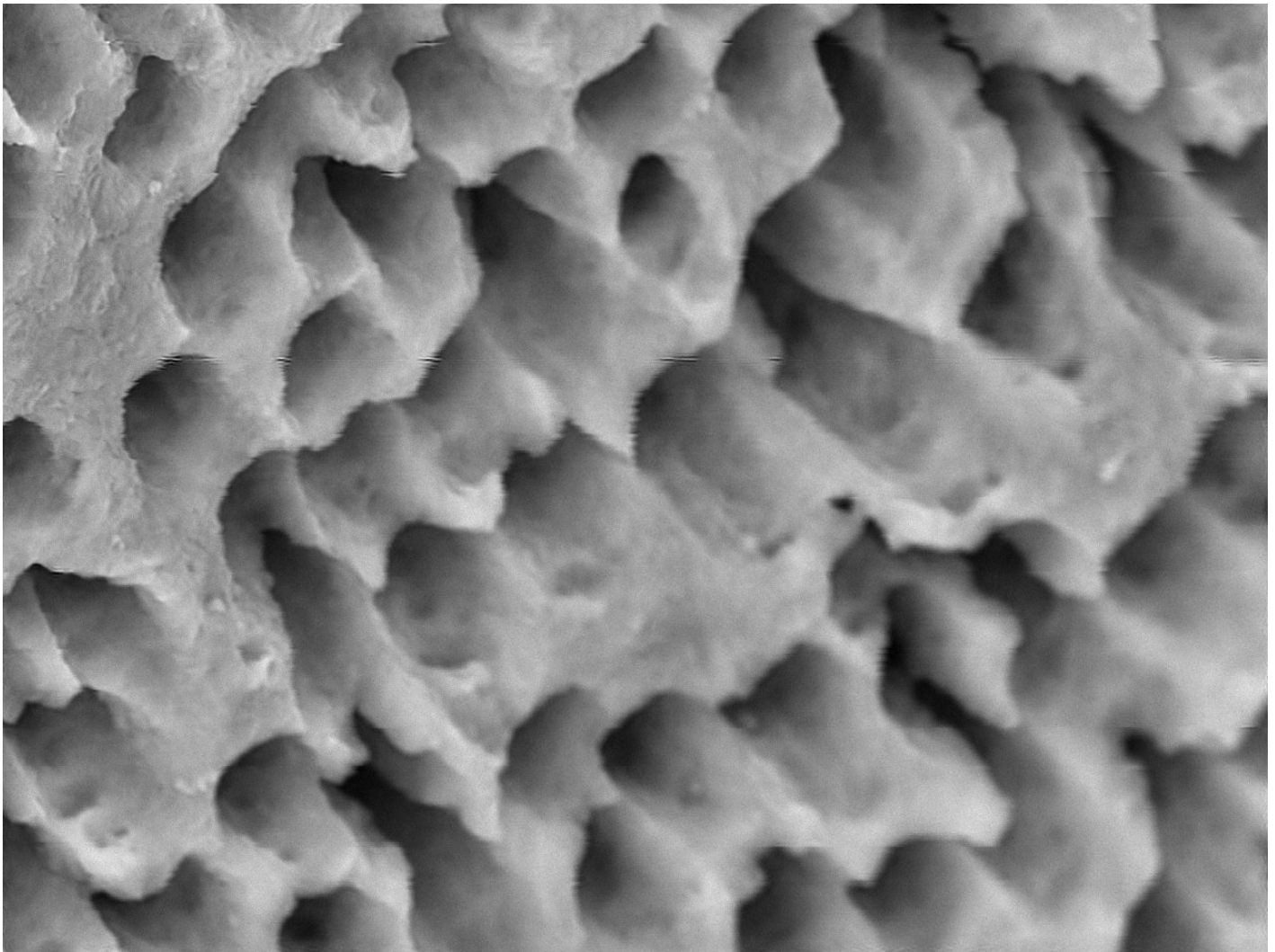
20 μm

113) image112

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image113

image113



29340-18

2017/03/03 10:55 N

x5.0k

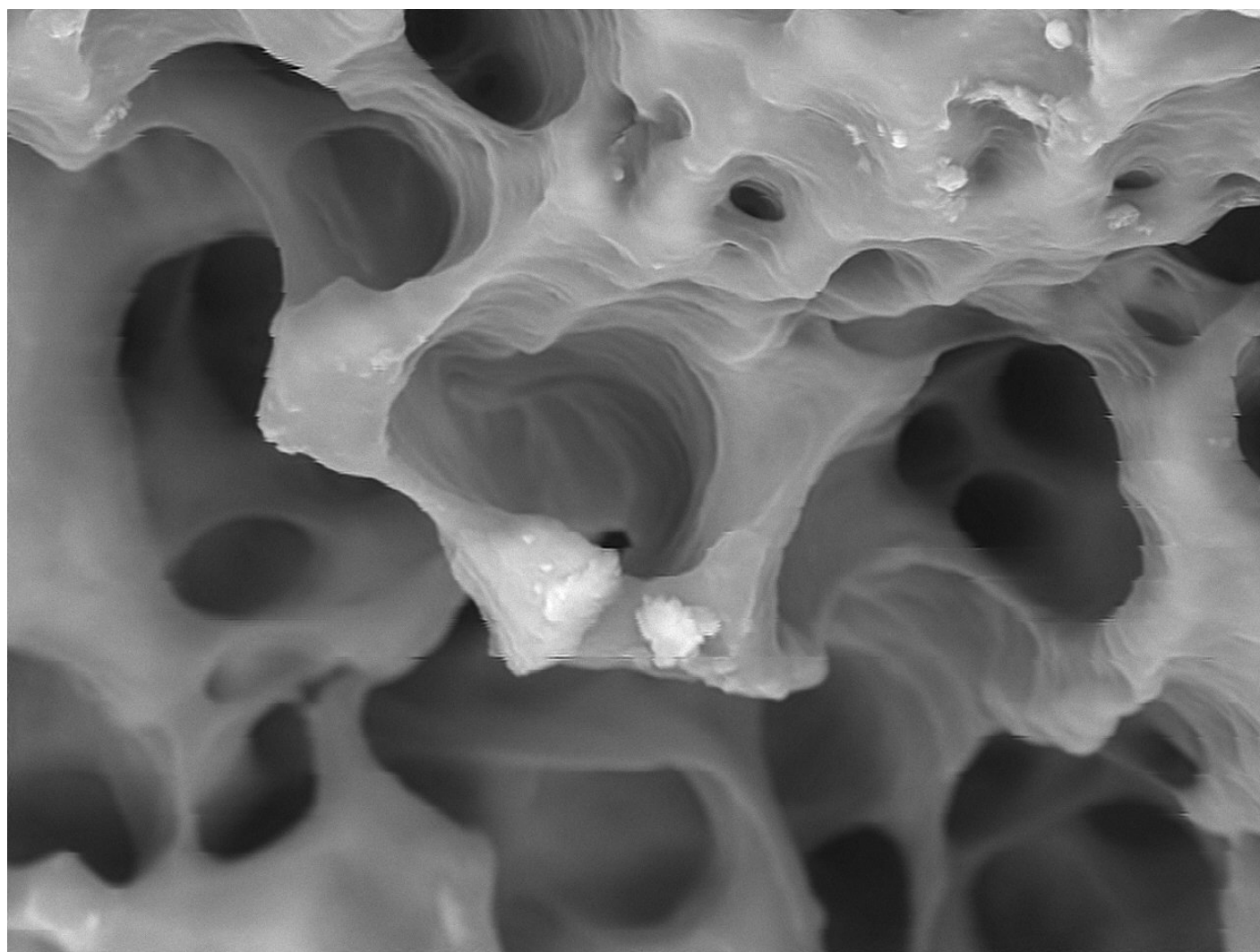
20 μm

114) image113

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image114

image114



29960-14

2017/03/01 10:36 N

x5.0k

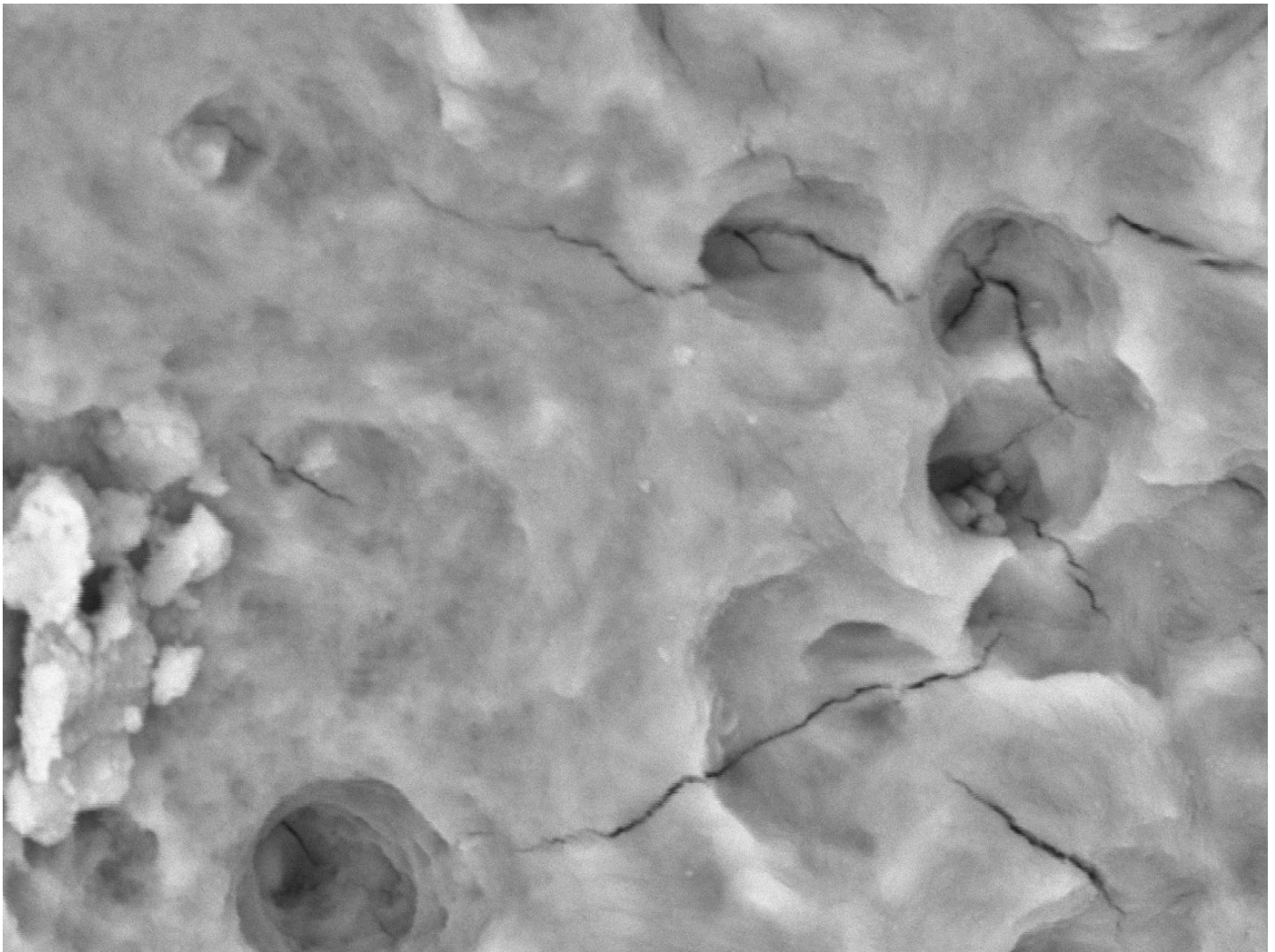
20 μ m

115) image114

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image115

image115



29952-15

2017/02/22 15:49 N

x5.0k

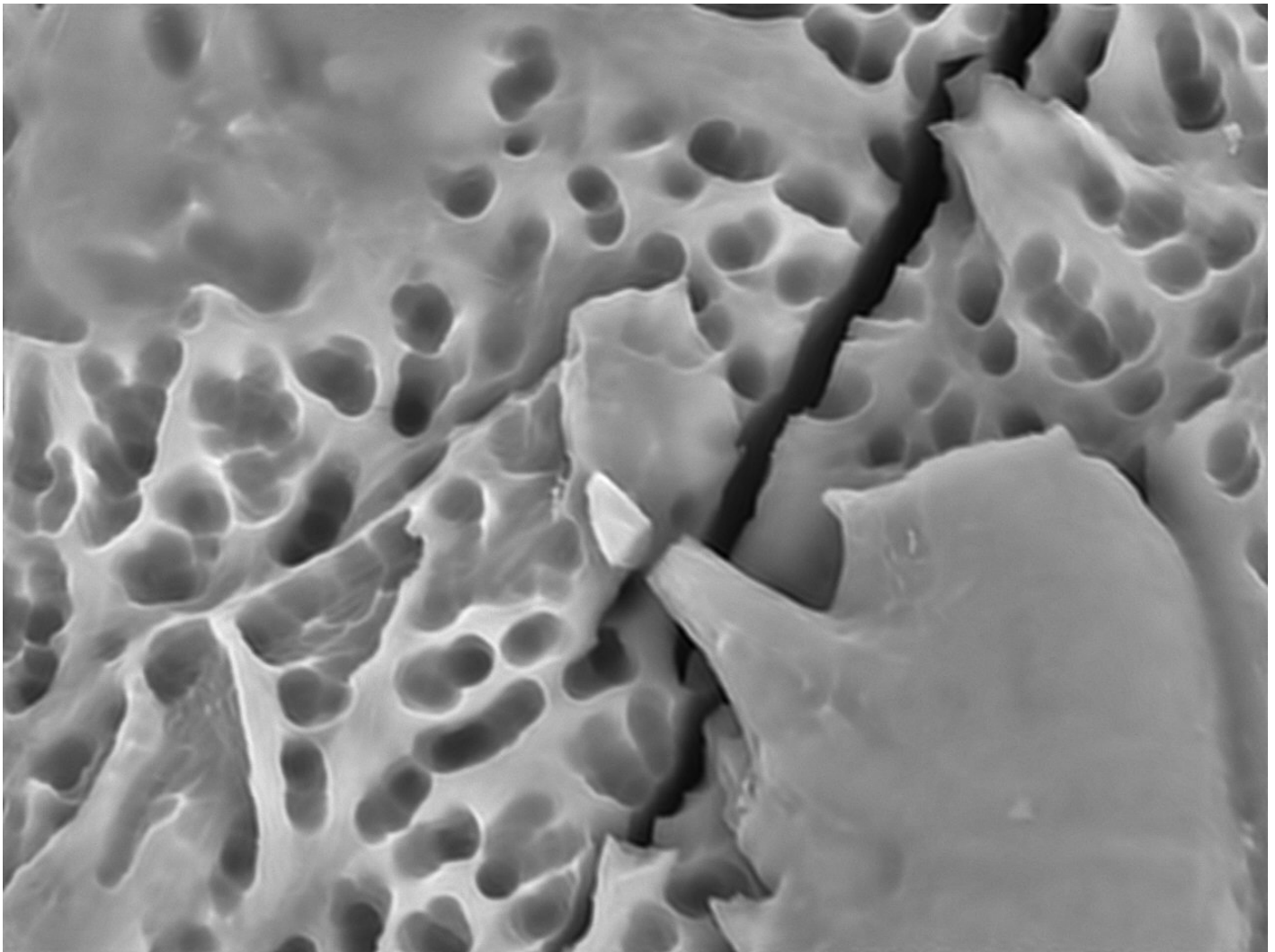
20 μm

116) image115

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image116

image116



29009-31

2017/03/08 14:45 H

x5.0k

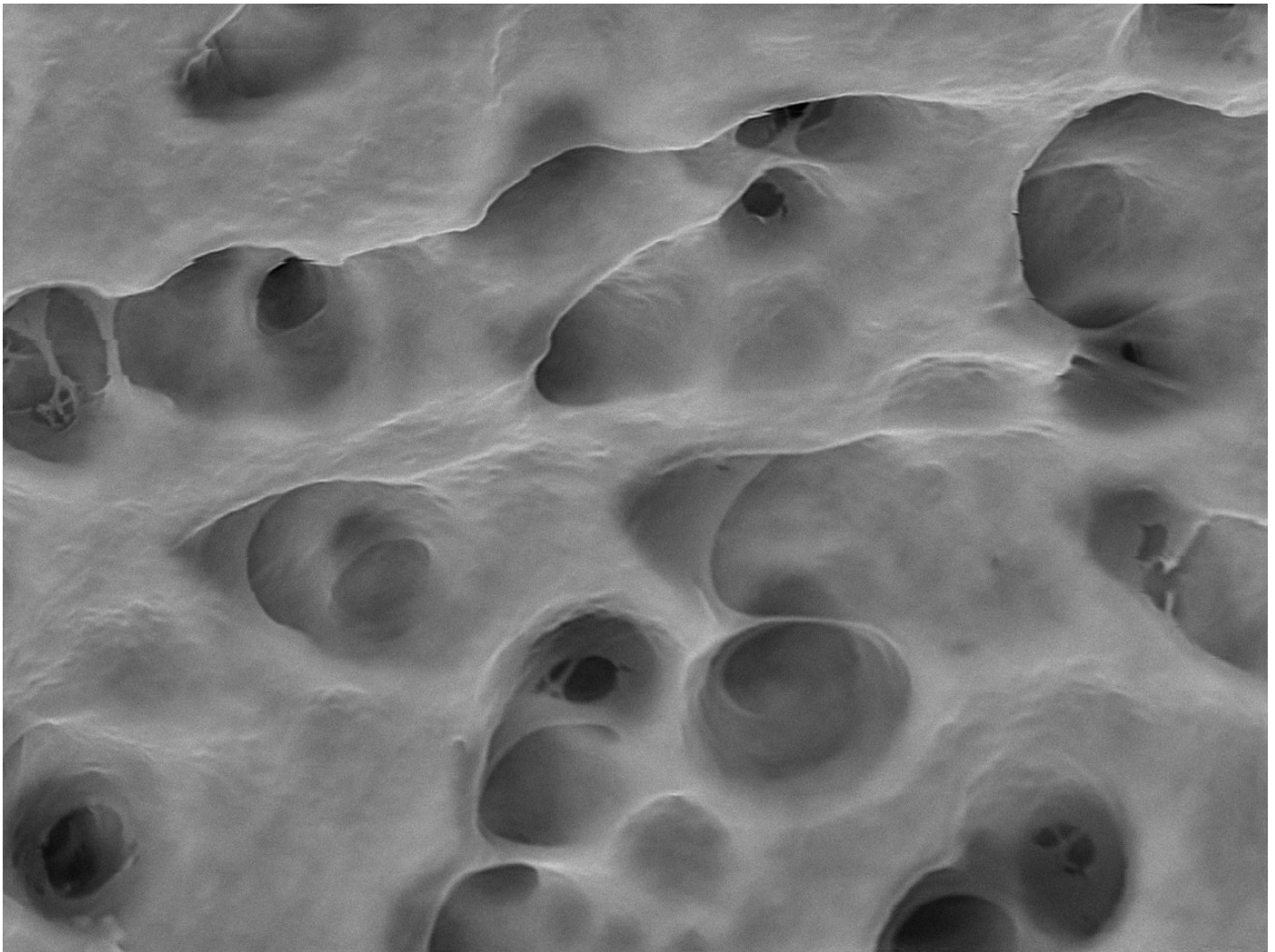
20 μm

117) image116

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image117

image117



29961-2

2017/03/01 14:54 N

x5.0k 20 μm

118) image117

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

Appendix B: REDCap survey, block 2

Block 2

Please complete the survey below.

Thank you!

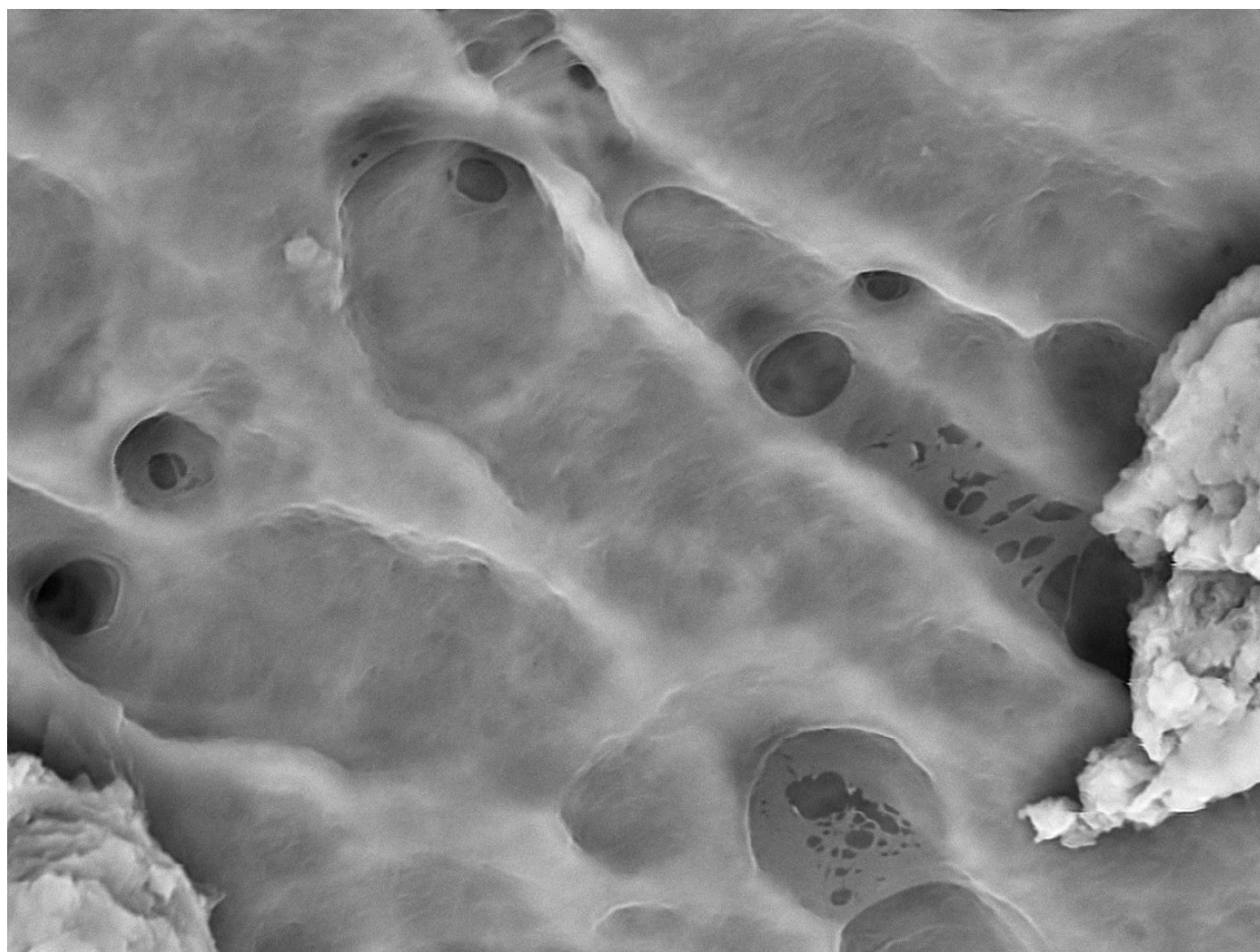
Identify rater

1) Who is rating these images?

- Garry Myers
- Vaughan Mayo
- Todd Kitten
- Cyrus Ardalan

image118

image118



29961-2

2017/03/01 14:55 N

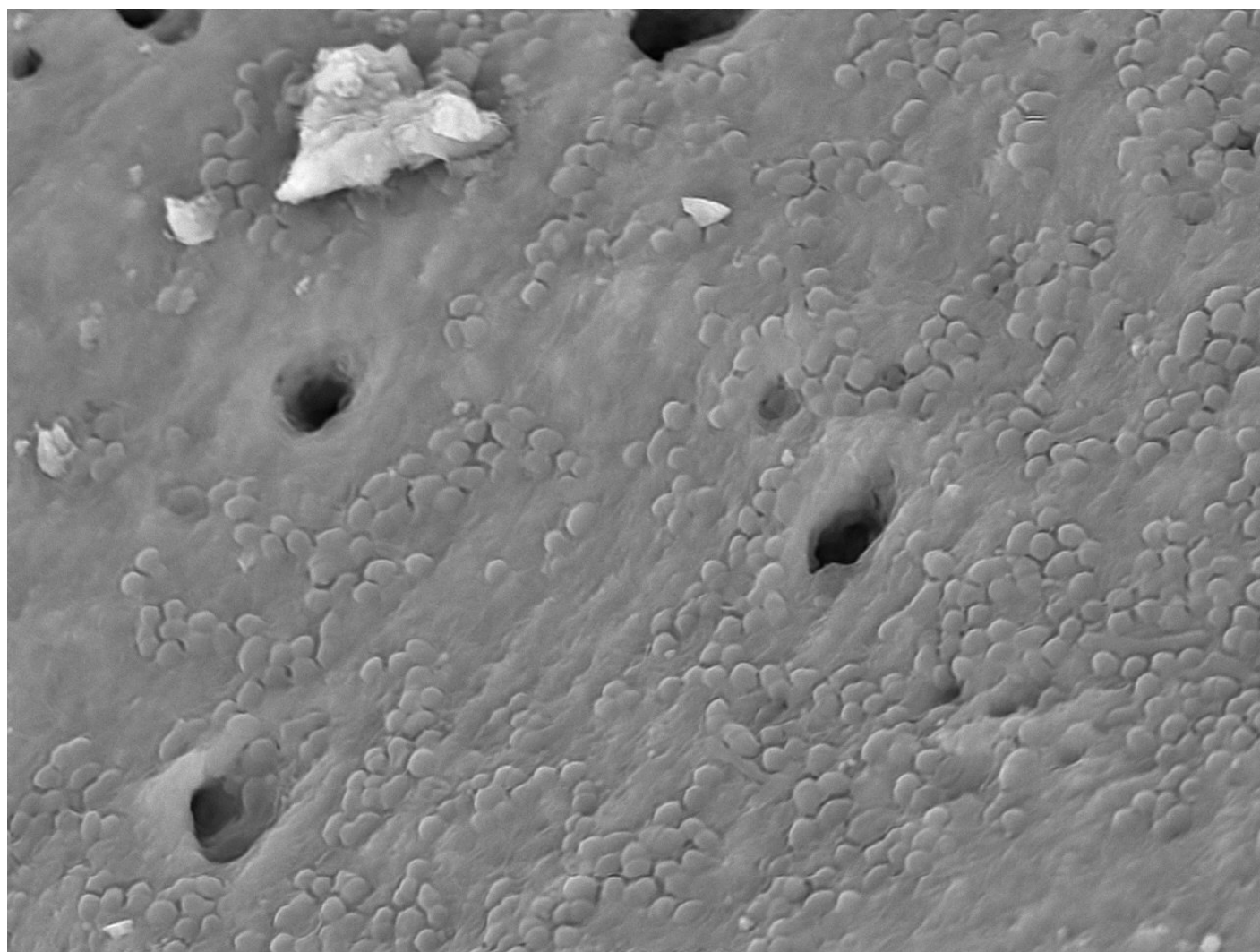
x5.0k 20 μm

2) image118

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image119

image119



29965-2

2017/03/02 15:22 N

x5.0k

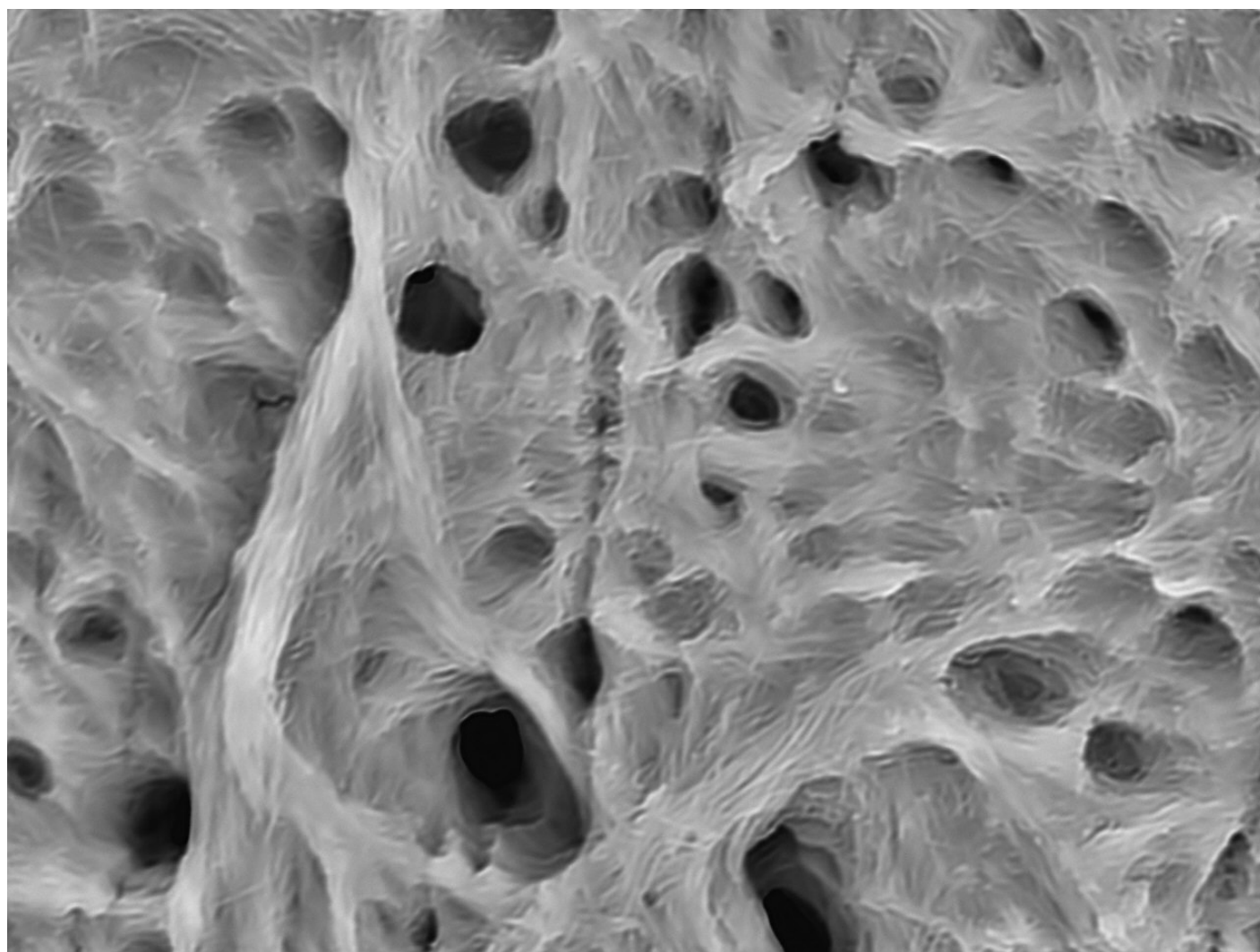
20 μm

3) image119

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image120

image120



29805-30

2017/03/09 14:46 H

x5.0k

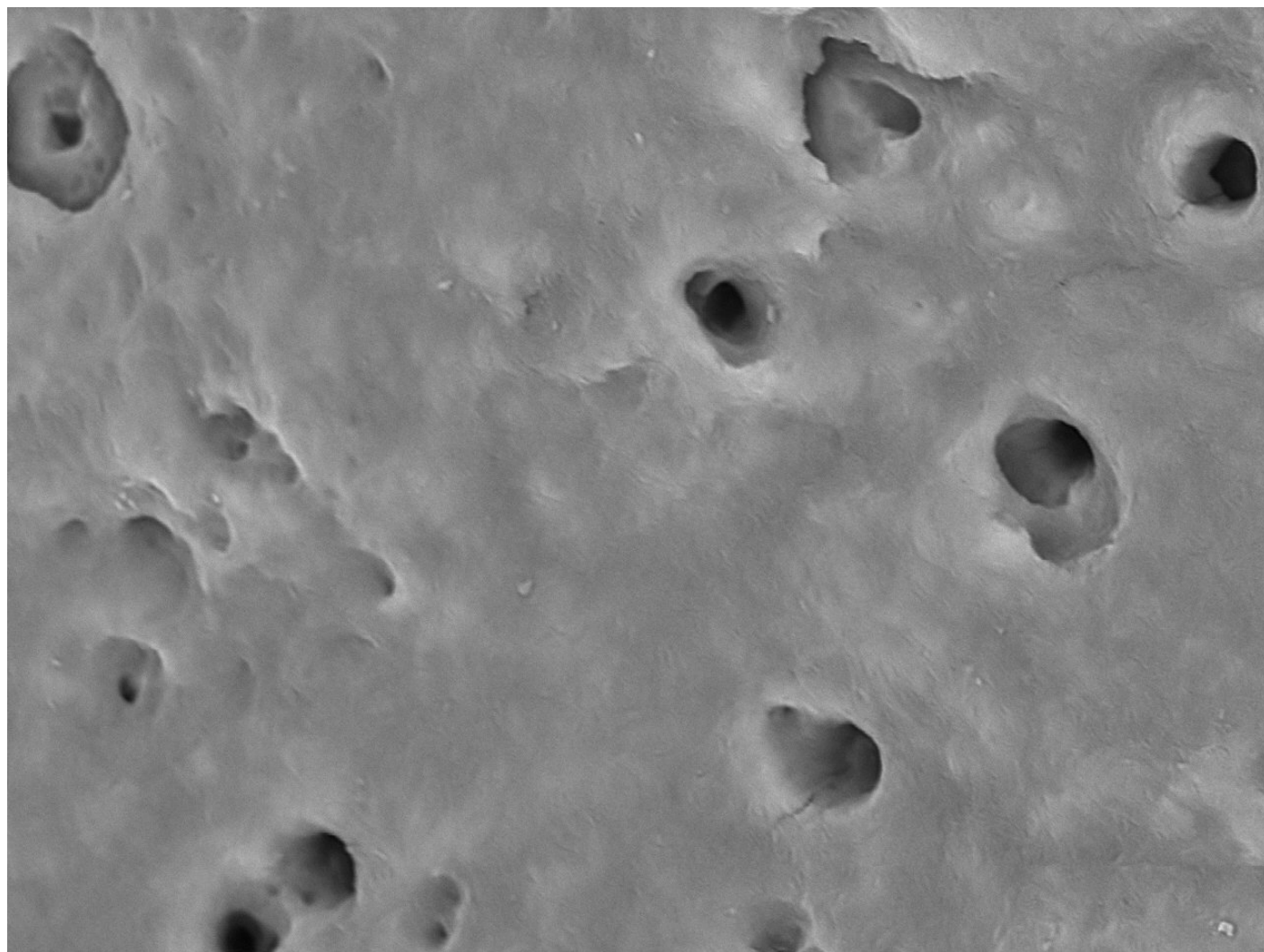
20 μ m

4) image120

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image121

image121



29576-18

2017/03/01 11:53 N

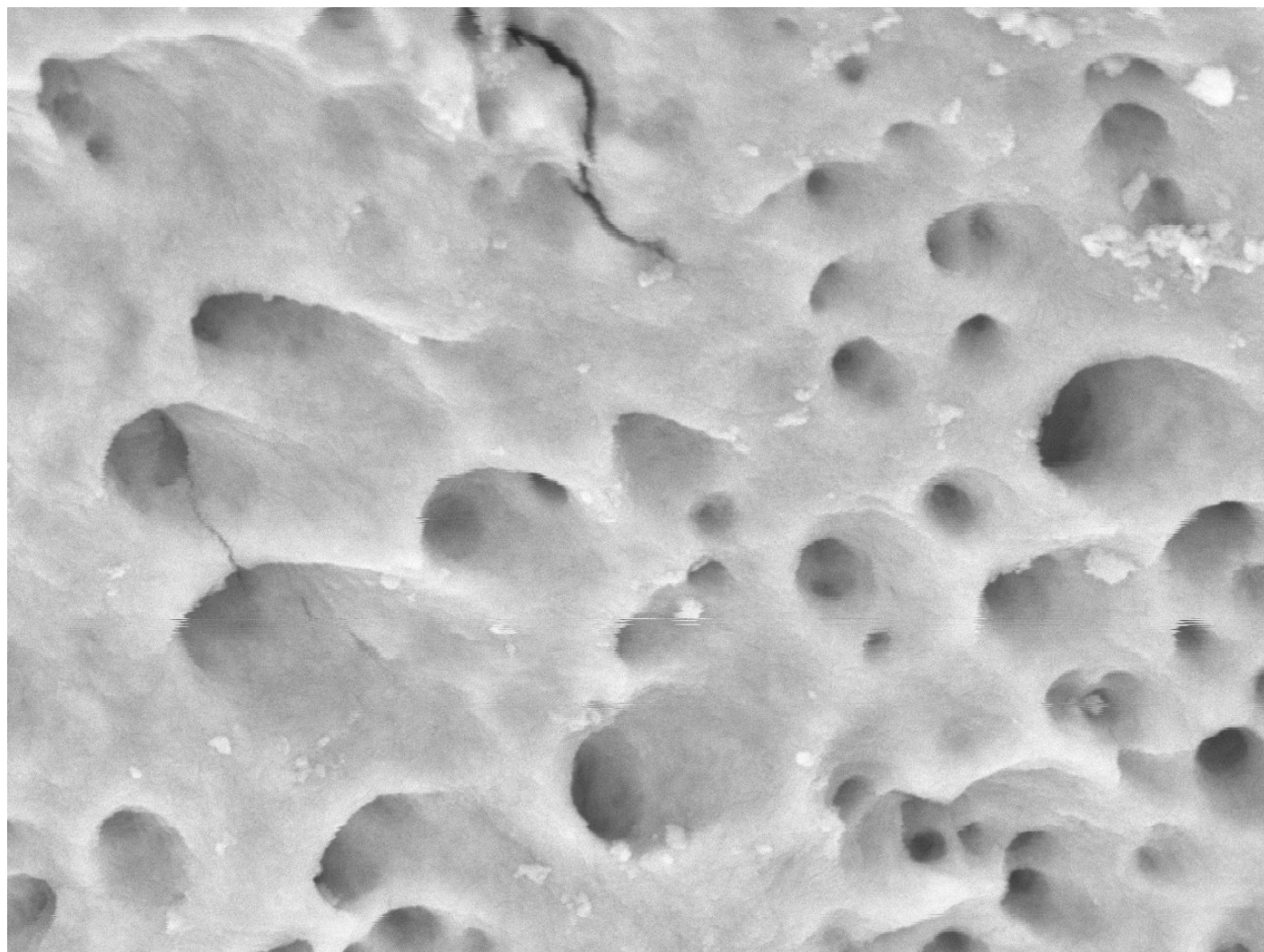
x5.0k 20 μm

5) image121

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image122

image122



29952-15

2017/02/22 15:47 N

x5.0k

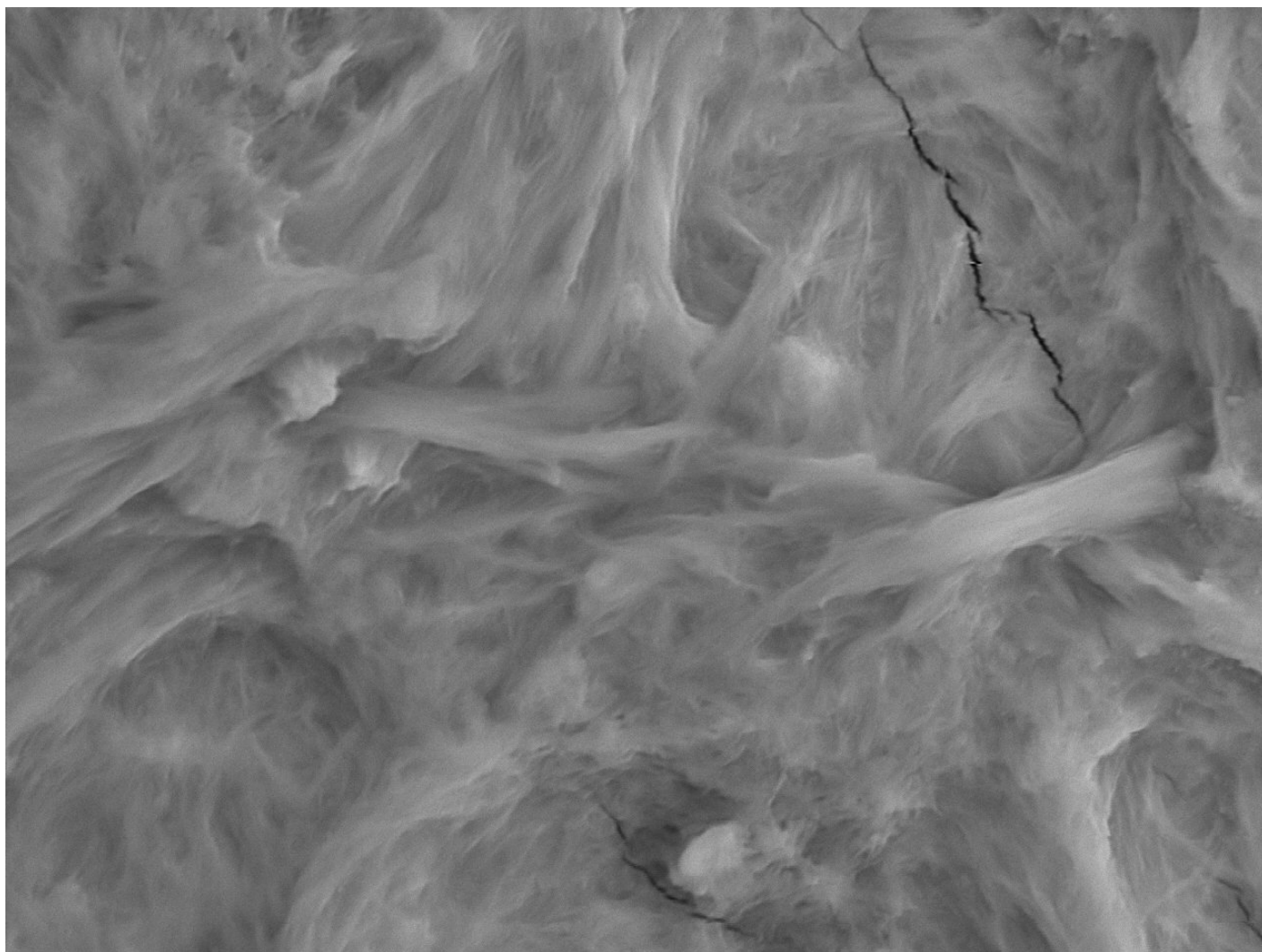
20 μ m

6) image122

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image123

image123



29028-15

2017/03/04 15:31 N

x5.0k

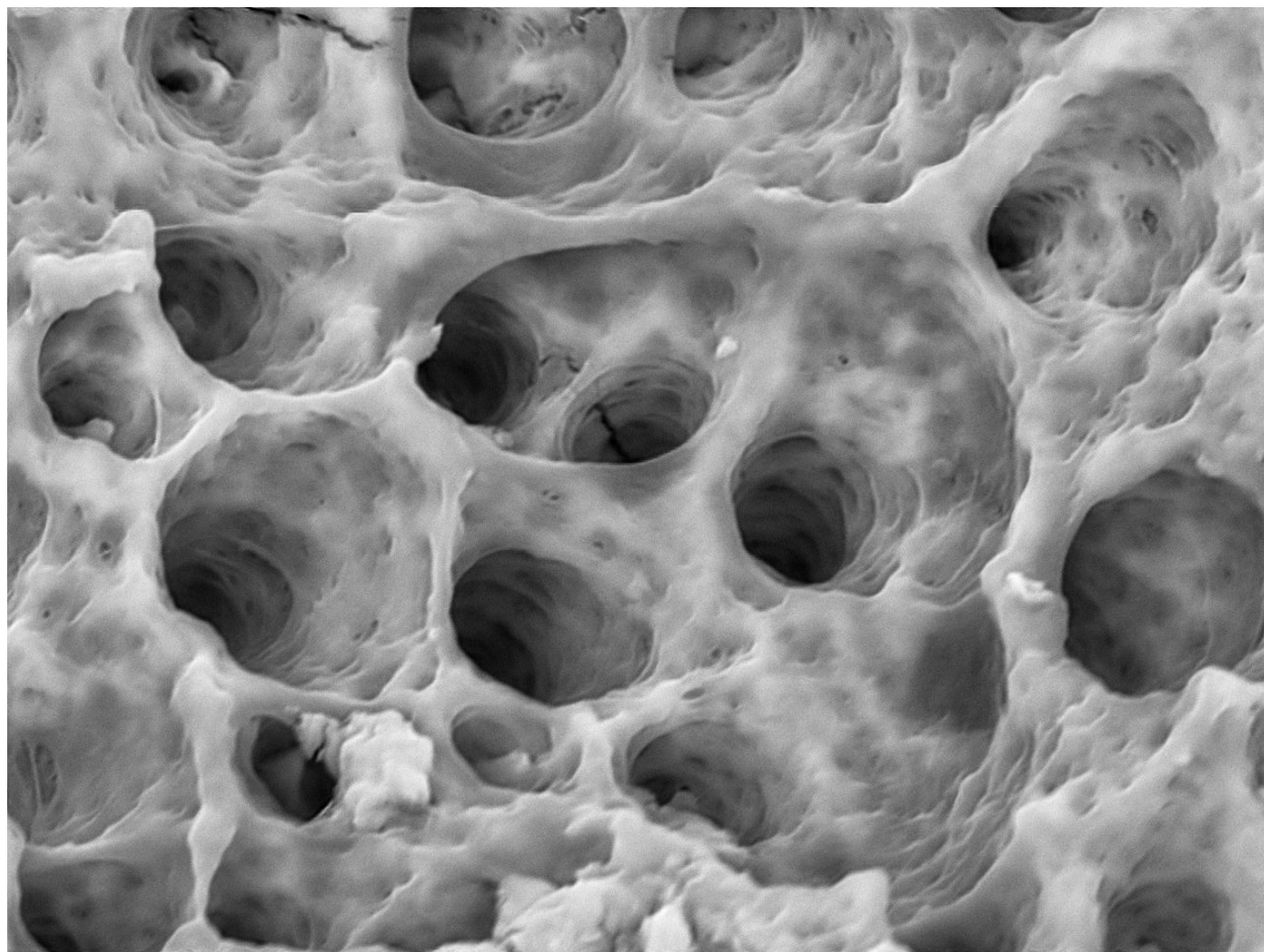
20 μm

7) image123

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image124

image124



29009-31

2017/03/08 10:34 N

x5.0k

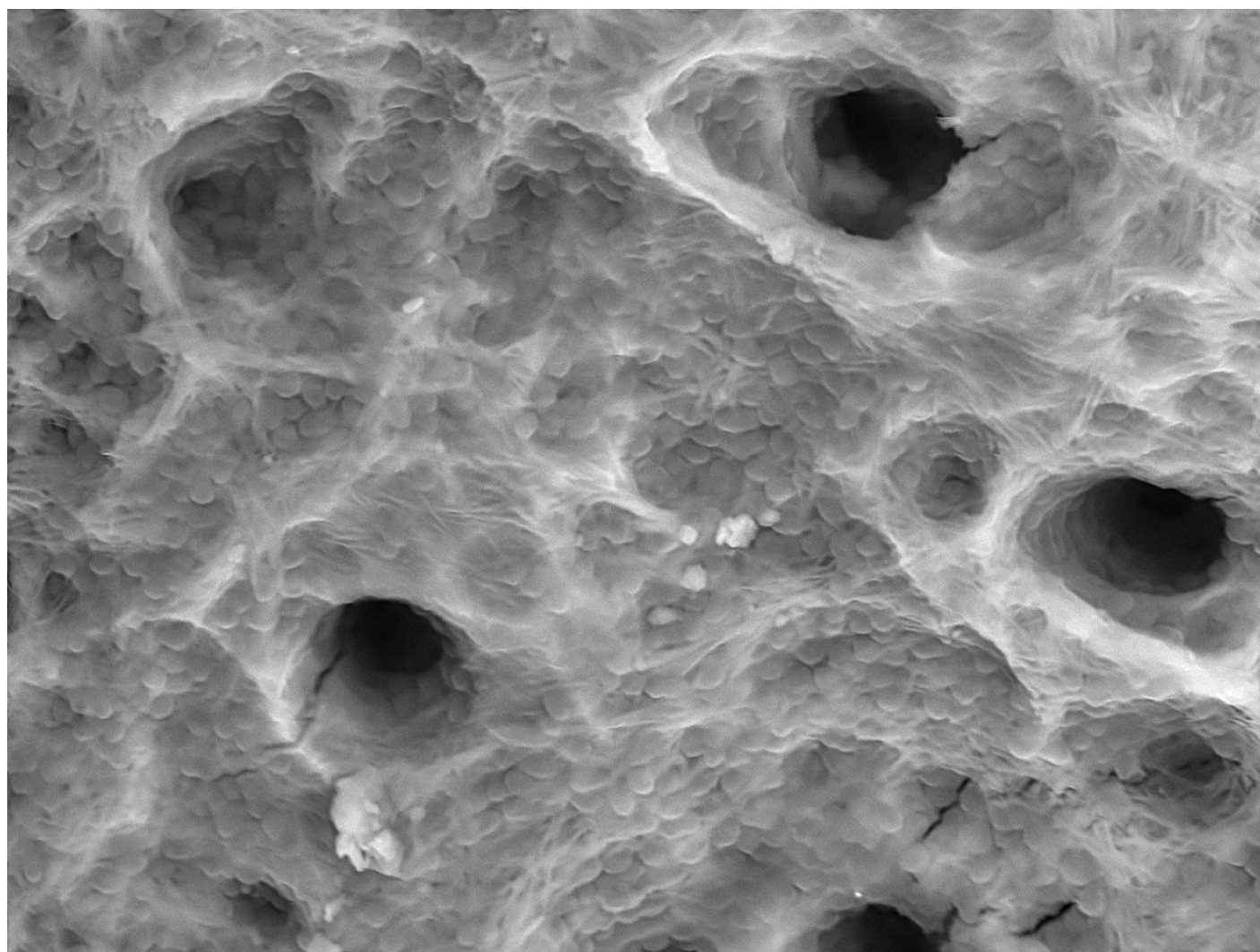
20 μ m

8) image124

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image125

image125



29694-2

2017/02/28 16:36 N

x5.0k

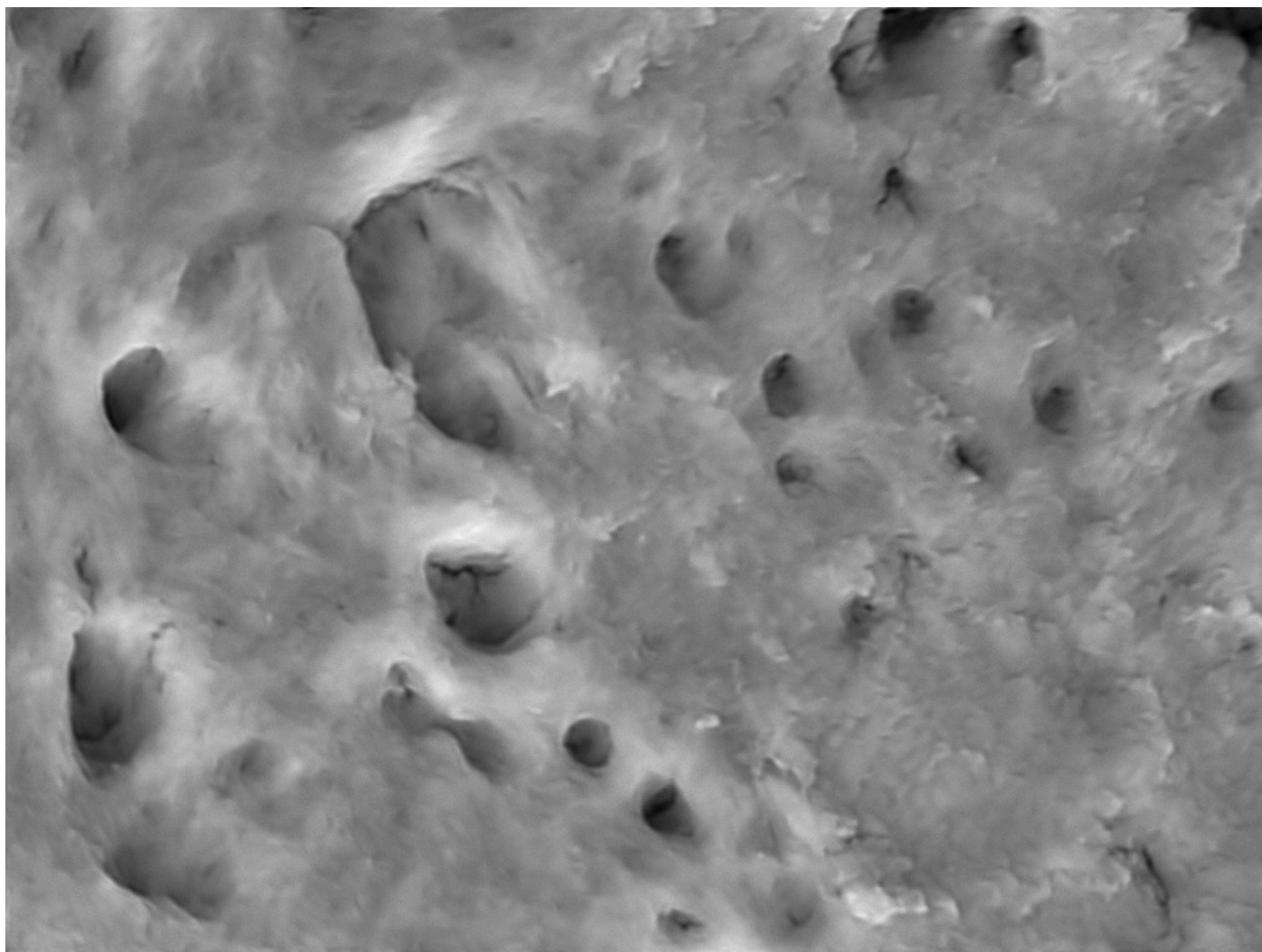
20 μm

9) image125

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image126

image126



29009-31

2017/03/08 15:03 H

x5.0k

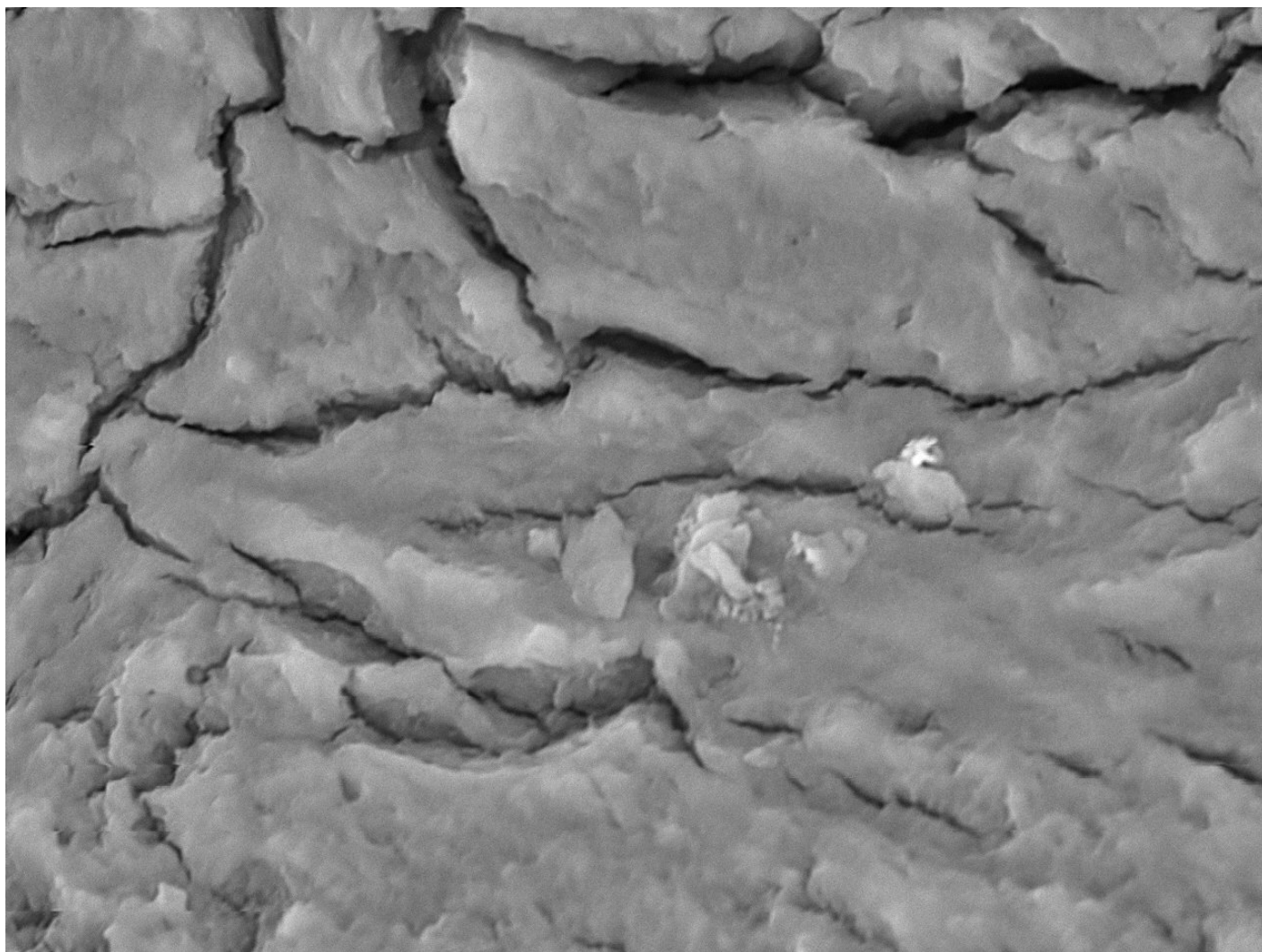
20 μ m

10) image126

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image127

image127



29009-31

2017/03/06 15:35 N

x5.0k

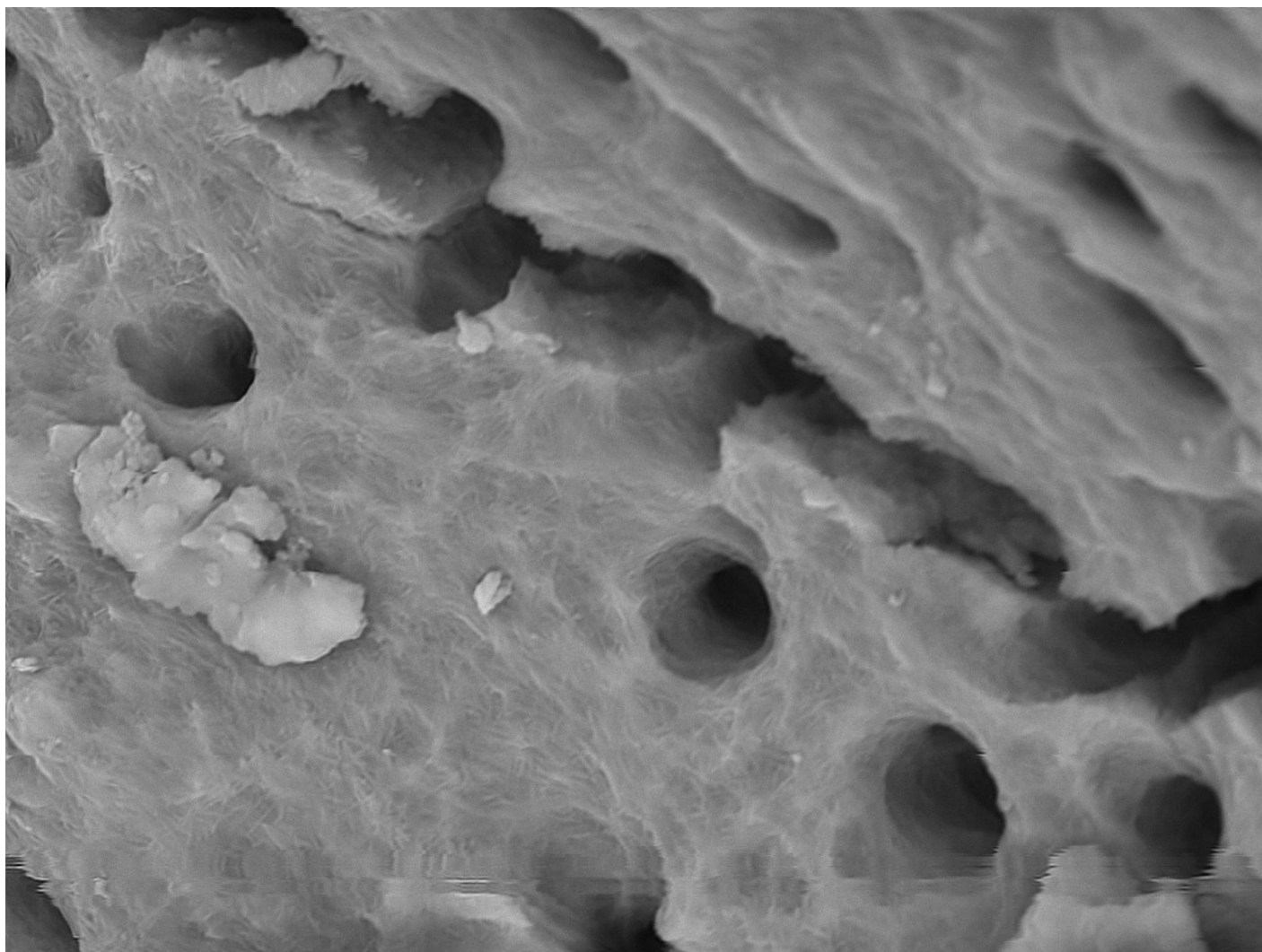
20 μ m

11) image127

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image128

image128



29211-18

2017/03/03 16:34 N

x5.0k

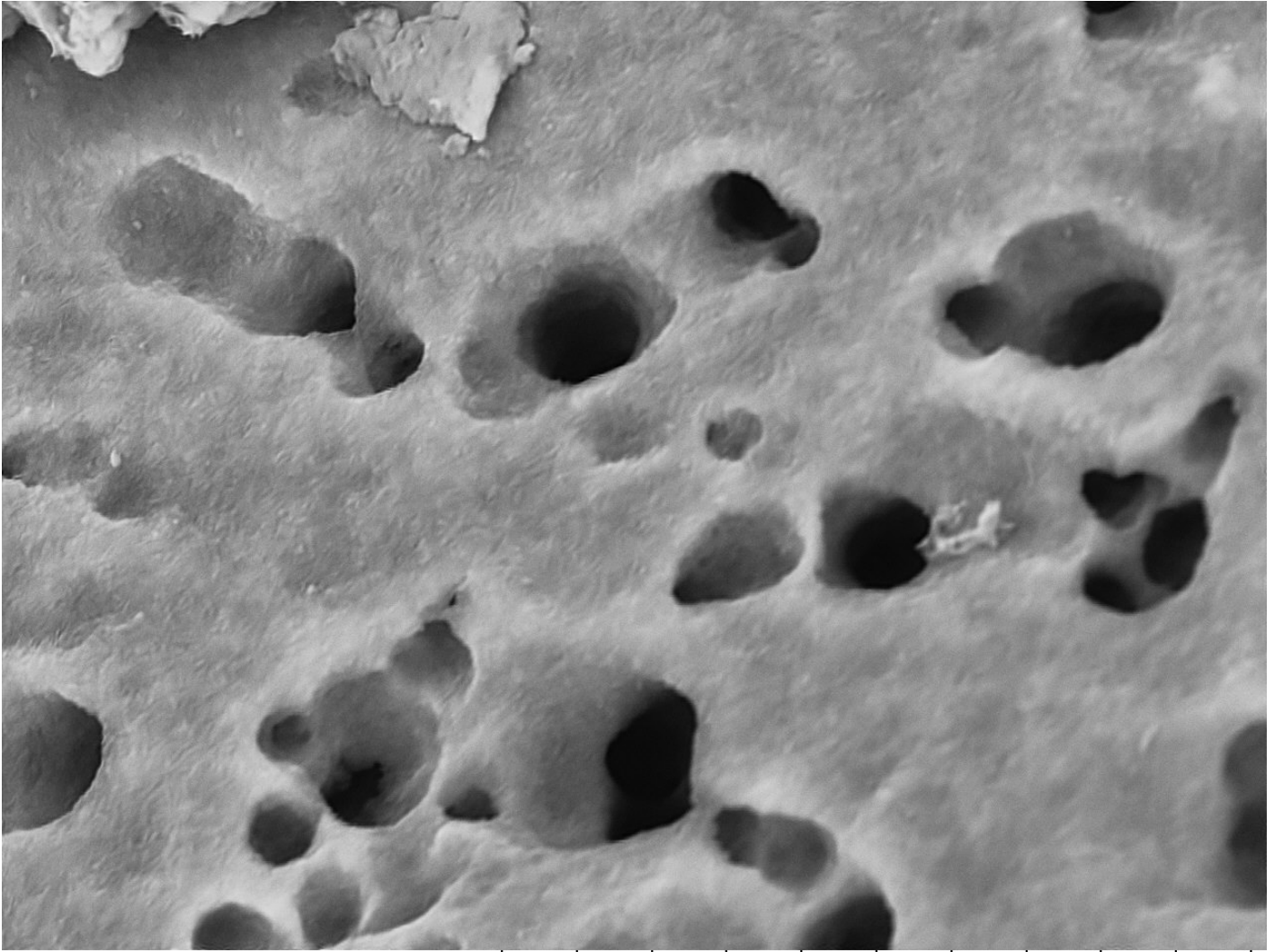
20 μm

12) image128

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image129

image129



29211-18

2017/03/03 15:53 N

x5.0k

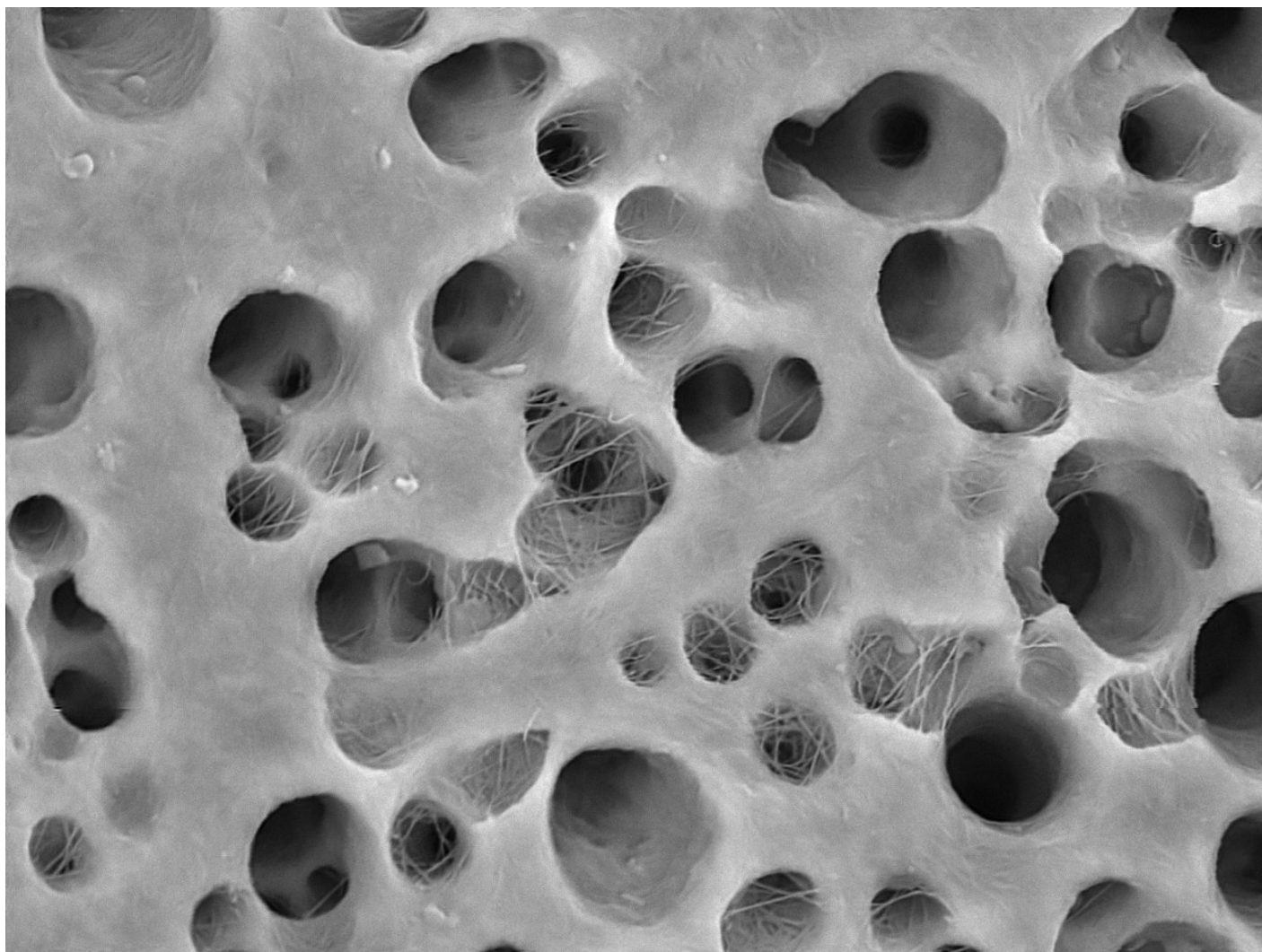
20 μm

13) image129

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image130

image130



29679-3

2017/02/27 10:01 N

x5.0k

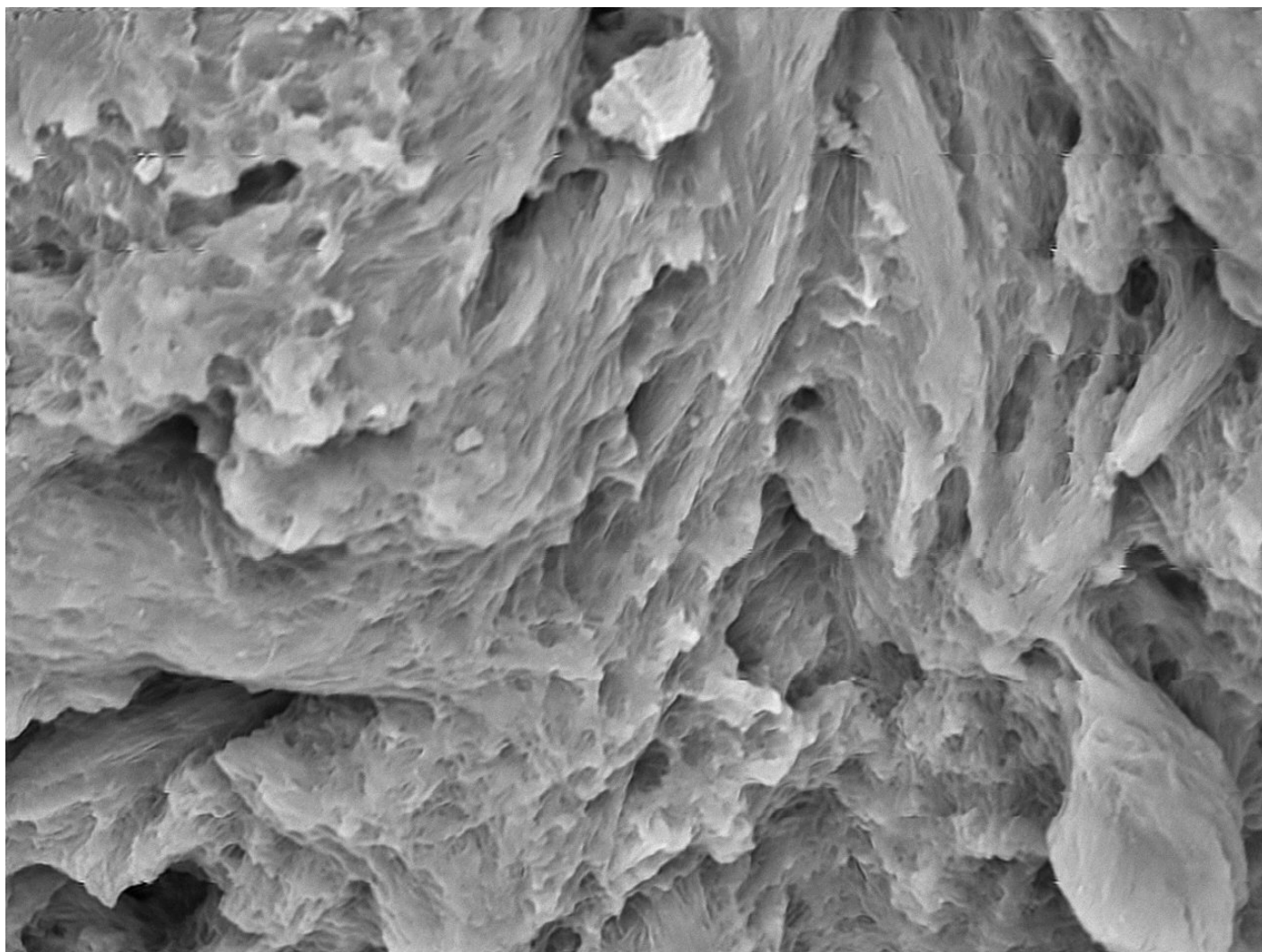
20 μ m

14) image130

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image131

image131



29028-15

2017/03/04 15:39 N

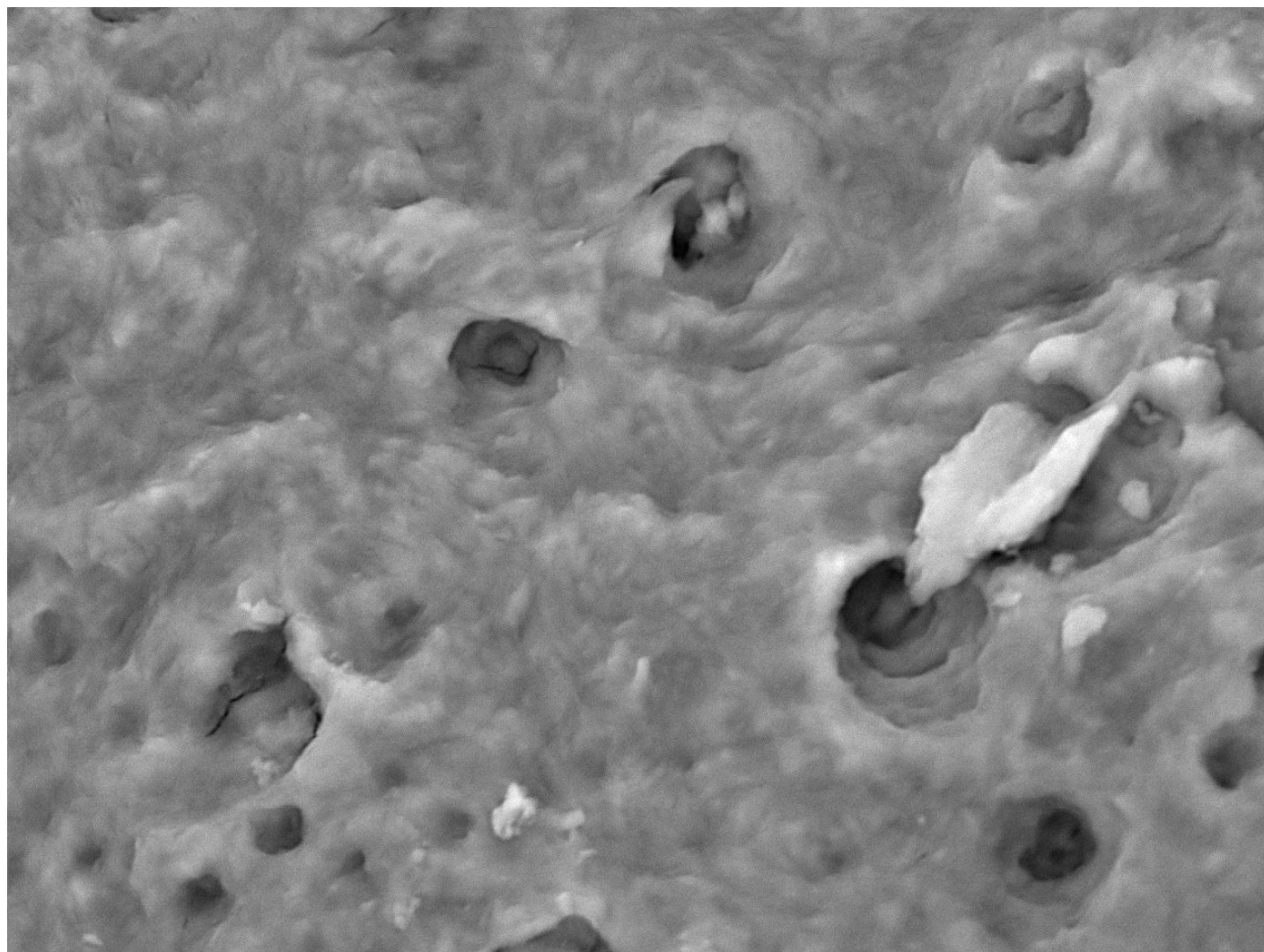
x5.0k 20 μ m

15) image131

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image132

image132



29211-18

2017/03/04 14:17 N

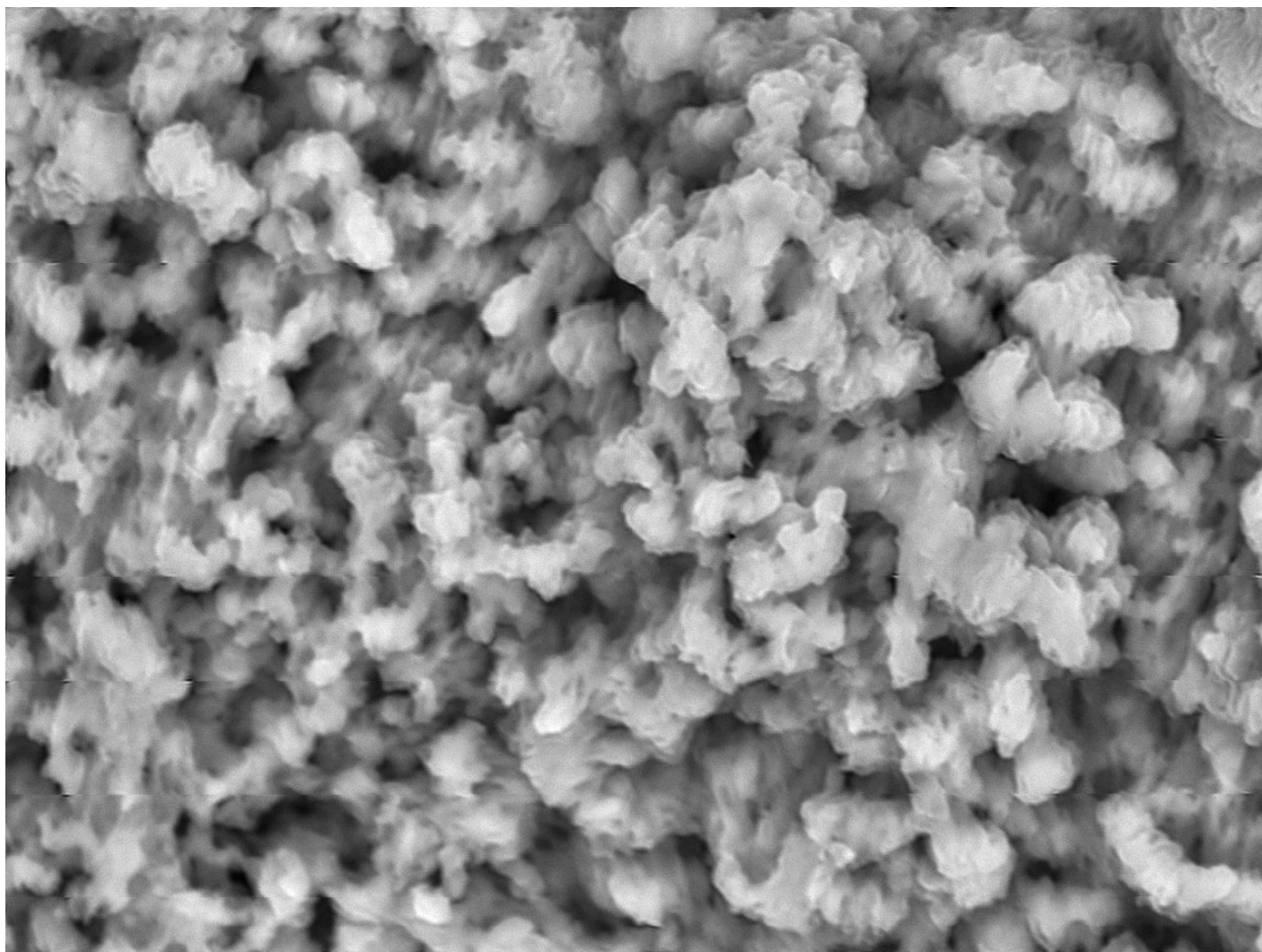
x5.0k 20 μm

16) image132

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image133

image133



29679-3

2017/02/27 16:17 N

x5.0k

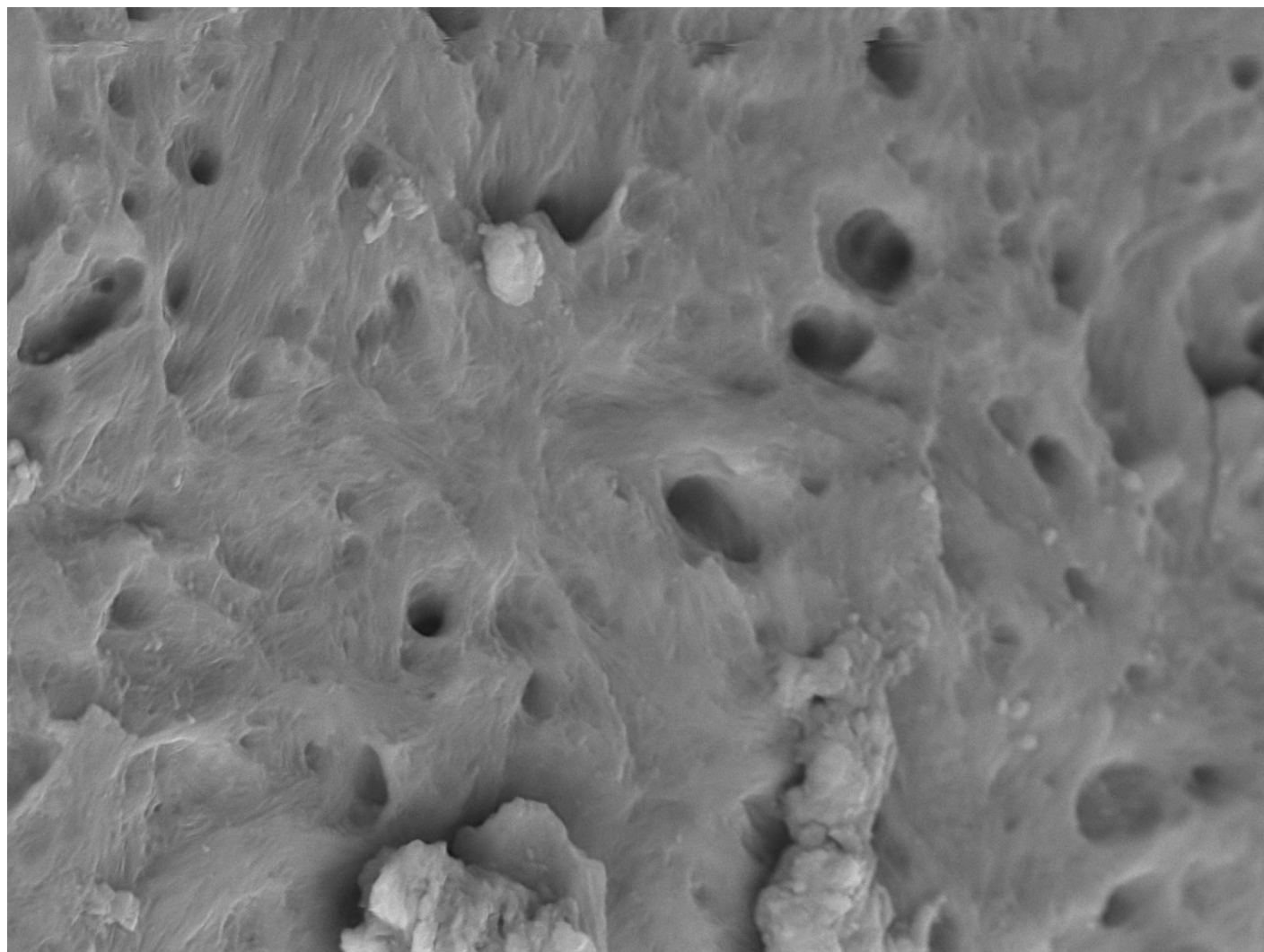
20 μ m

17) image133

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image134

image134



29265-2

2017/02/27 11:41 N

x5.0k

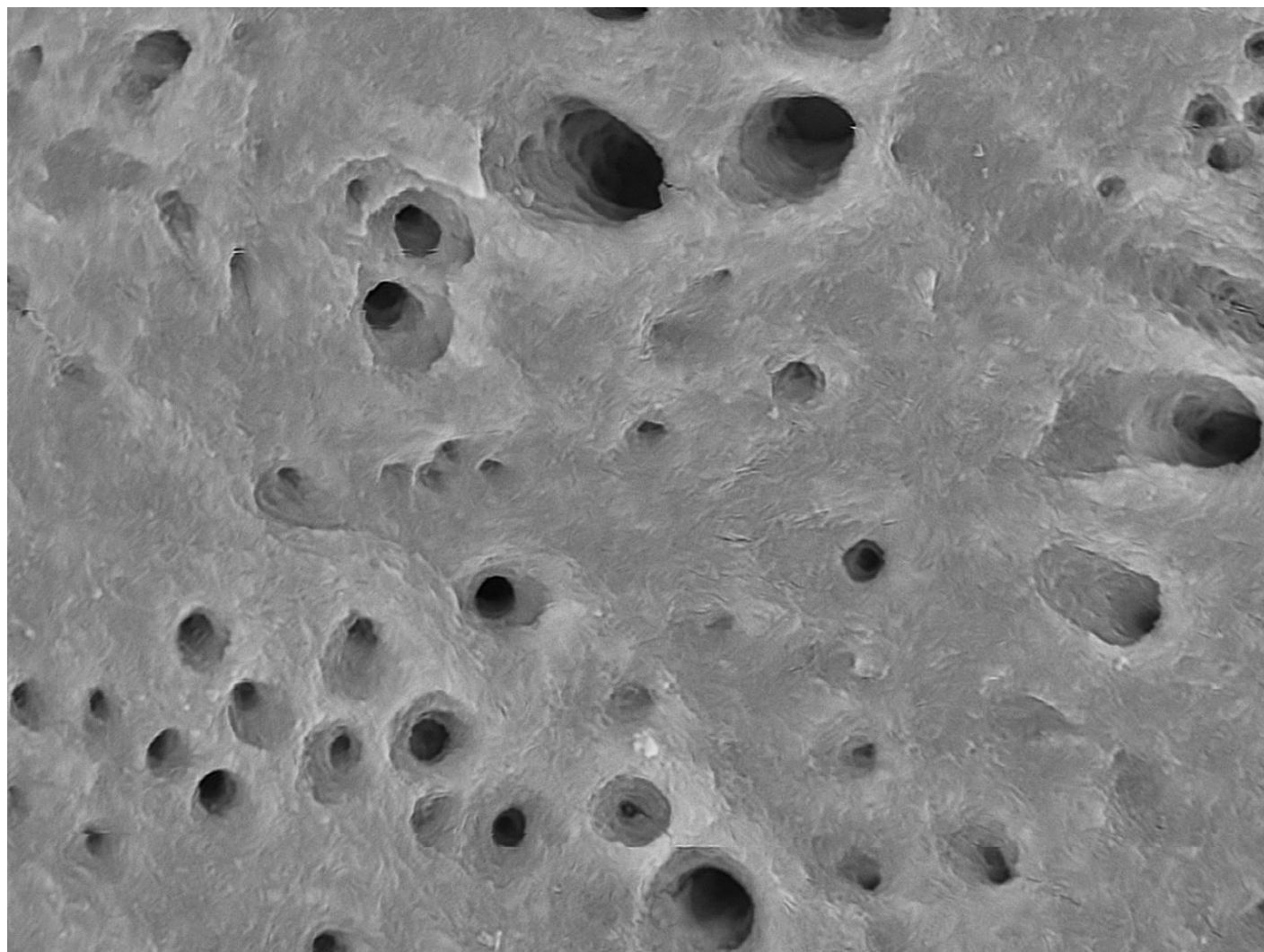
20 μ m

18) image134

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image135

image135



29009-31

2017/03/06 10:06 N

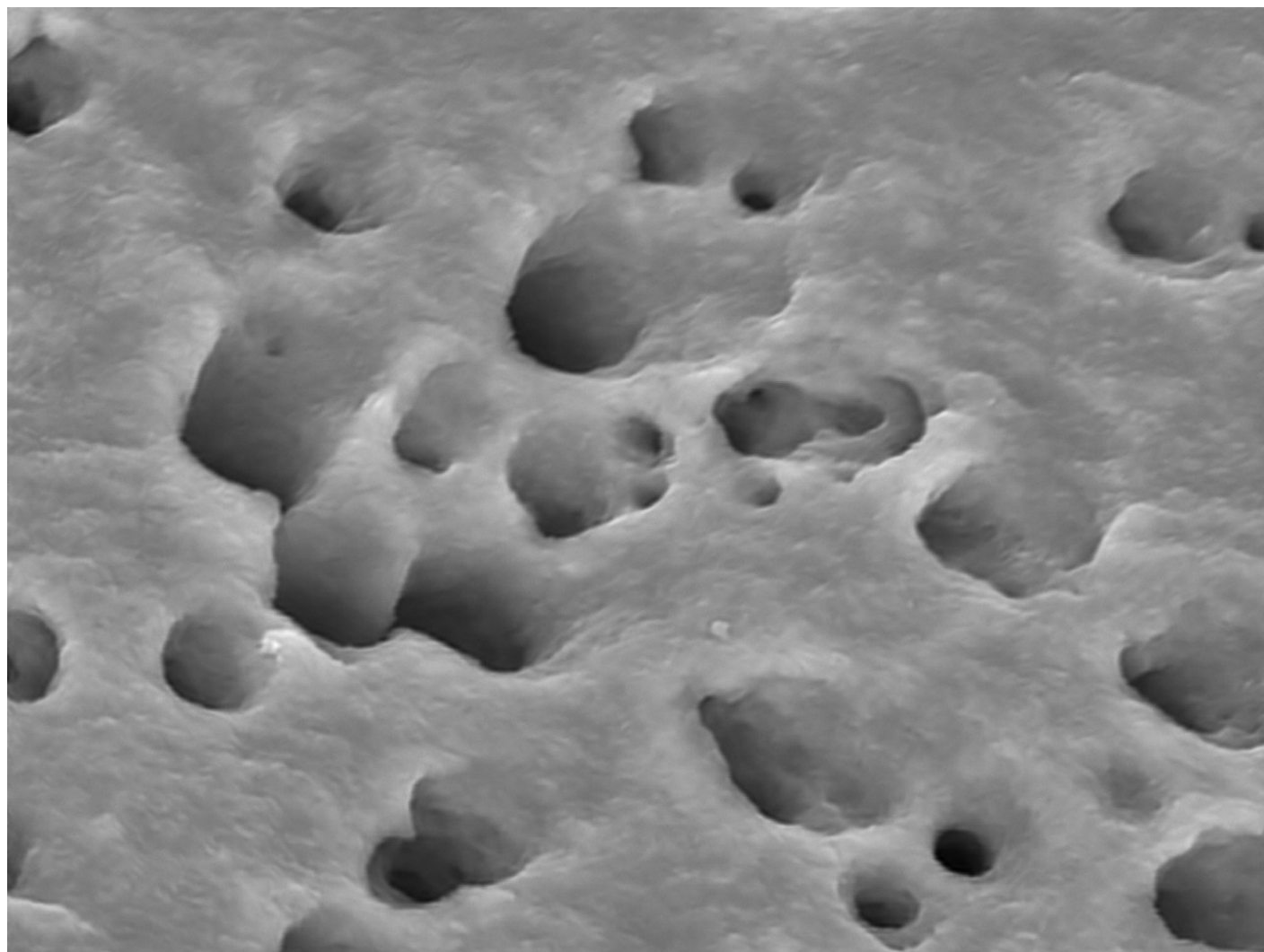
x5.0k 20 μm

19) image135

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image136

image136



29805-30

2017/03/09 14:50 H

x5.0k

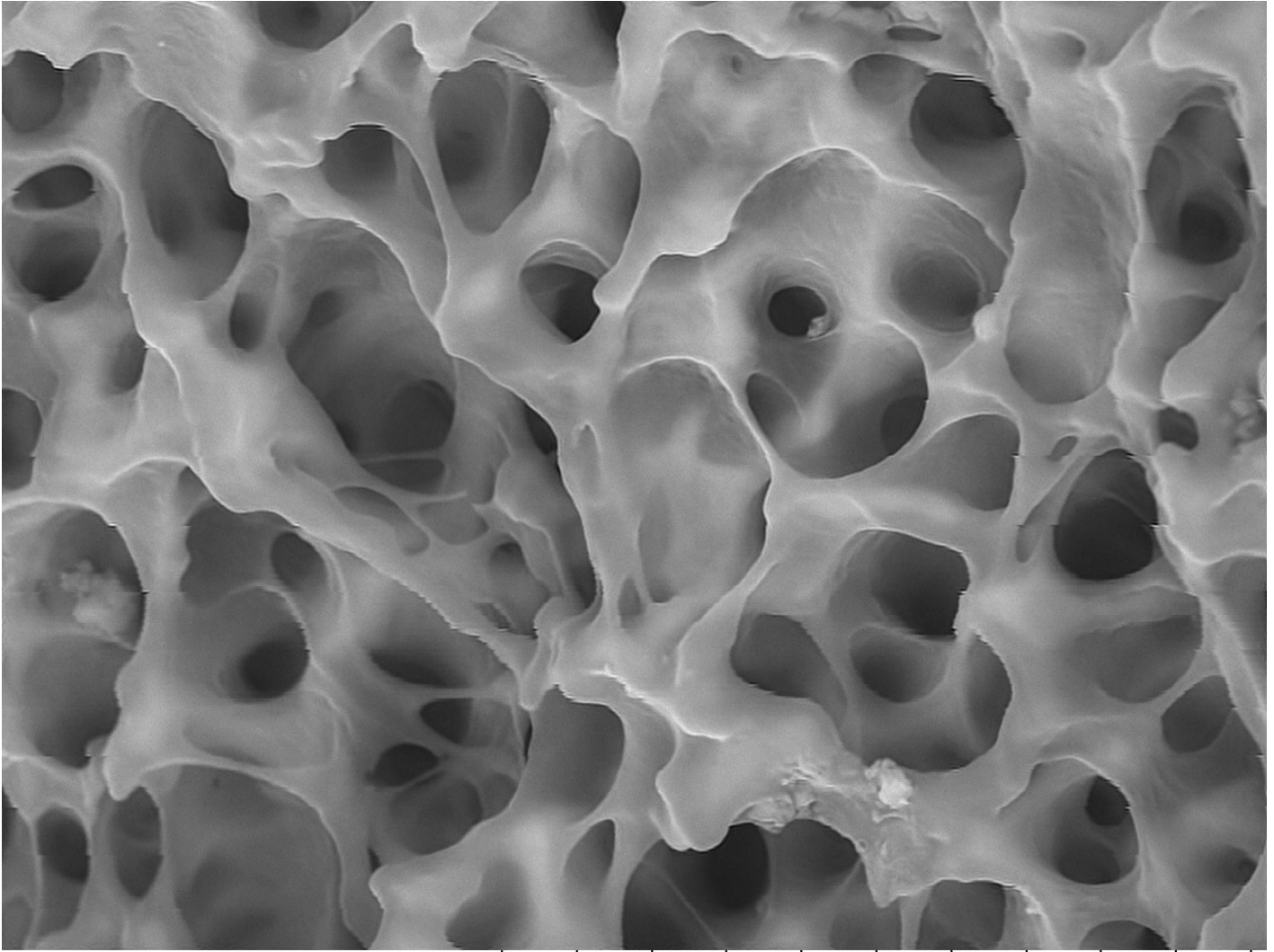
20 μm

20) image136

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image137

image137



29960-14

2017/03/01 10:32 N

x5.0k

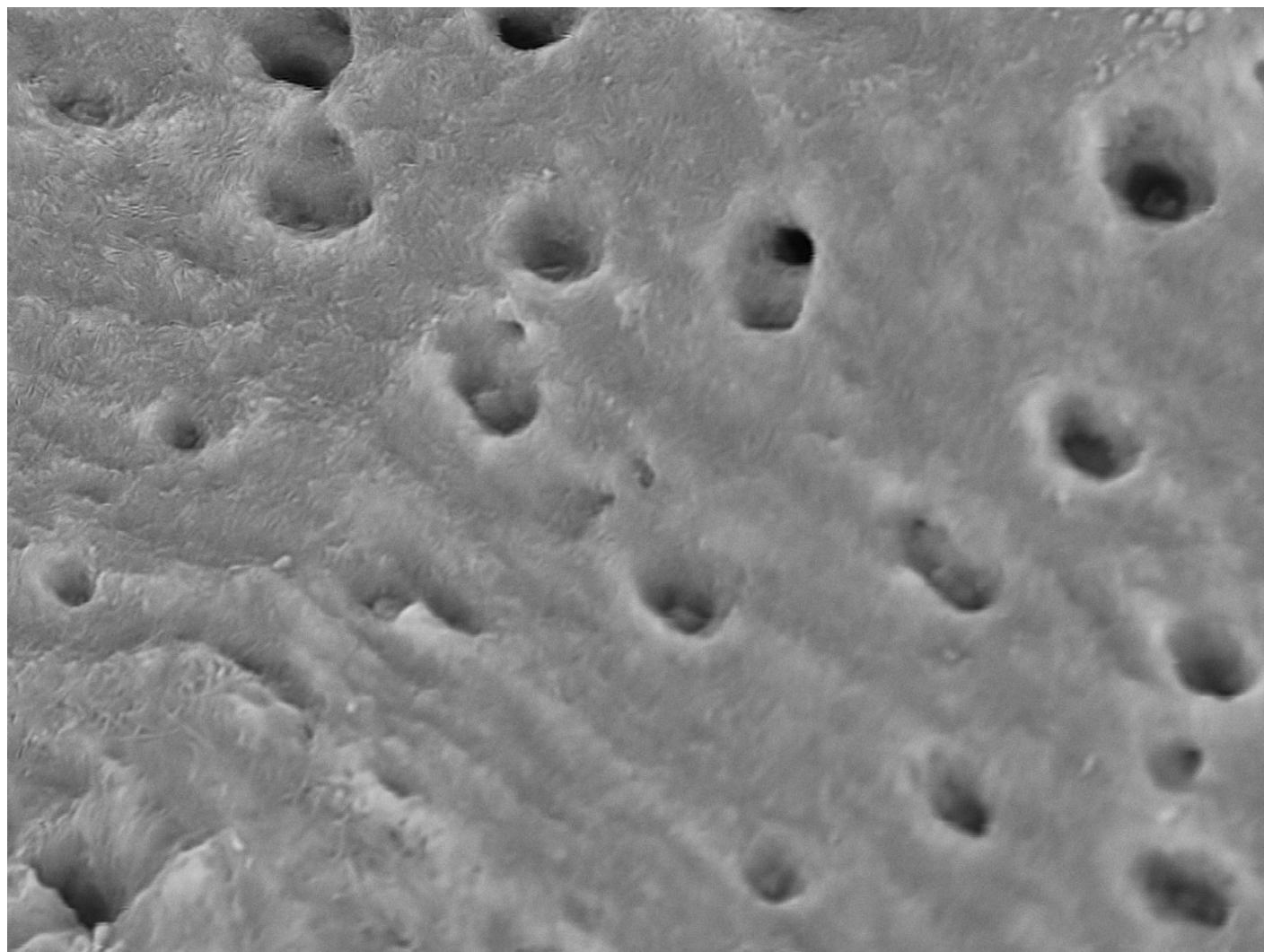
20 μm

21) image137

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image138

image138



29340-18

2017/03/03 10:34 N

x5.0k

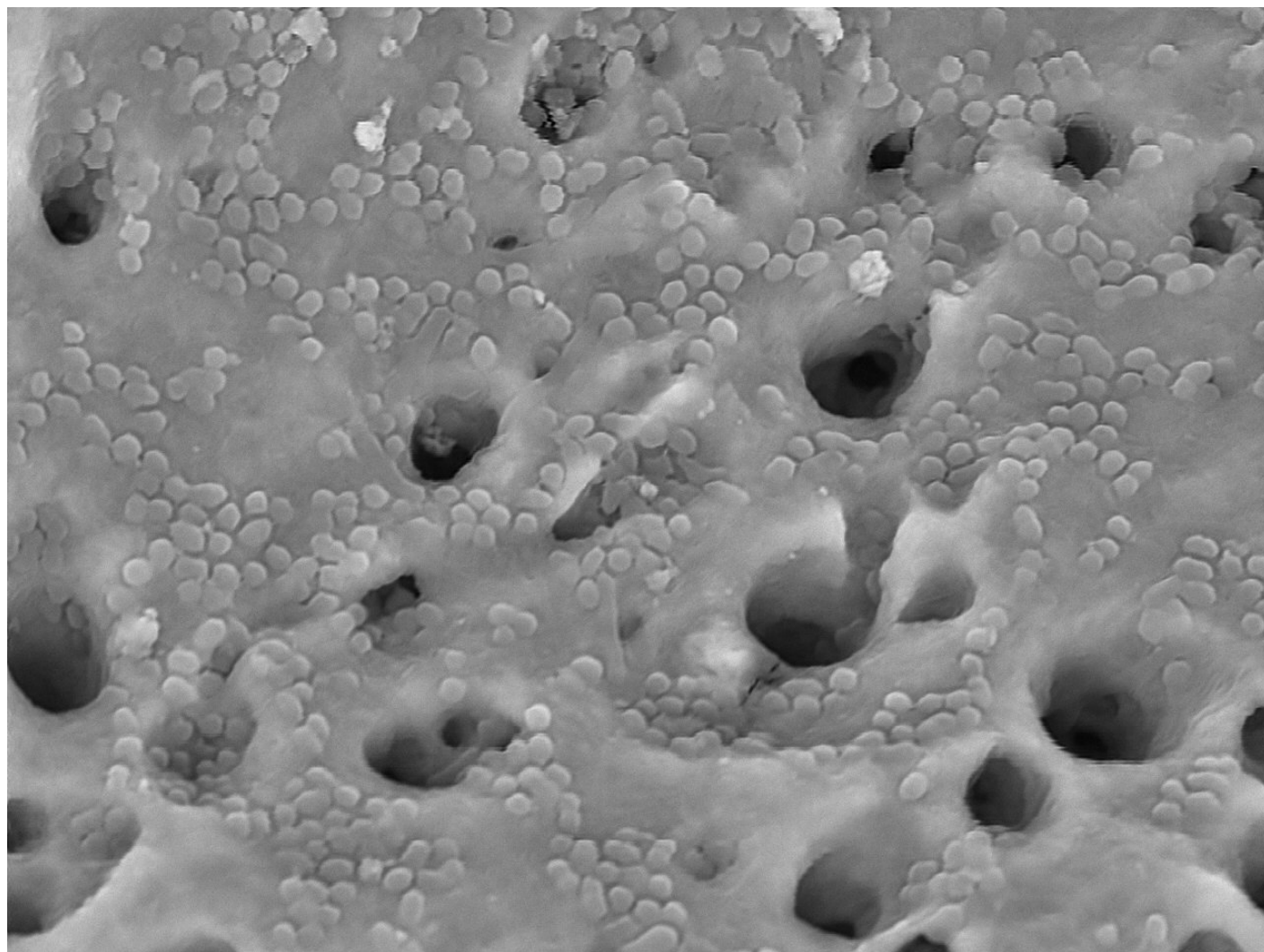
20 μm

22) image138

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image139

image139



29965-2

2017/03/02 15:25 N

x5.0k

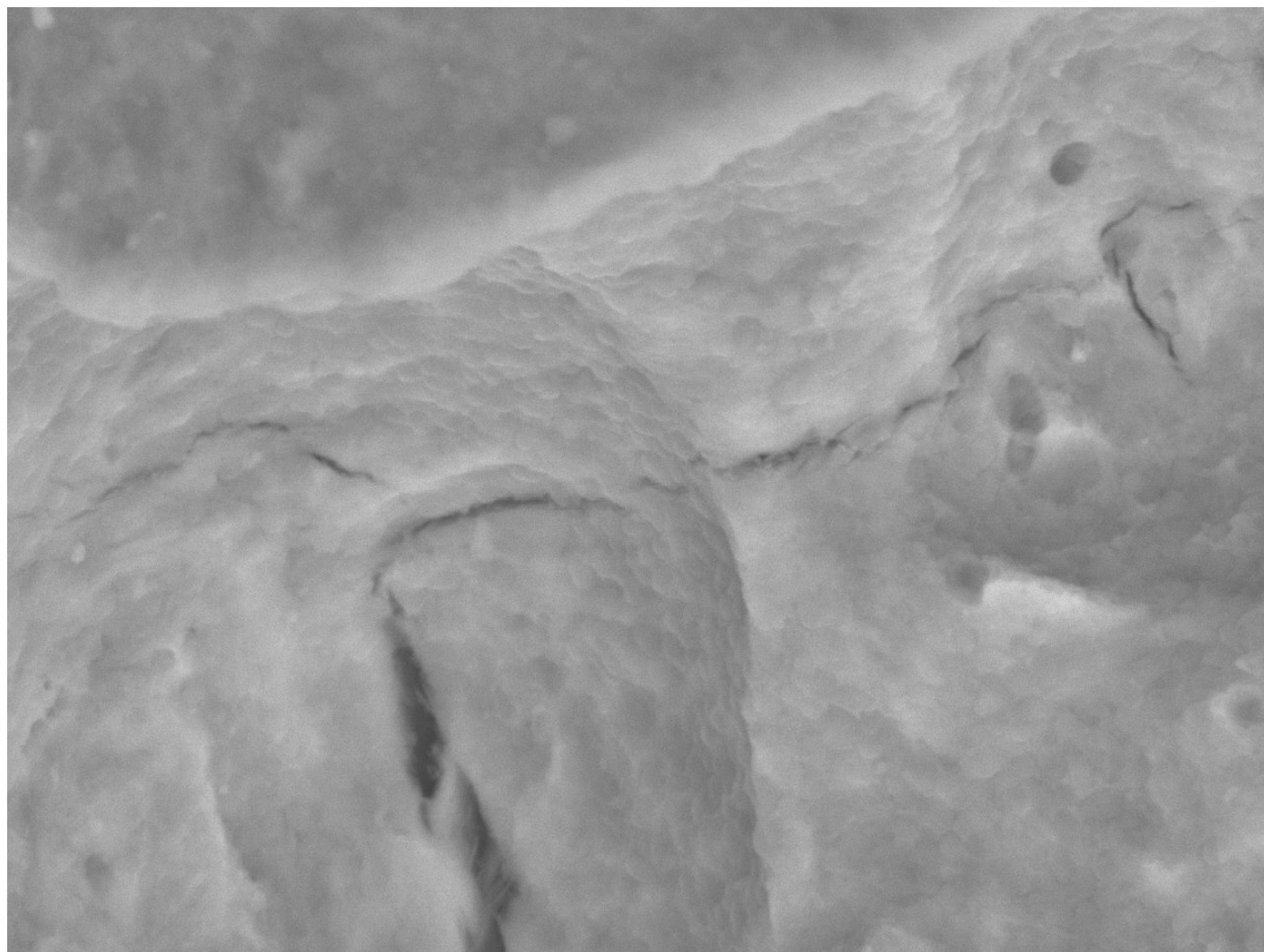
20 μ m

23) image139

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image140

image140



29856-30

2017/02/22 13:29 N

x5.0k

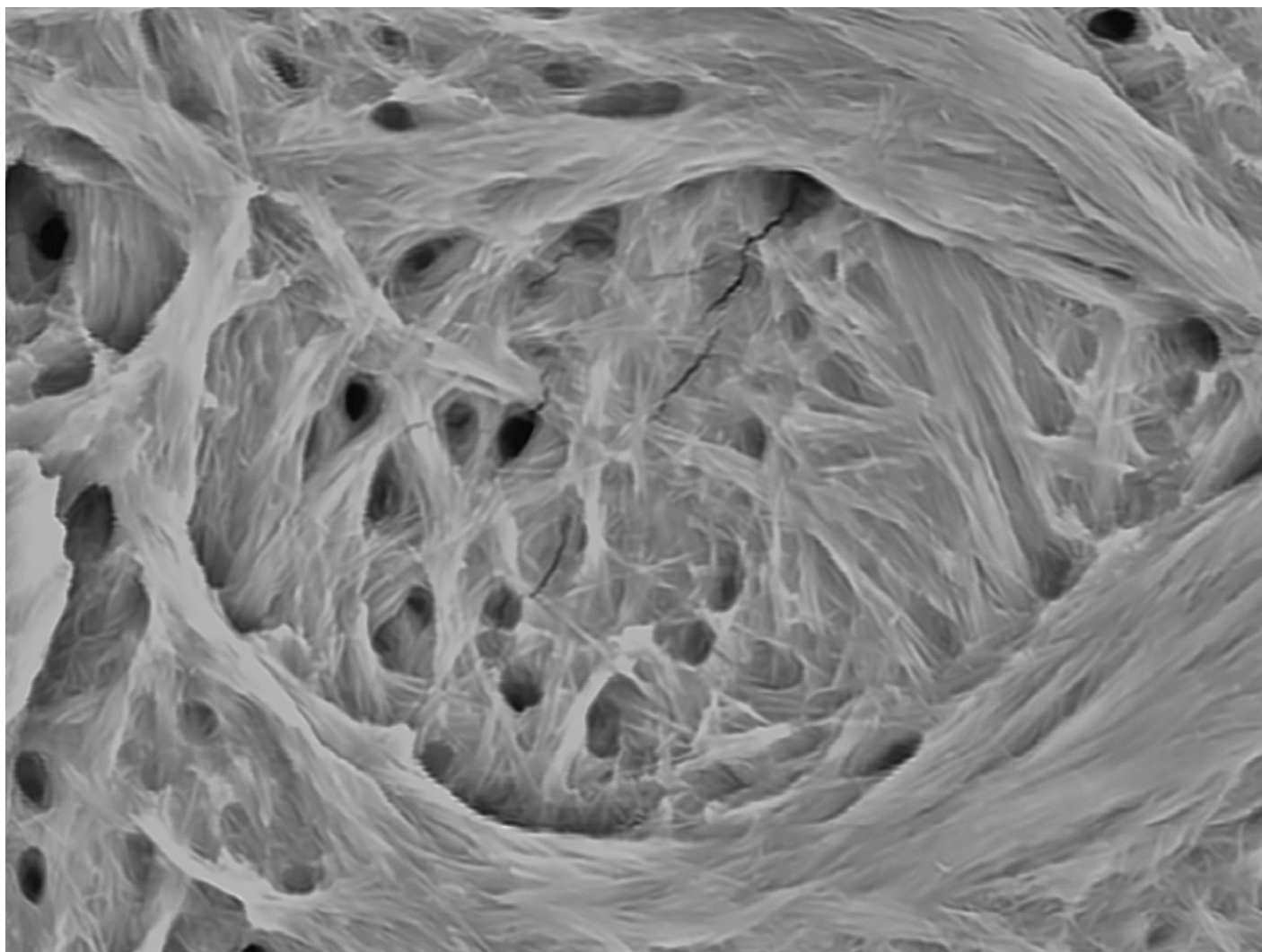
20 μ m

24) image140

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image141

image141



29805-30

2017/03/09 14:35 H

x5.0k

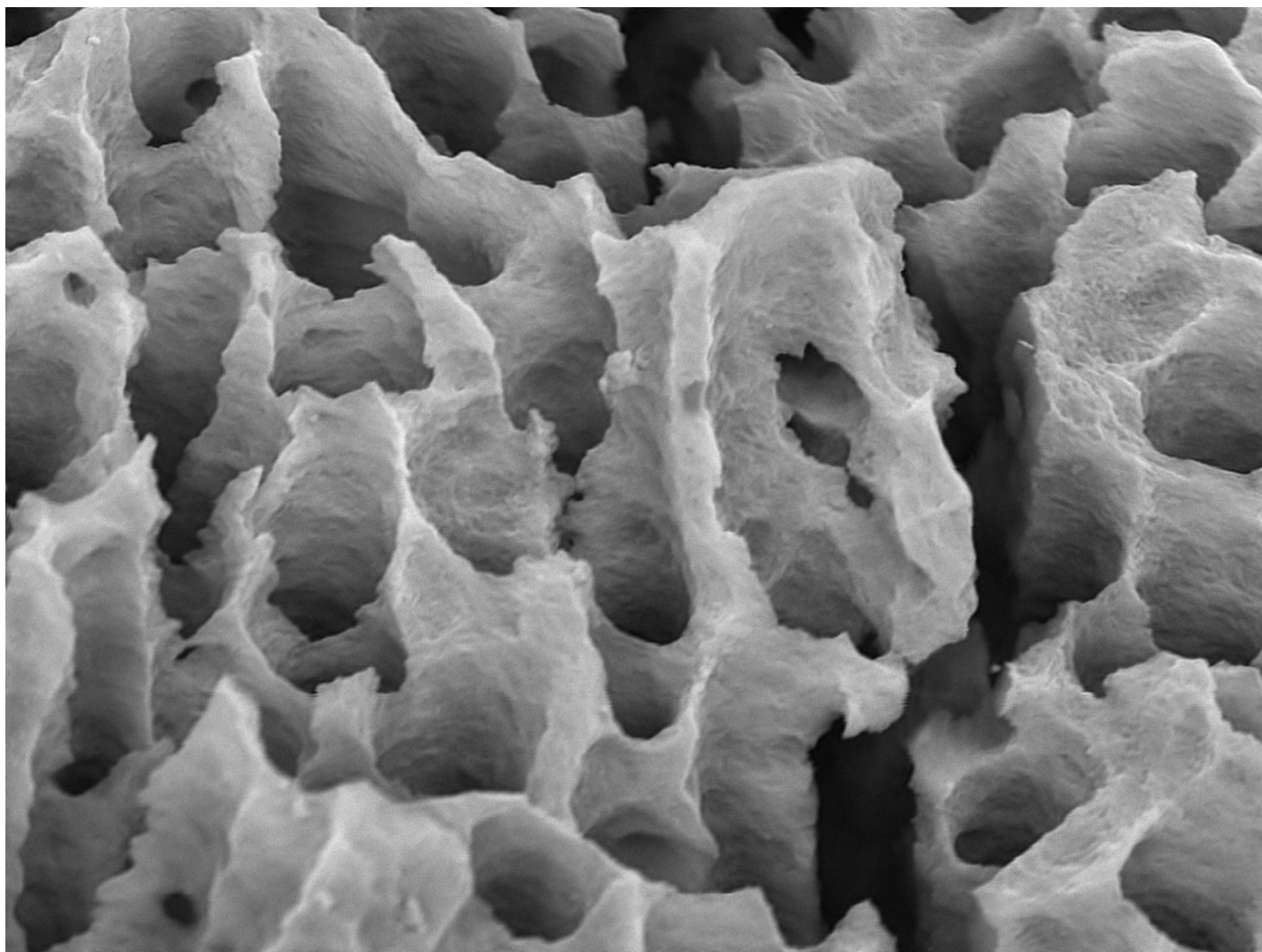
20 μm

25) image141

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image142

image142



29340-18

2017/03/03 10:27 N

x5.0k

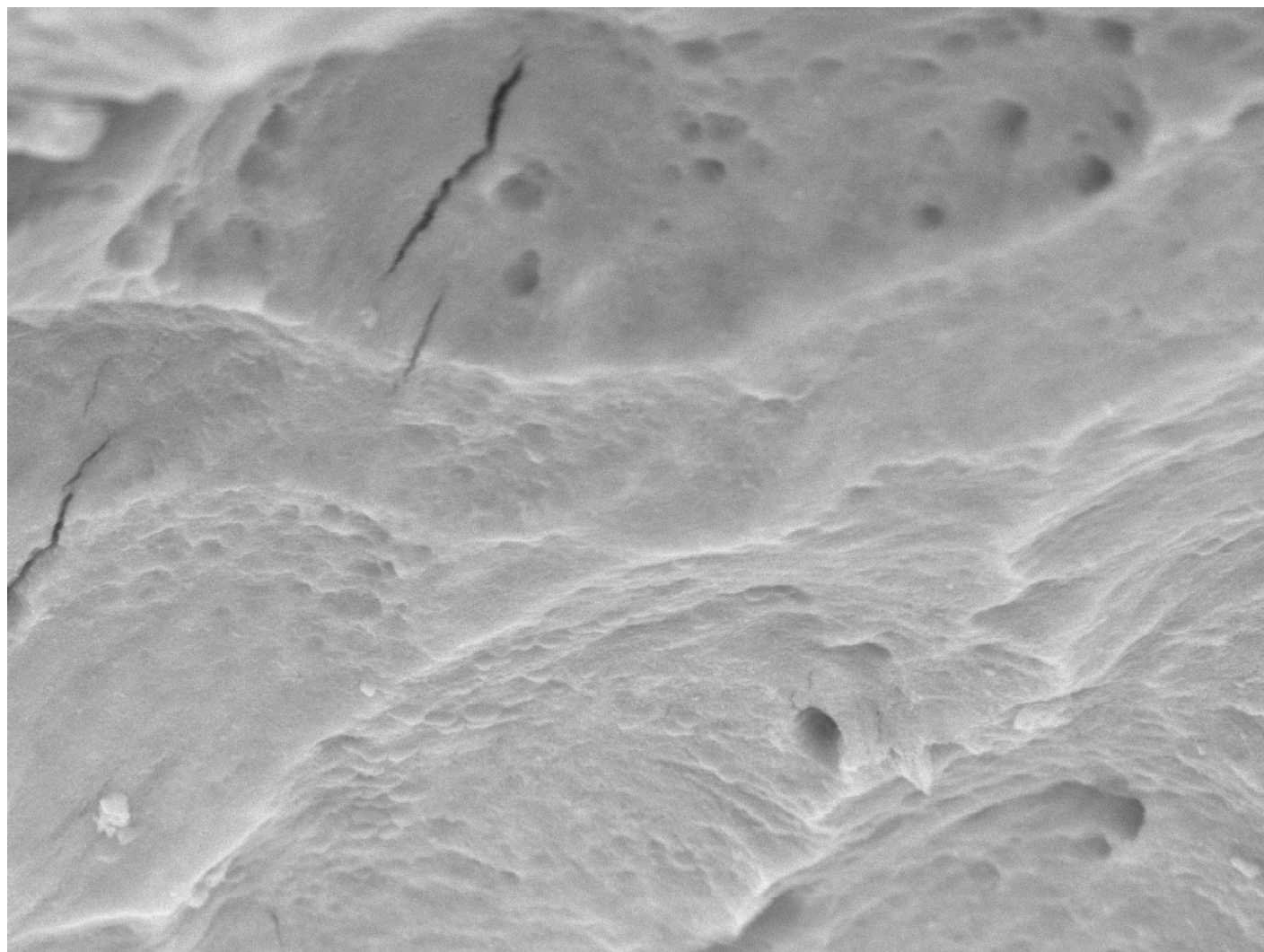
20 µm

26) image142

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image143

image143



29856-30

2017/02/22 14:11 N

x5.0k

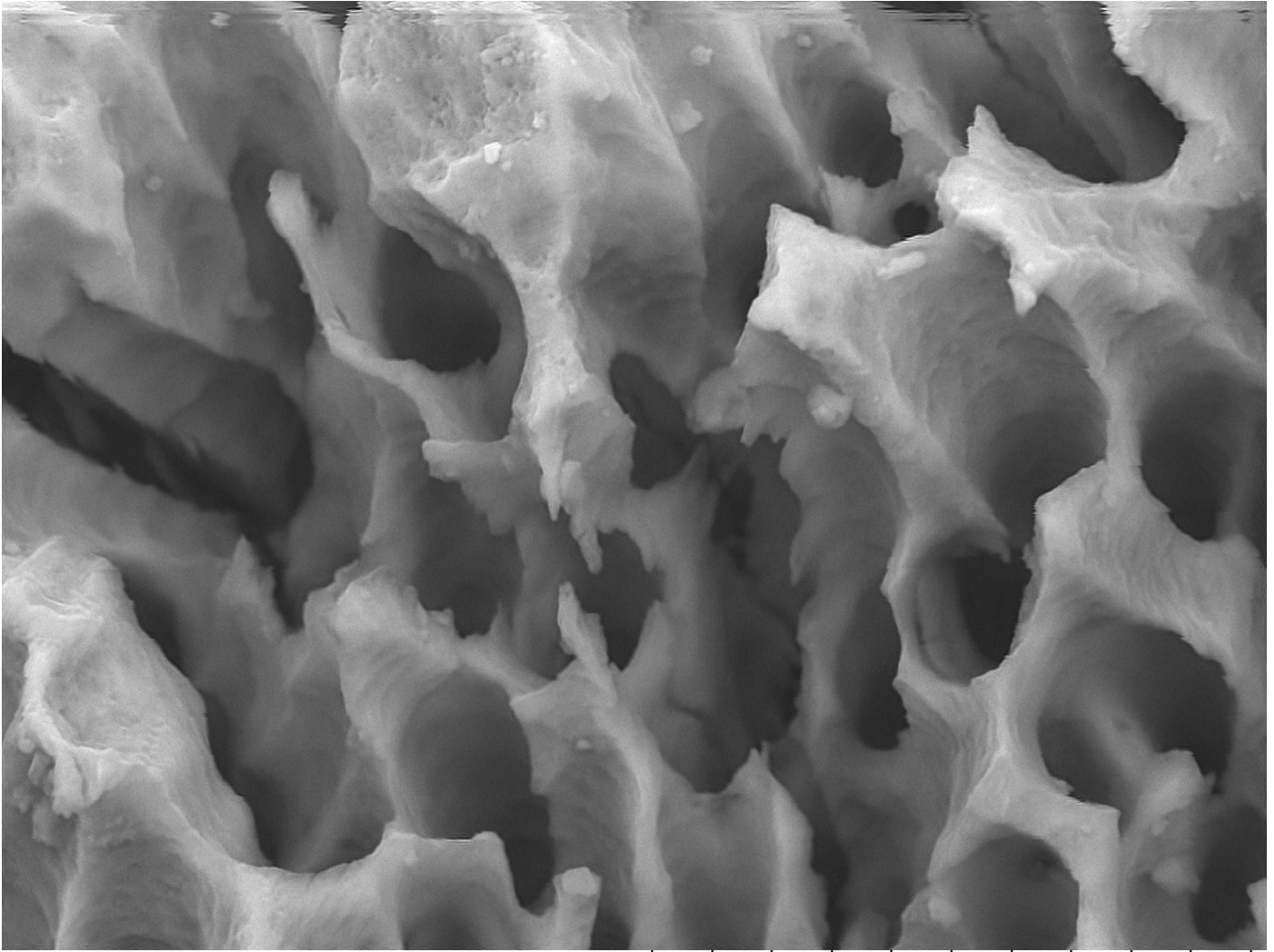
20 μ m

27) image143

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image144

image144



29211-18

2017/03/03 14:55 N

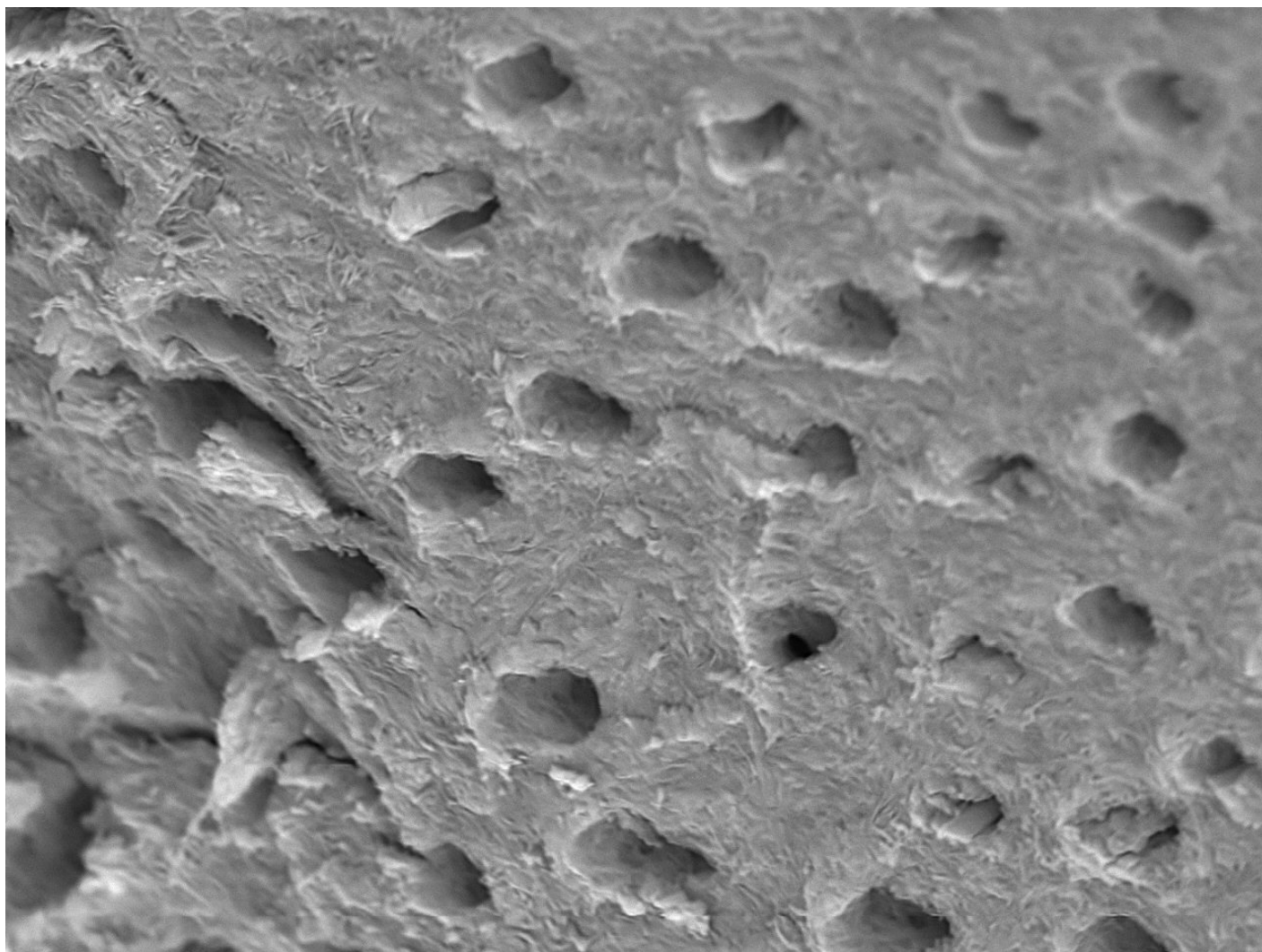
x4.0k 20 μm

28) image144

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image145

image145



29565-15

2017/02/28 15:32 N

x5.0k

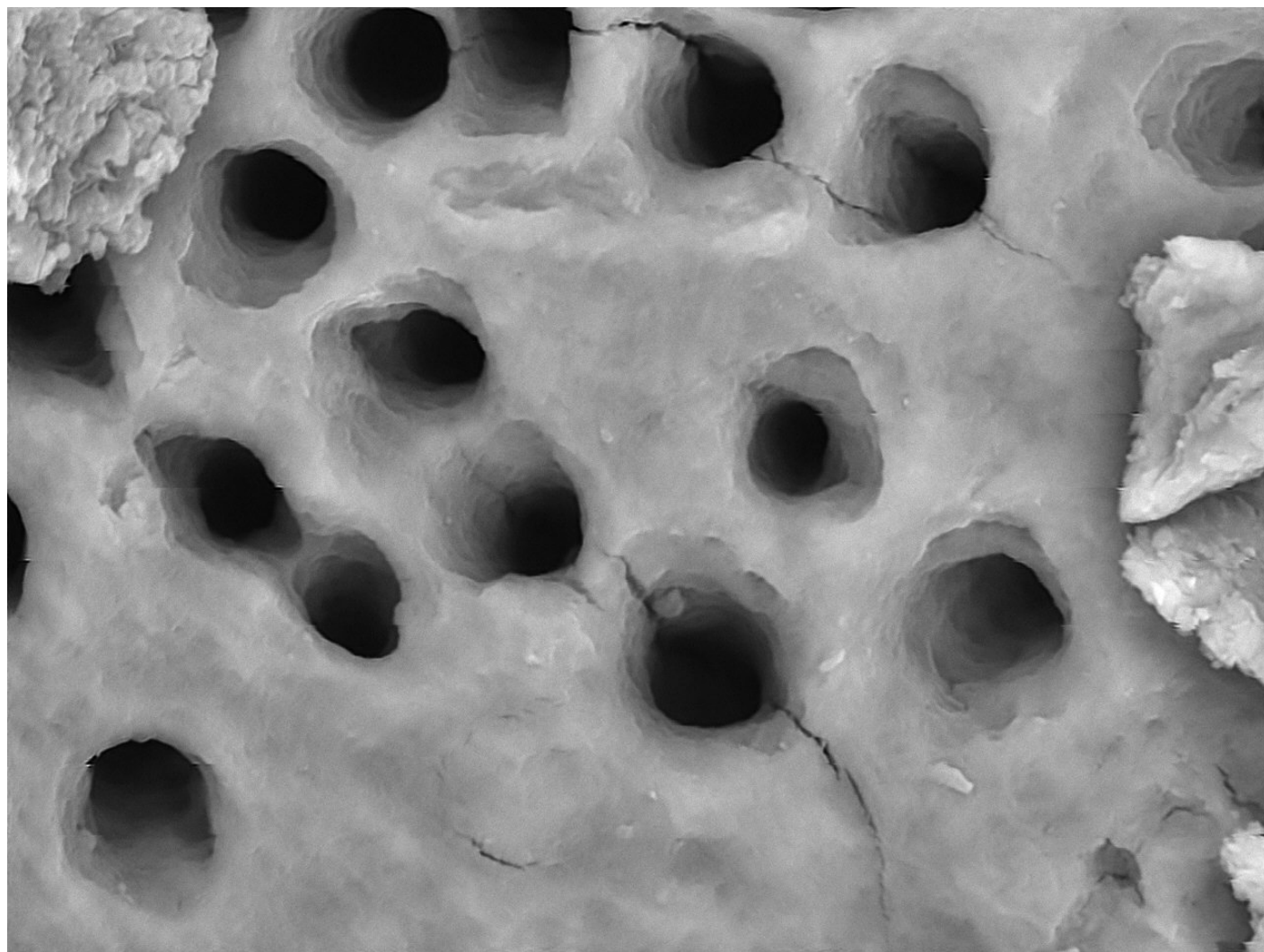
20 μm

29) image145

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image146

image146



29565-15

2017/02/28 15:31 N

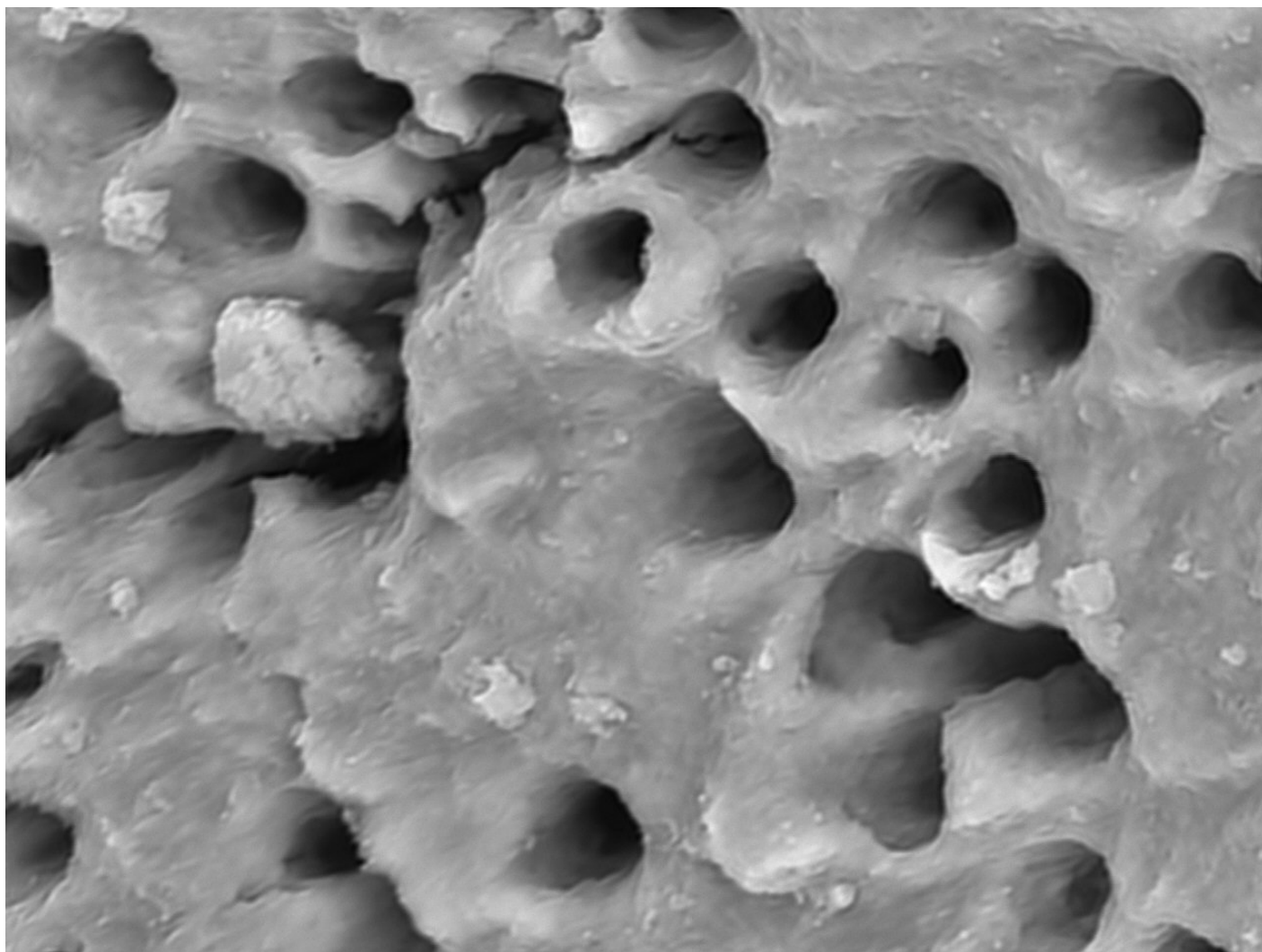
x5.0k 20 μ m

30) image146

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image147

image147



29009-31

2017/03/08 14:44 H

x5.0k

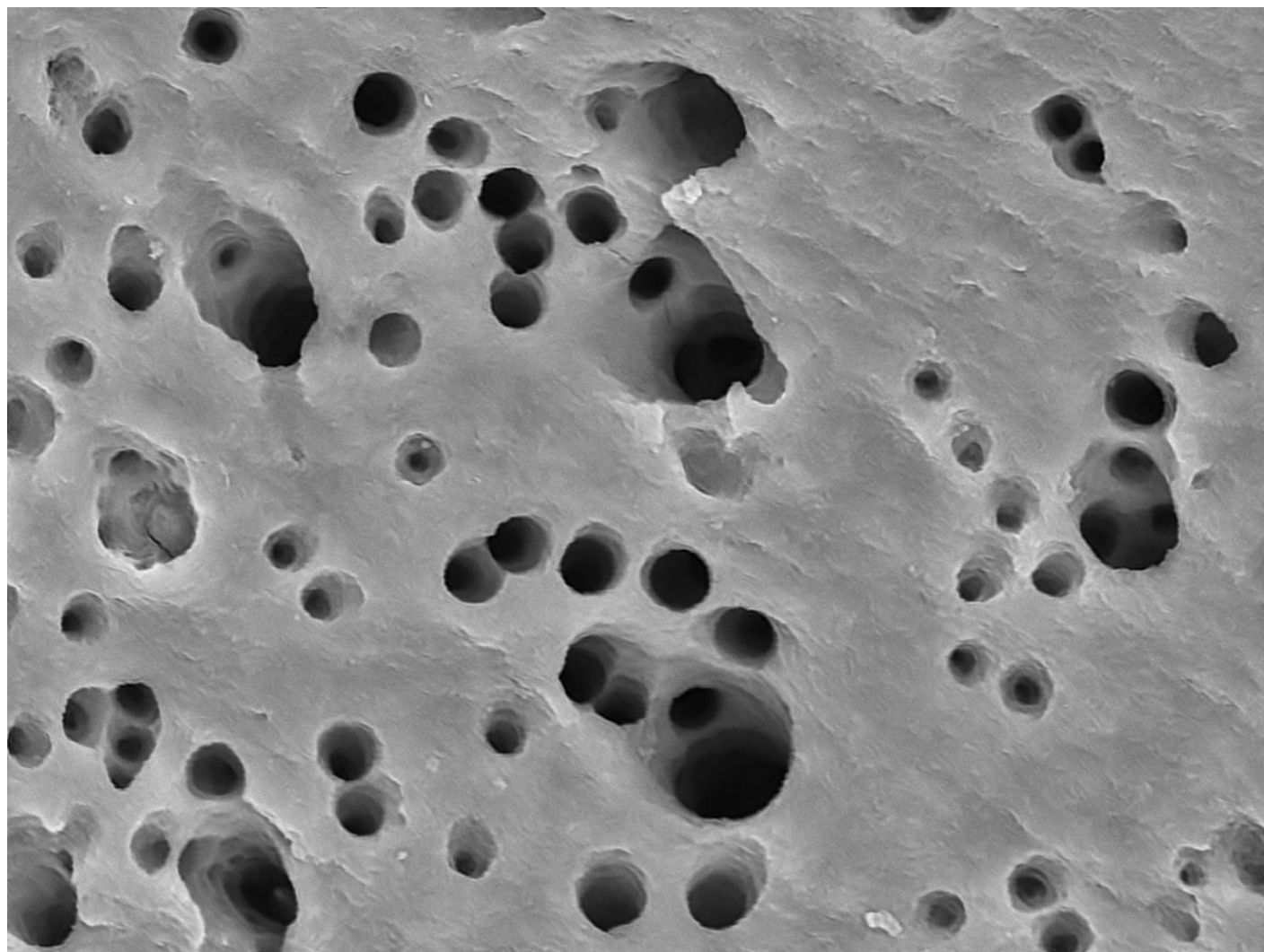
20 μ m

31) image147

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image148

image148



29211-18

2017/03/04 13:55 N

x5.0k

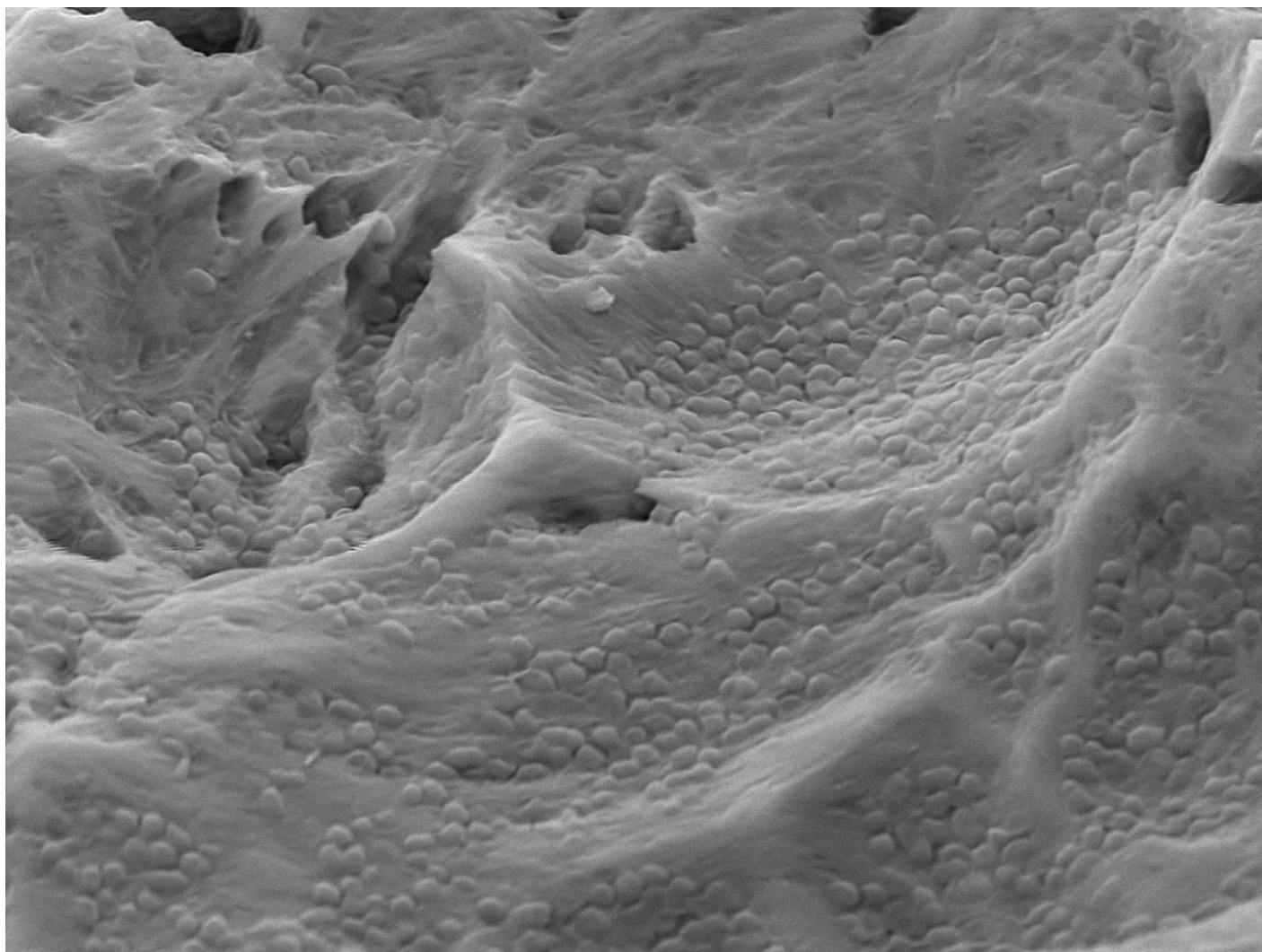
20 μm

32) image148

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image149

image149



29679-3

2017/02/27 10:04 N

x5.0k

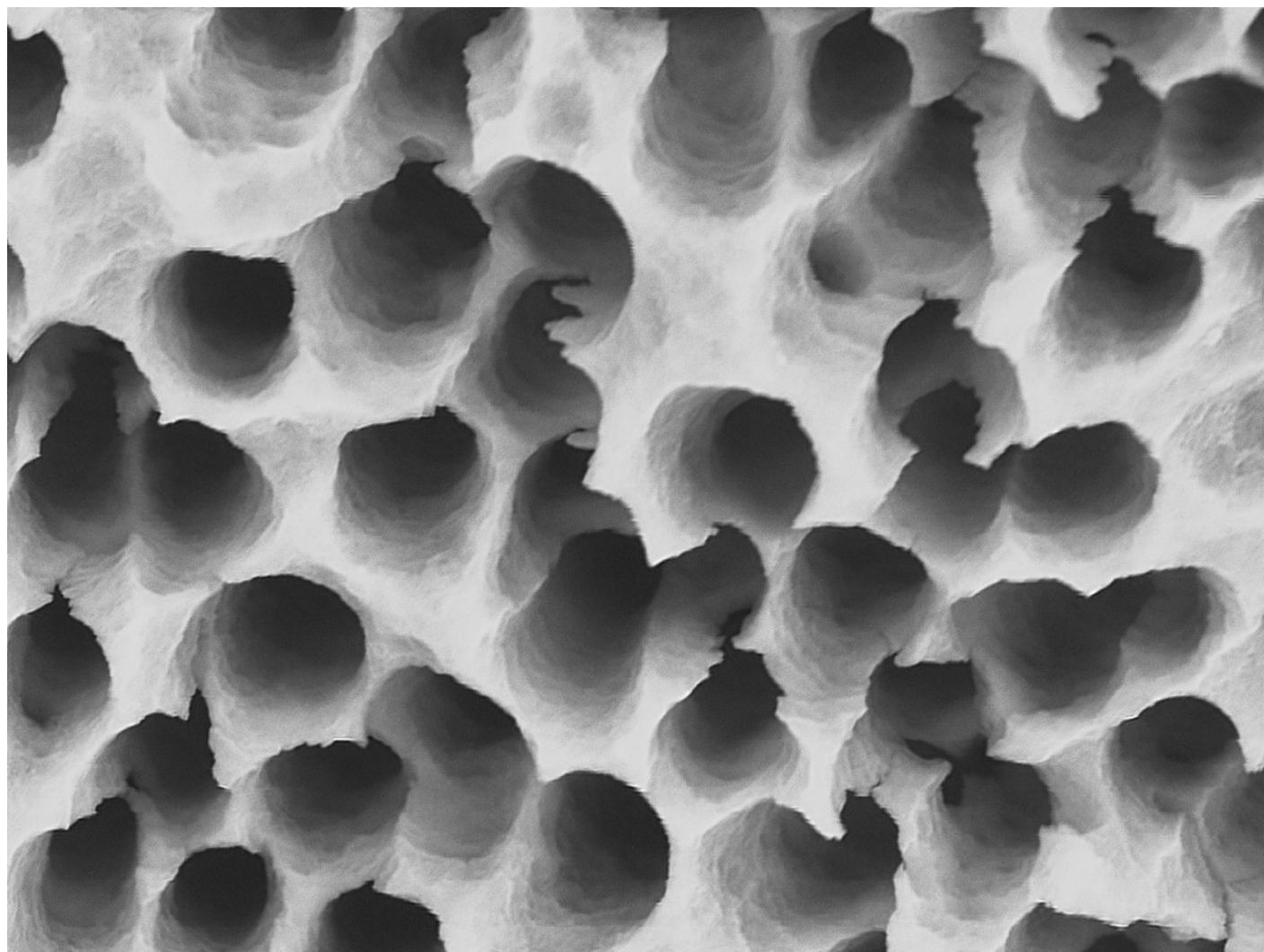
20 μ m

33) image149

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image150

image150



29340-18

2017/03/03 10:18 N

x5.0k

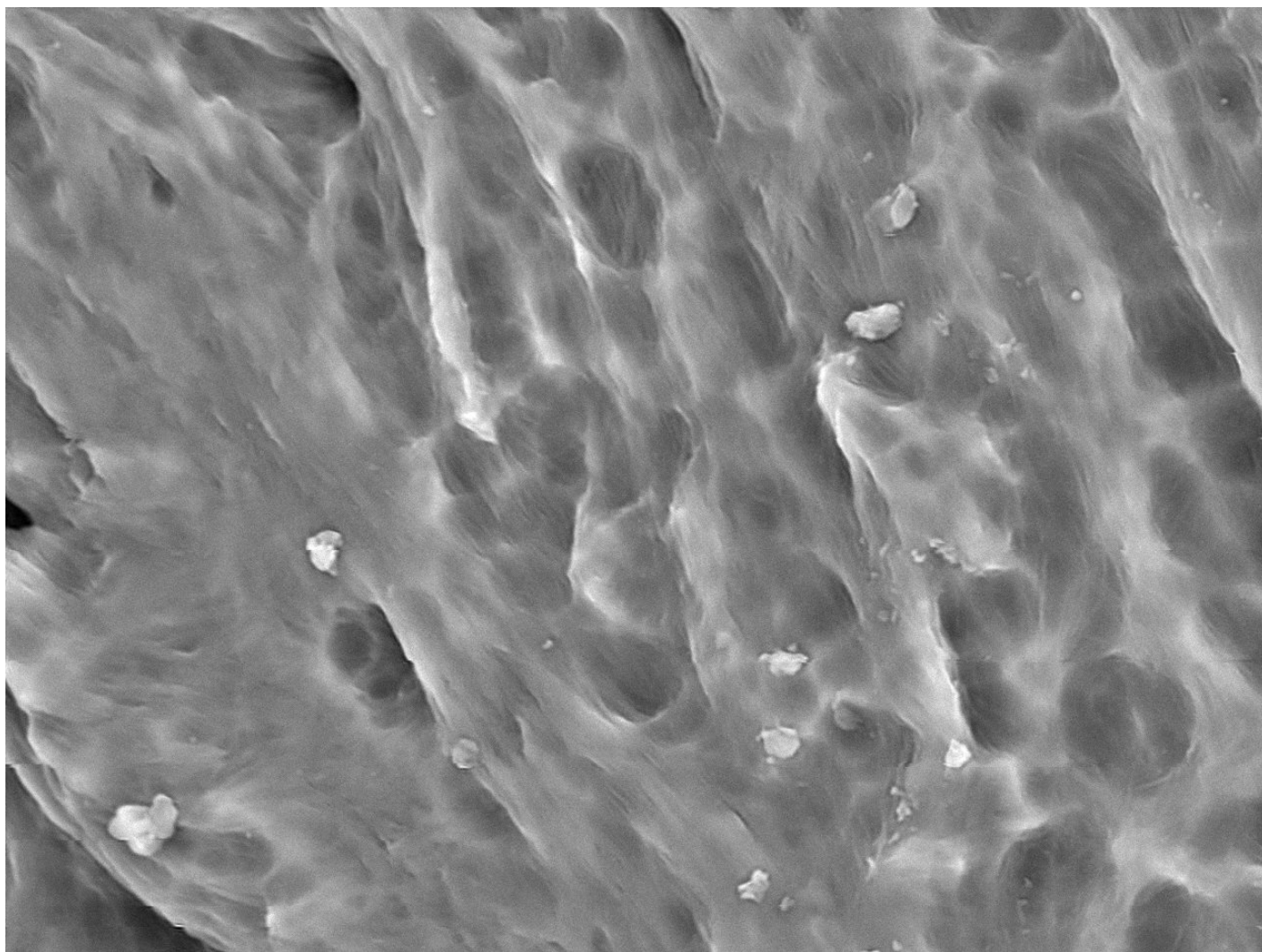
20 μ m

34) image150

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image151

image151



29340-18

2017/03/03 09:56 N

x5.0k

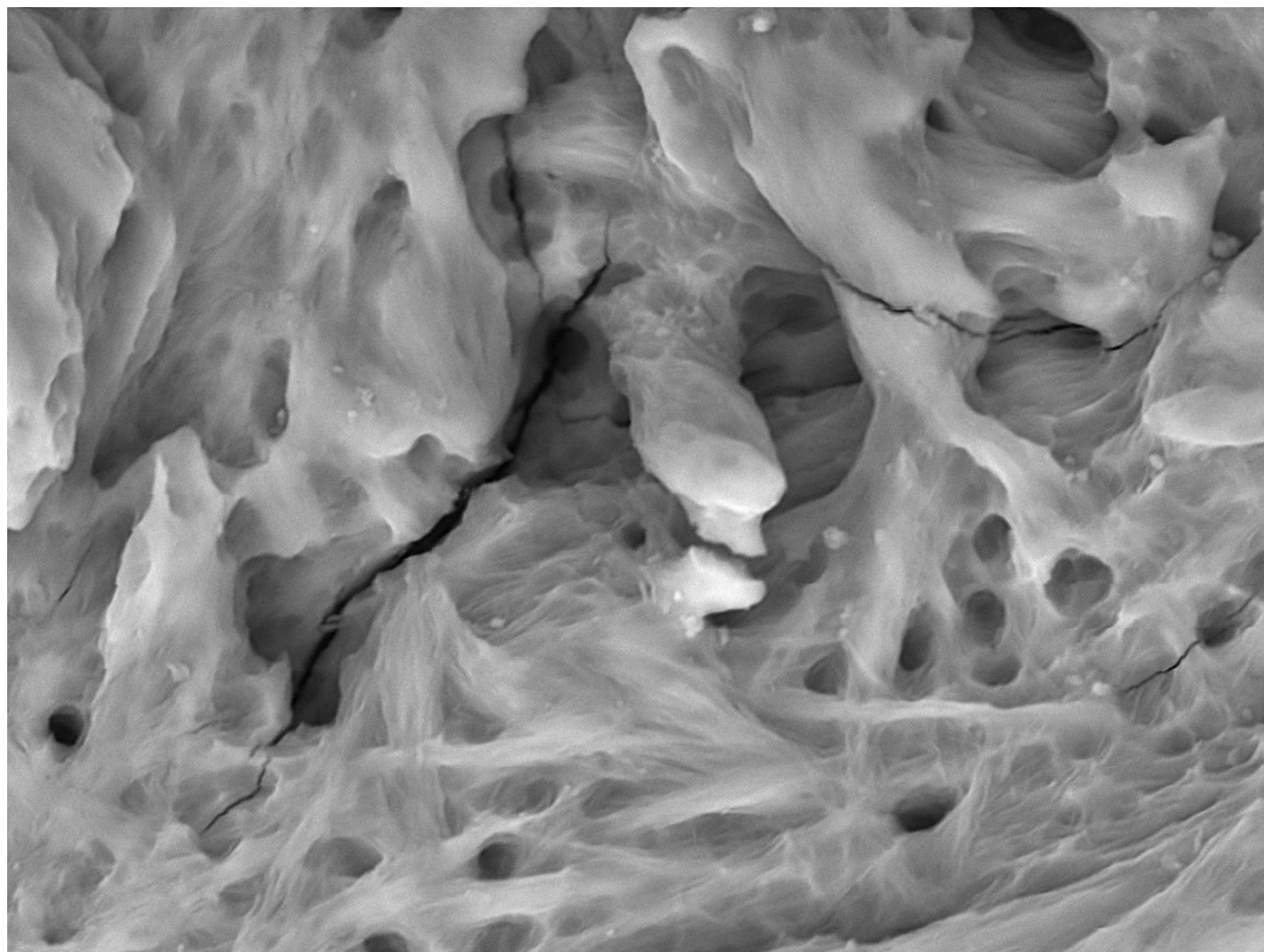
20 µm

35) image151

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image152

image152



29679-3

2017/02/27 15:45 N

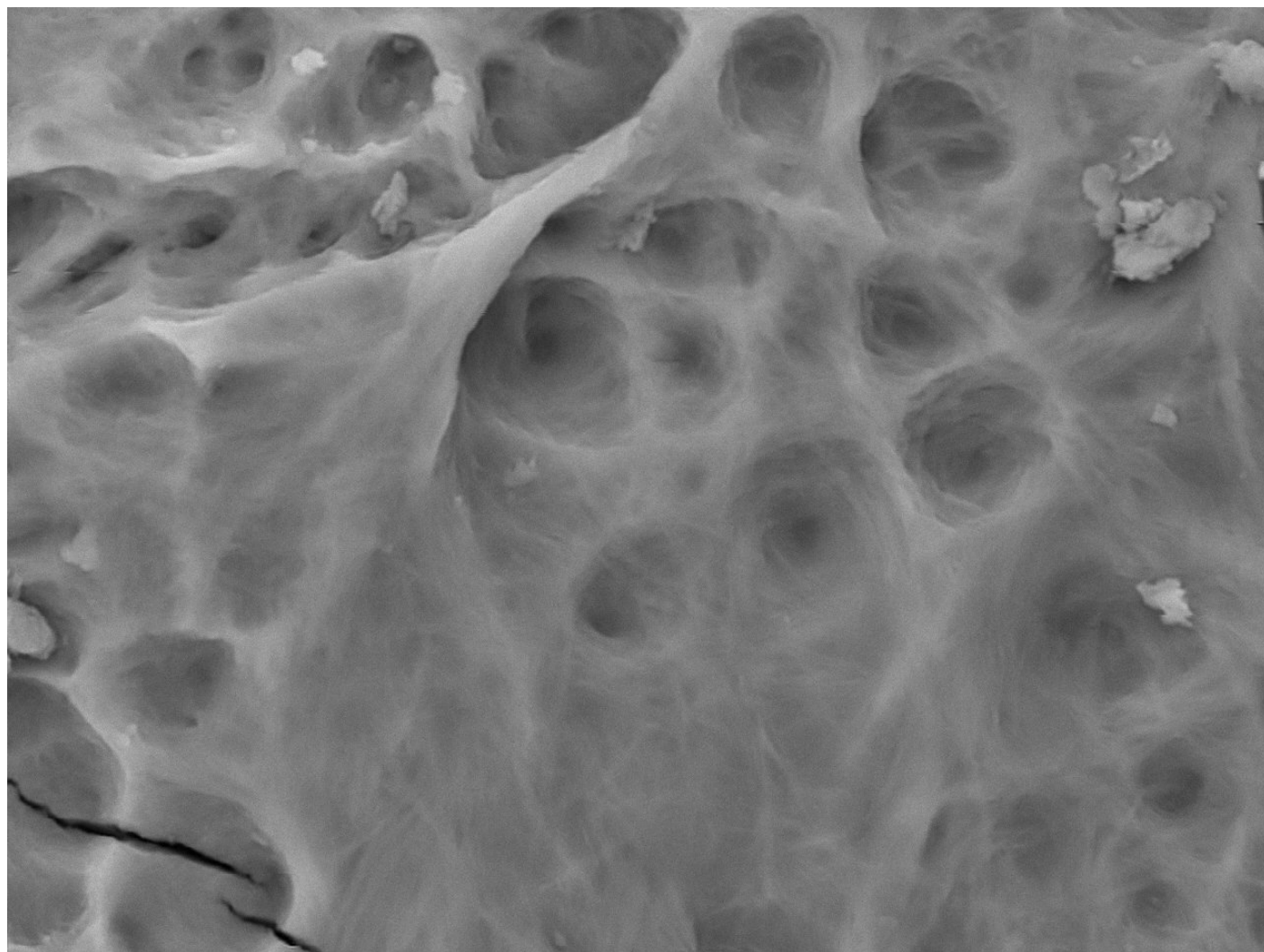
x5.0k 20 μm

36) image152

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image153

image153



29576-18

2017/03/01 11:32 N

x5.0k

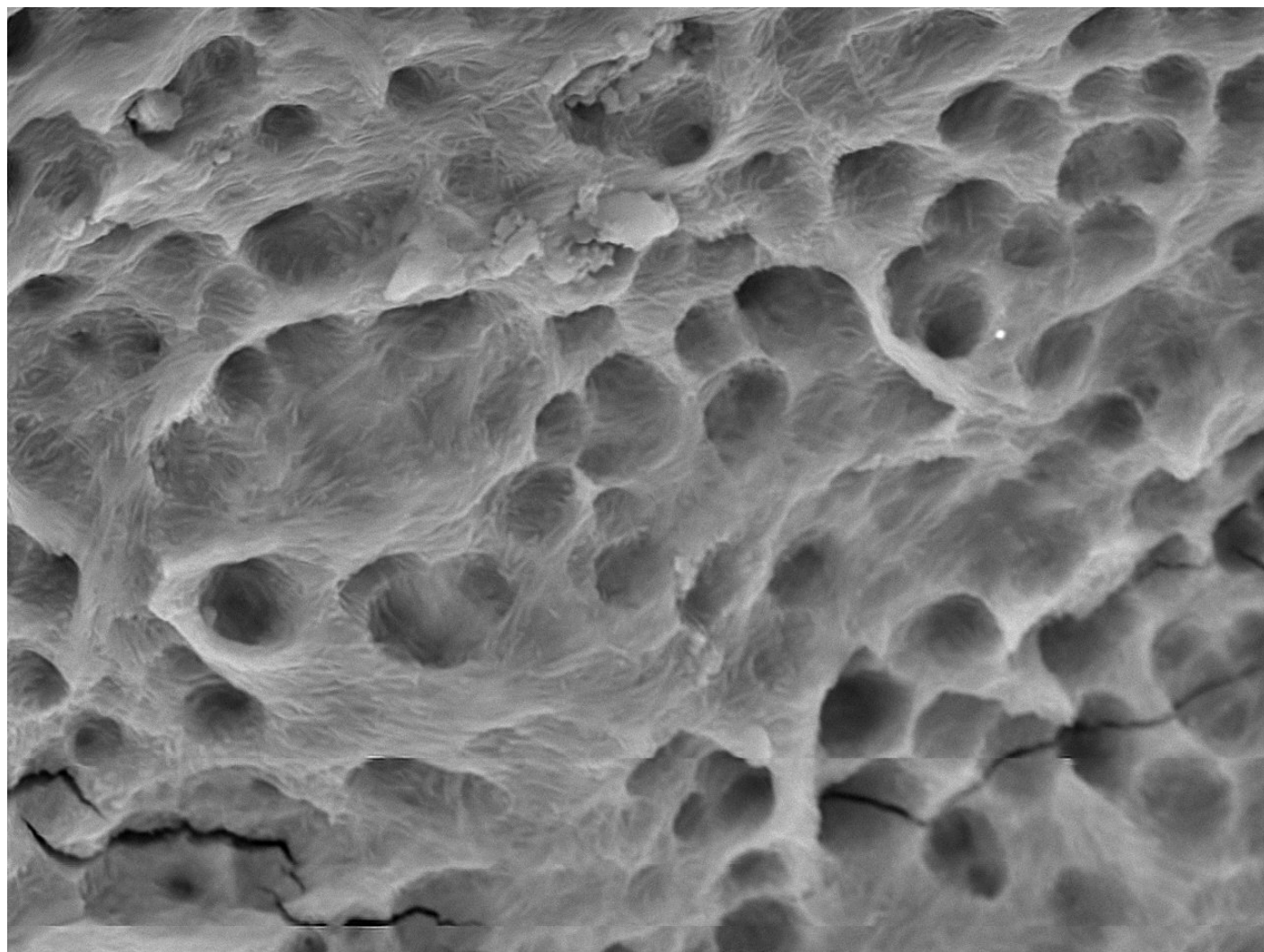
20 μm

37) image153

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image154

image154



29009-31

2017/03/06 10:17 N

x5.0k

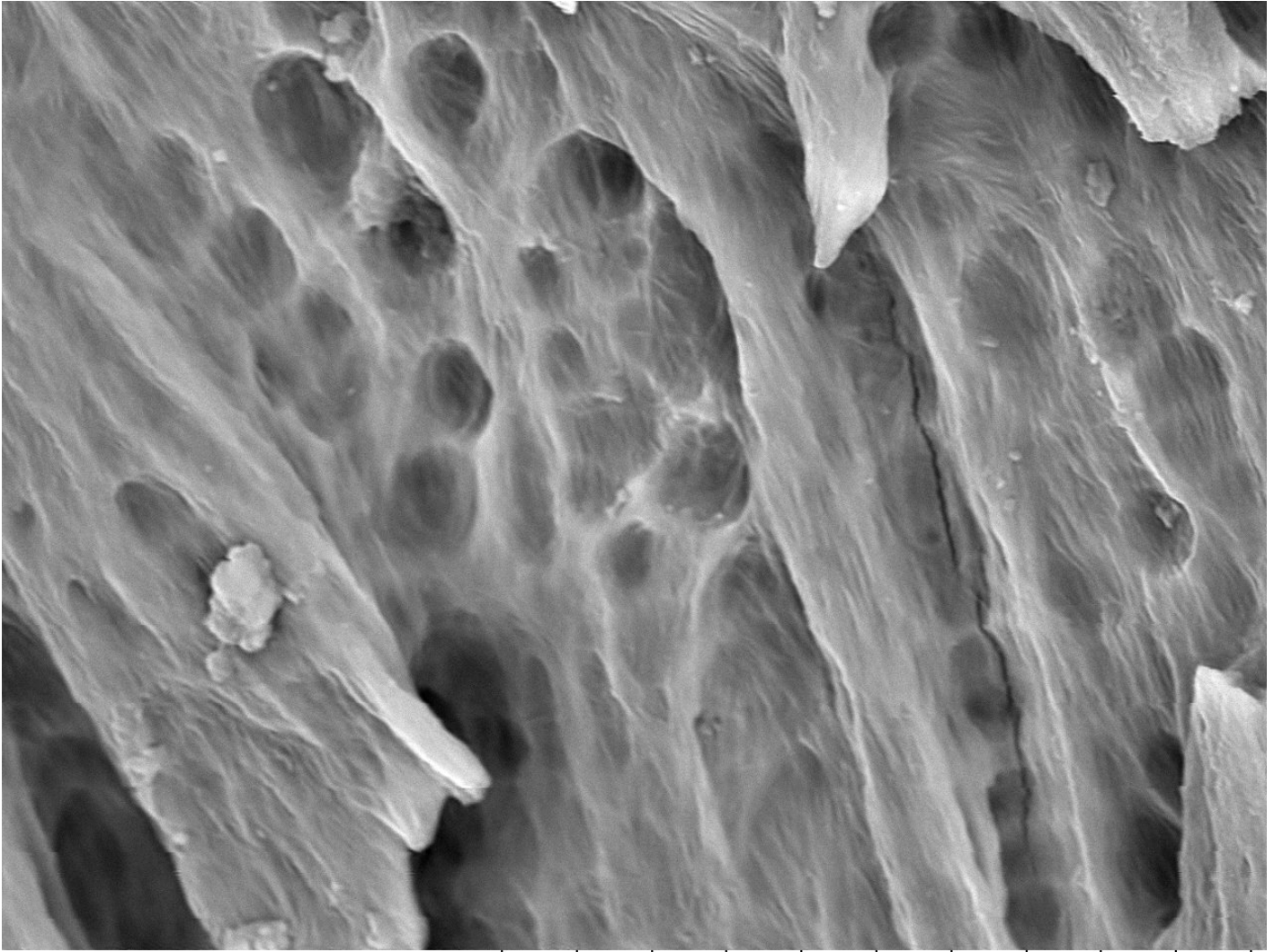
20 μ m

38) image154

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image155

image155



29265-2

2017/02/27 11:50 N

x5.0k

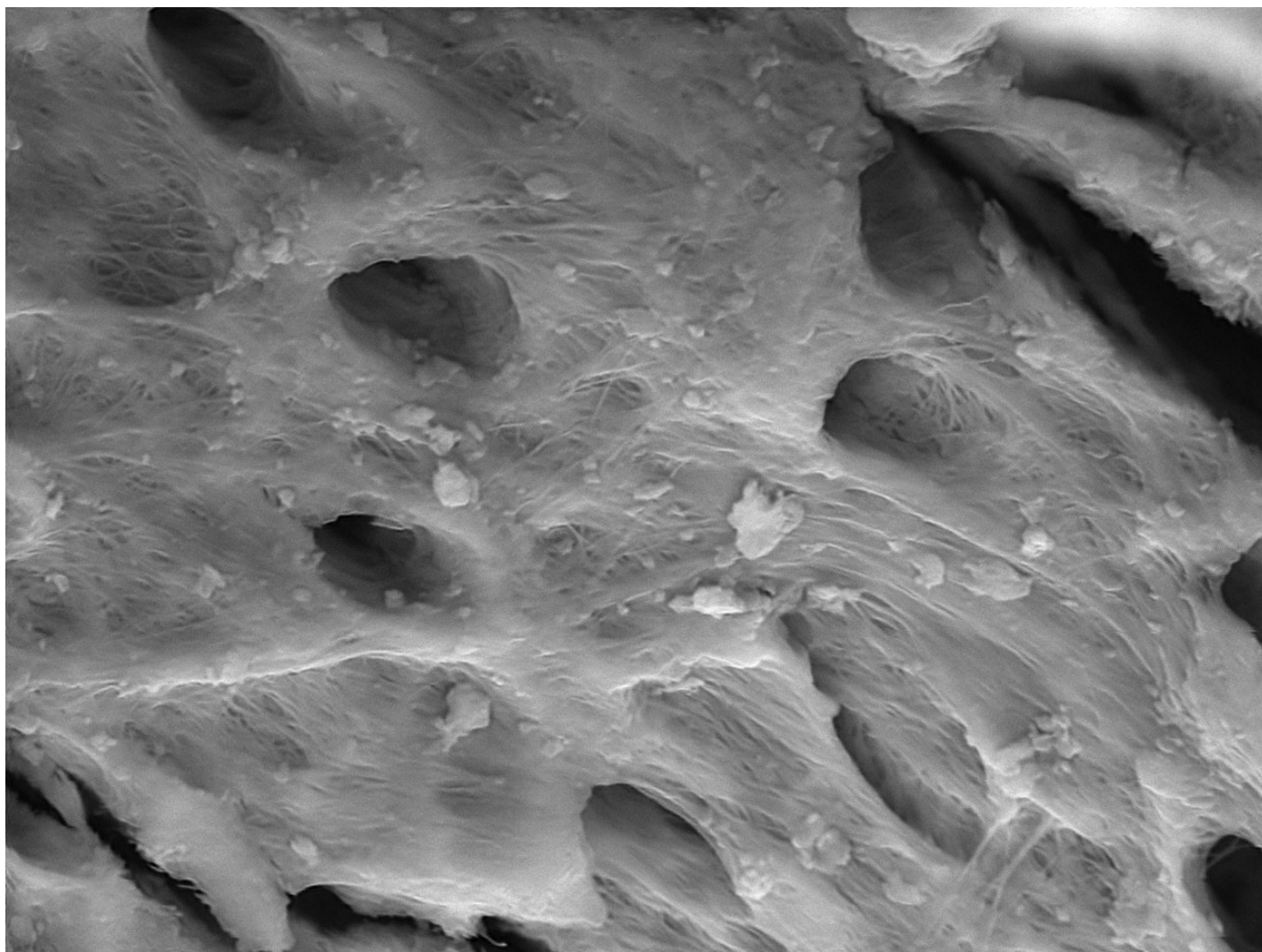
20 μm

39) image155

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image156

image156



29694-2

2017/02/28 15:52 N

x5.0k

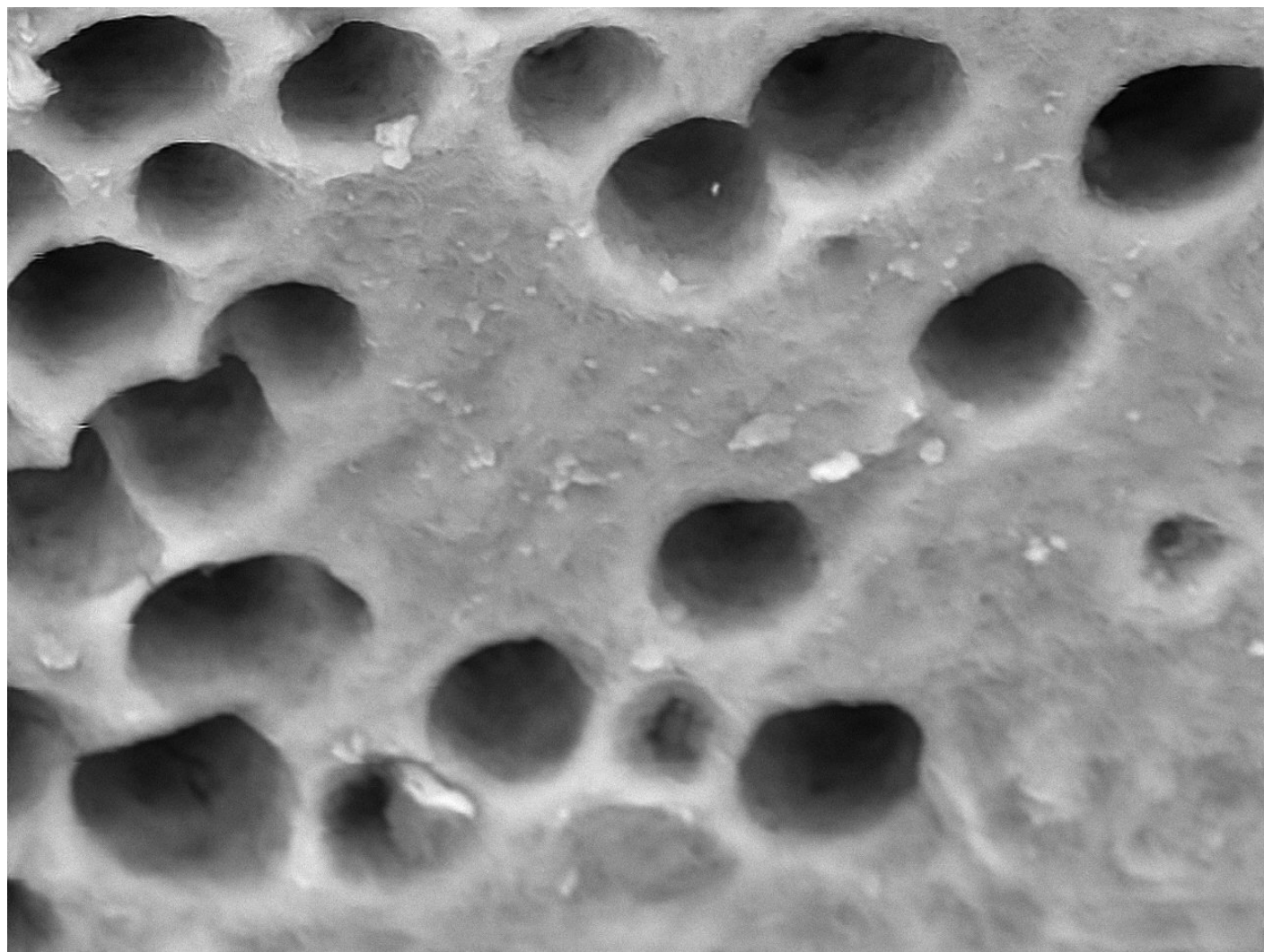
20 μ m

40) image156

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image157

image157



29009-31

2017/03/06 09:20 N

x5.0k

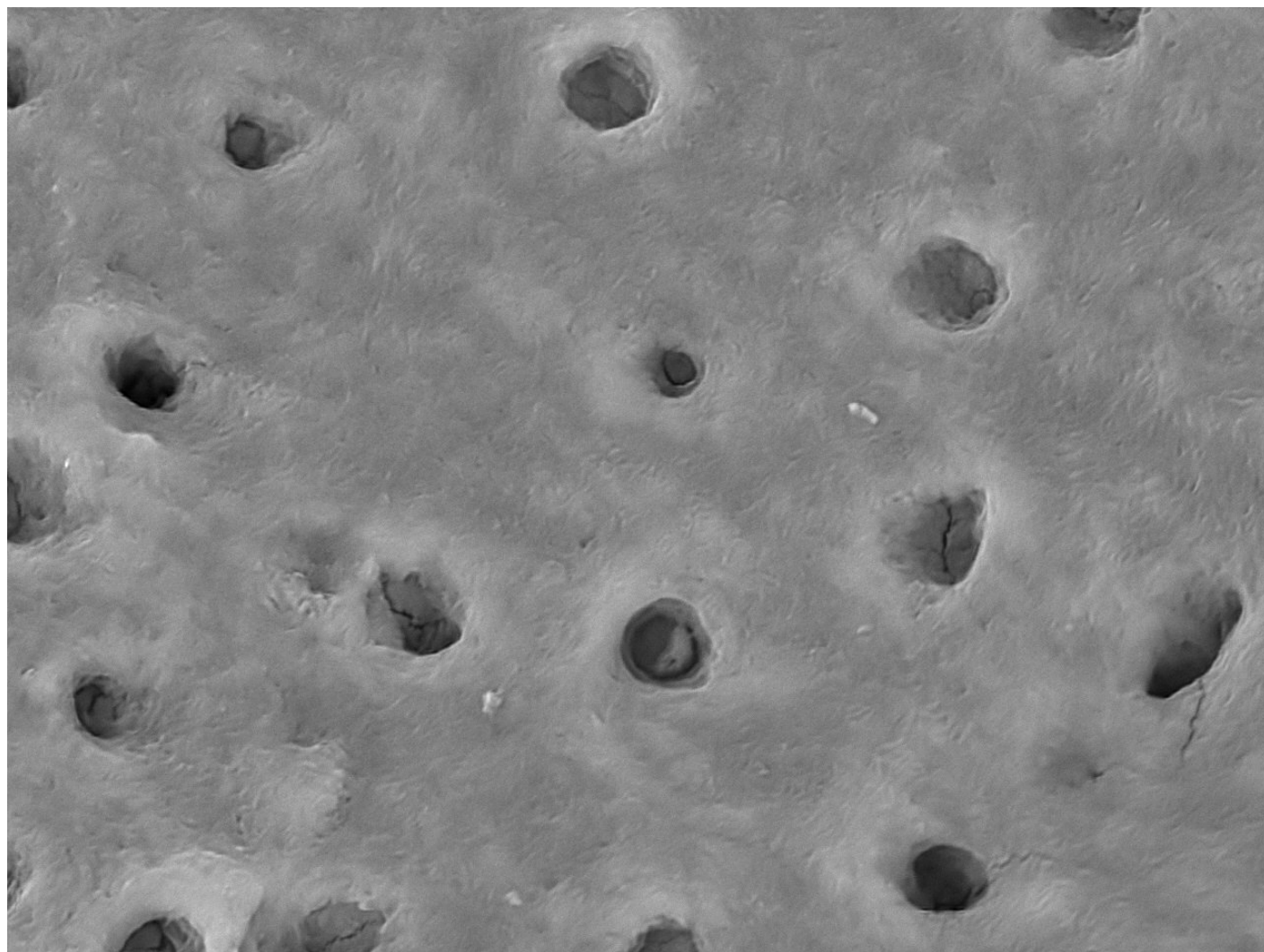
20 μ m

41) image157

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image158

image158



29340-18

2017/03/03 09:45 N

x5.0k

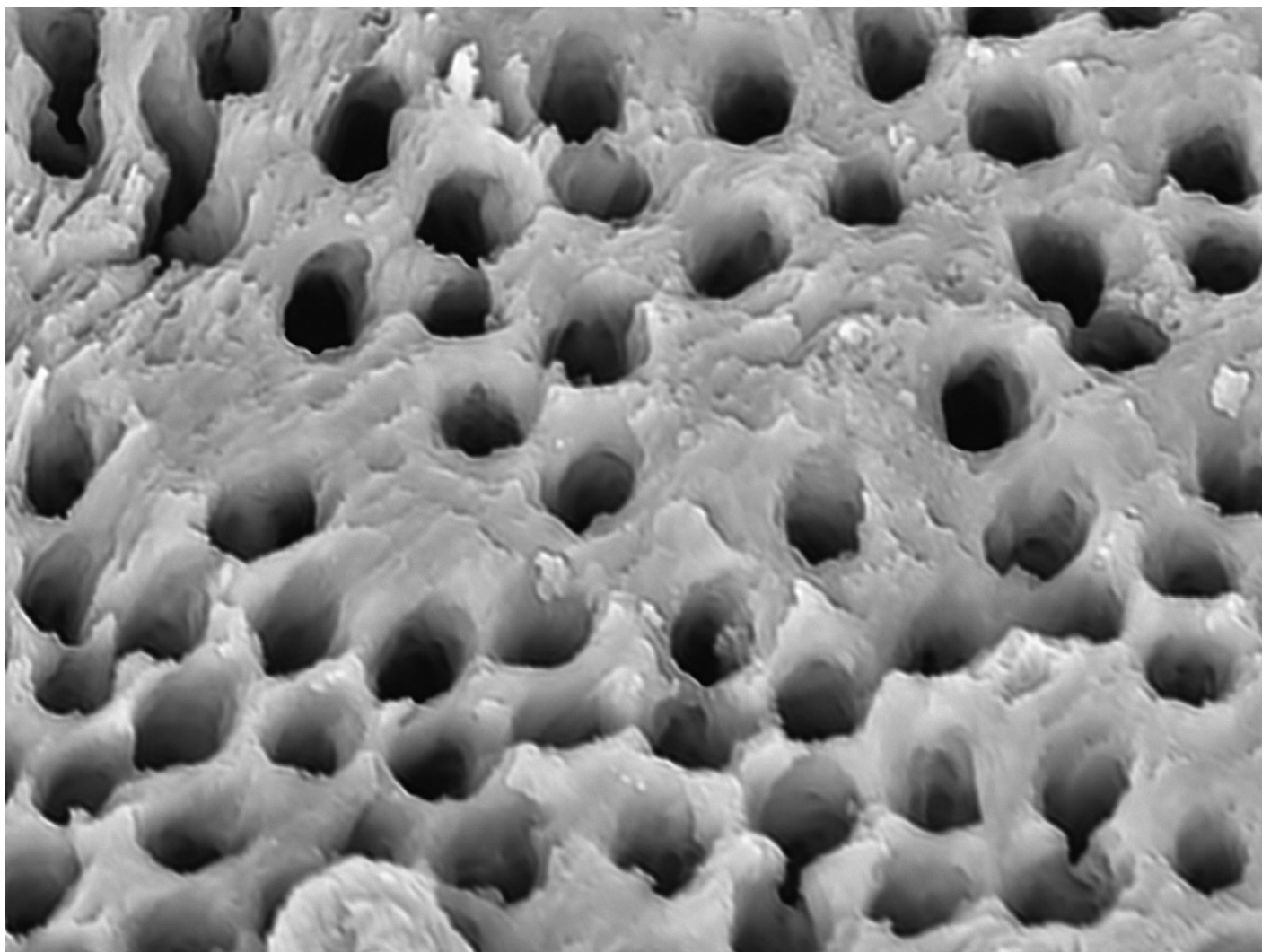
20 μm

42) image158

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image159

image159



29009-31

2017/03/08 14:39 H

x5.0k

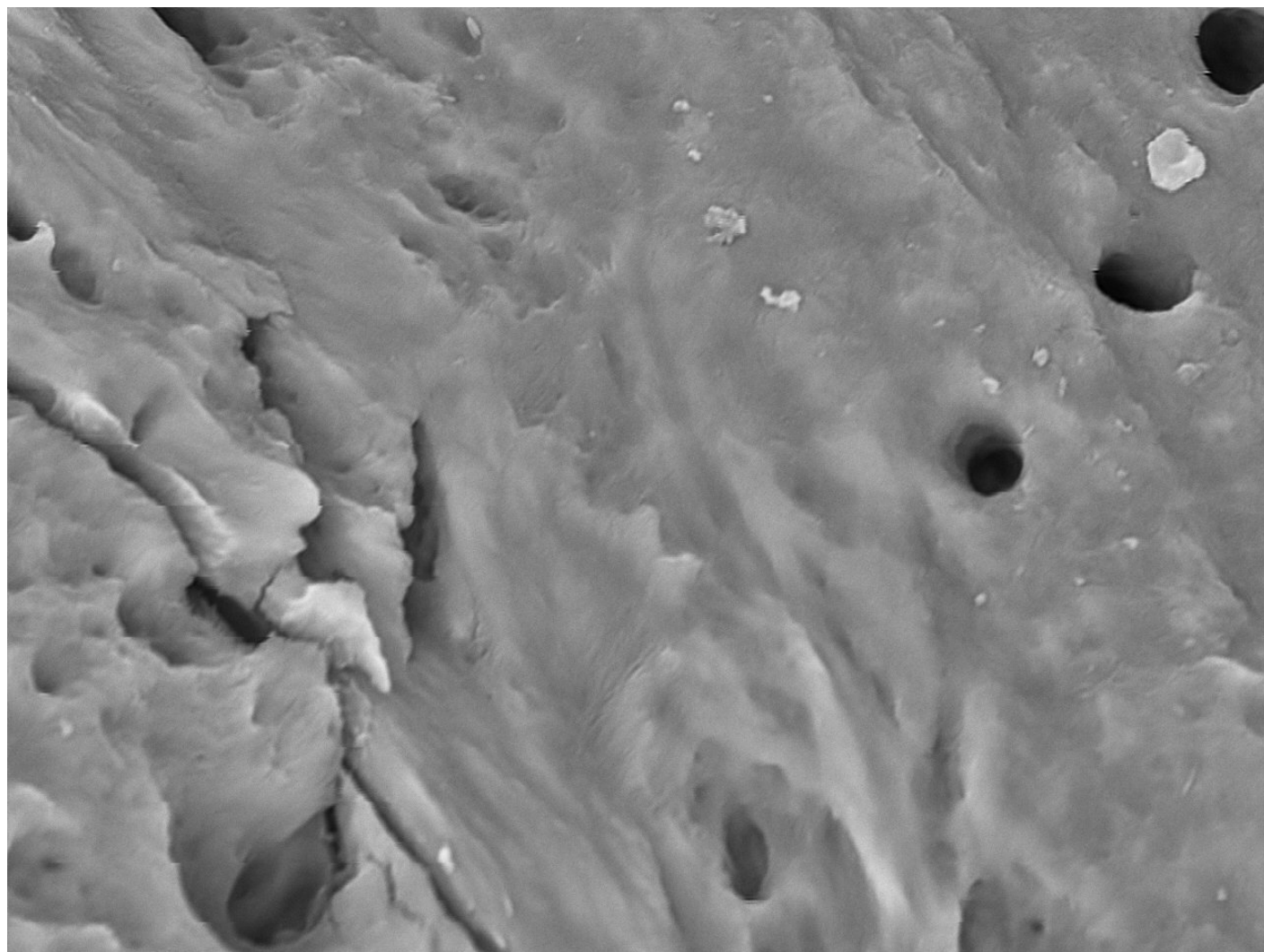
20 μ m

43) image159

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image160

image160



29576-18

2017/03/01 11:44 N

x5.0k

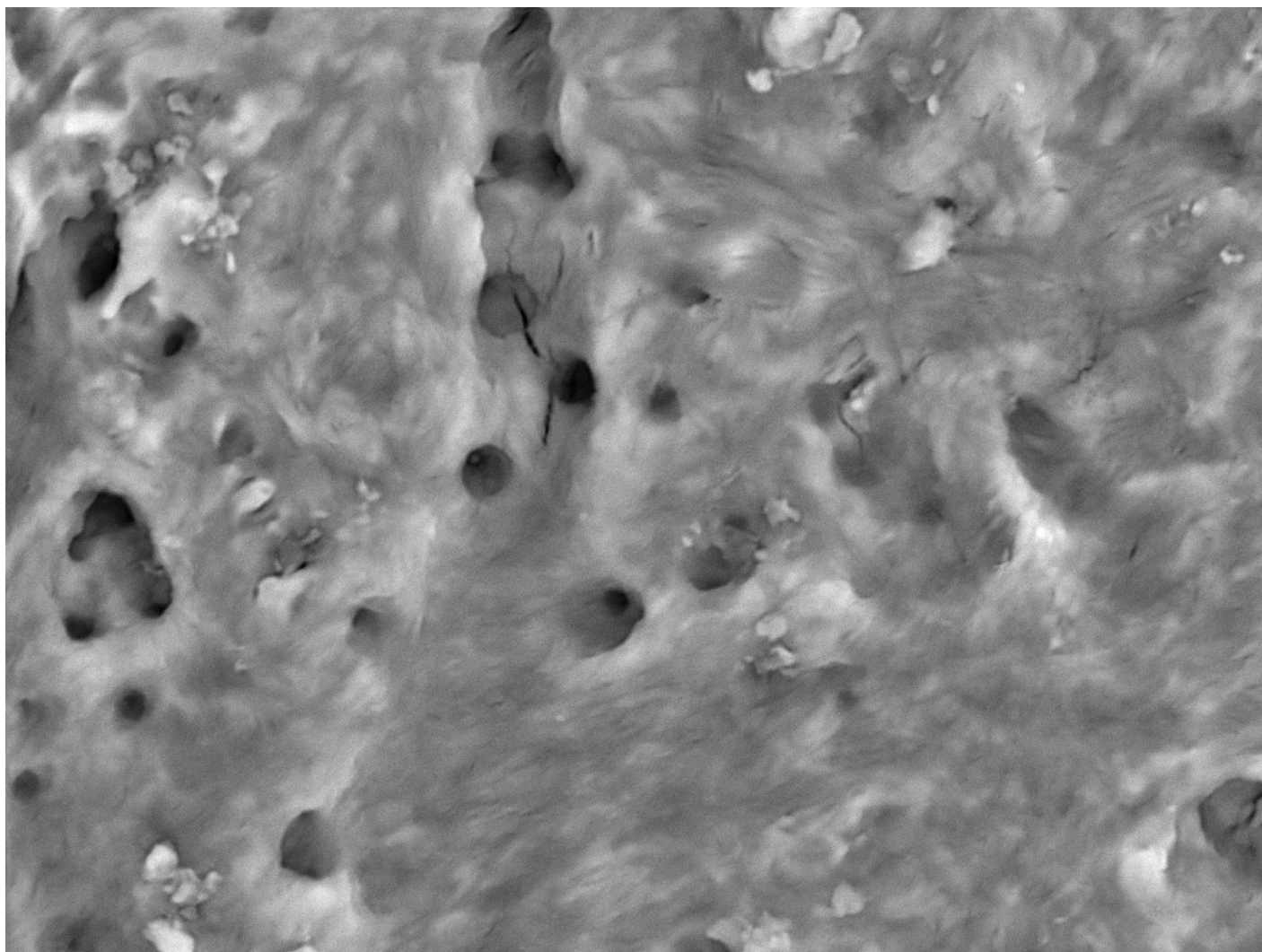
20 μ m

44) image160

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image161

image161



29211-18

2017/03/04 14:16 N

x5.0k

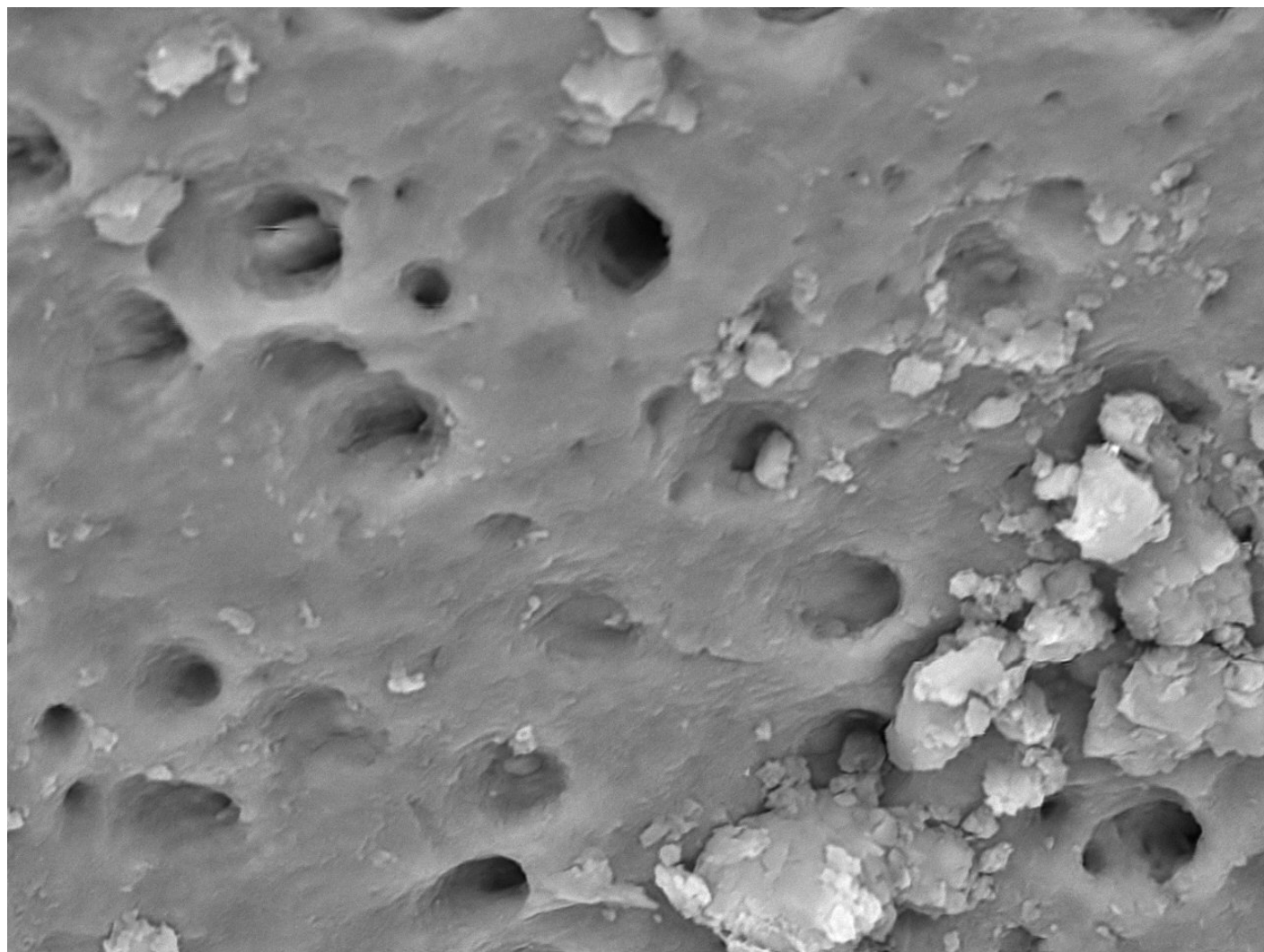
20 μ m

45) image161

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image162

image162



29679-3

2017/02/27 15:22 N

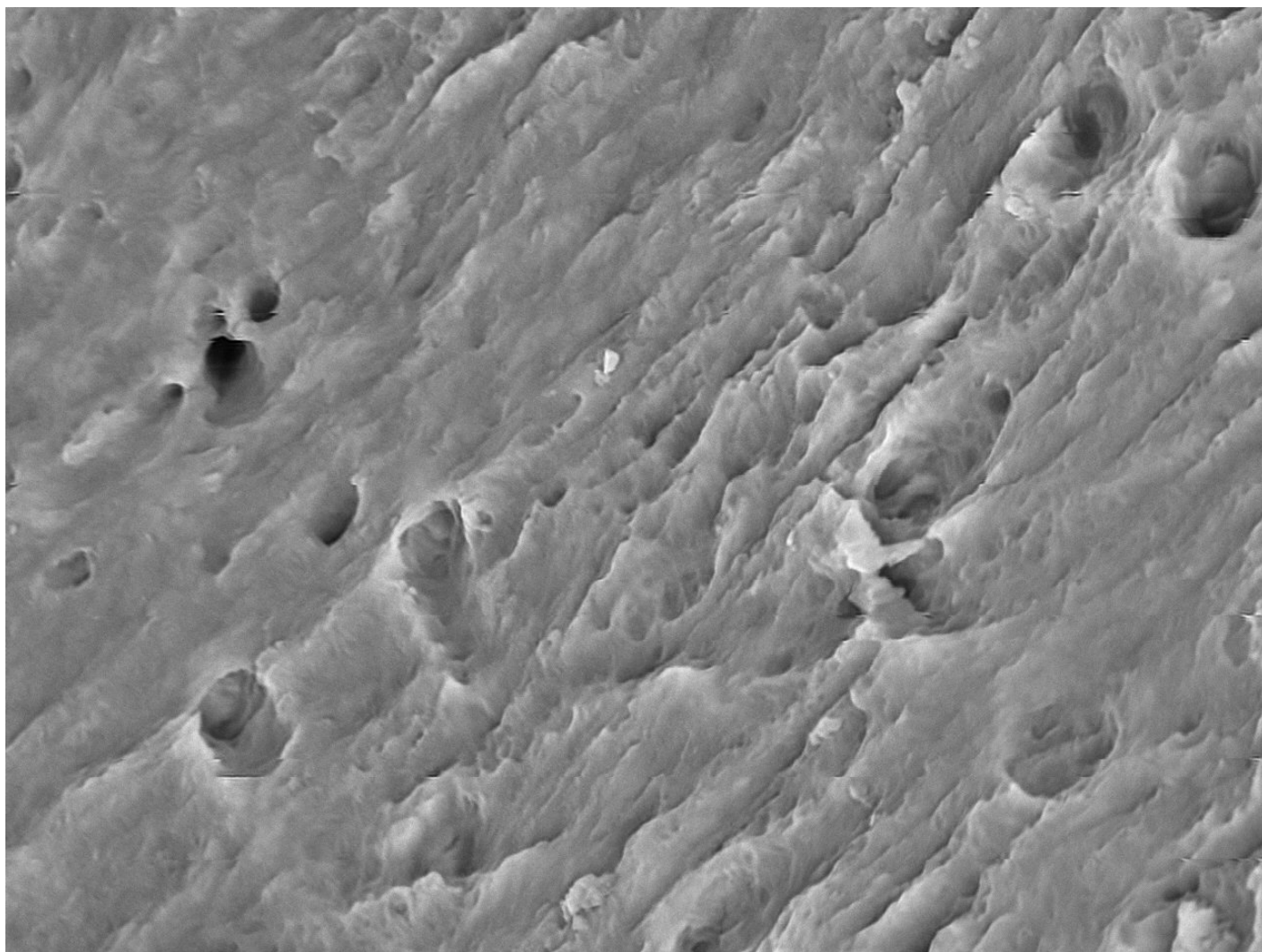
x5.0k 20 μ m

46) image162

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image163

image163



29179-3

2017/03/03 11:48 N

x5.0k

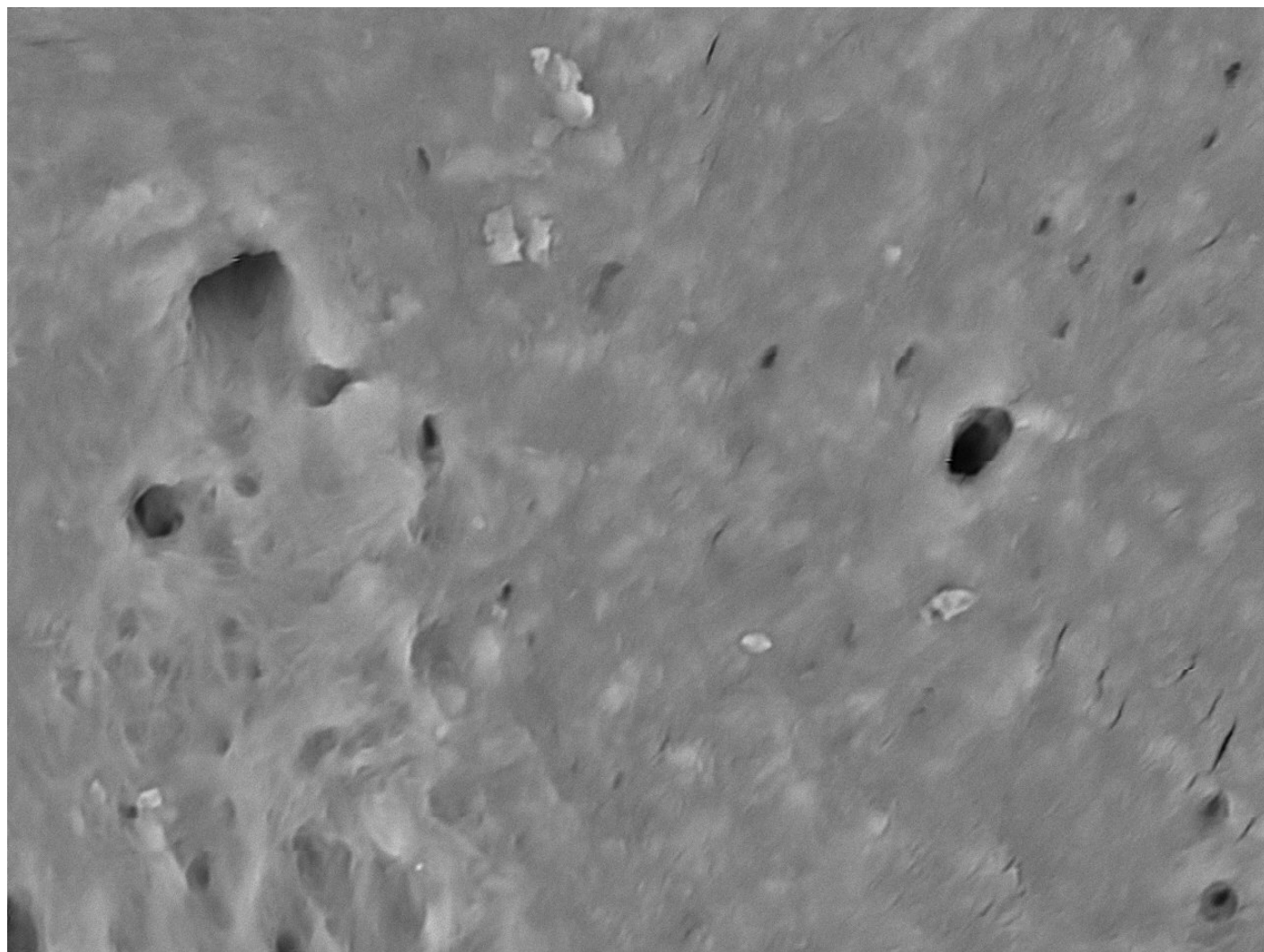
20 μ m

47) image163

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image164

image164



29009-31

2017/03/06 10:15 N

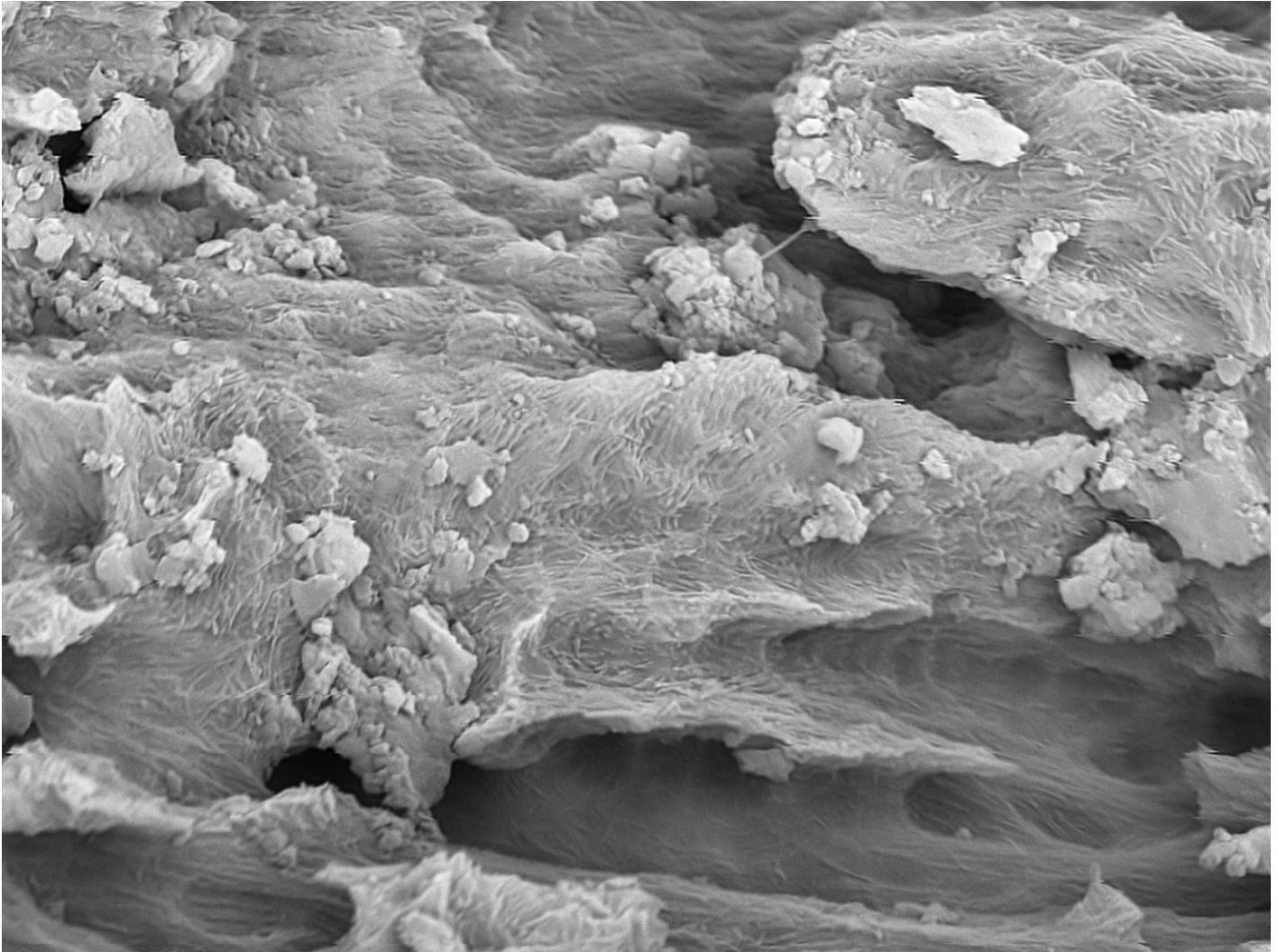
x5.0k 20 μ m

48) image164

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image165

image165



29211-18

2017/03/03 16:20 N

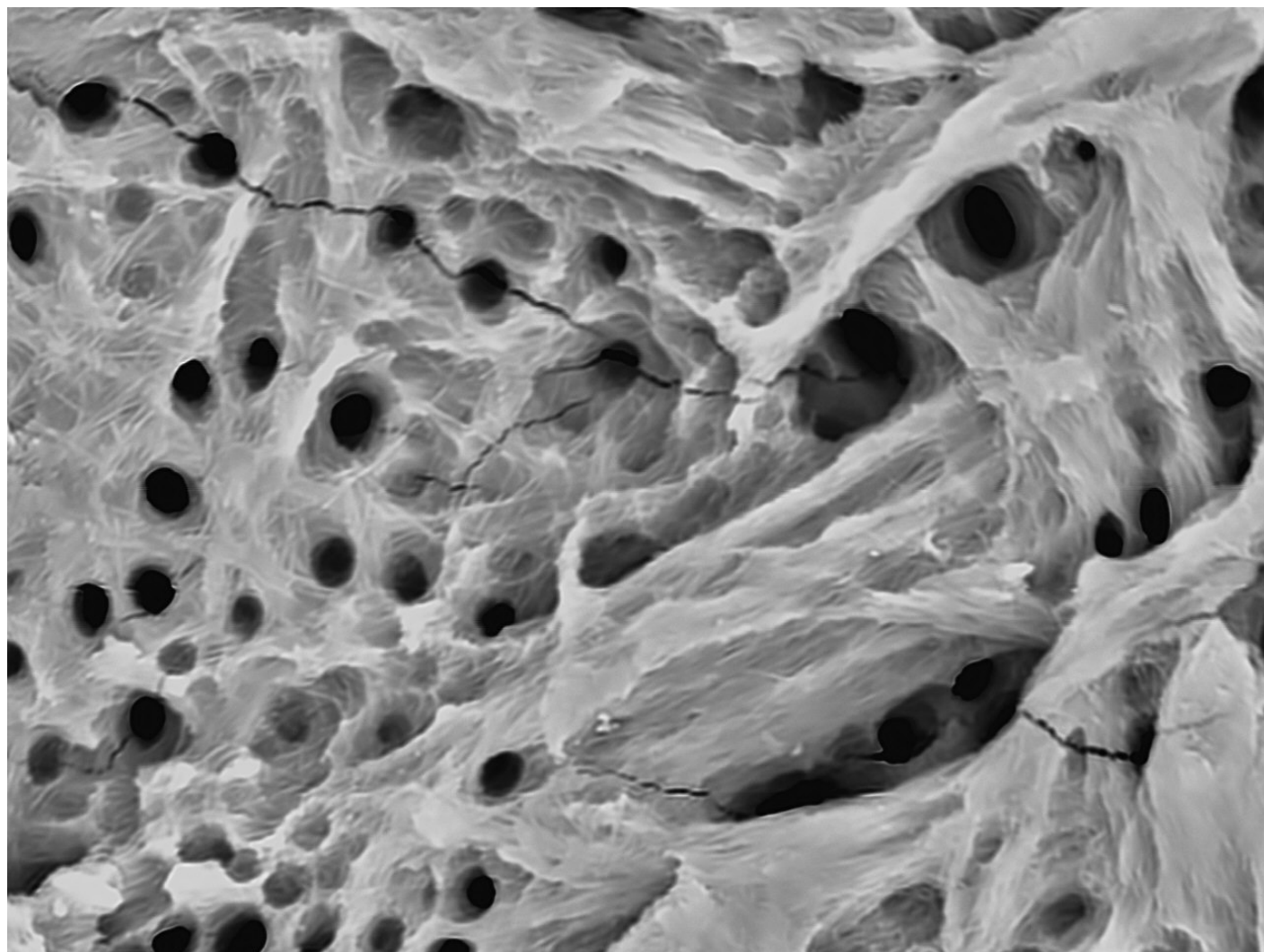
x5.0k 20 μ m

49) image165

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image166

image166



29805-30

2017/03/09 14:37 H

x5.0k

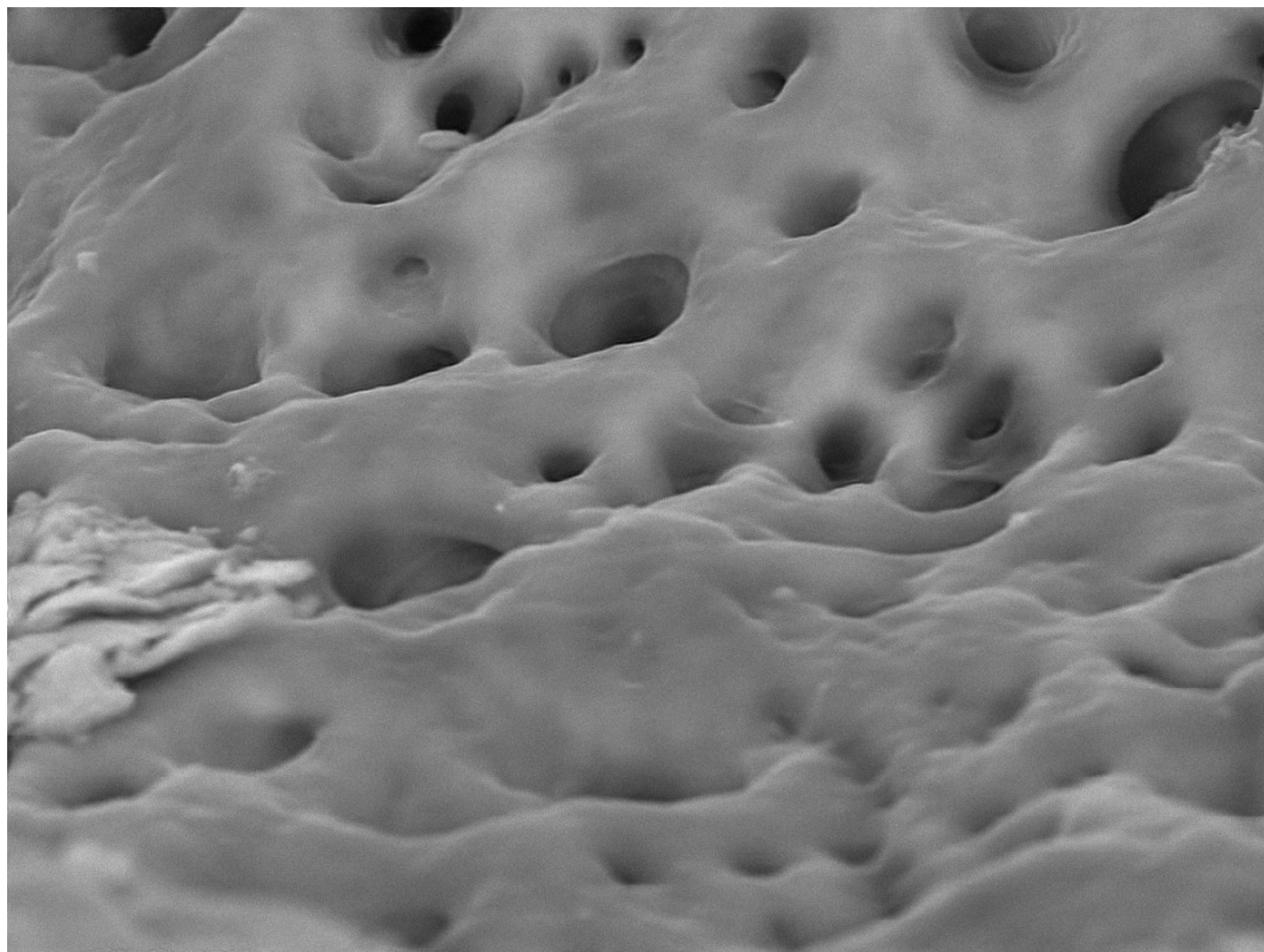
20 μ m

50) image166

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image167

image167



29963-15

2017/03/01 10:13 N

x5.0k

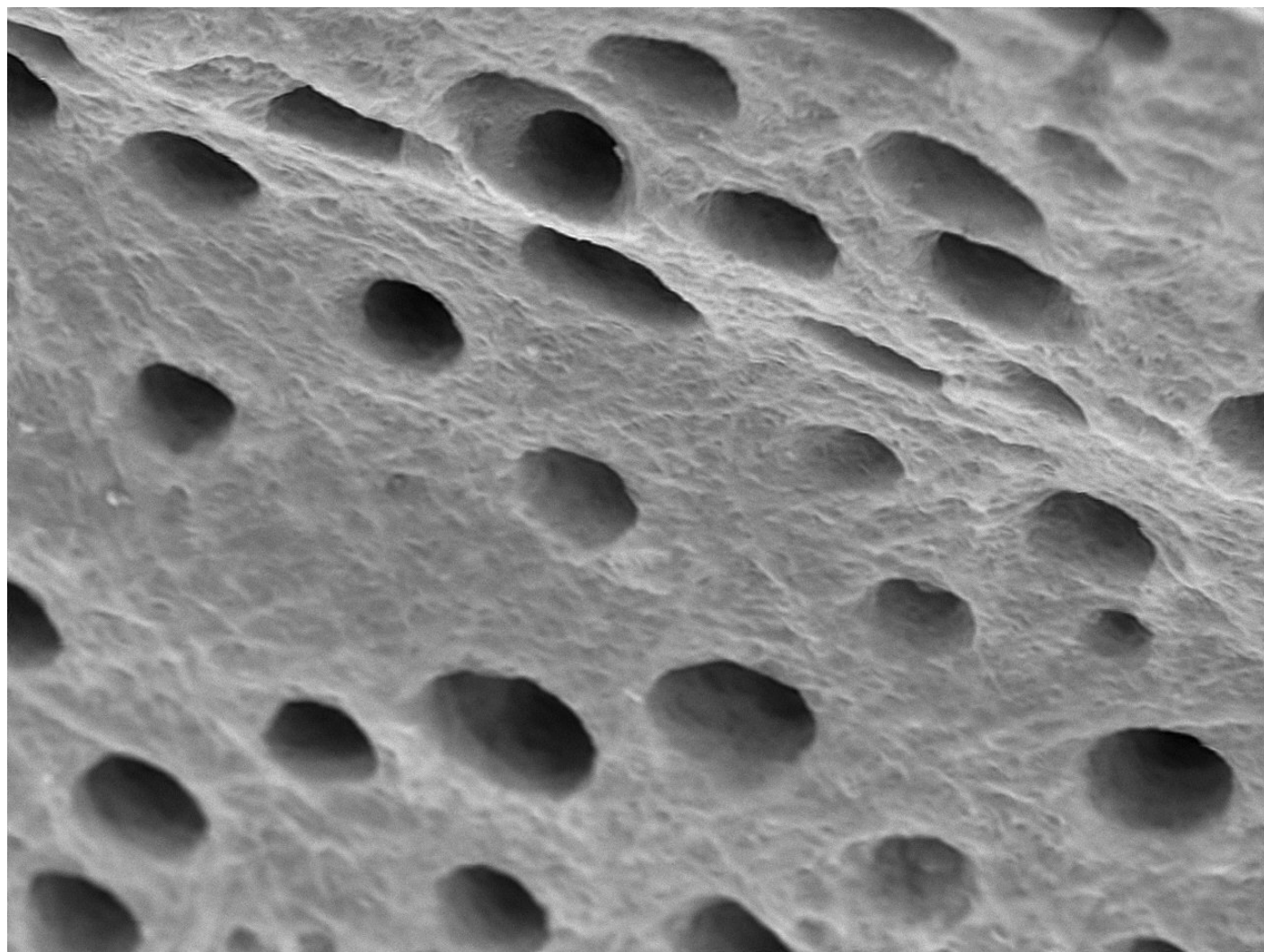
20 μm

51) image167

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image168

image168



29265-2

2017/02/27 10:58 N

x5.0k

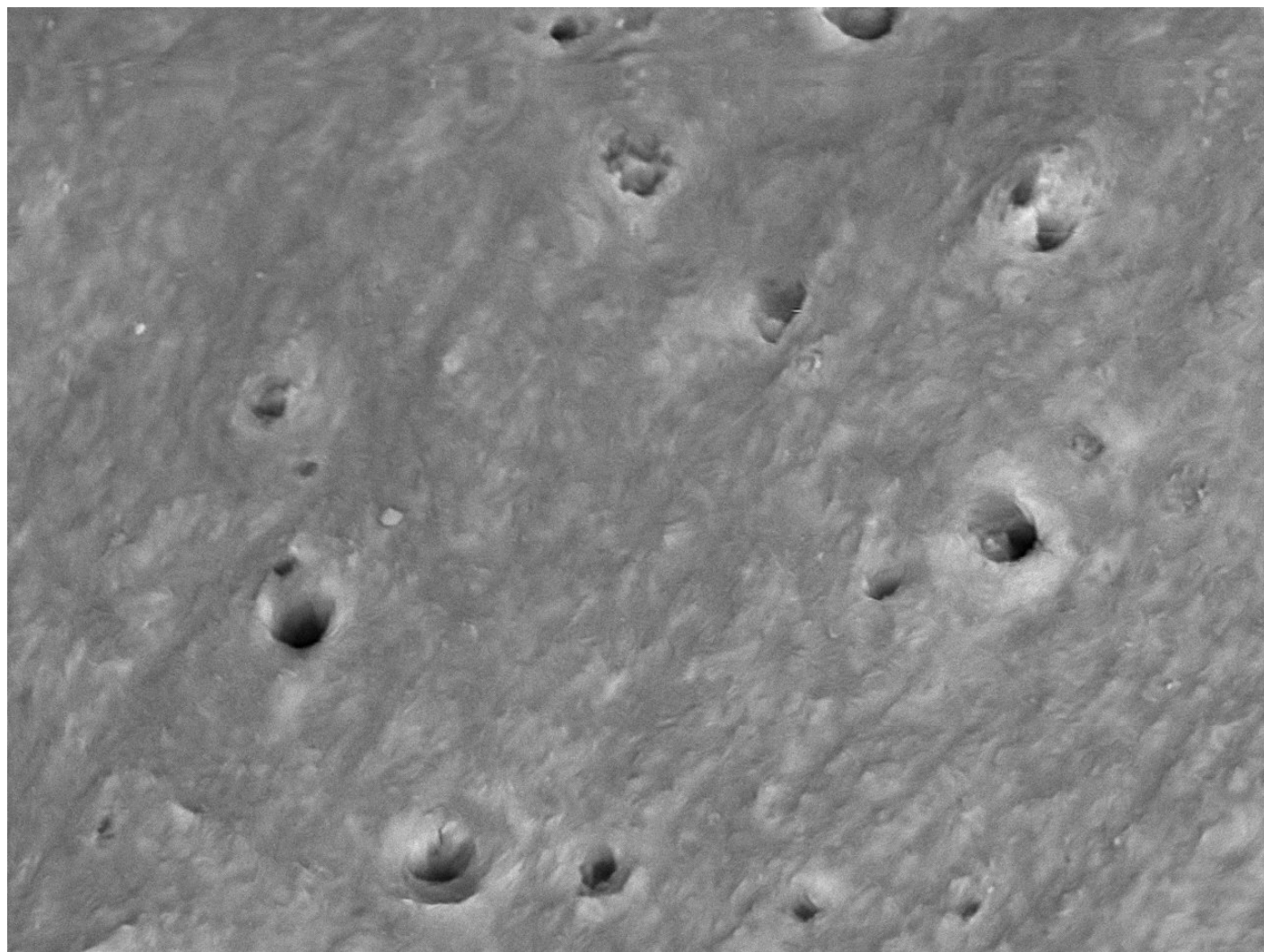
20 μm

52) image168

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image169

image169



29052-14

2017/02/28 18:26 N

x5.0k

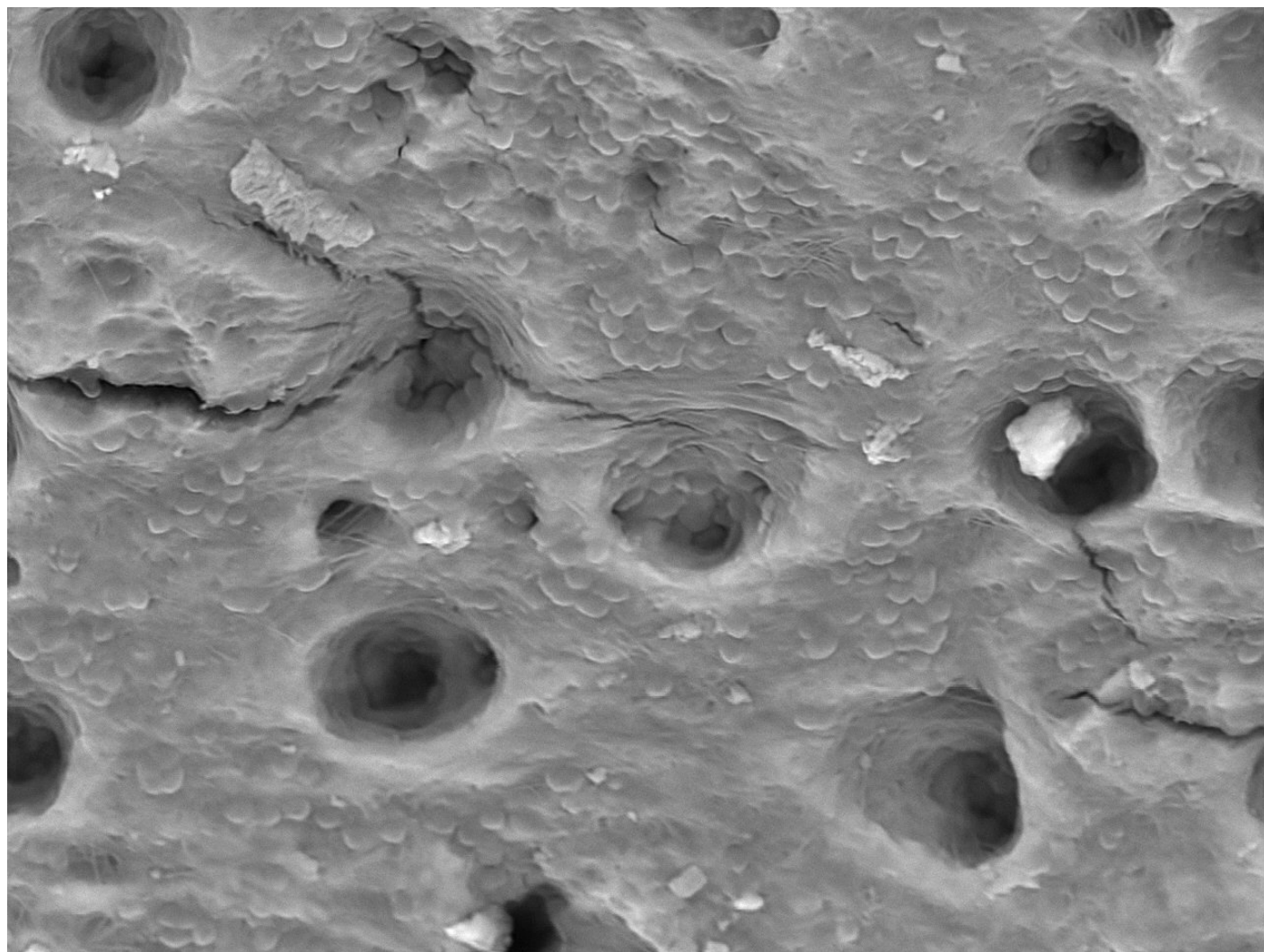
20 μm

53) image169

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image170

image170



29694-2

2017/02/28 16:58 N

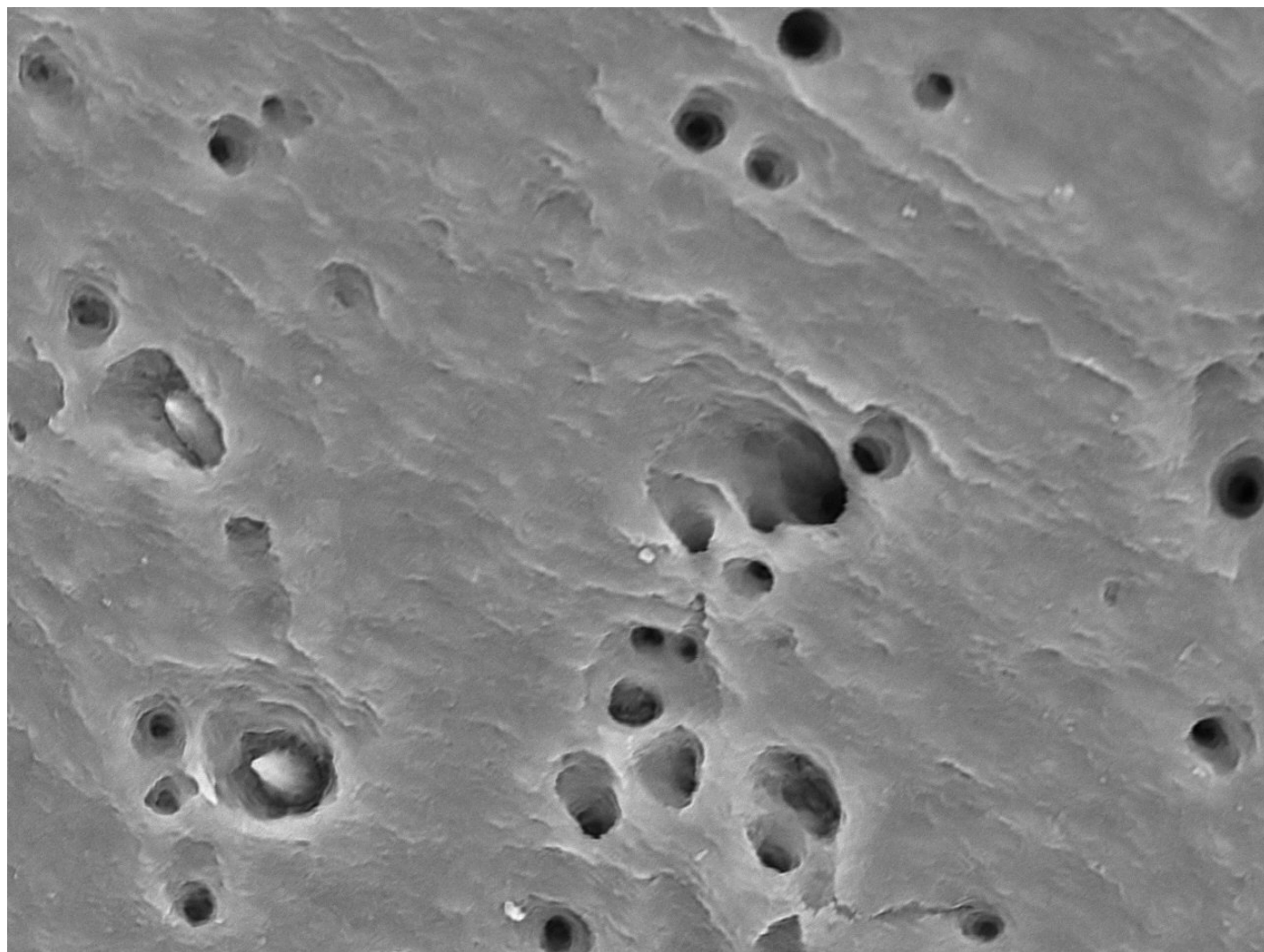
x5.0k 20 μm

54) image170

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image171

image171



29211-18

2017/03/04 13:53 N

x5.0k

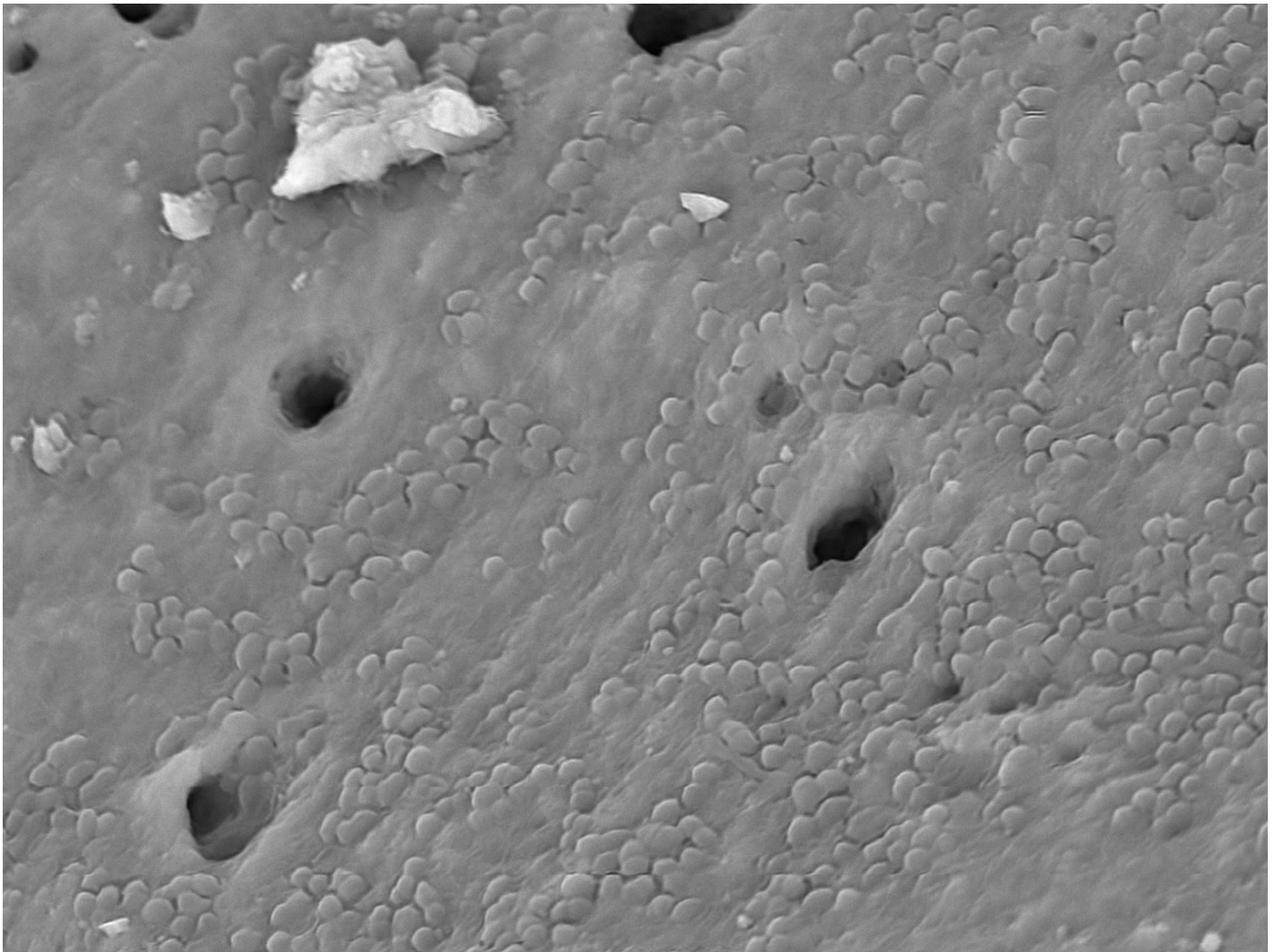
20 μm

55) image171

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image172

image172



29965-2

2017/03/02 15:22 N

x5.0k

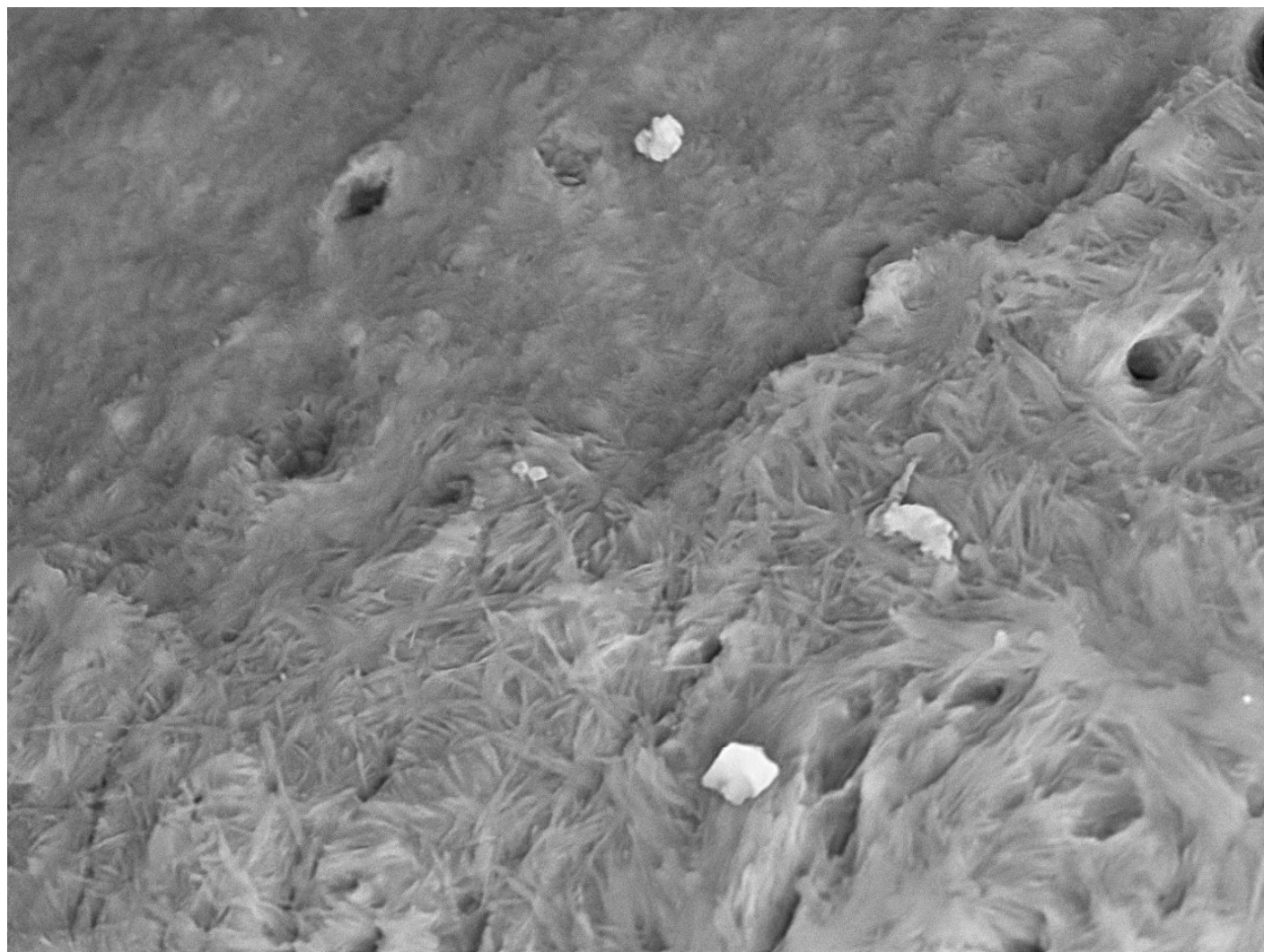
20 μ m

56) image172

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image173

image173



29052-14

2017/02/28 18:25 N

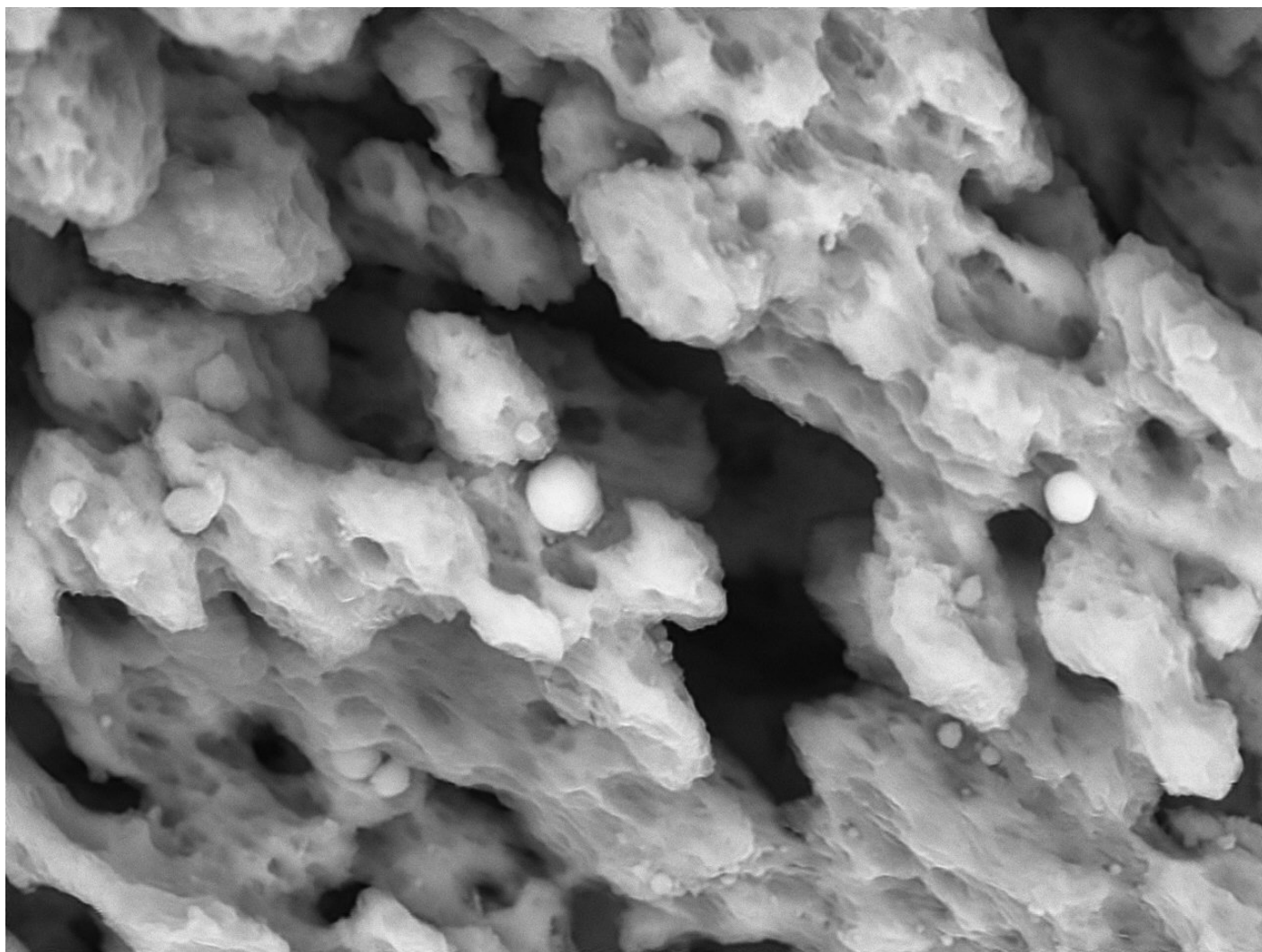
x5.0k 20 μm

57) image173

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image174

image174



29856-30

2017/02/22 10:50 N

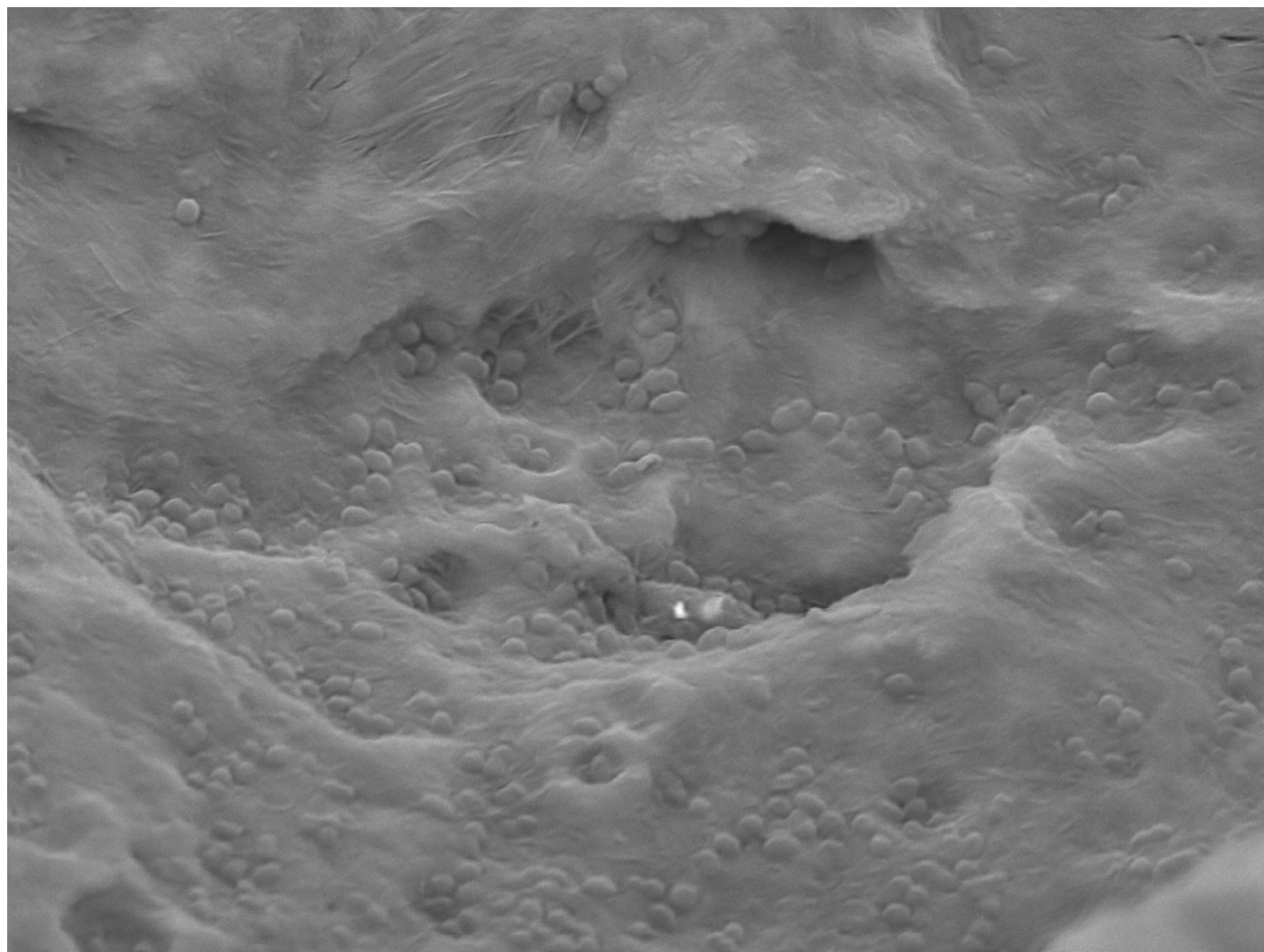
x5.0k 20 μm

58) image174

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image175

image175



29679-3

2017/02/27 09:45 N

x5.0k

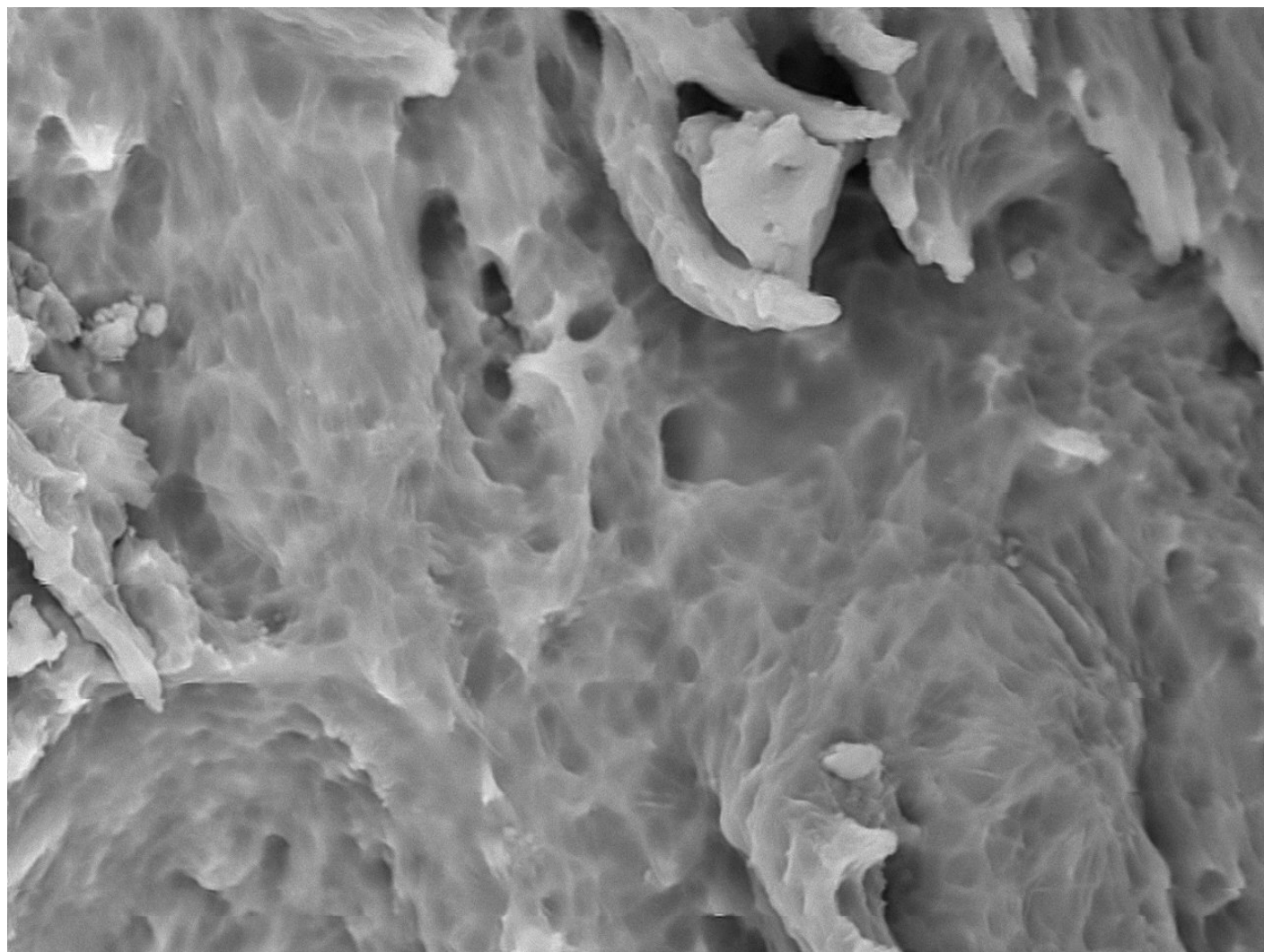
20 μm

59) image175

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image176

image176



29028-15

2017/03/04 15:32 N

x5.0k

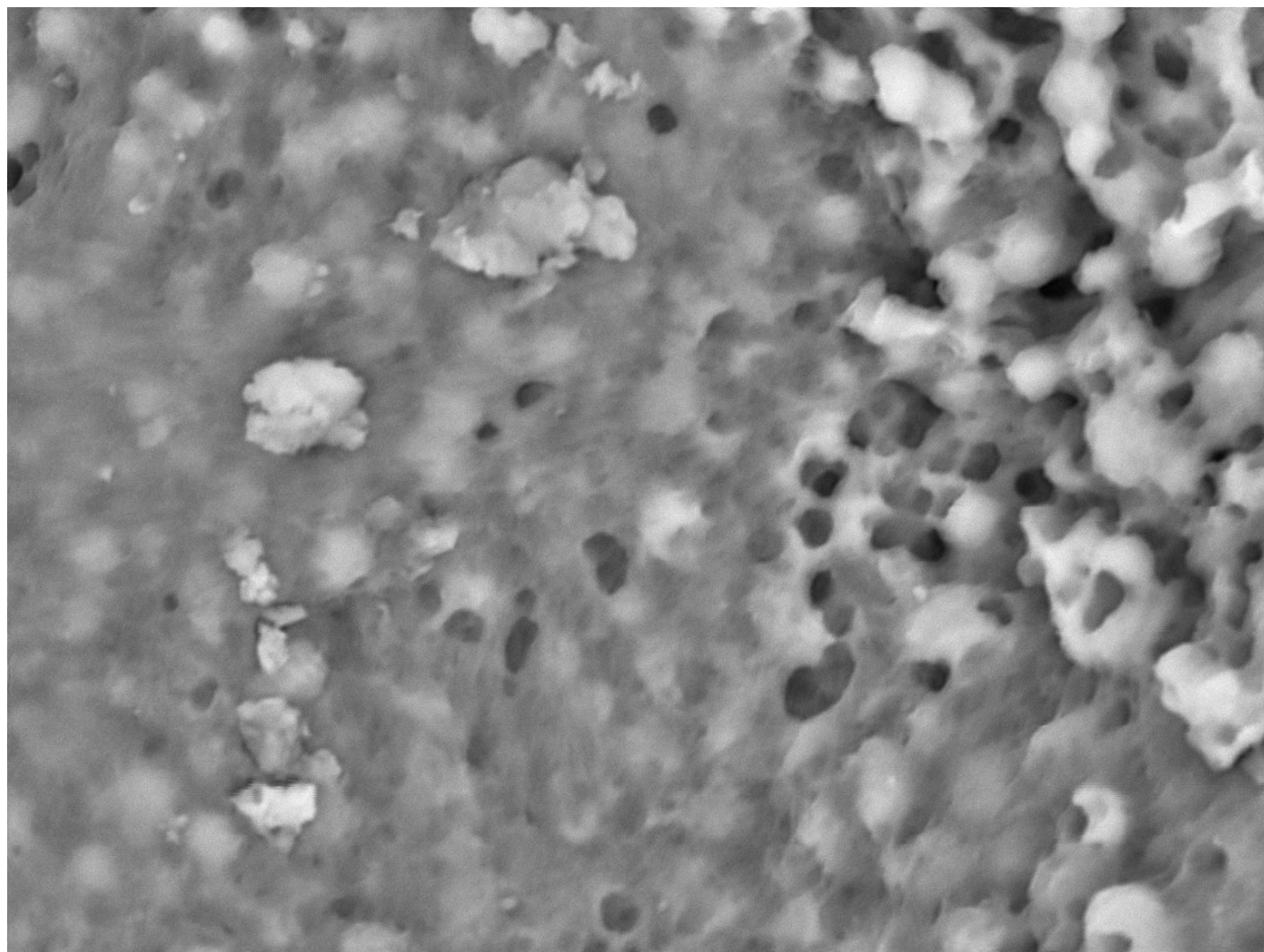
20 μ m

60) image176

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image177

image177



29679-3

2017/02/27 16:10 N

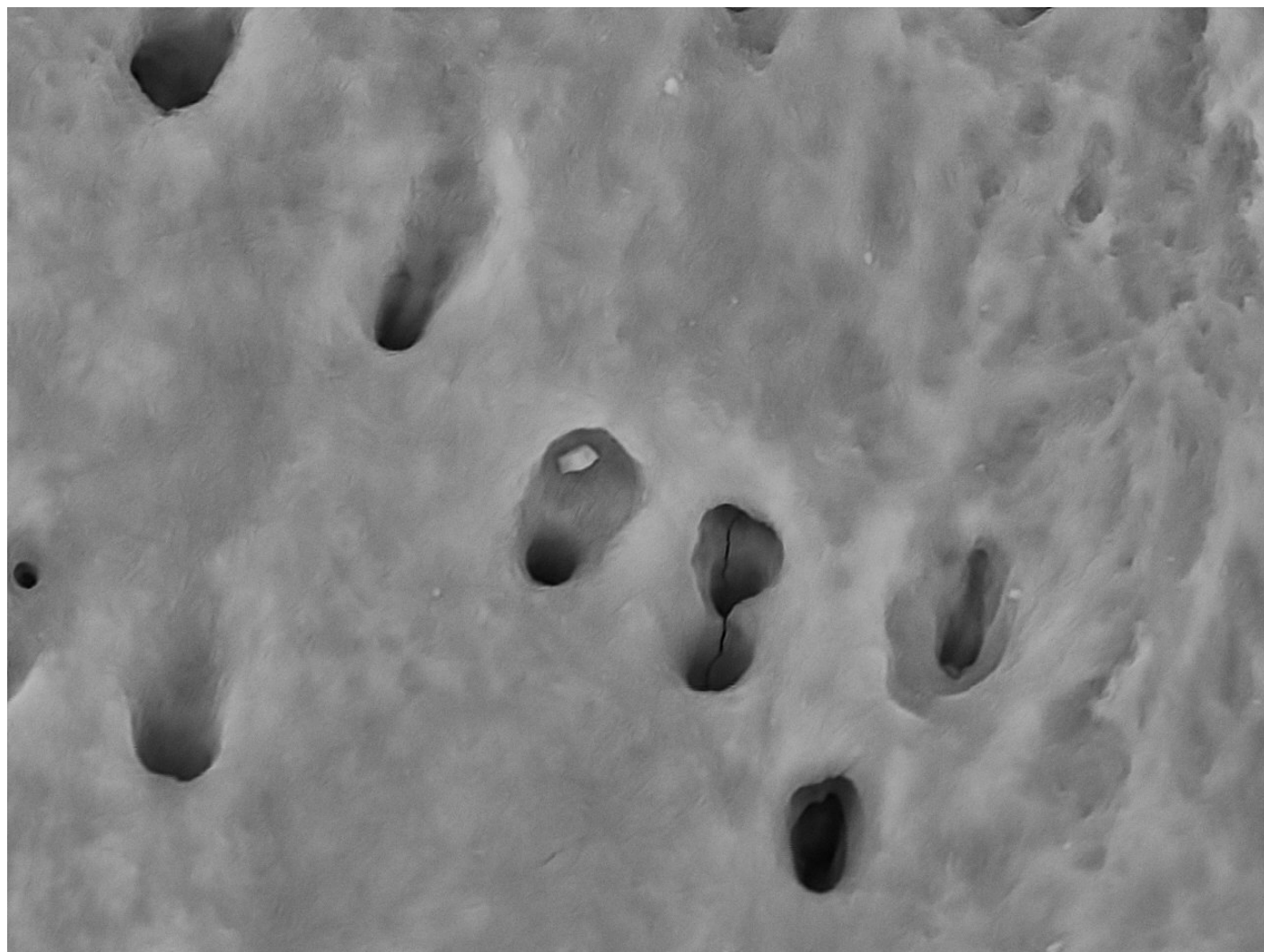
x5.0k 20 μ m

61) image177

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image178

image178



29576-18

2017/03/01 12:00 N

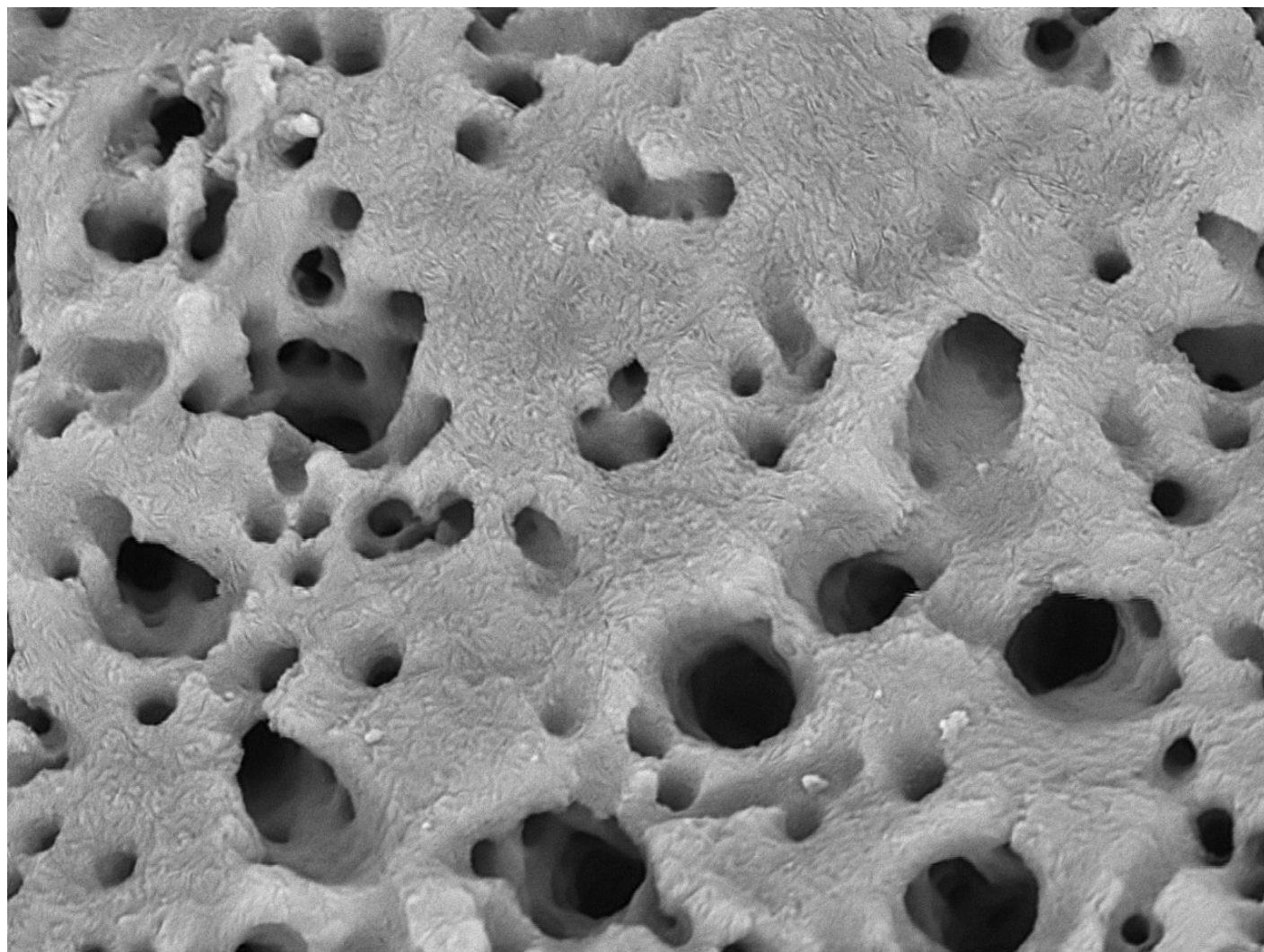
x5.0k 20 μm

62) image178

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image179

image179



29009-31

2017/03/06 15:44 N

x5.0k

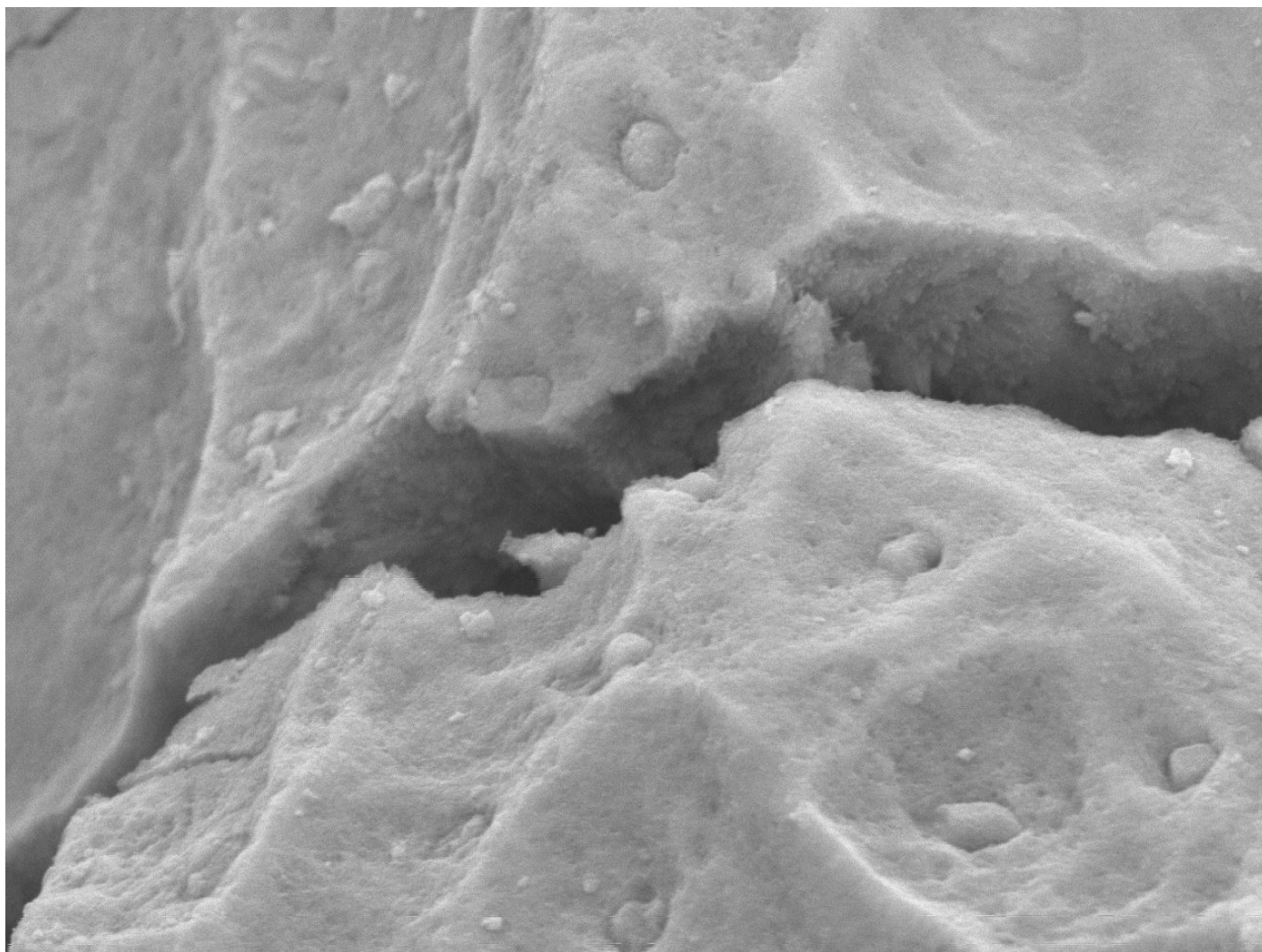
20 μm

63) image179

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image180

image180



29952-15

2017/02/22 16:07 N

x5.0k

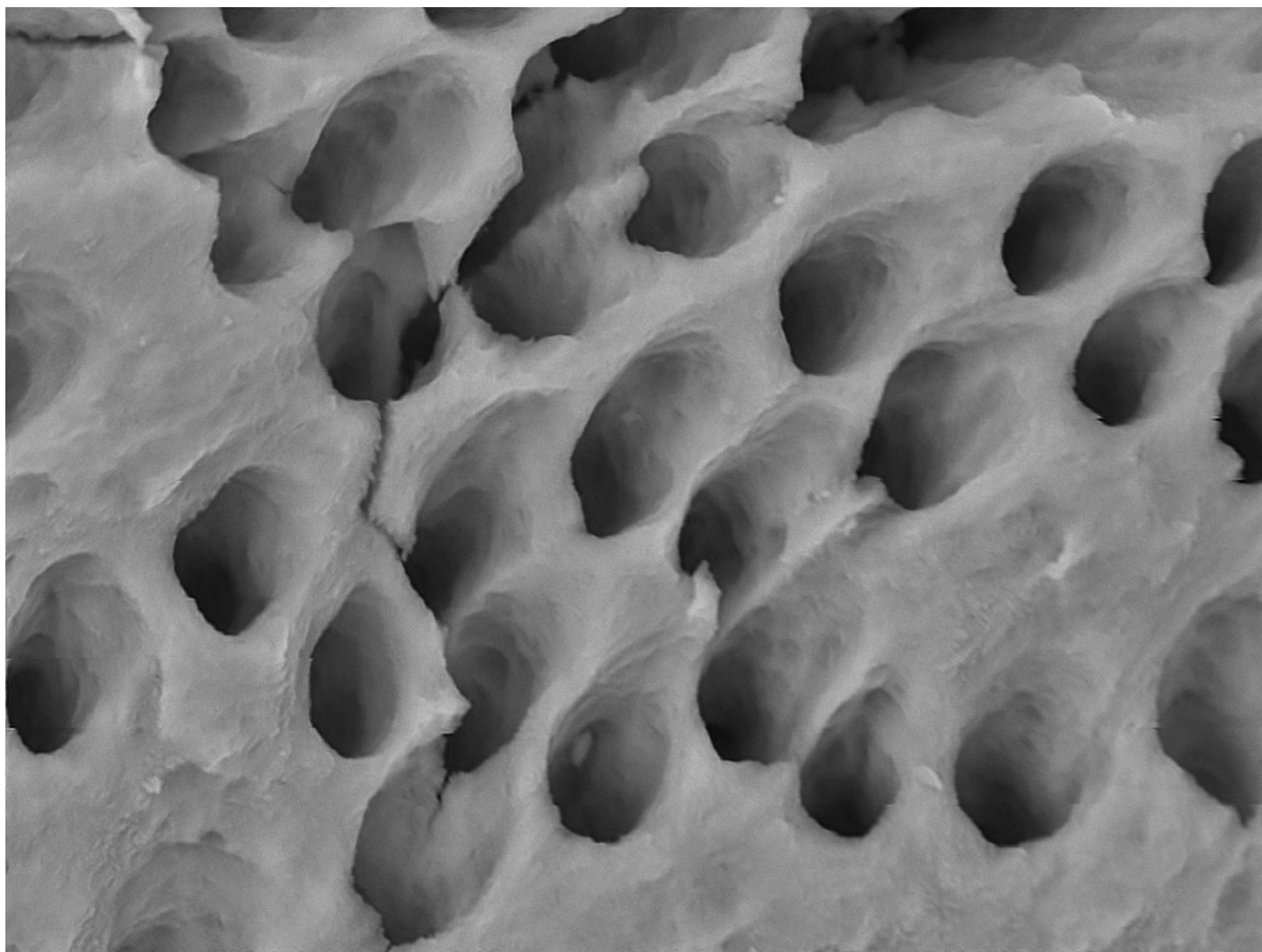
20 μ m

64) image180

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image181

image181



29340-18

2017/03/03 10:49 N

x5.0k

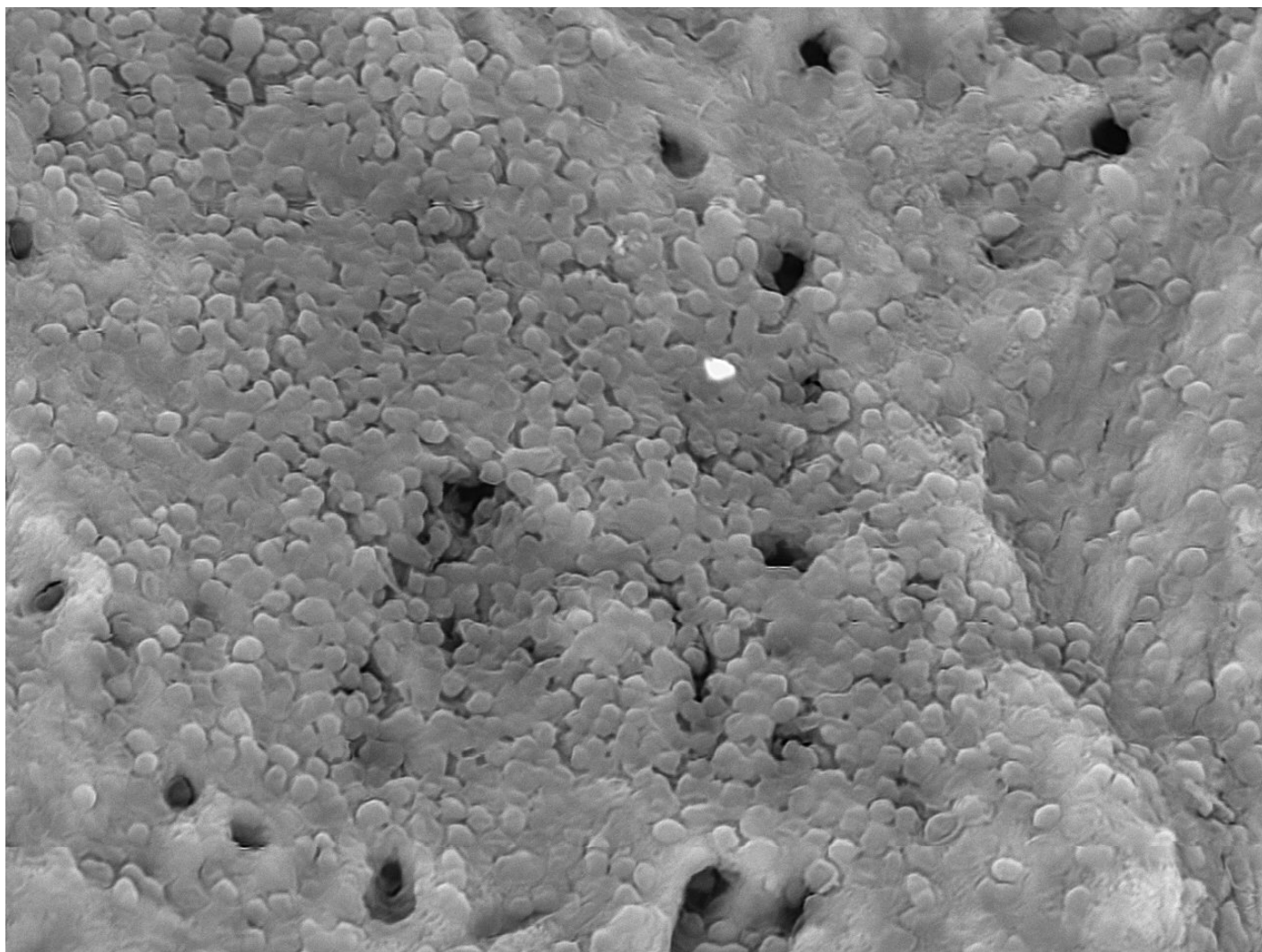
20 μ m

65) image181

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image182

image182



29965-2

2017/03/02 17:46 N

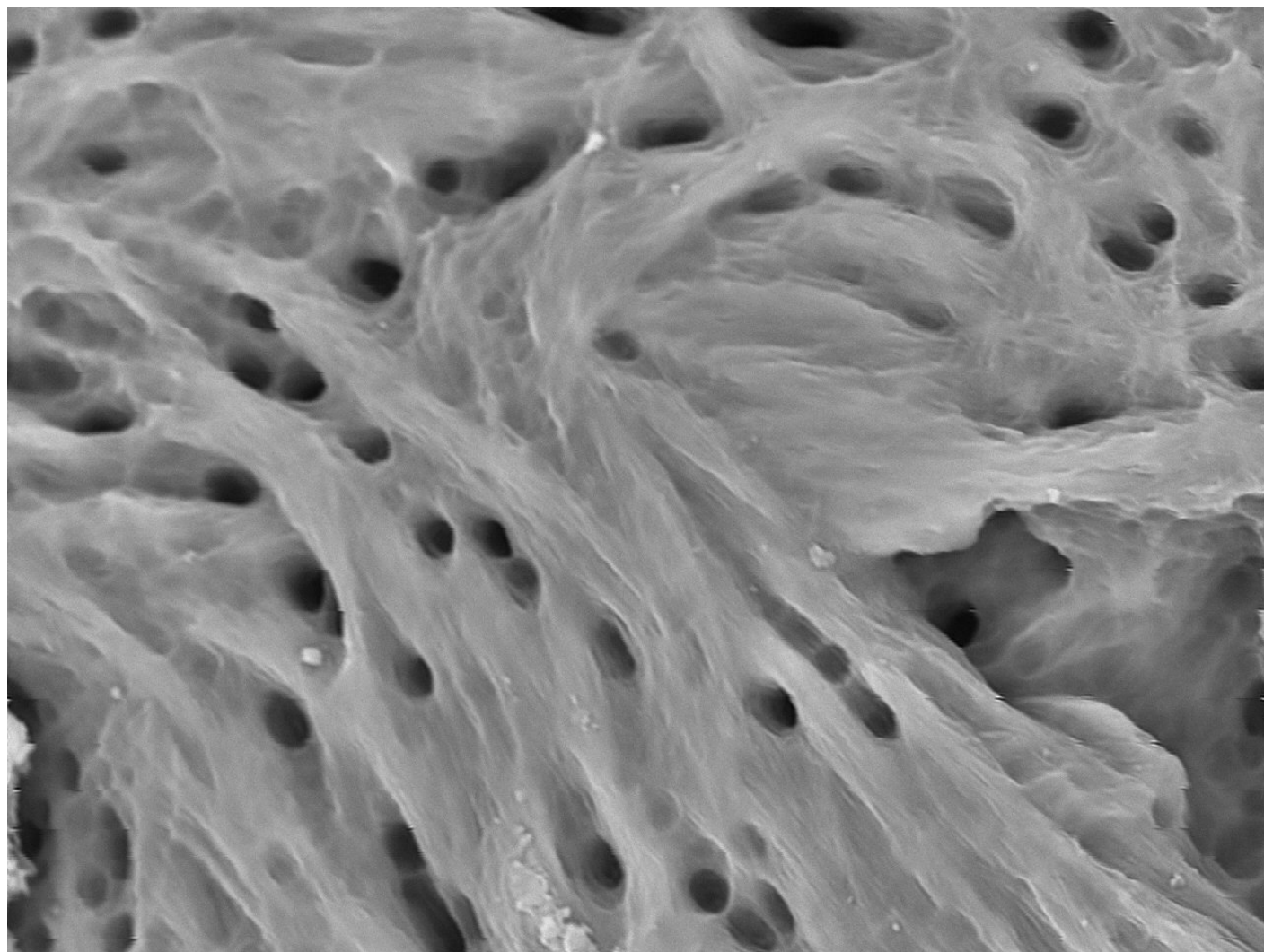
x5.0k 20 µm

66) image182

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image183

image183



29576-18

2017/03/01 11:50 N

x5.0k

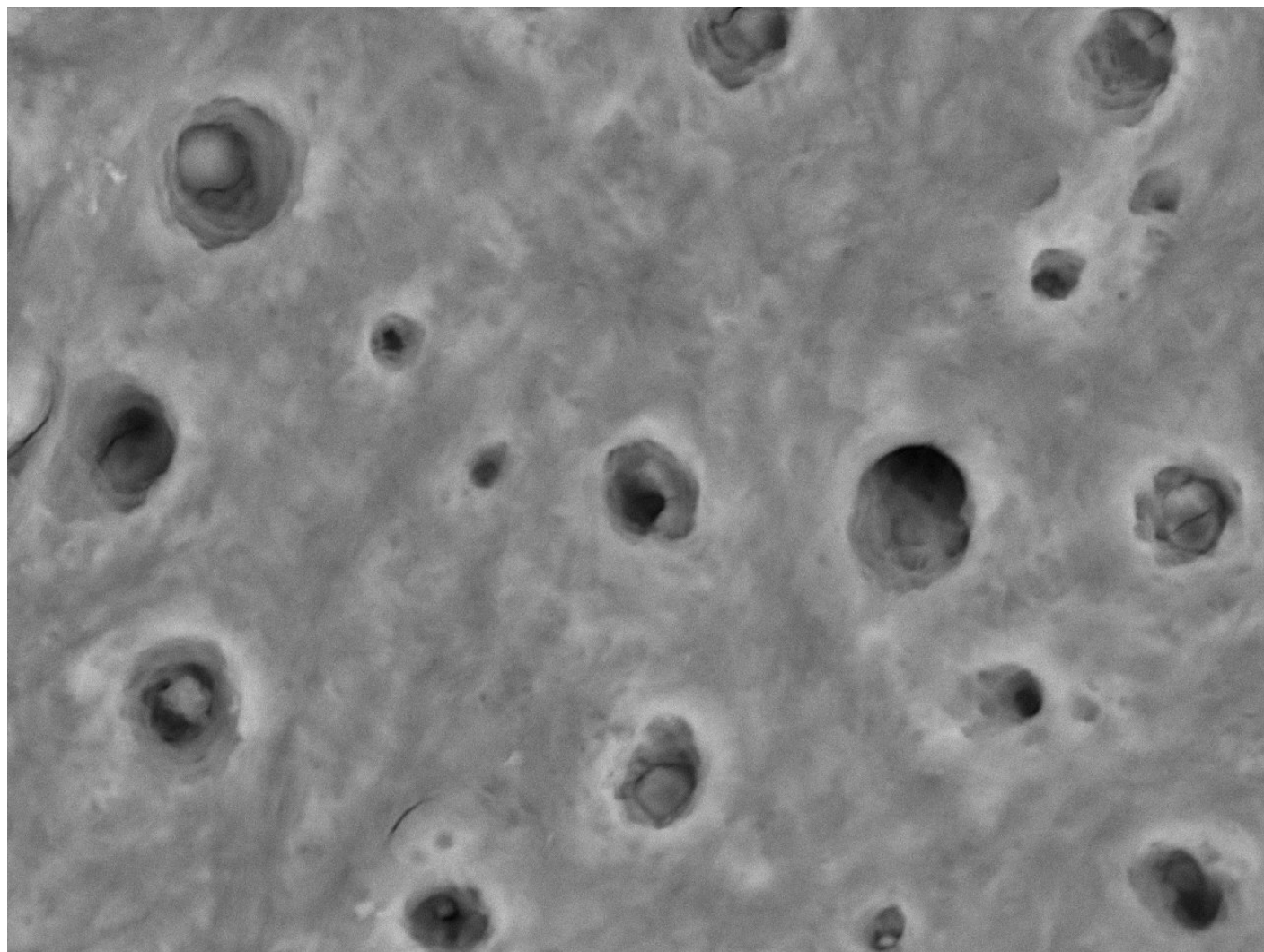
20 μm

67) image183

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image184

image184



29211-18

2017/03/04 14:02 N

x5.0k

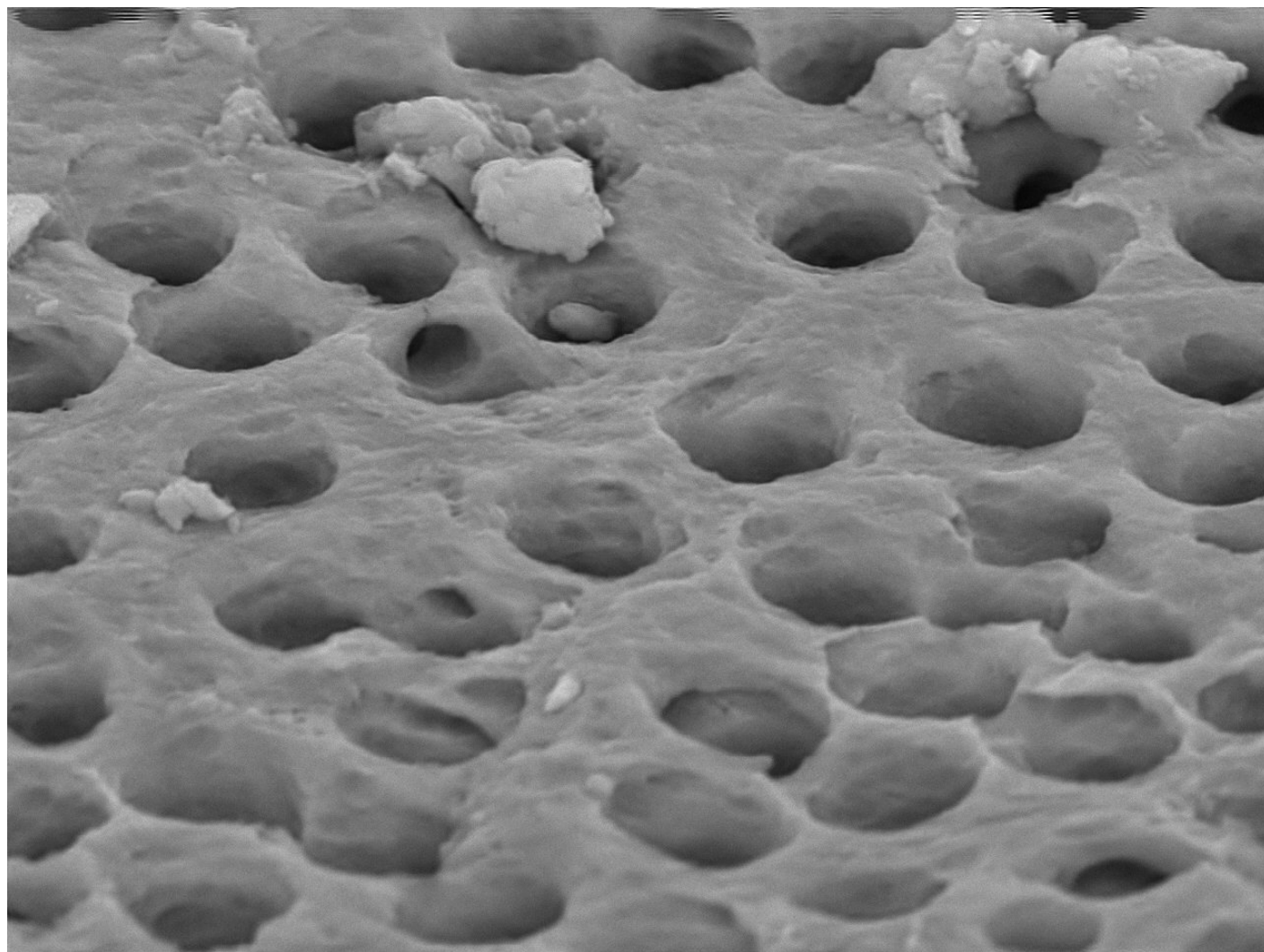
20 μ m

68) image184

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image185

image185



29265-2

2017/02/27 11:30 N

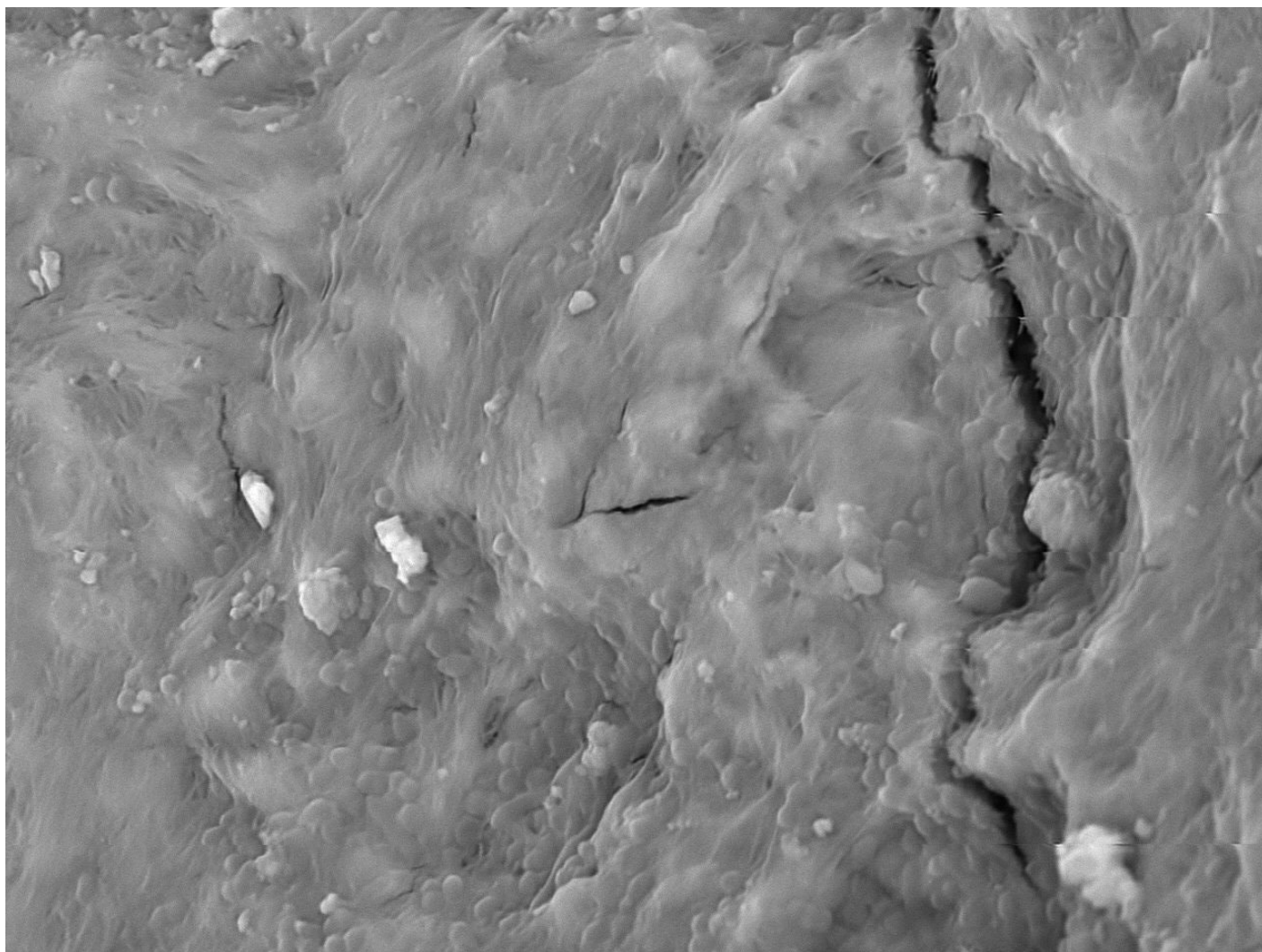
x5.0k 20 μ m

69) image185

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image186

image186



29052-14

2017/02/28 17:42 N

x5.0k

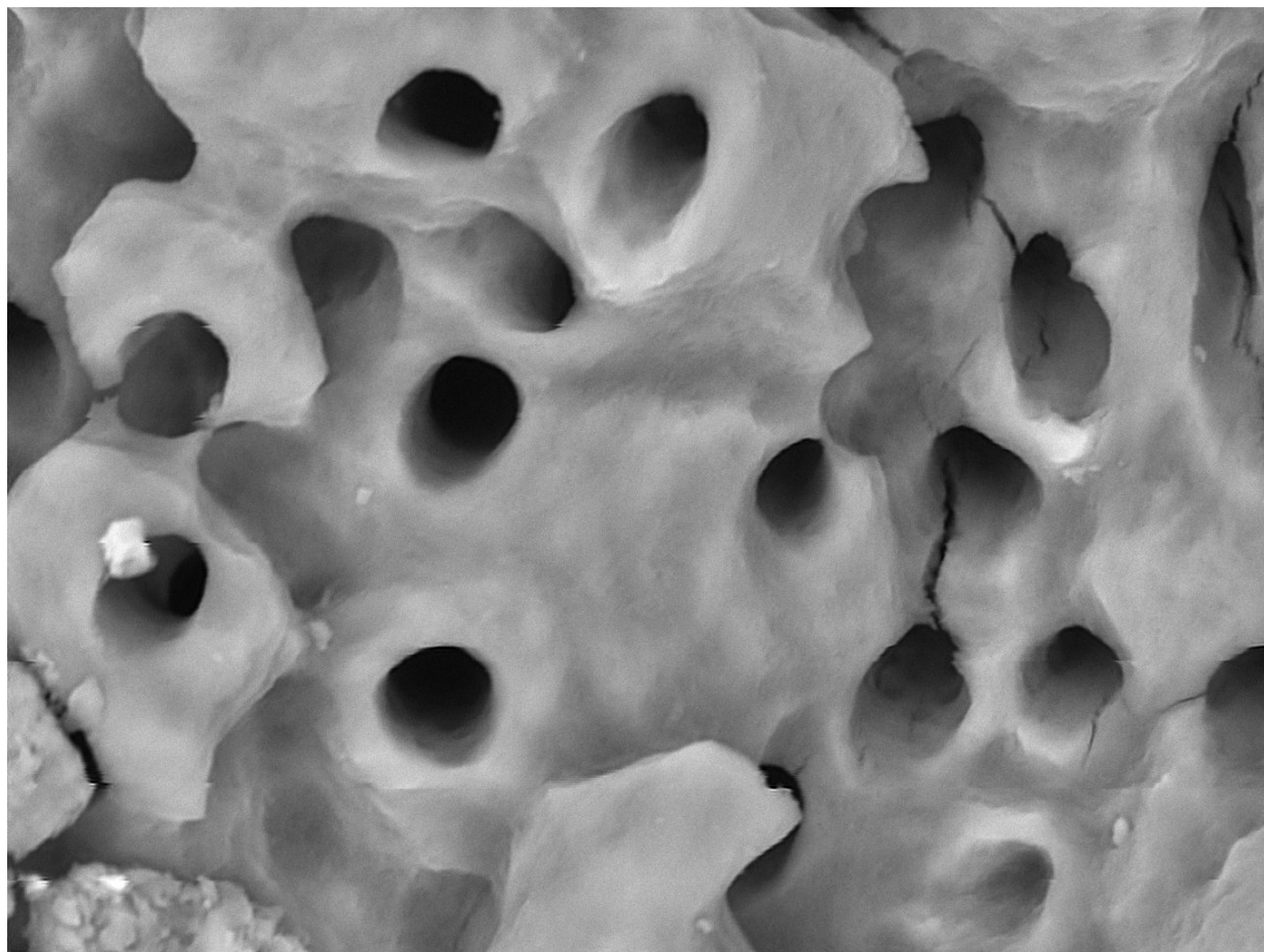
20 μ m

70) image186

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image187

image187



29179-3

2017/03/03 11:59 N

x5.0k

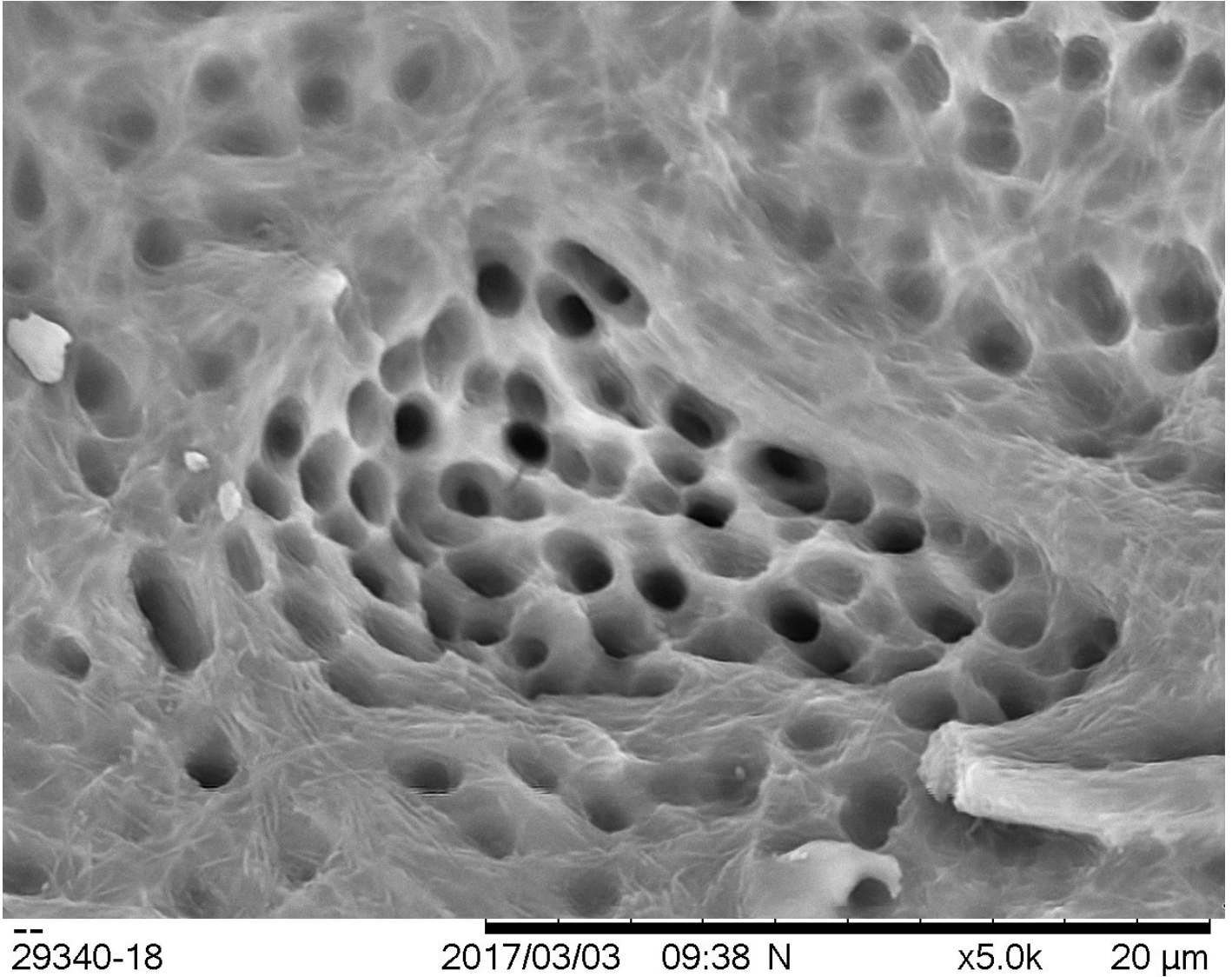
20 μm

71) image187

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image188

image188

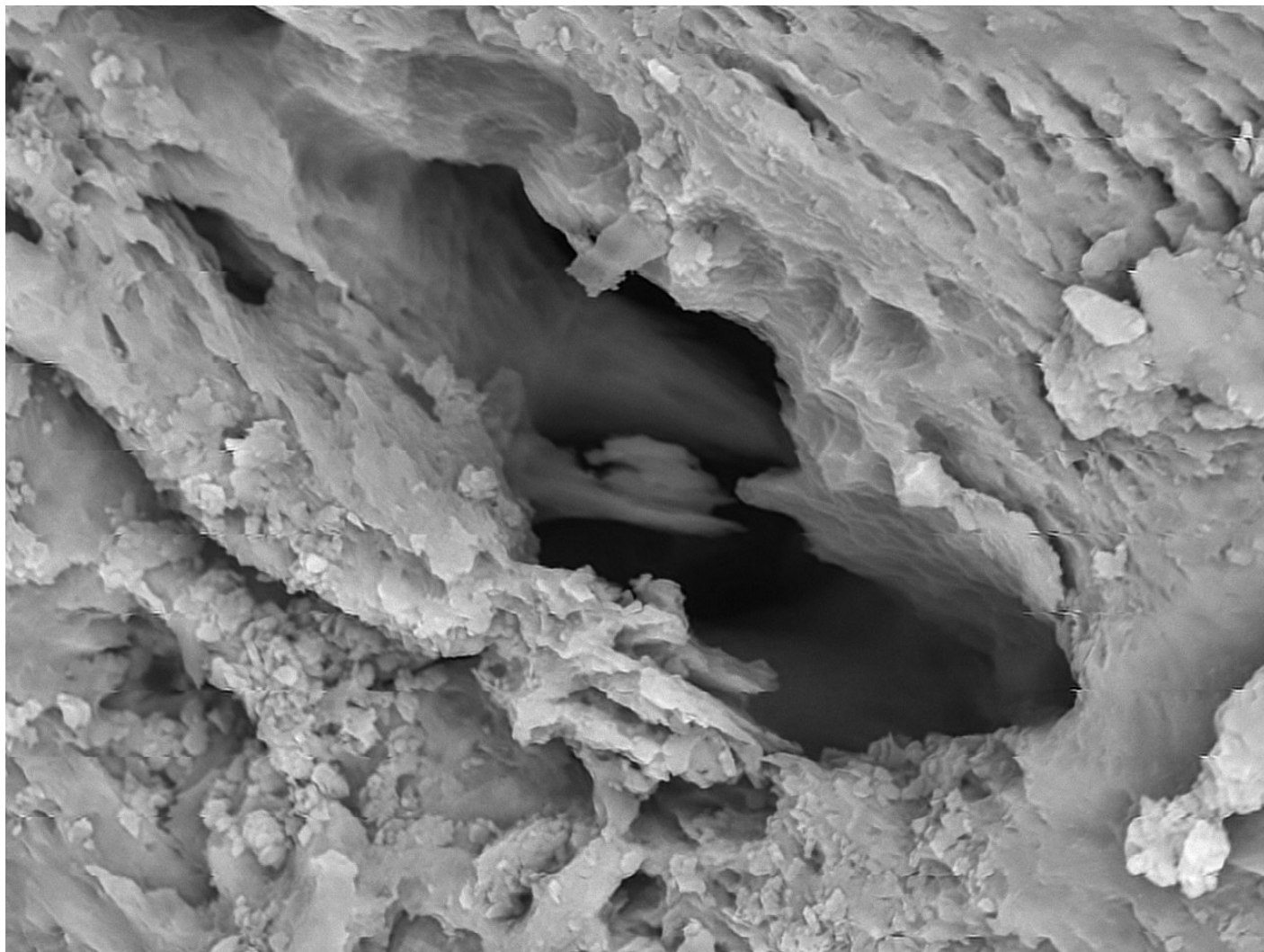


72) image188

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image189

image189



29211-18

2017/03/03 16:33 N

x5.0k

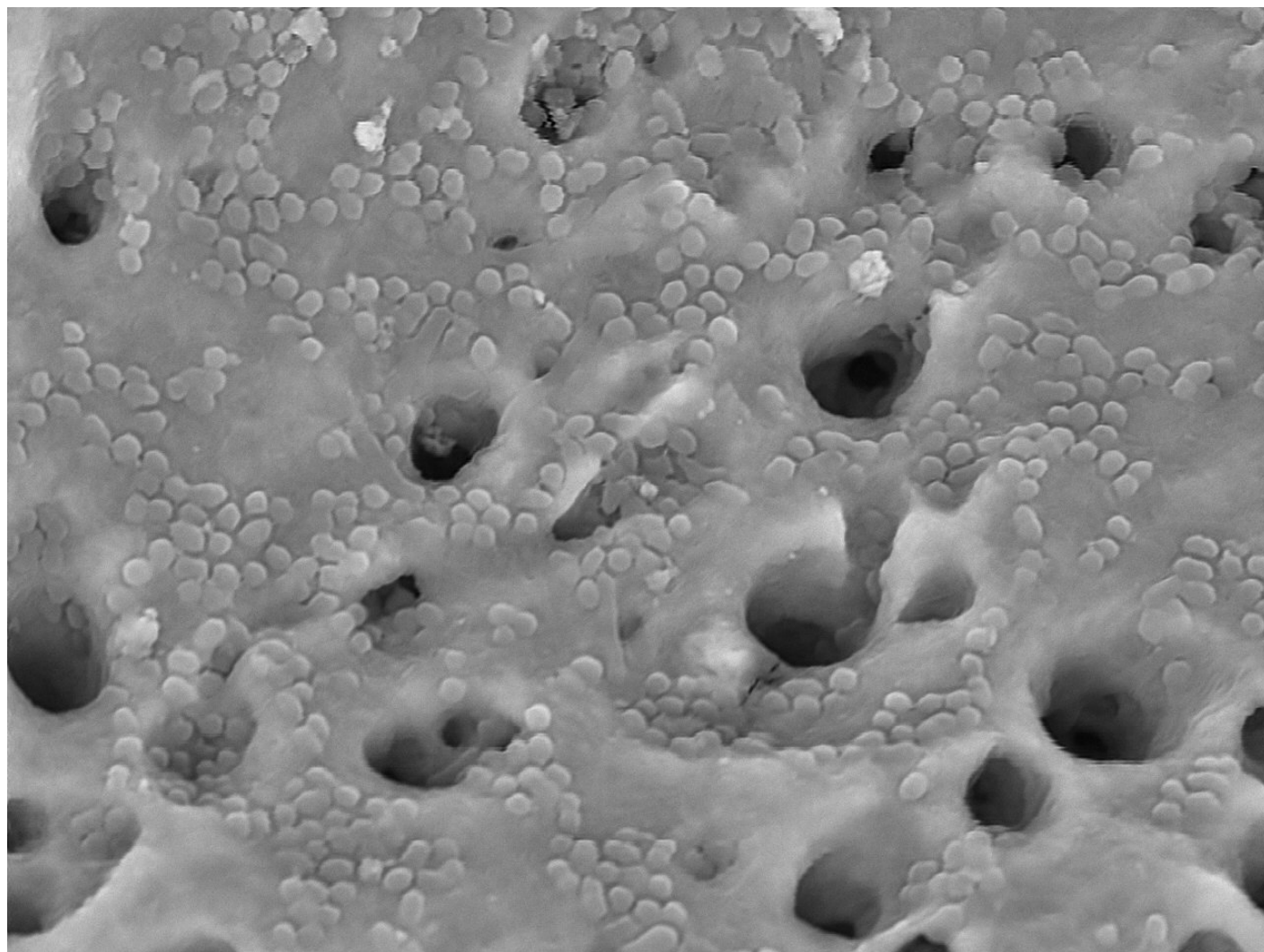
20 μ m

73) image189

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image190

image190



29965-2

2017/03/02 15:25 N

x5.0k

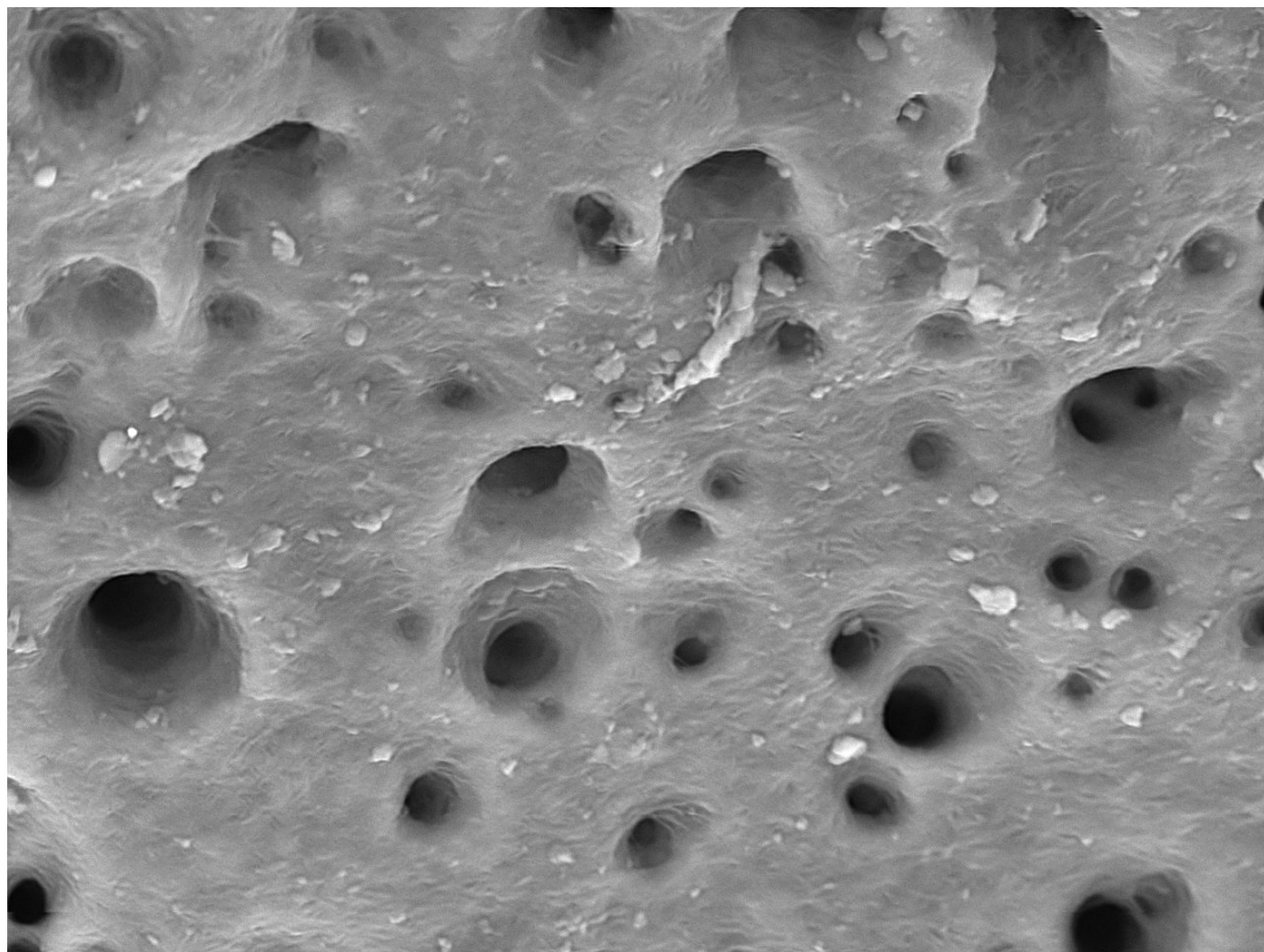
20 μ m

74) image190

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image191

image191



29694-2

2017/02/28 16:14 N

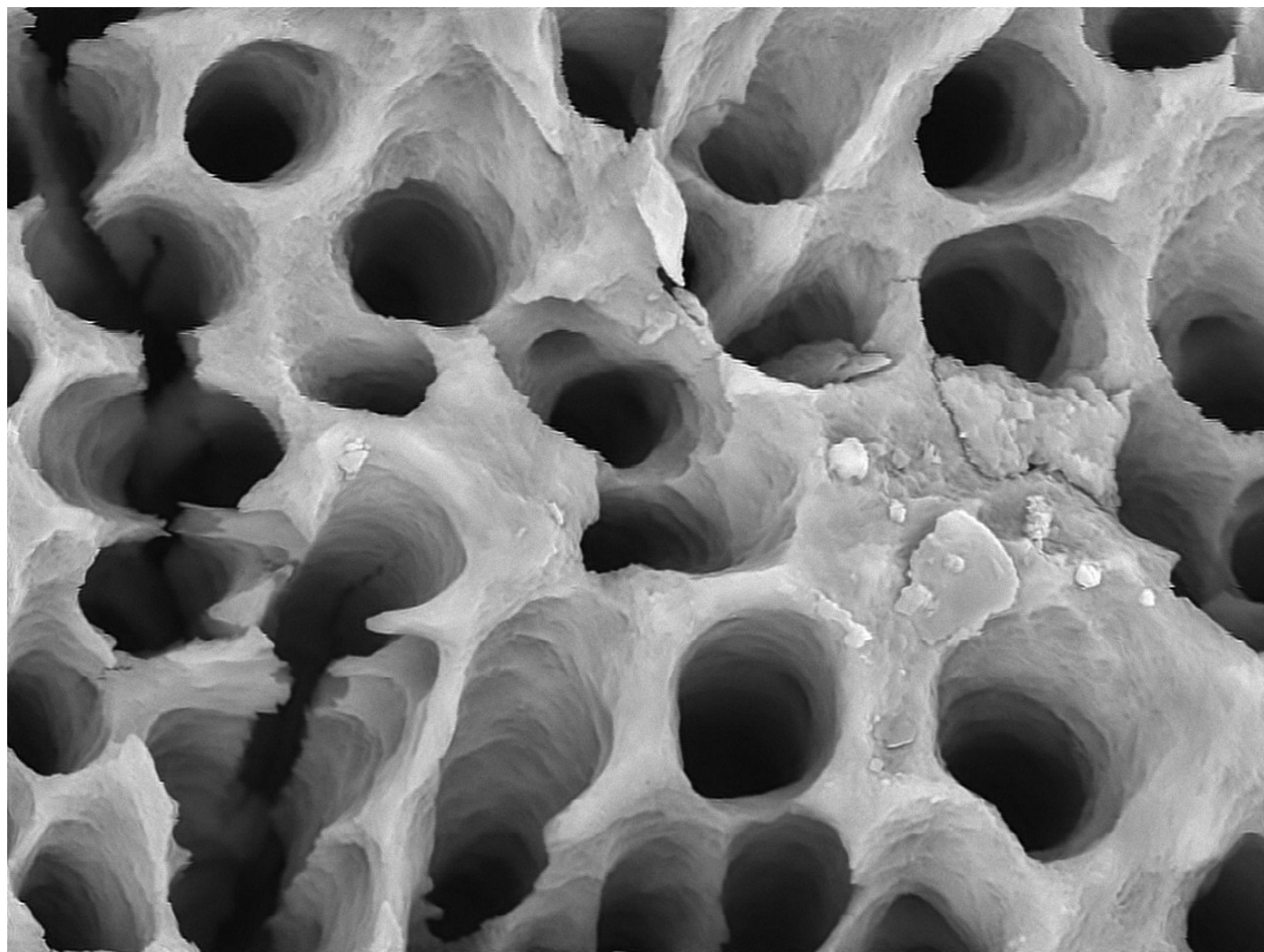
x5.0k 20 μm

75) image191

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image192

image192



29340-18

2017/03/03 10:26 N

x5.0k

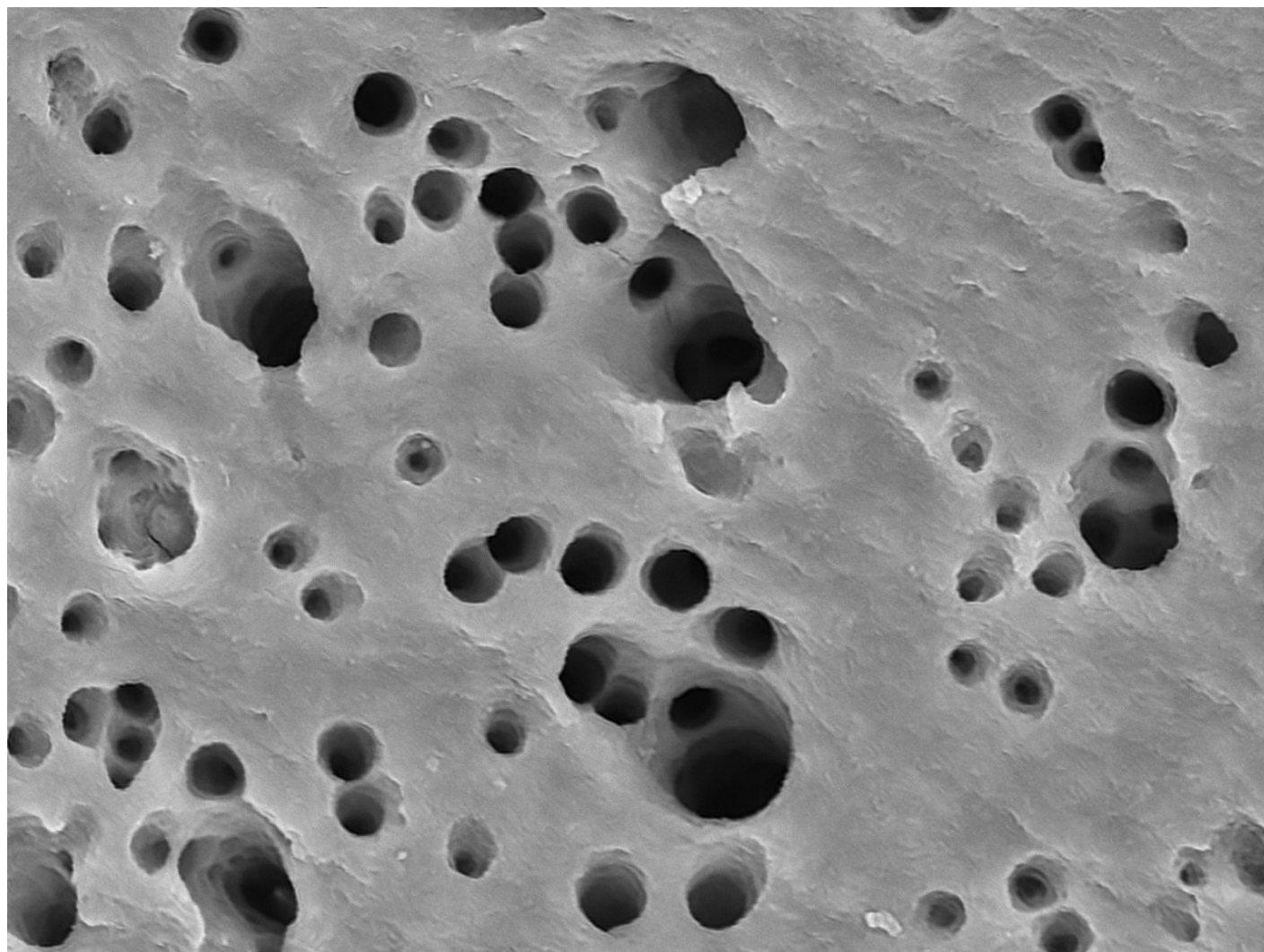
20 μm

76) image192

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image193

image193



29211-18

2017/03/04 13:55 N

x5.0k

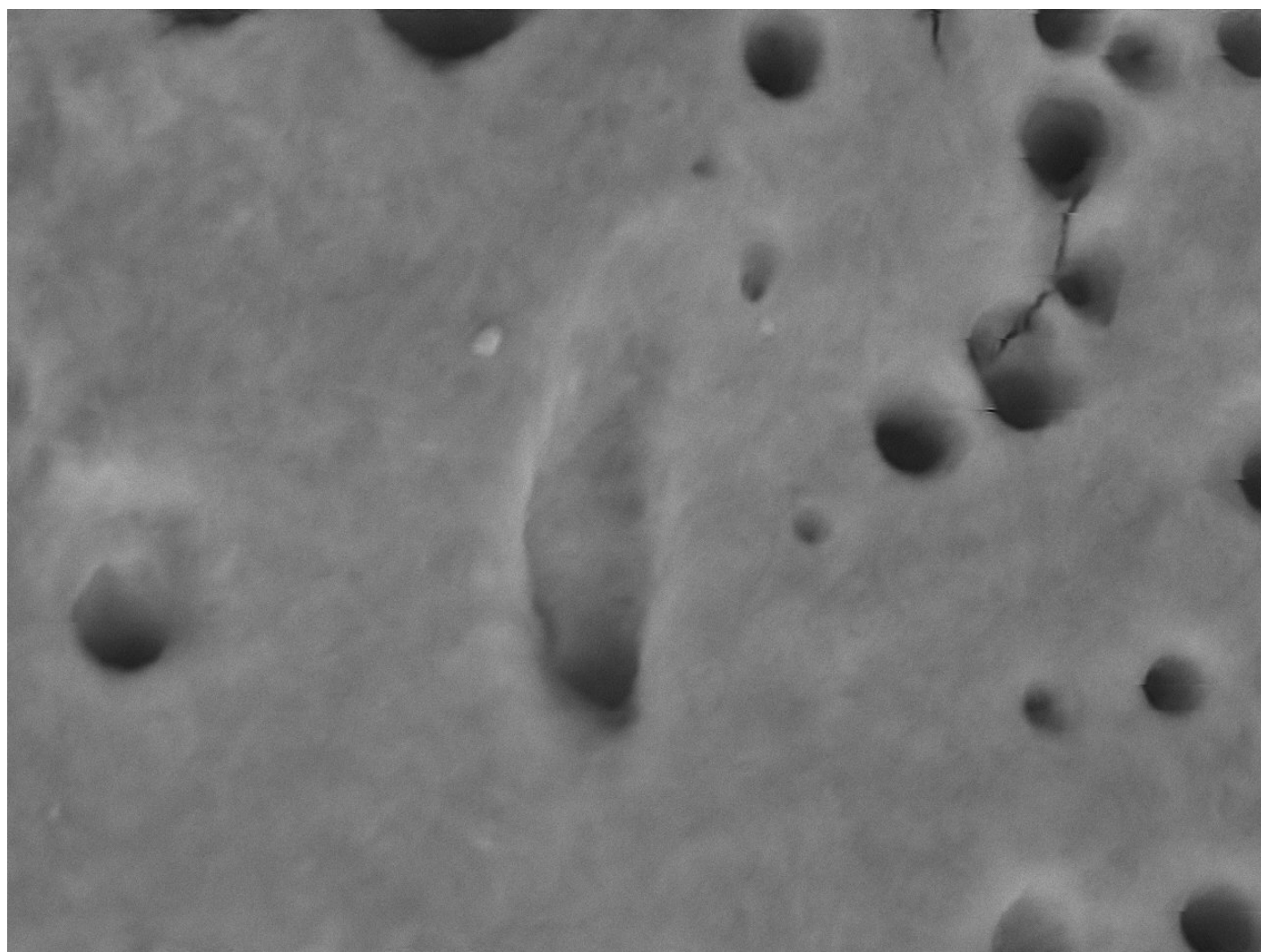
20 μm

77) image193

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image194

image194



29009-31

2017/03/06 09:06 N

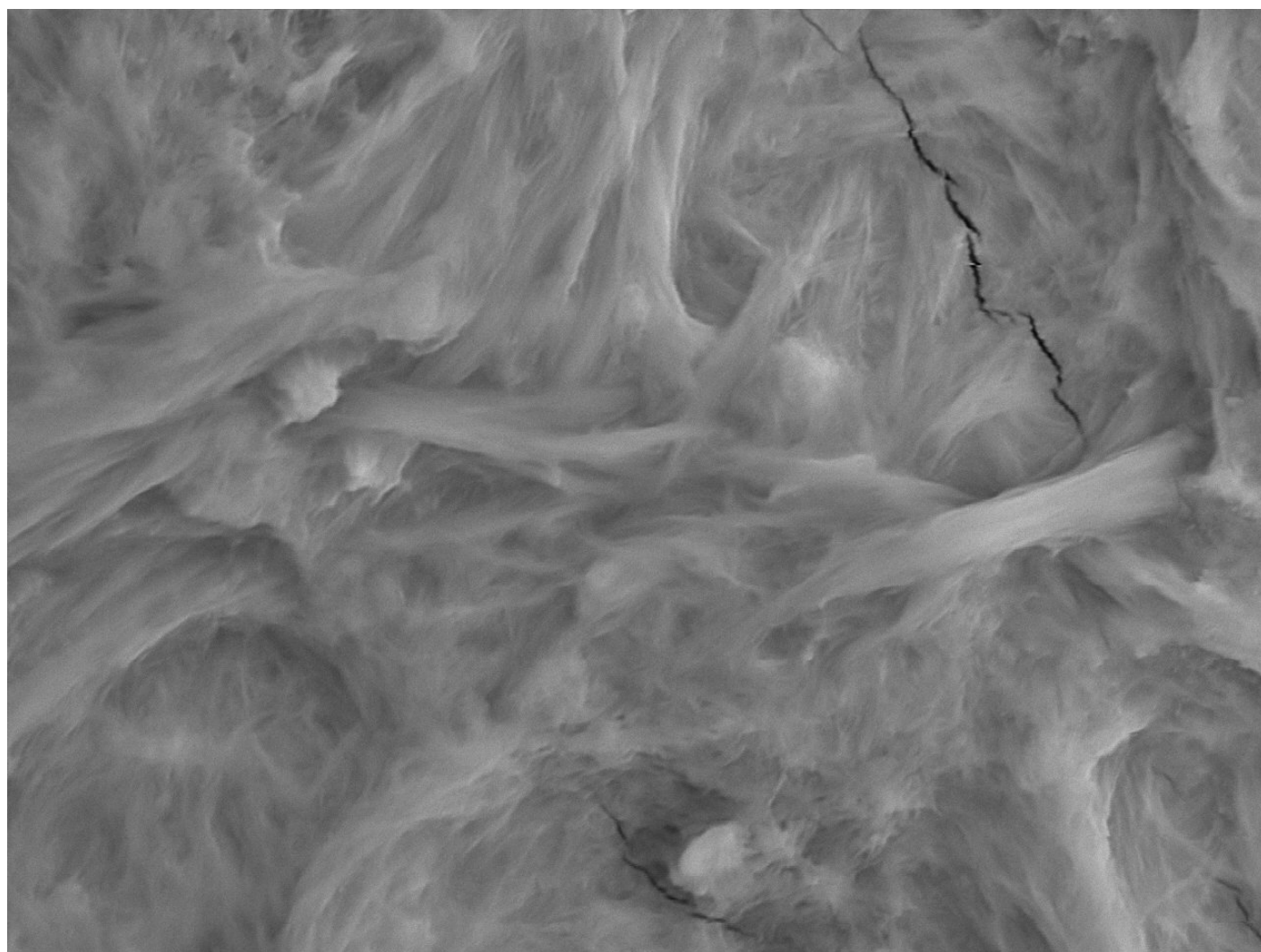
x5.0k 20 μ m

78) image194

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image195

image195



29028-15

2017/03/04 15:31 N

x5.0k

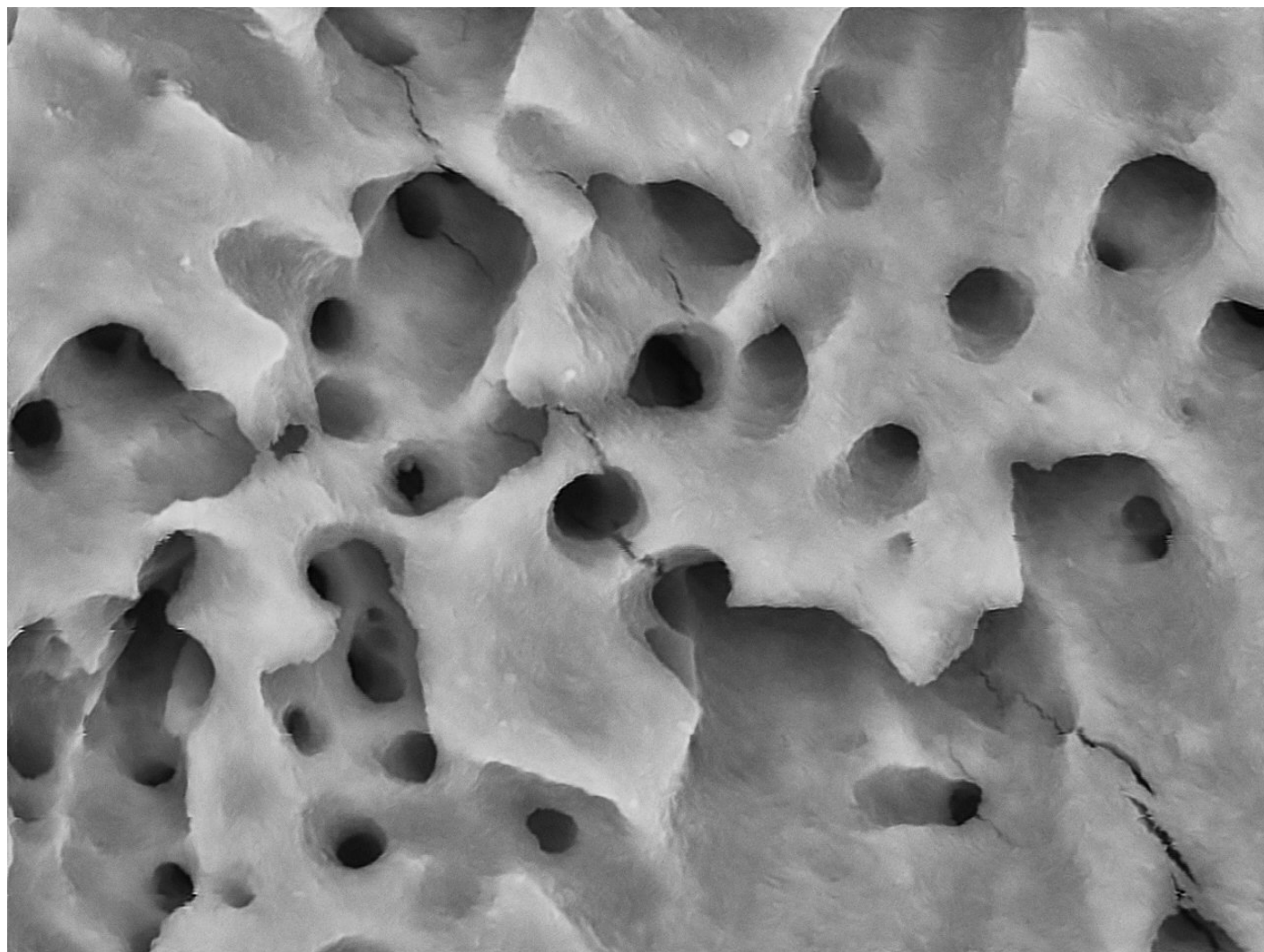
20 μm

79) image195

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image196

image196



29963-15

2017/03/01 14:16 N

x5.0k

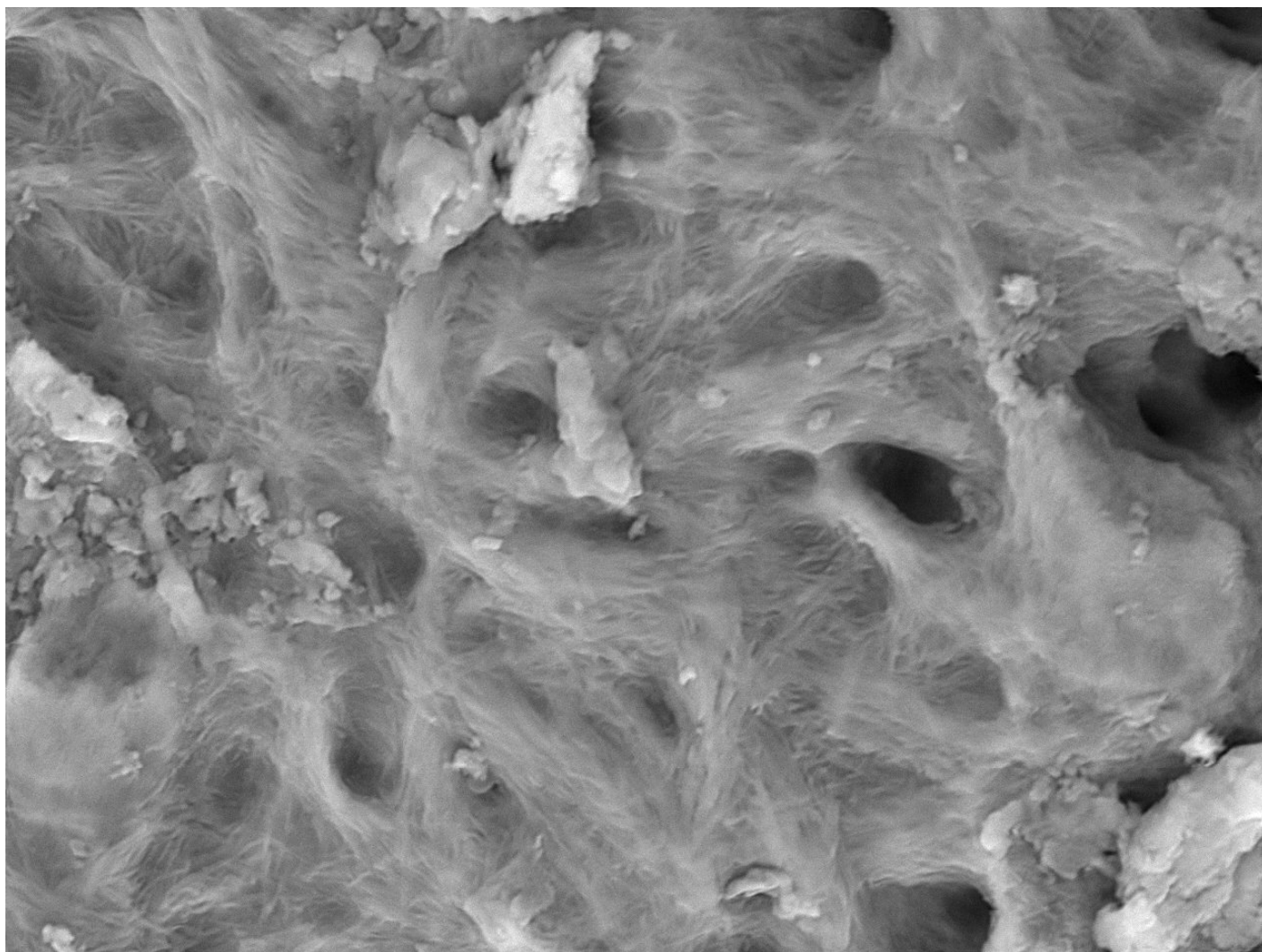
20 μ m

80) image196

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image197

image197



29052-14

2017/02/28 18:19 N

x5.0k

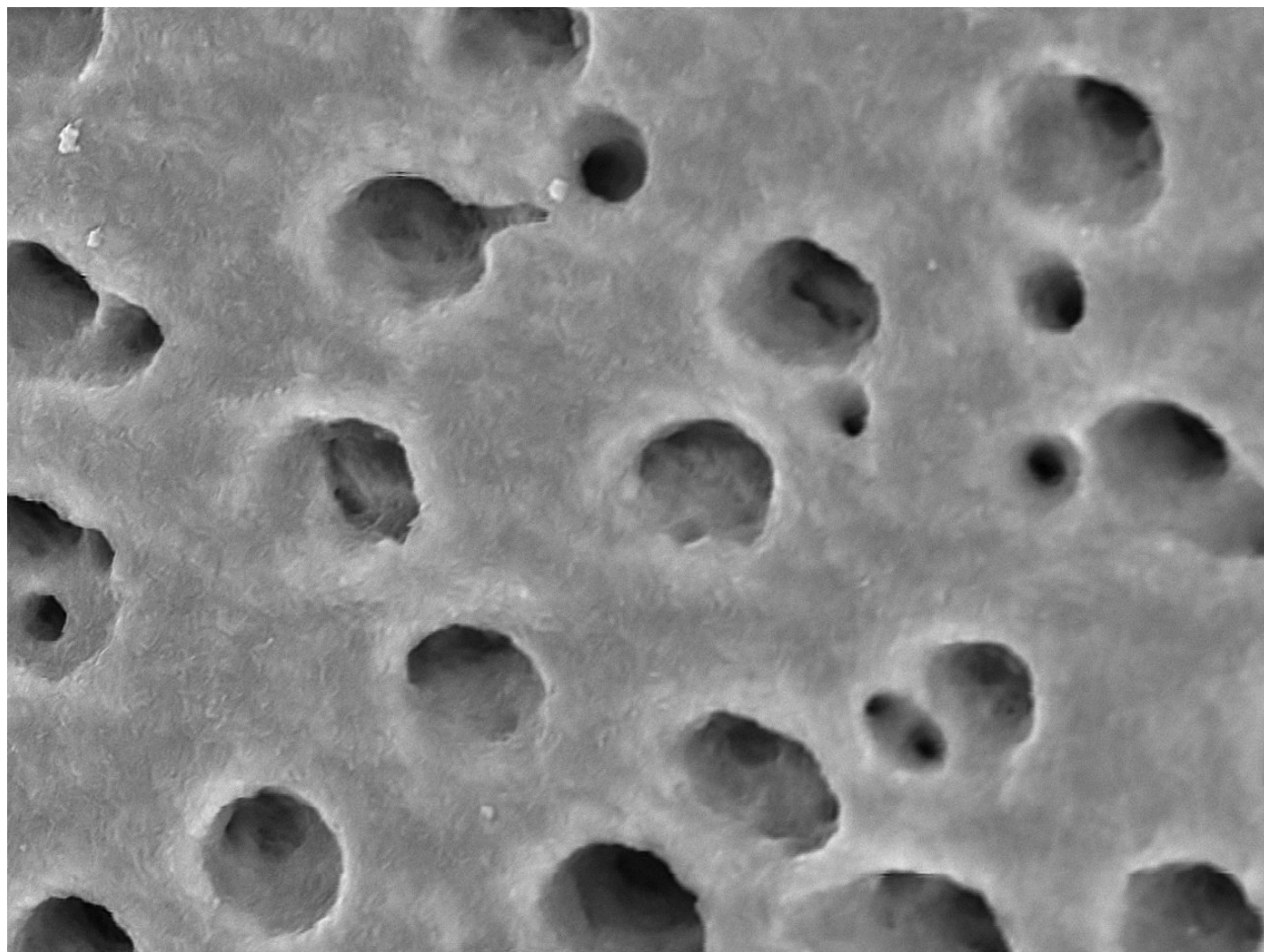
20 μ m

81) image197

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image198

image198



29340-18

2017/03/03 10:43 N

x5.0k

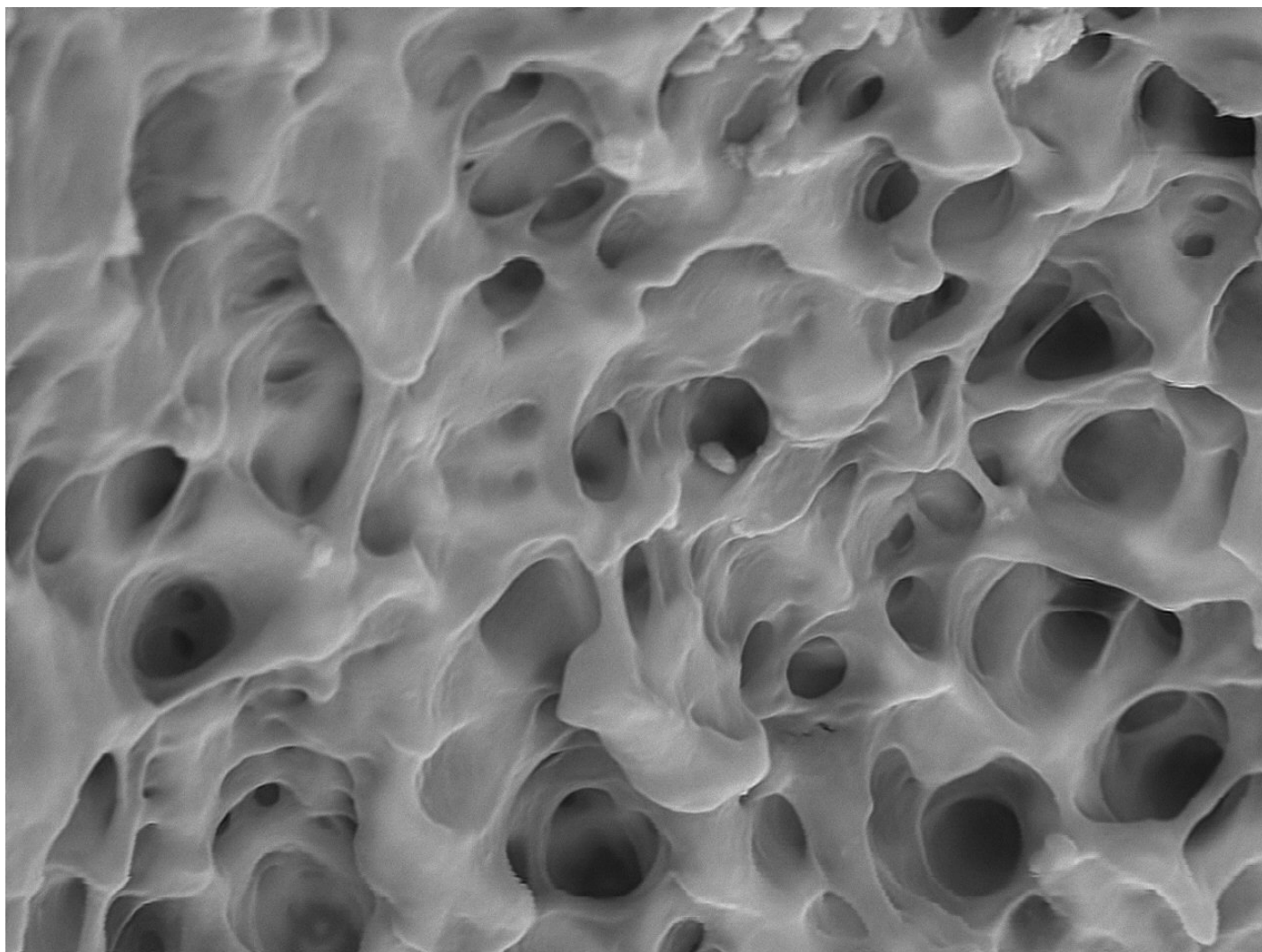
20 μm

82) image198

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image199

image199



29960-14

2017/03/01 10:33 N

x5.0k

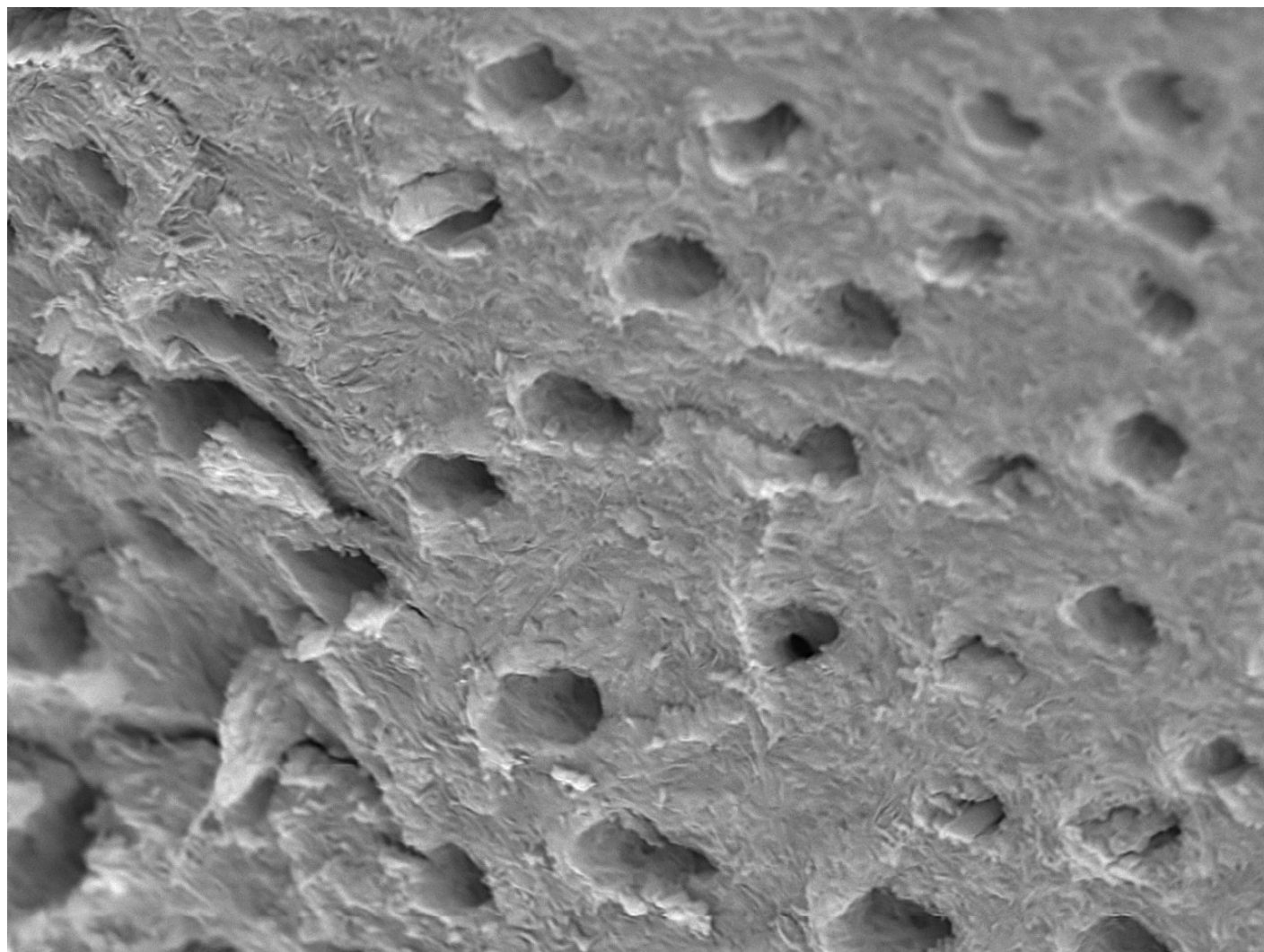
20 μ m

83) image199

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image200

image200



29565-15

2017/02/28 15:32 N

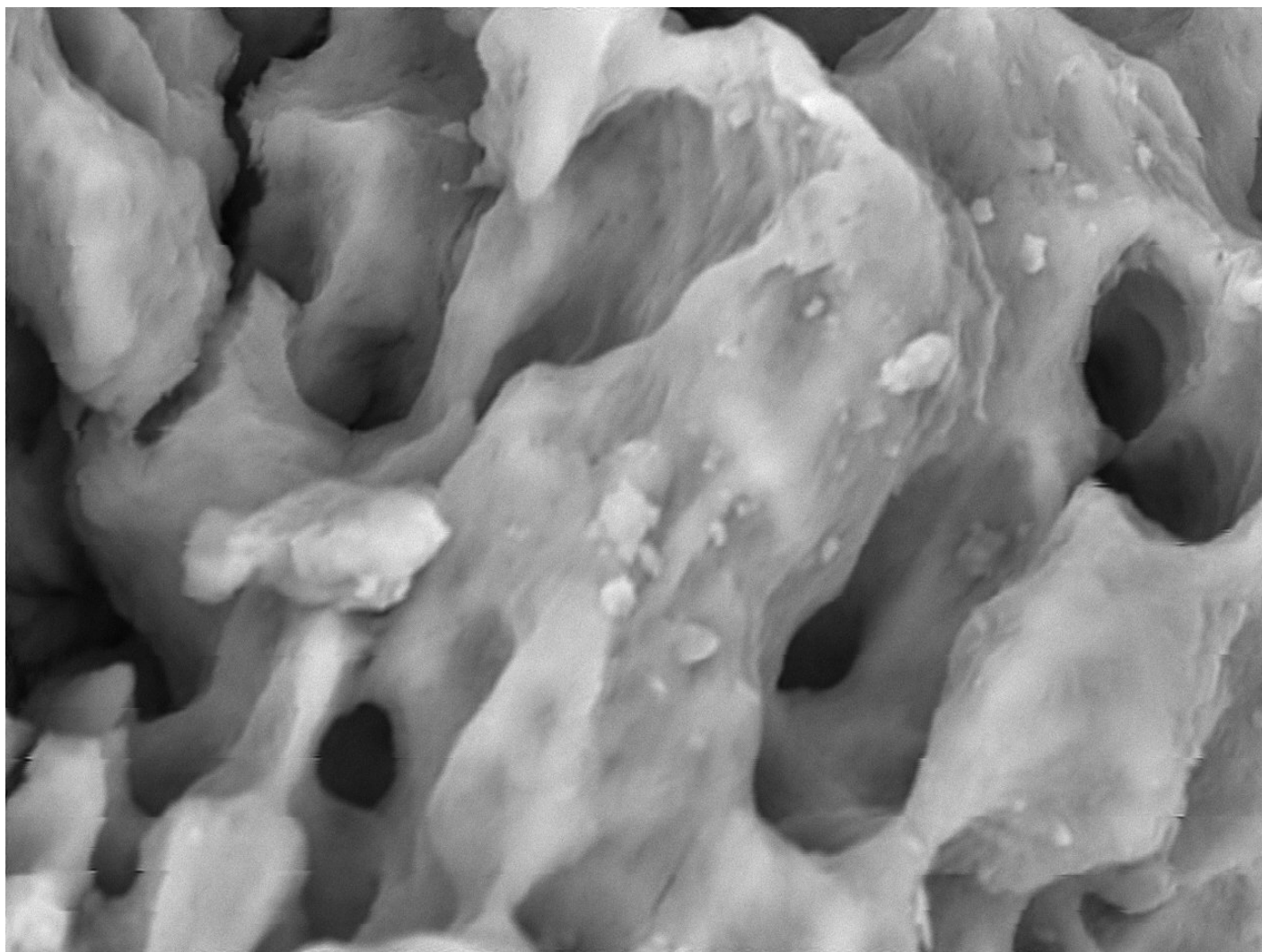
x5.0k 20 μm

84) image200

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image201

image201



29179-3

2017/03/03 12:03 N

x5.0k

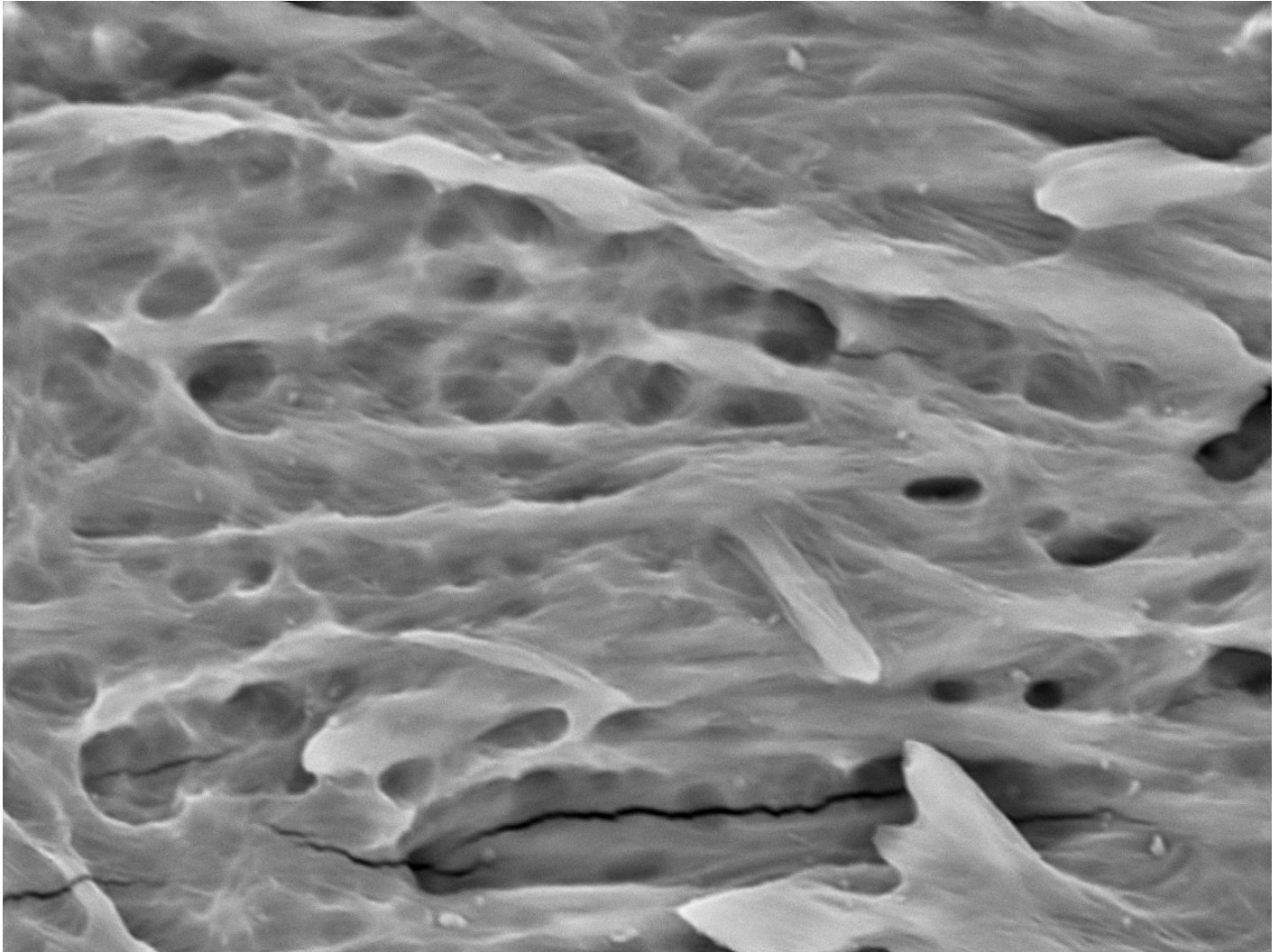
20 μ m

85) image201

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image202

image202



29679-3

2017/02/27 15:31 N

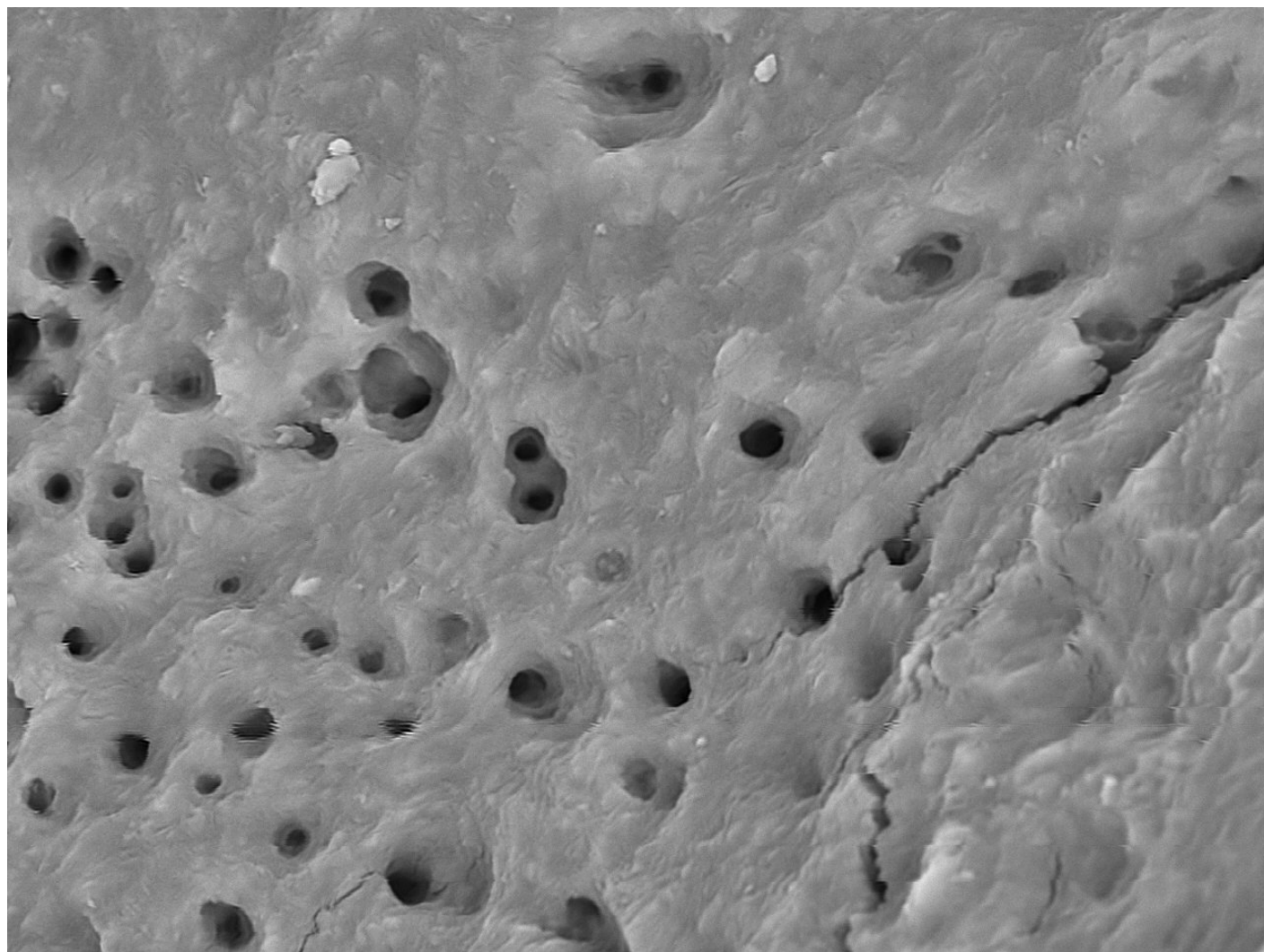
x5.0k 20 μ m

86) image202

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image203

image203



29052-14

2017/02/28 18:00 N

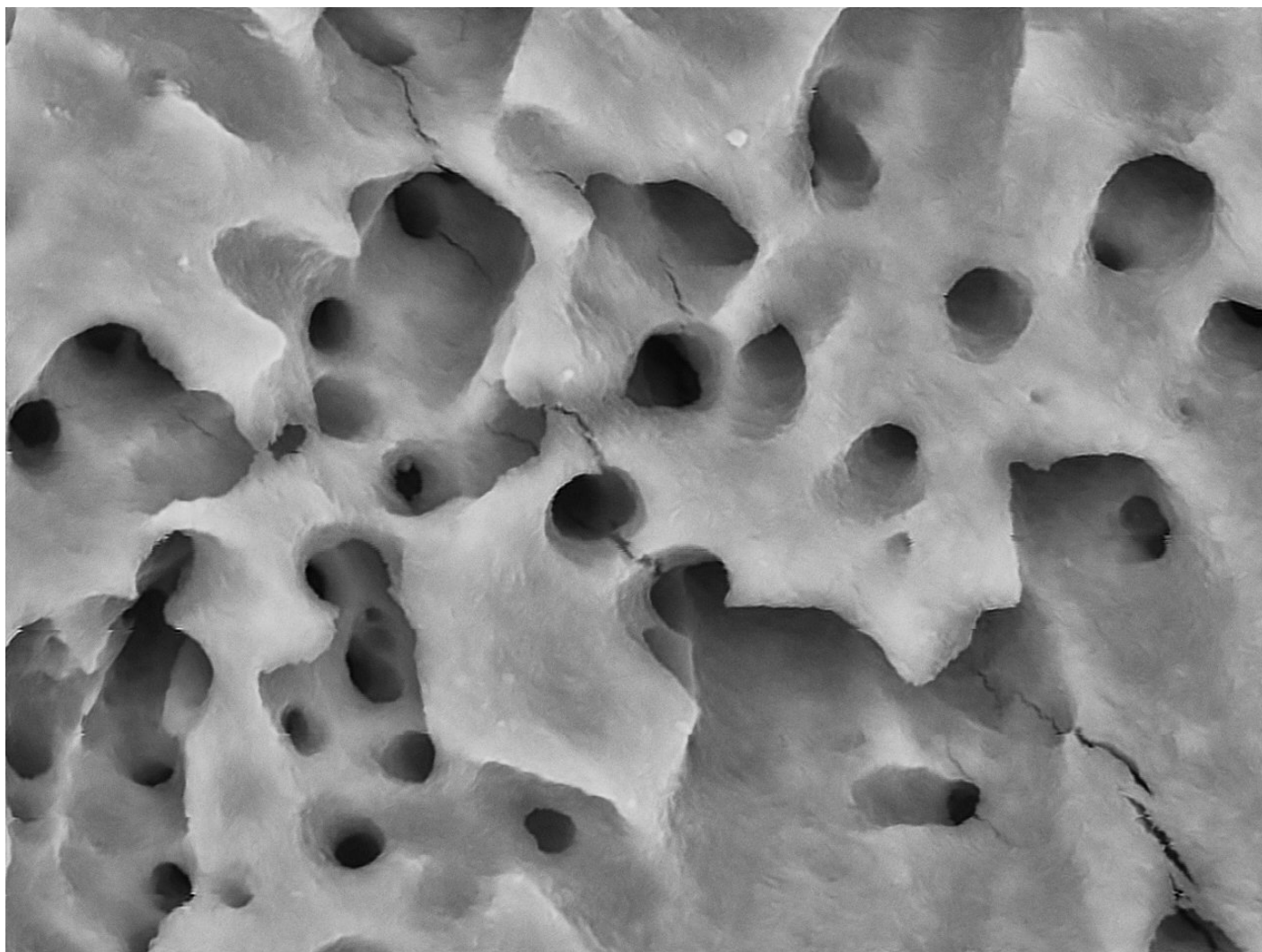
x5.0k 20 μm

87) image203

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image204

image204



29963-15

2017/03/01 14:16 N

x5.0k

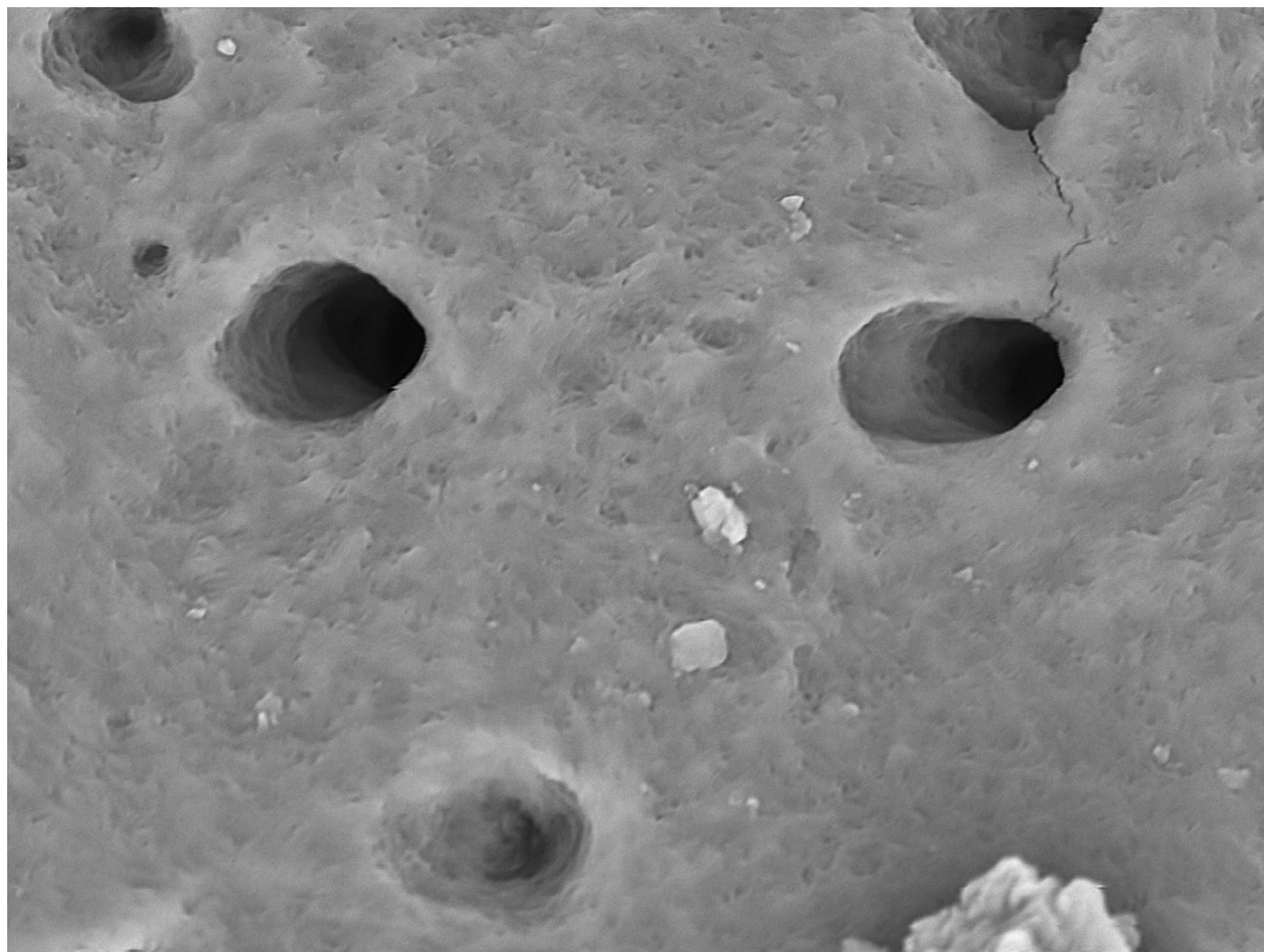
20 μ m

88) image204

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image205

image205



29576-18

2017/03/01 11:25 N

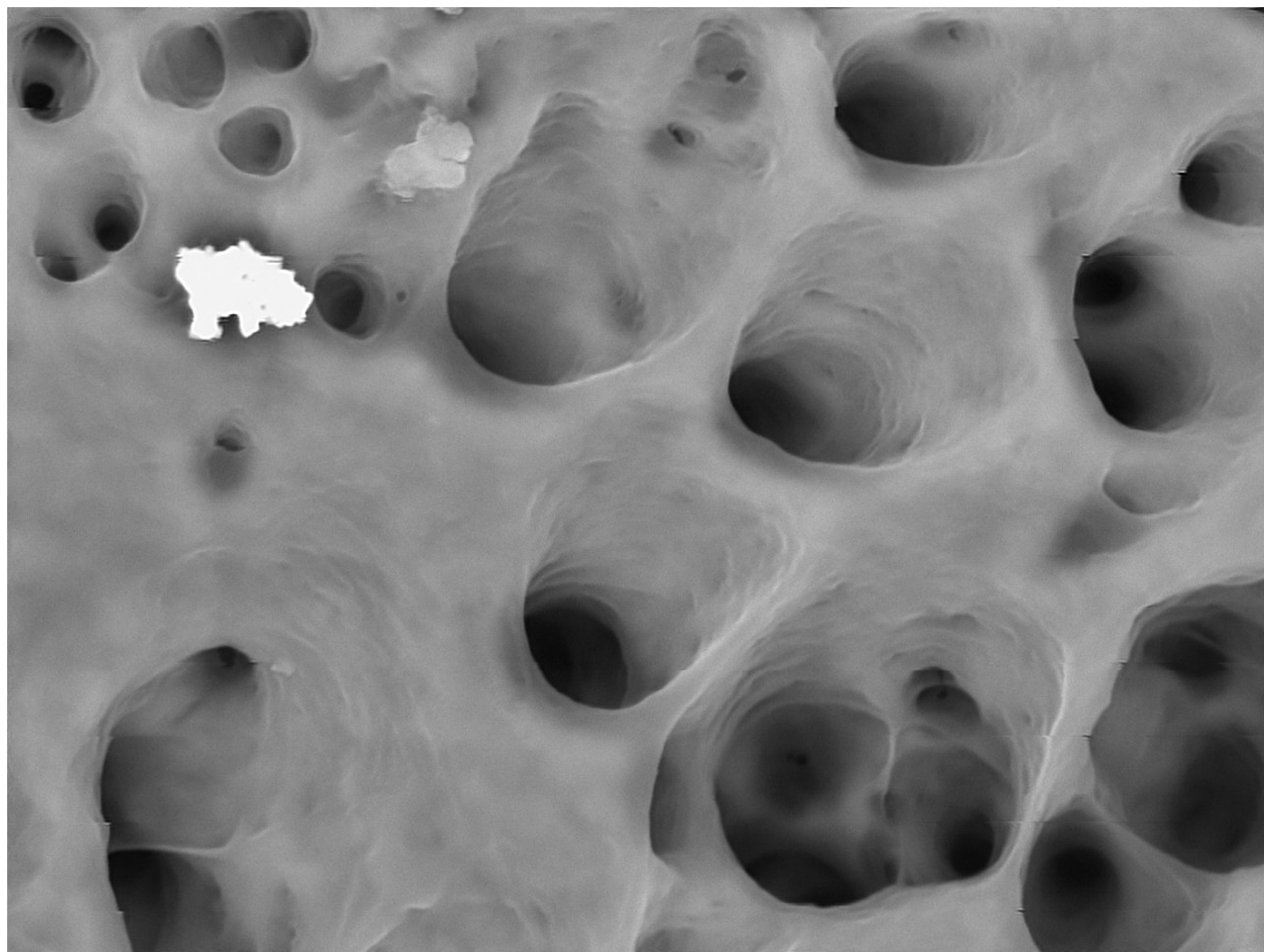
x5.0k 20 μ m

89) image205

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image206

image206



29963-15

2017/03/01 10:08 N

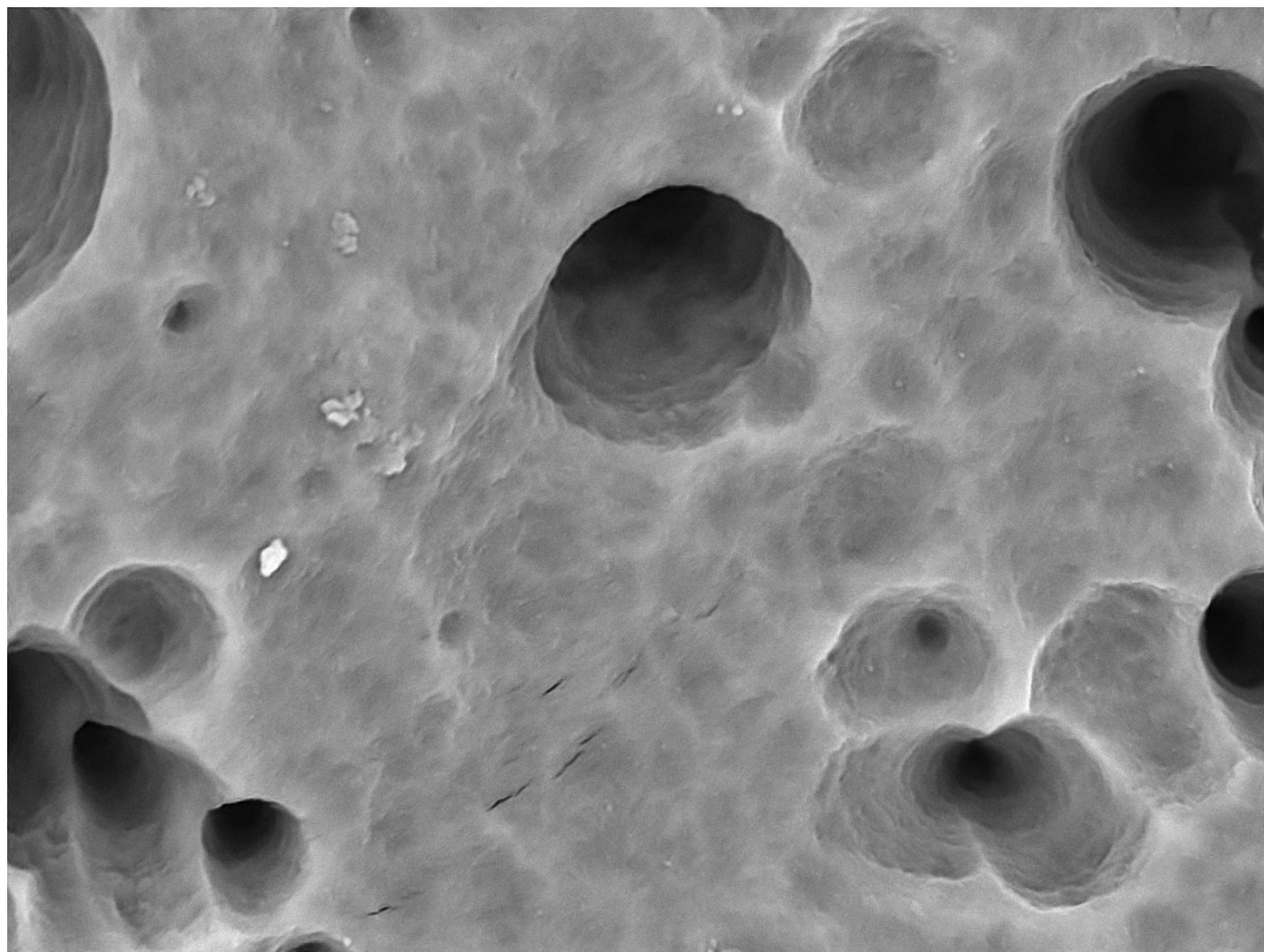
x5.0k 20 μ m

90) image206

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image207

image207



29211-18

2017/03/03 16:16 N

x5.0k

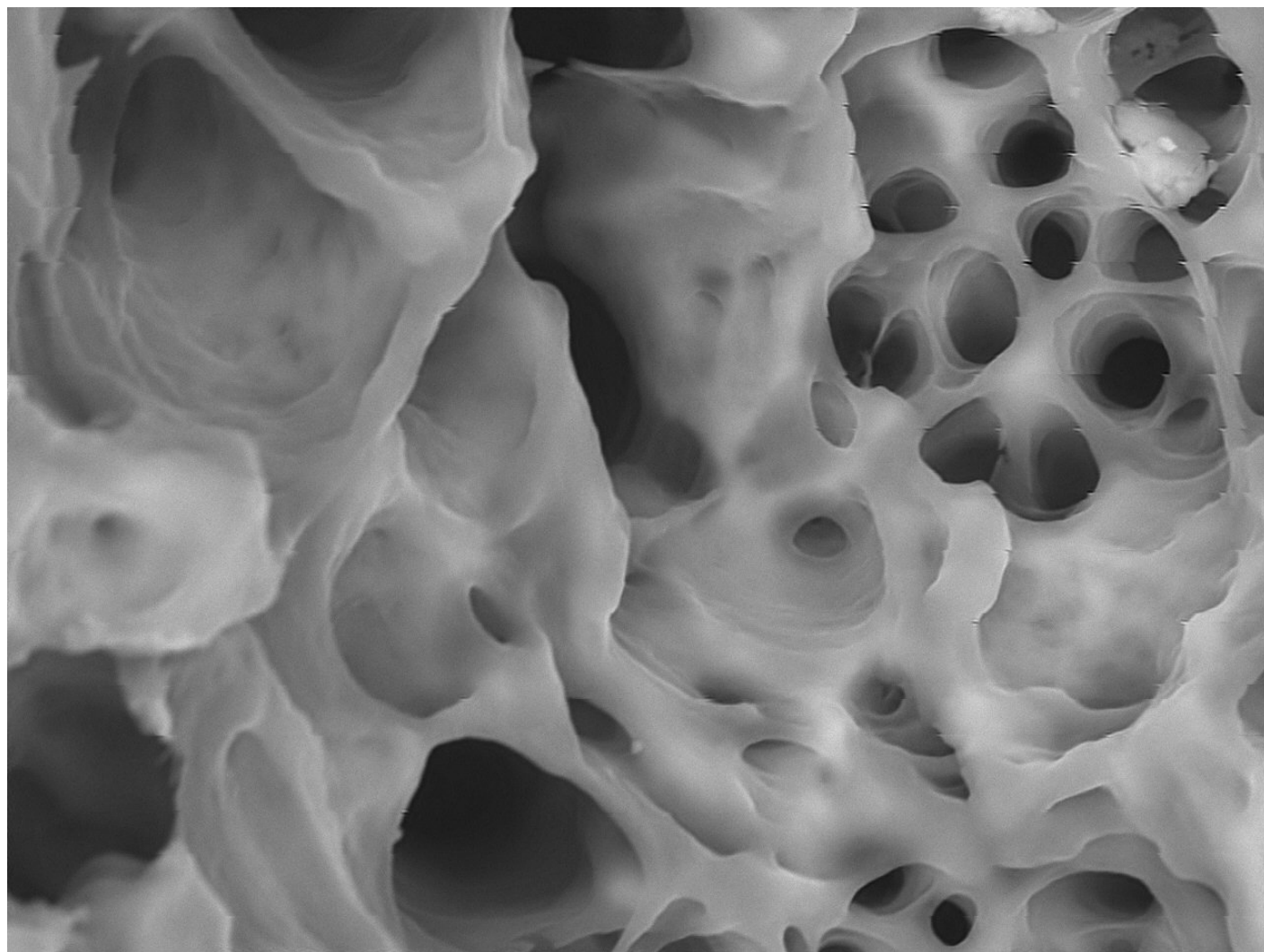
20 µm

91) image207

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image208

image208



29960-14

2017/03/01 10:38 N

x5.0k

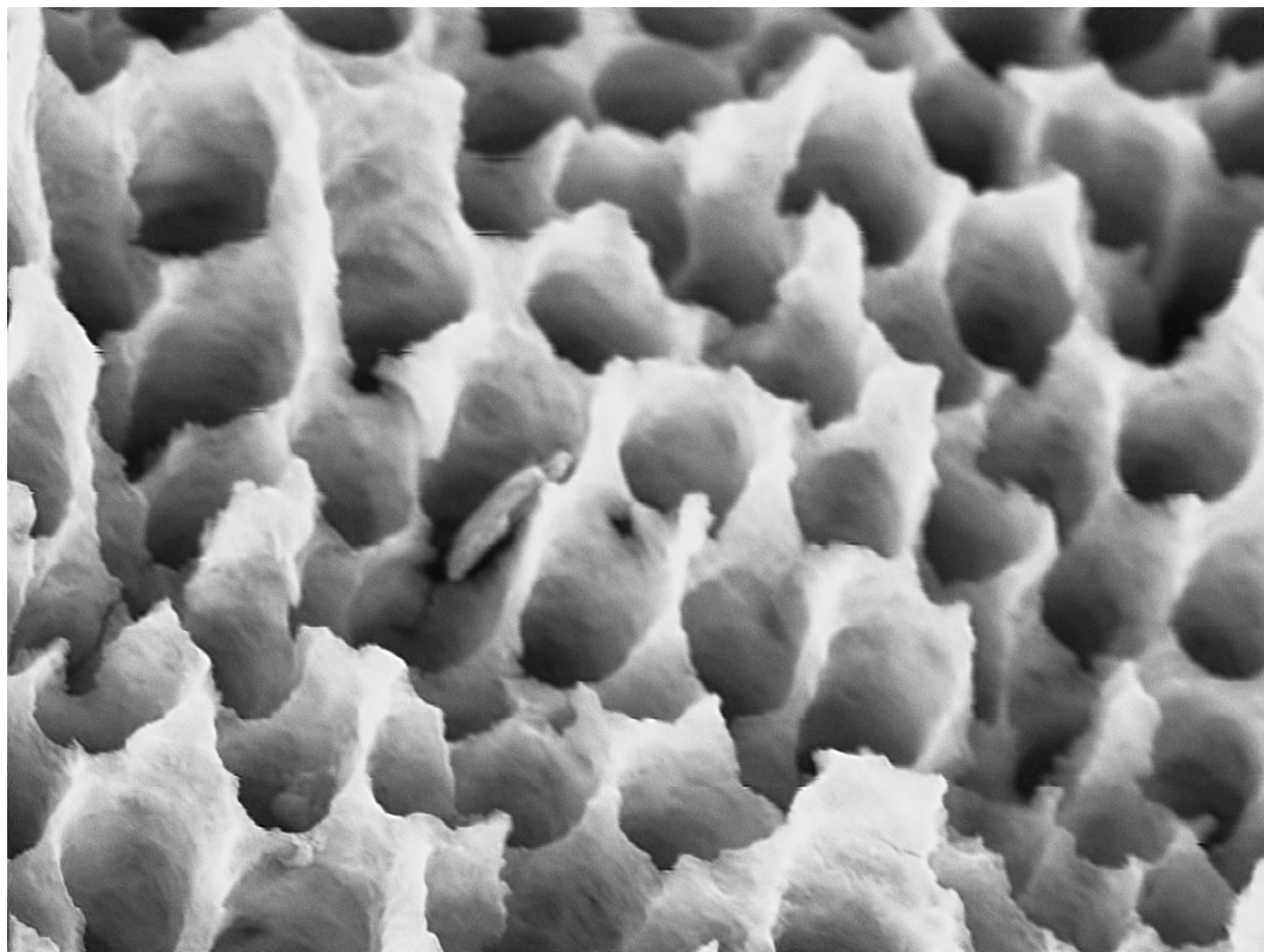
20 μ m

92) image208

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image209

image209



29340-18

2017/03/03 10:21 N

x5.0k

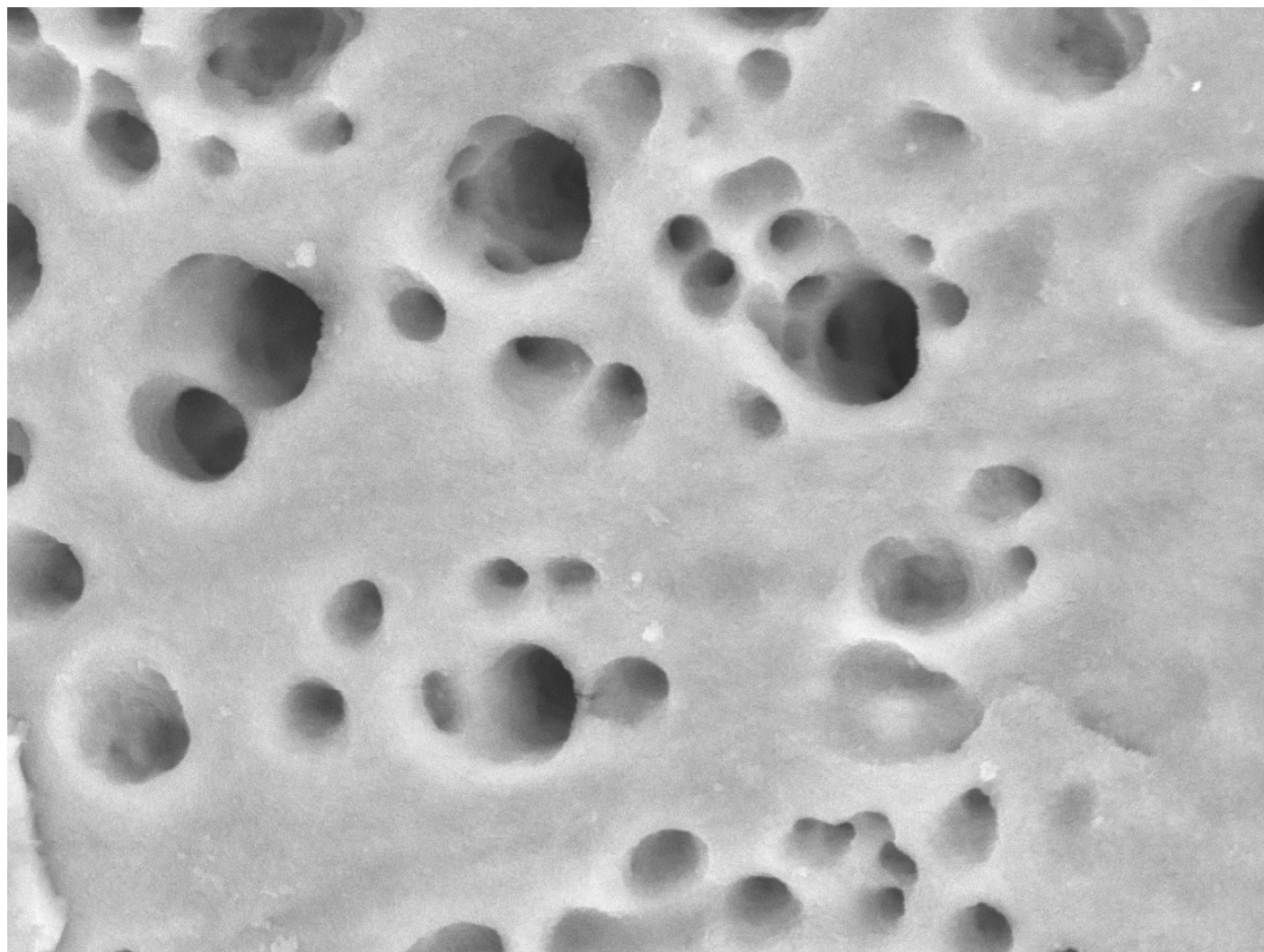
20 μ m

93) image209

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image210

image210



29856-30

2017/02/22 14:20 N

x5.0k

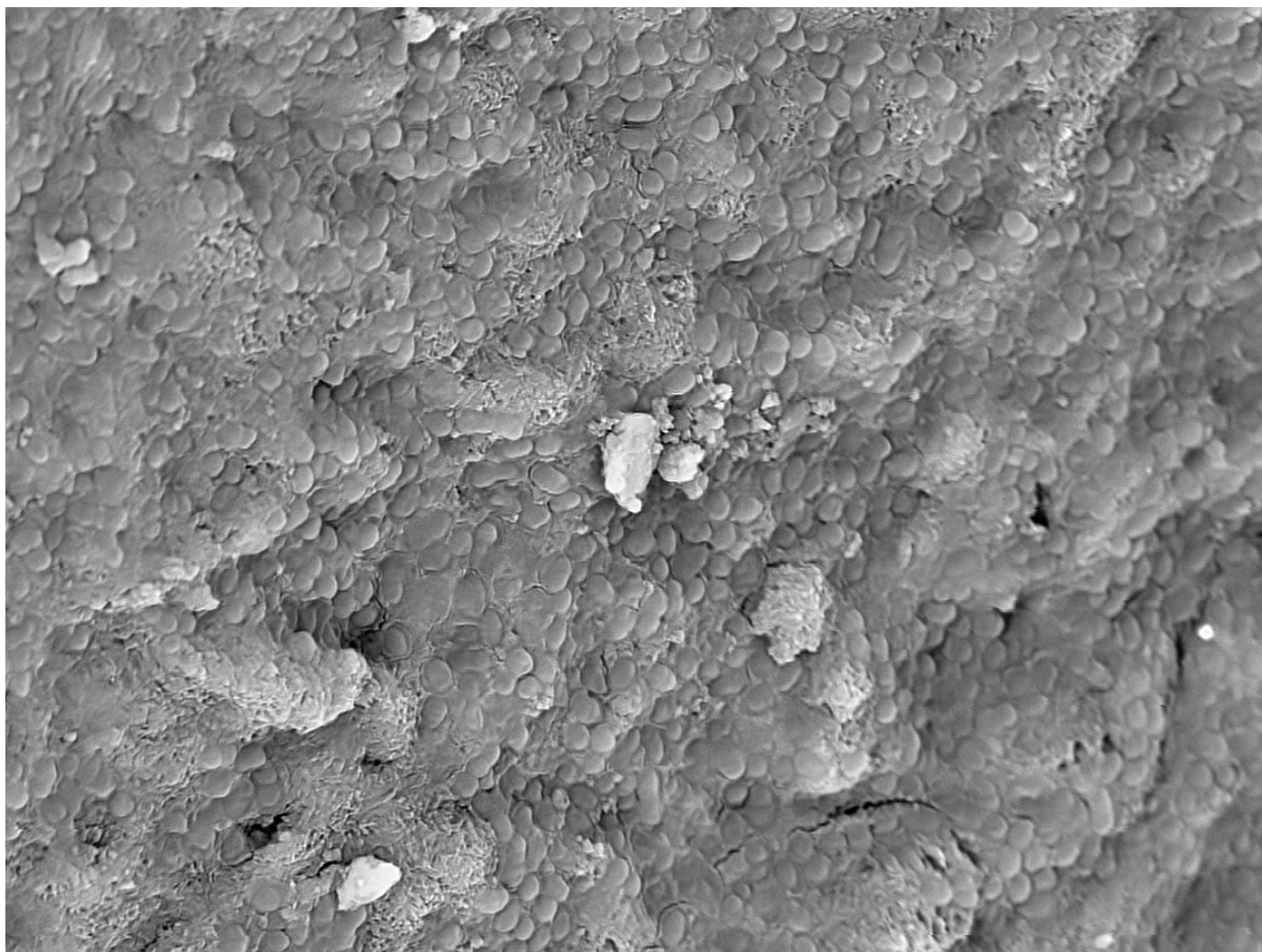
20 μ m

94) image210

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image211

image211



29266-15

2017/03/04 14:46 N

x5.0k

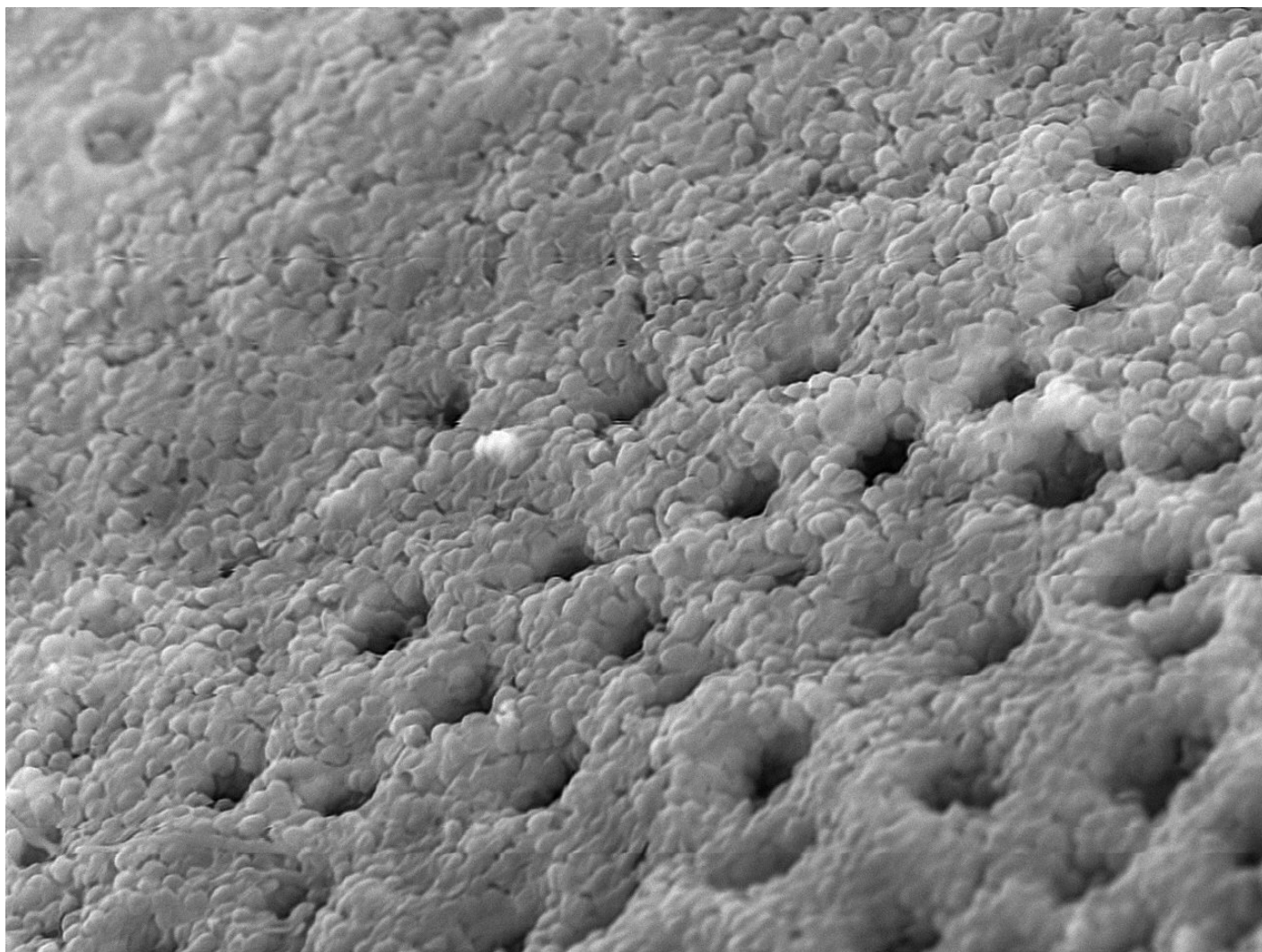
20 μ m

95) image211

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image212

image212



29965-2

2017/03/02 17:38 N

x5.0k

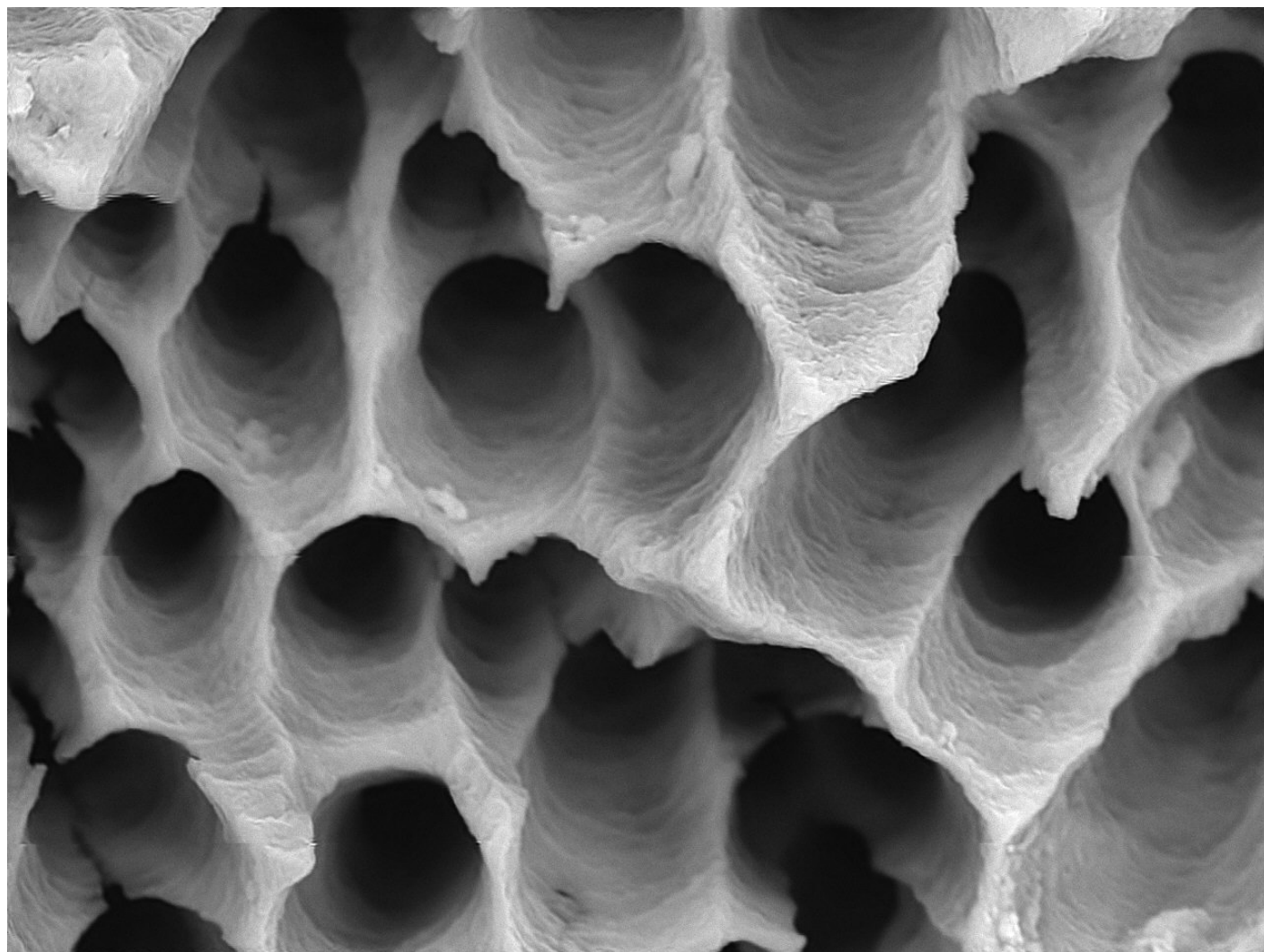
20 μ m

96) image212

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image213

image213



29211-18

2017/03/03 16:04 N

x5.0k

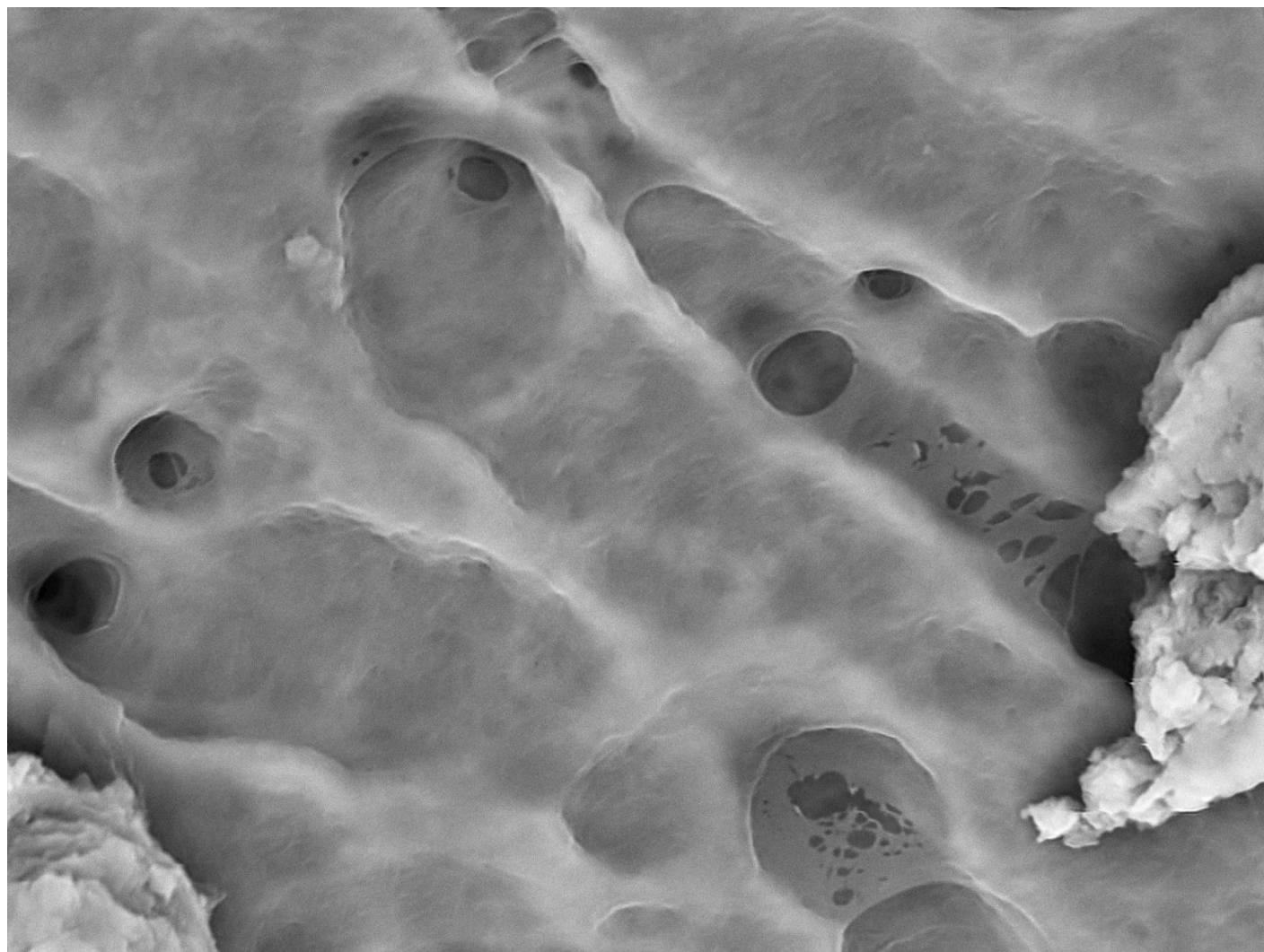
20 μ m

97) image213

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image214

image214



29961-2

2017/03/01 14:55 N

x5.0k

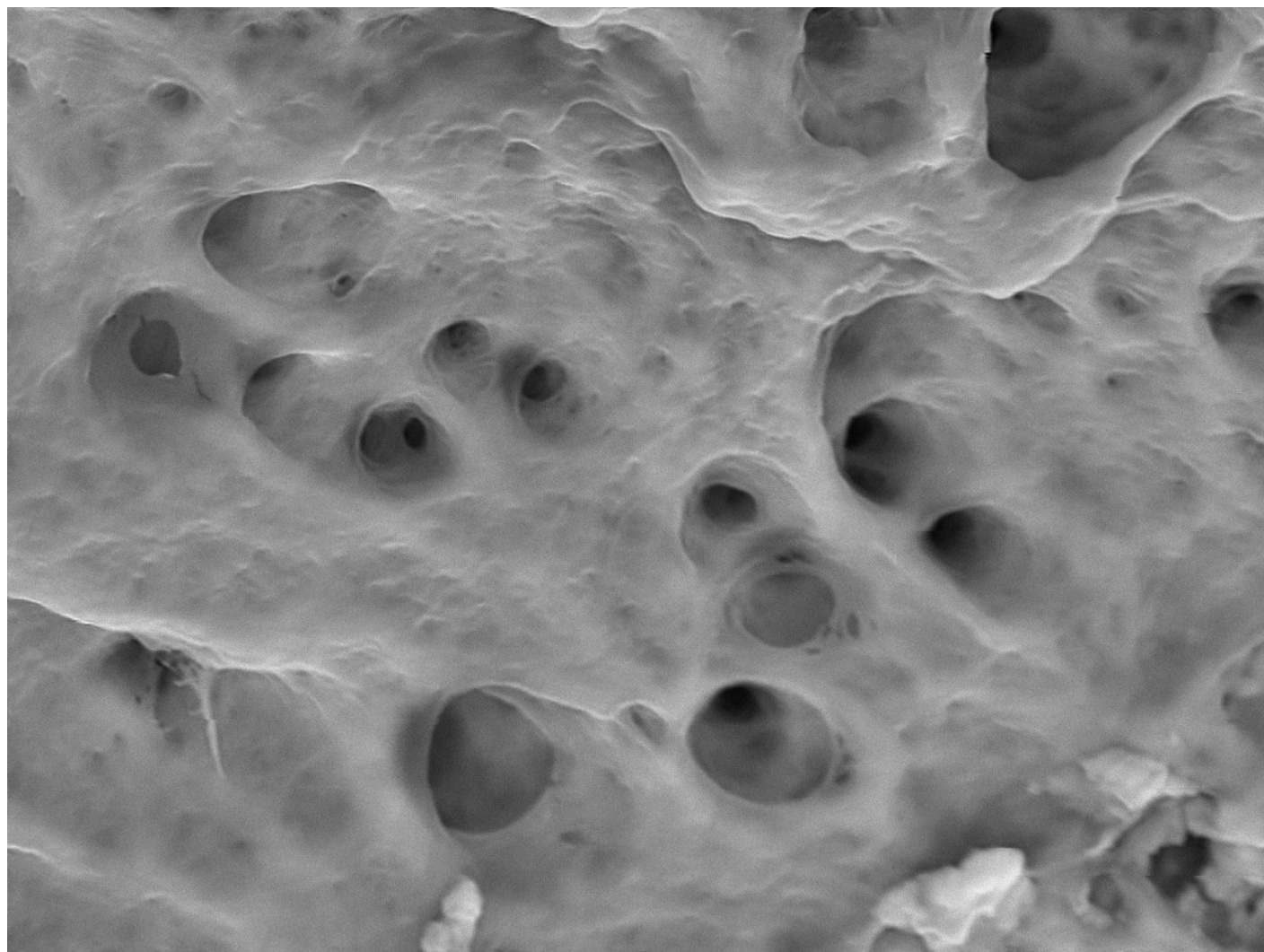
20 μ m

98) image214

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image215

image215



29961-2

2017/03/01 14:56 N

x5.0k

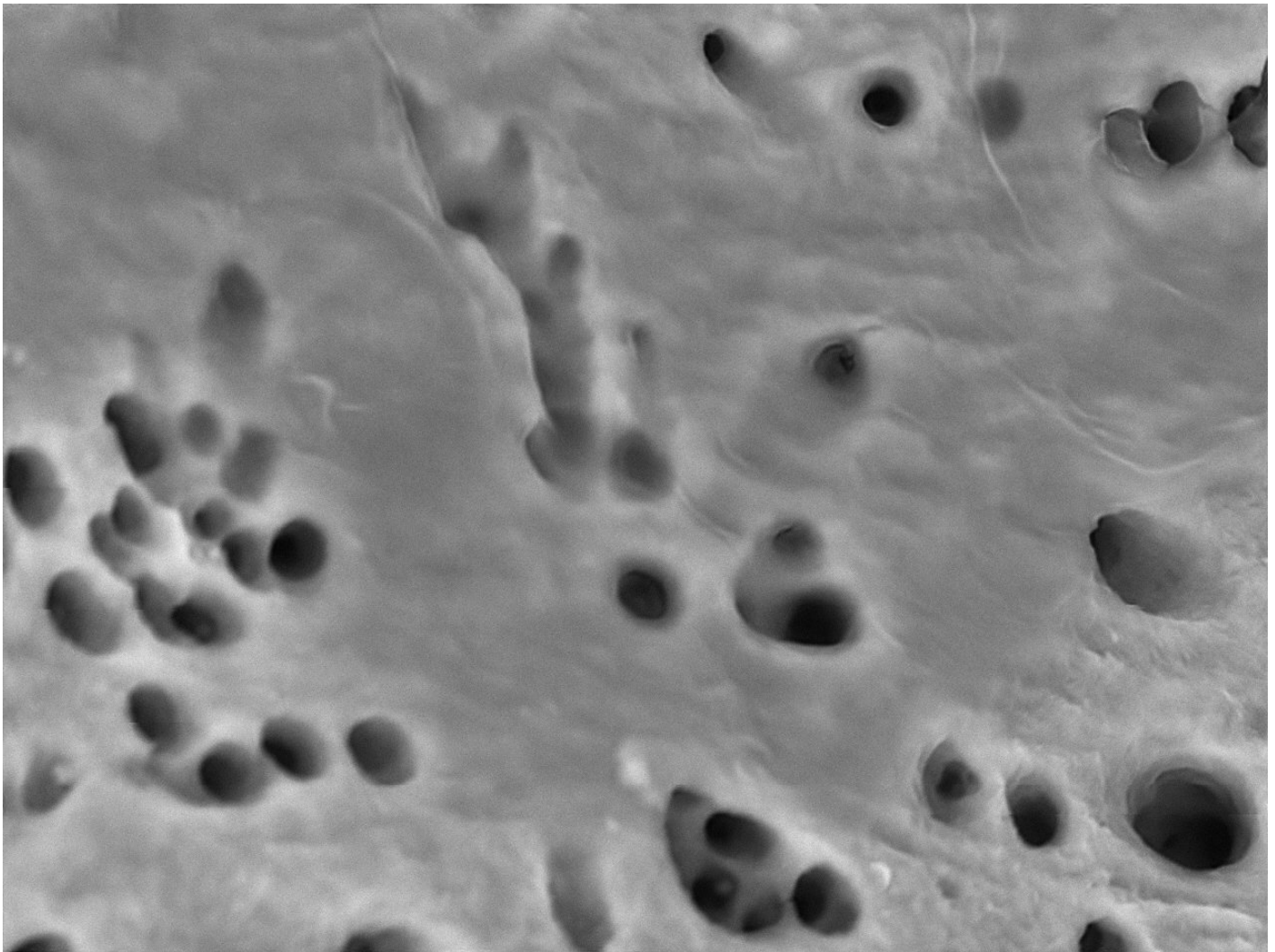
20 μ m

99) image215

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image216

image216



29009-31

2017/03/06 09:11 N

x5.0k

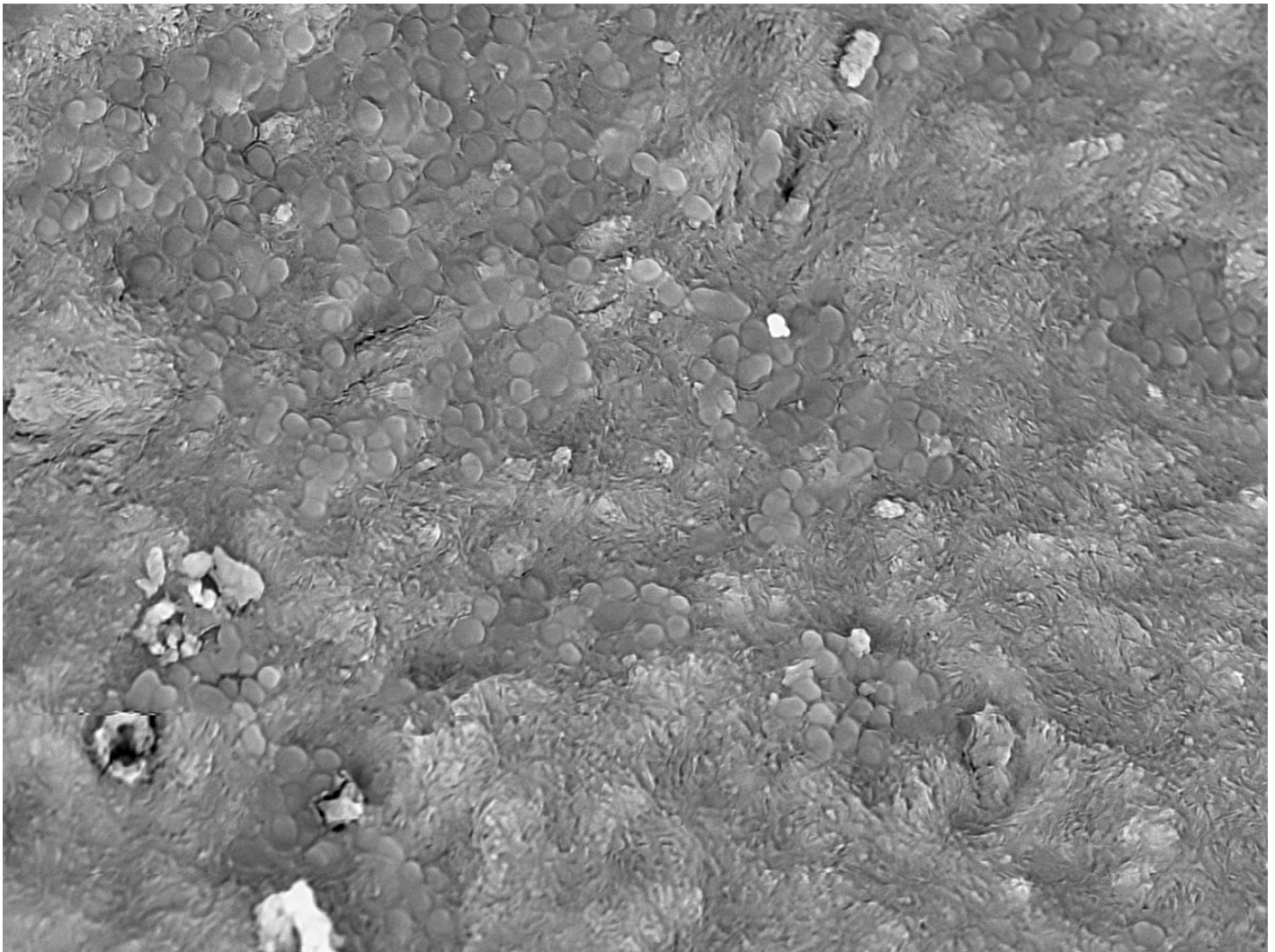
20 μm

100) image216

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image217

image217



29266-15

2017/03/04 14:47 N

x5.0k

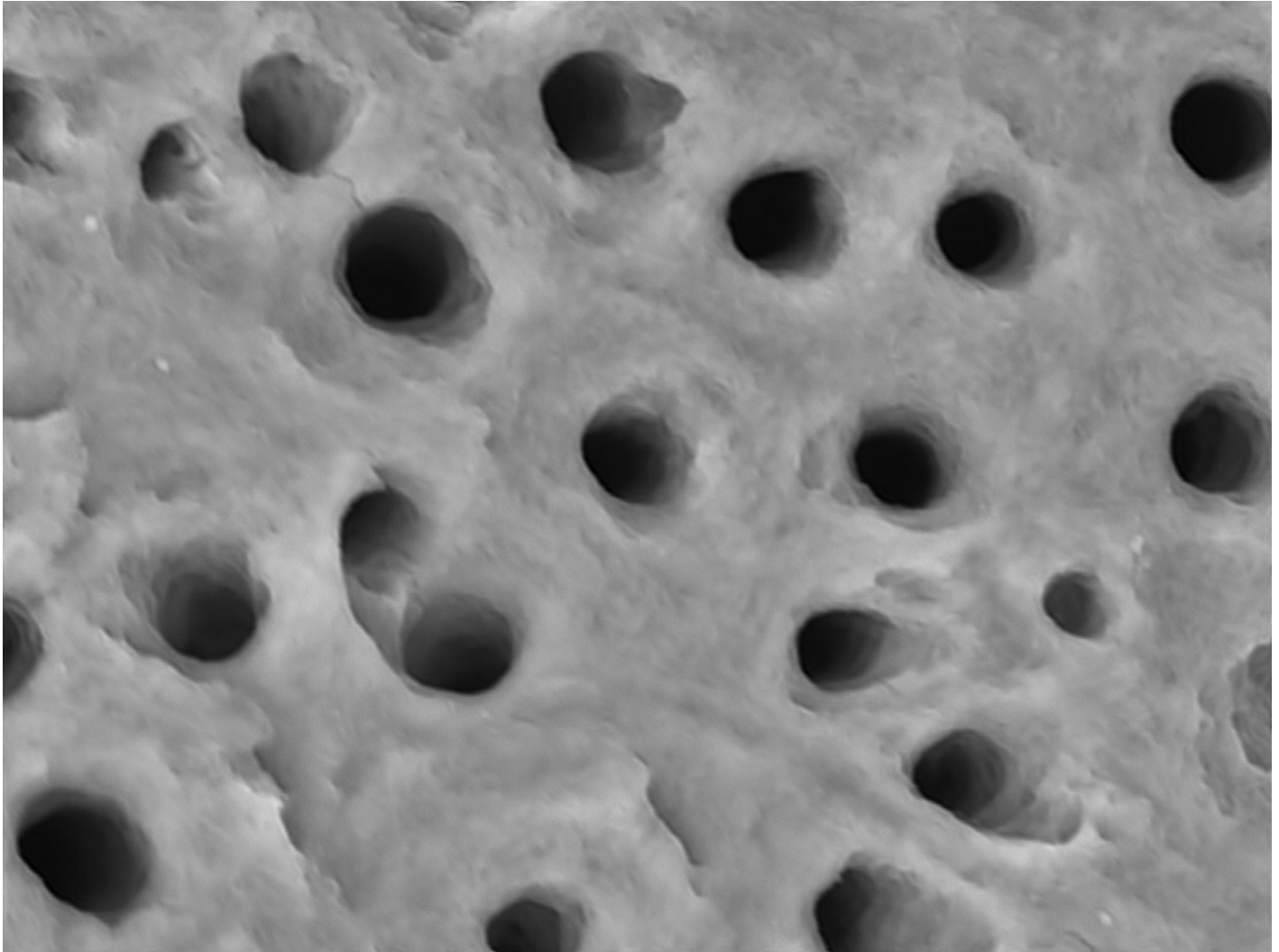
20 μ m

101) image217

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image218

image218



29009-31

2017/03/08 14:58 H

x5.0k

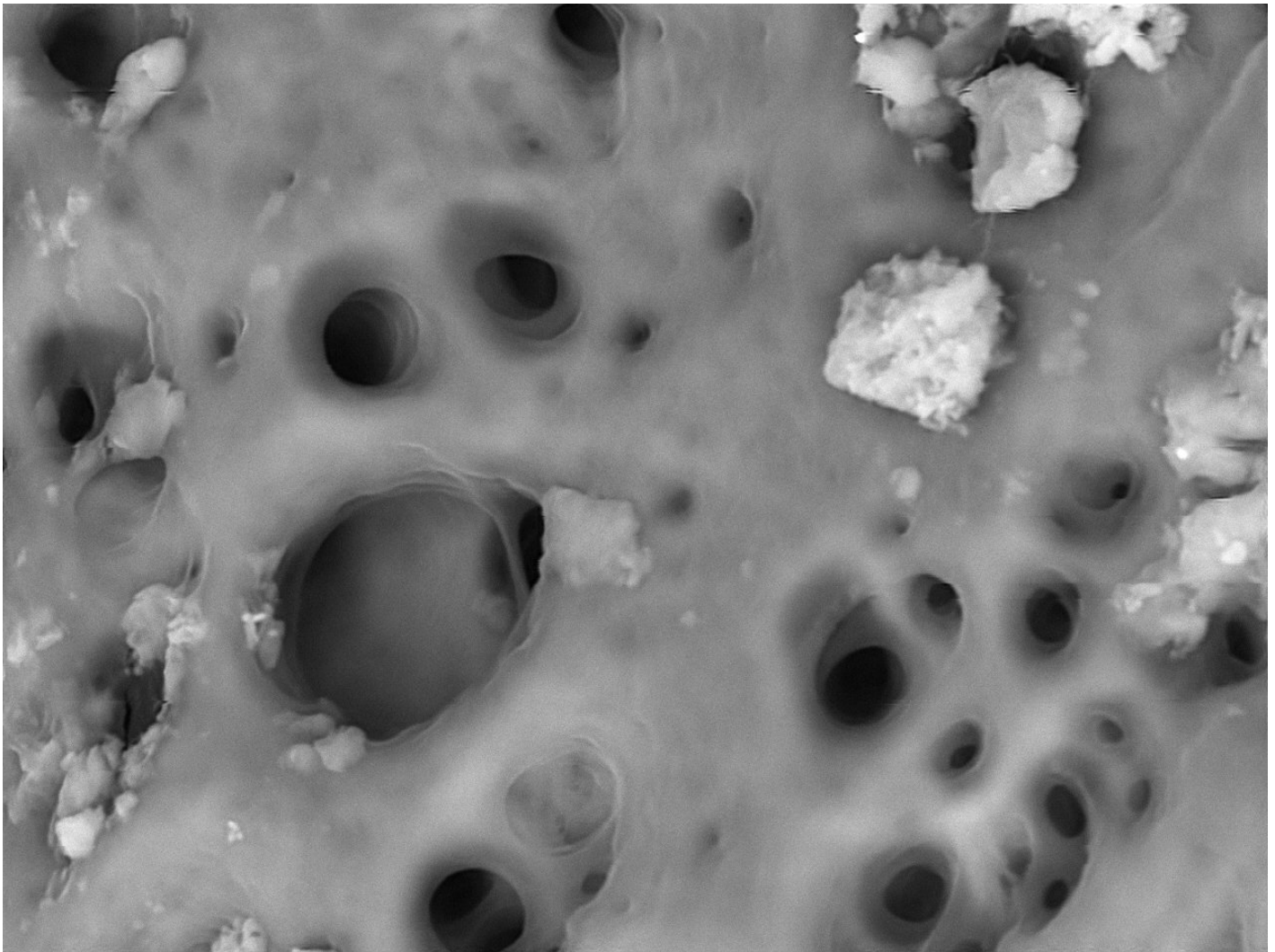
20 μm

102) image218

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image219

image219



29963-15

2017/03/01 10:15 N

x5.0k

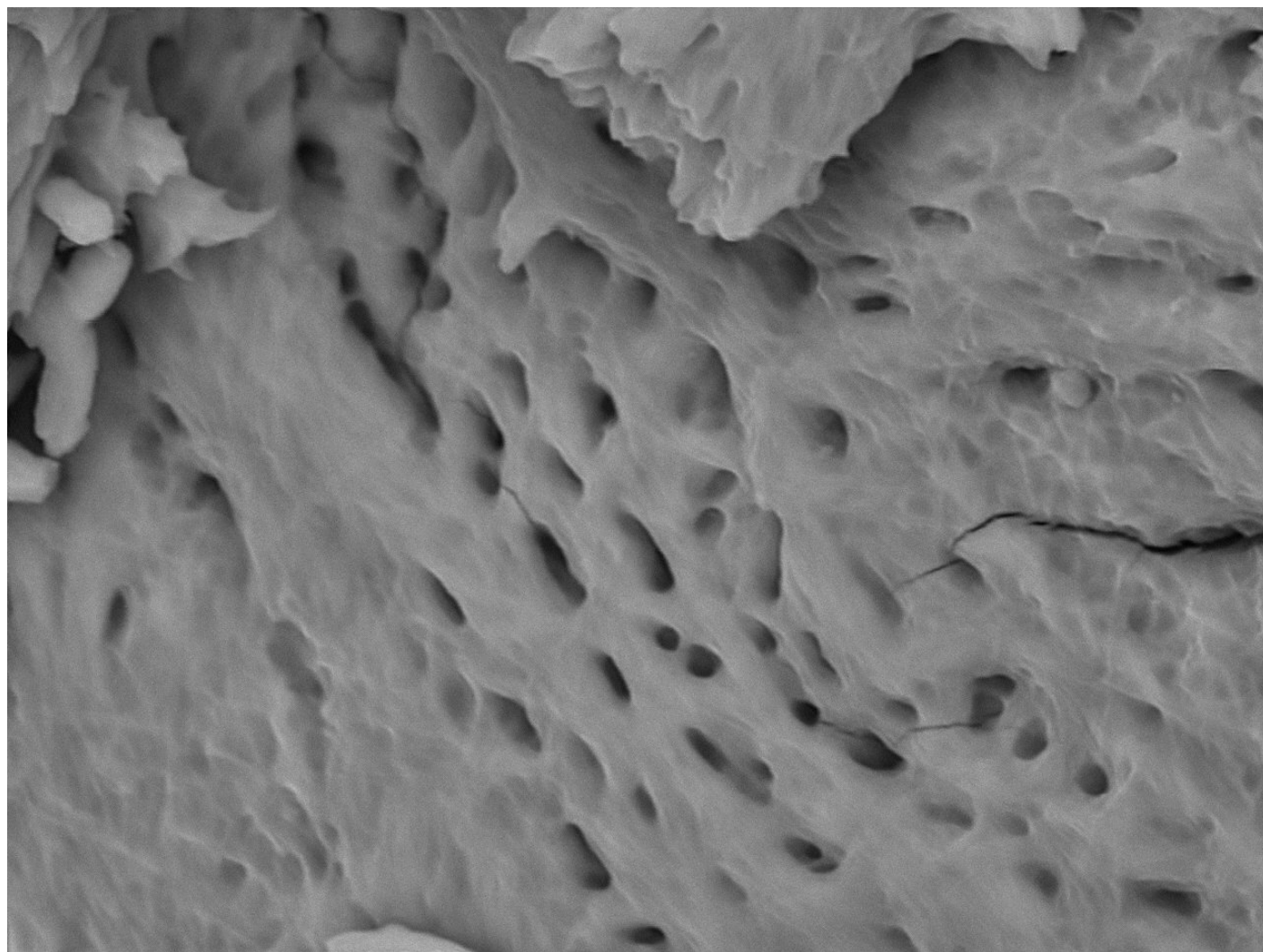
20 μ m

103) image219

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image220

image220



29593-3

2017/02/27 12:10 N

x5.0k

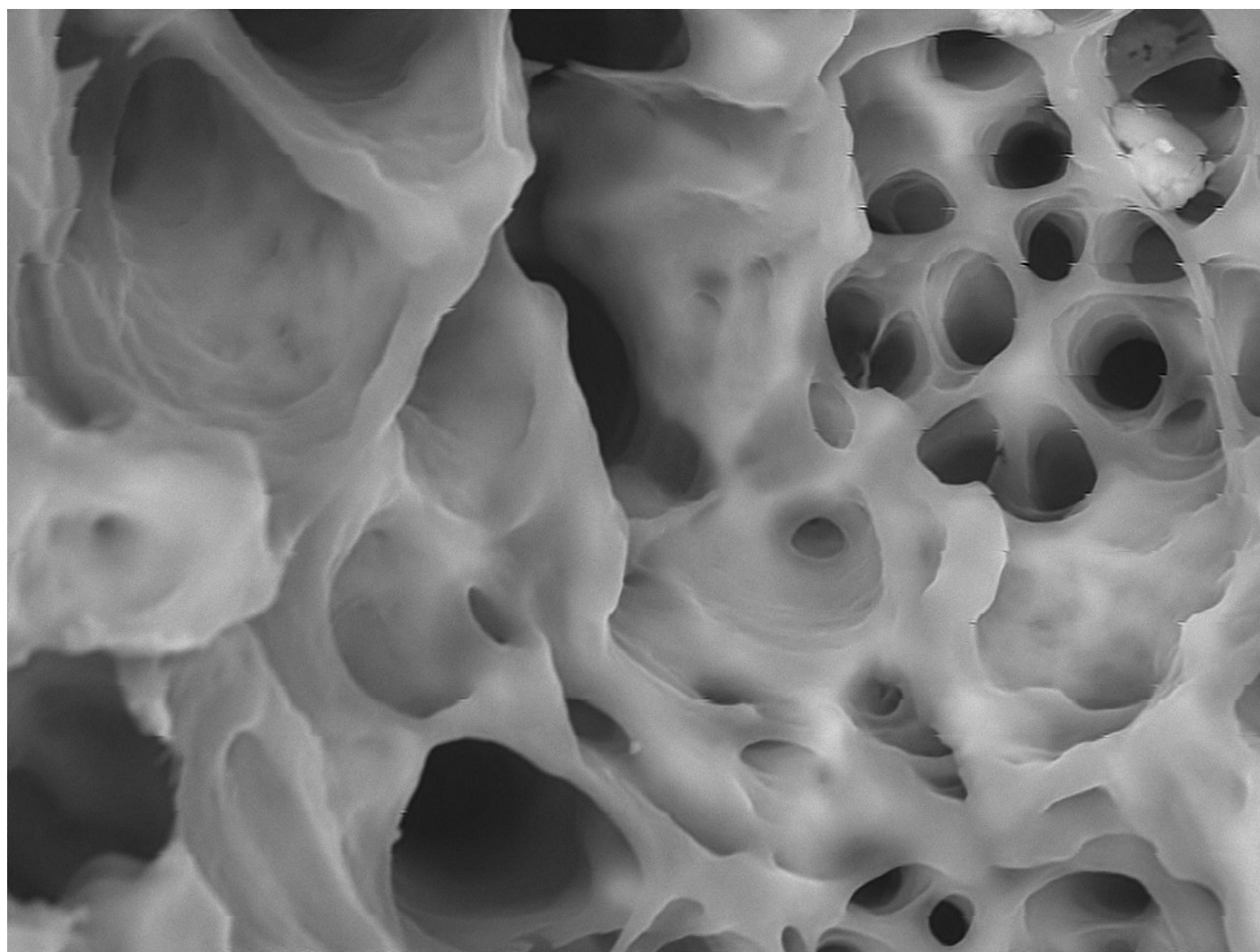
20 μm

104) image220

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image221

image221



29960-14

2017/03/01 10:38 N

x5.0k

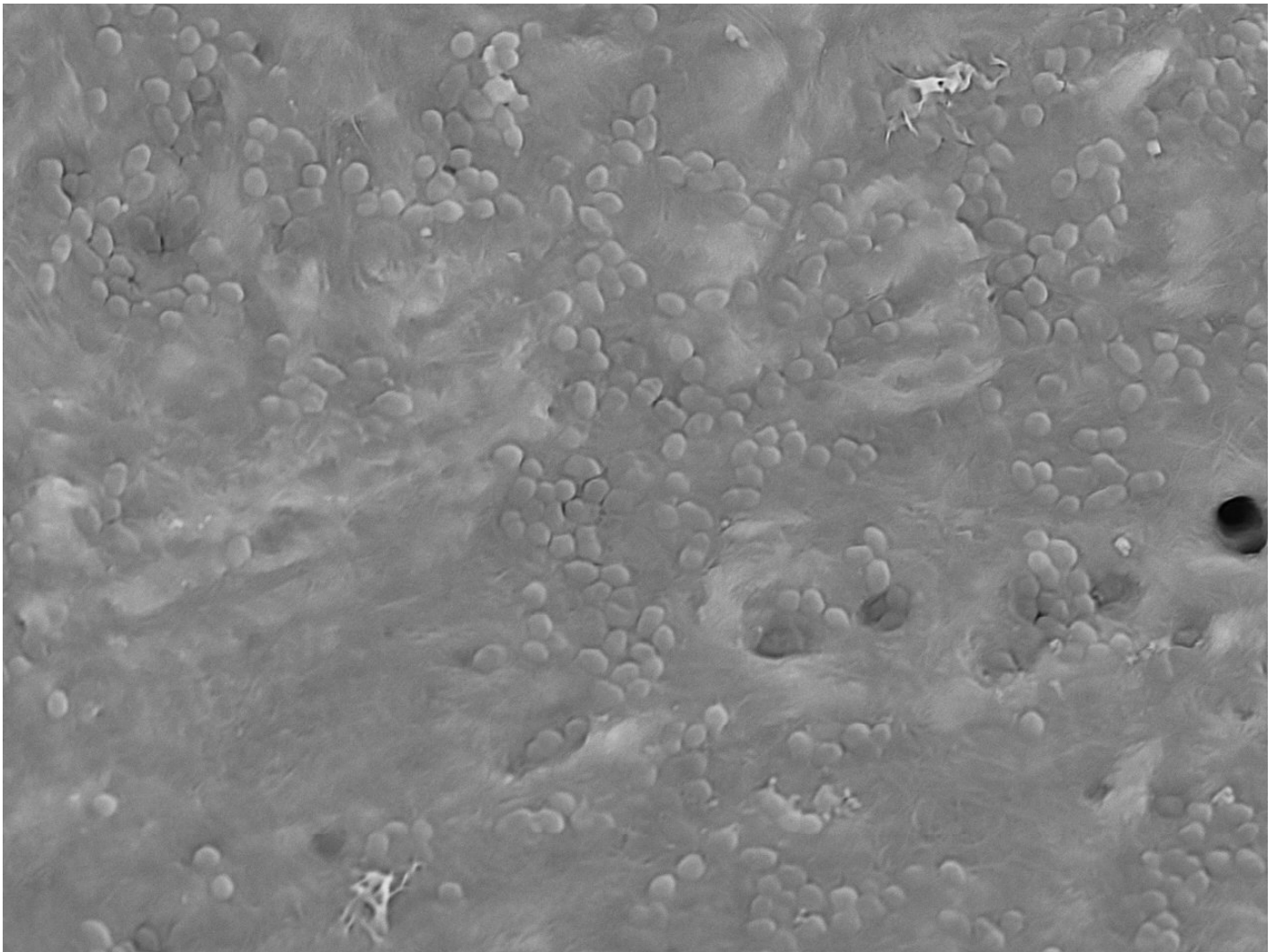
20 μm

105) image221

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image222

image222



29266-15

2017/03/04 15:08 N

x5.0k

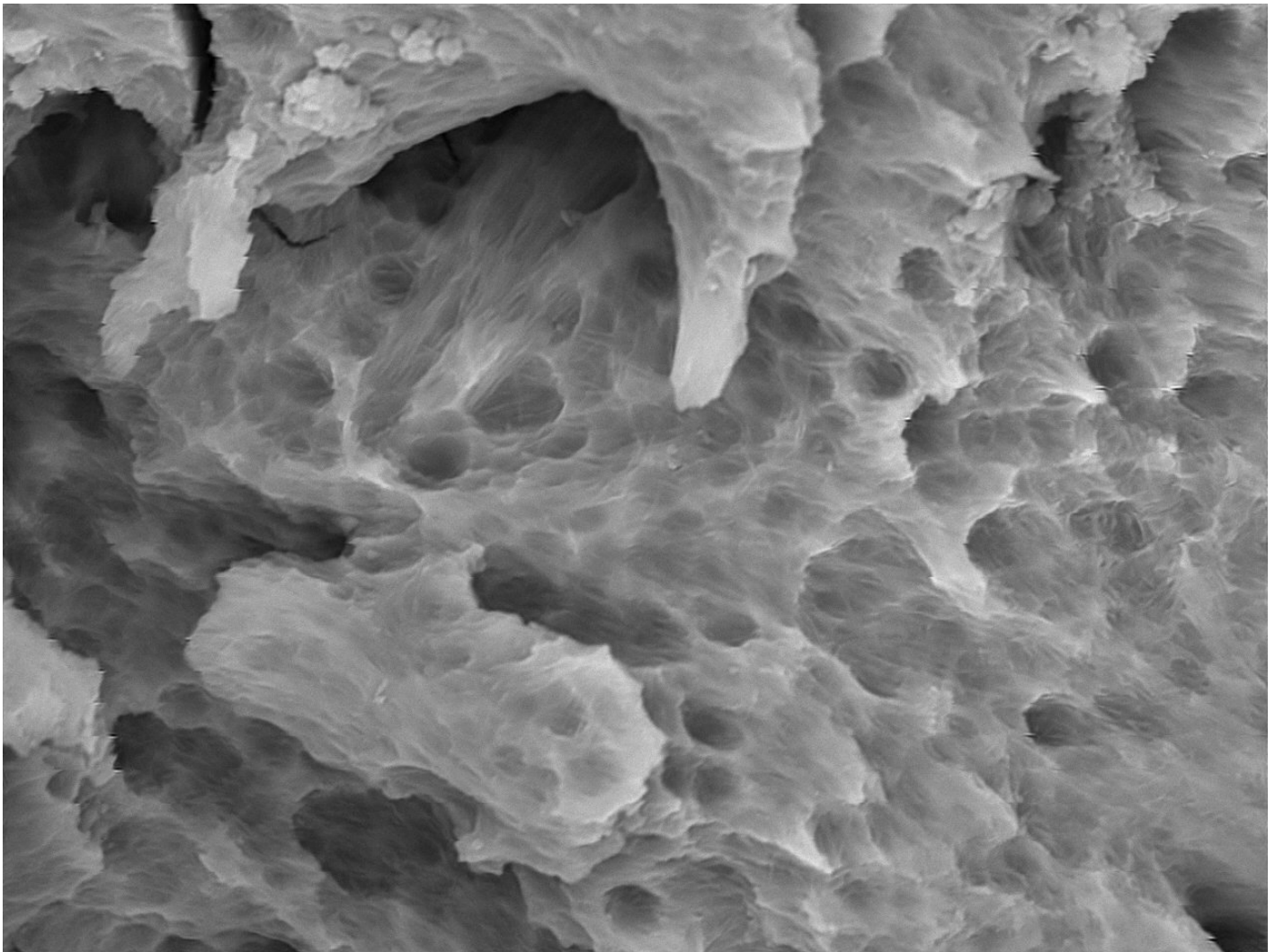
20 μ m

106) image222

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image223

image223



29211-18

2017/03/03 16:32 N

x5.0k

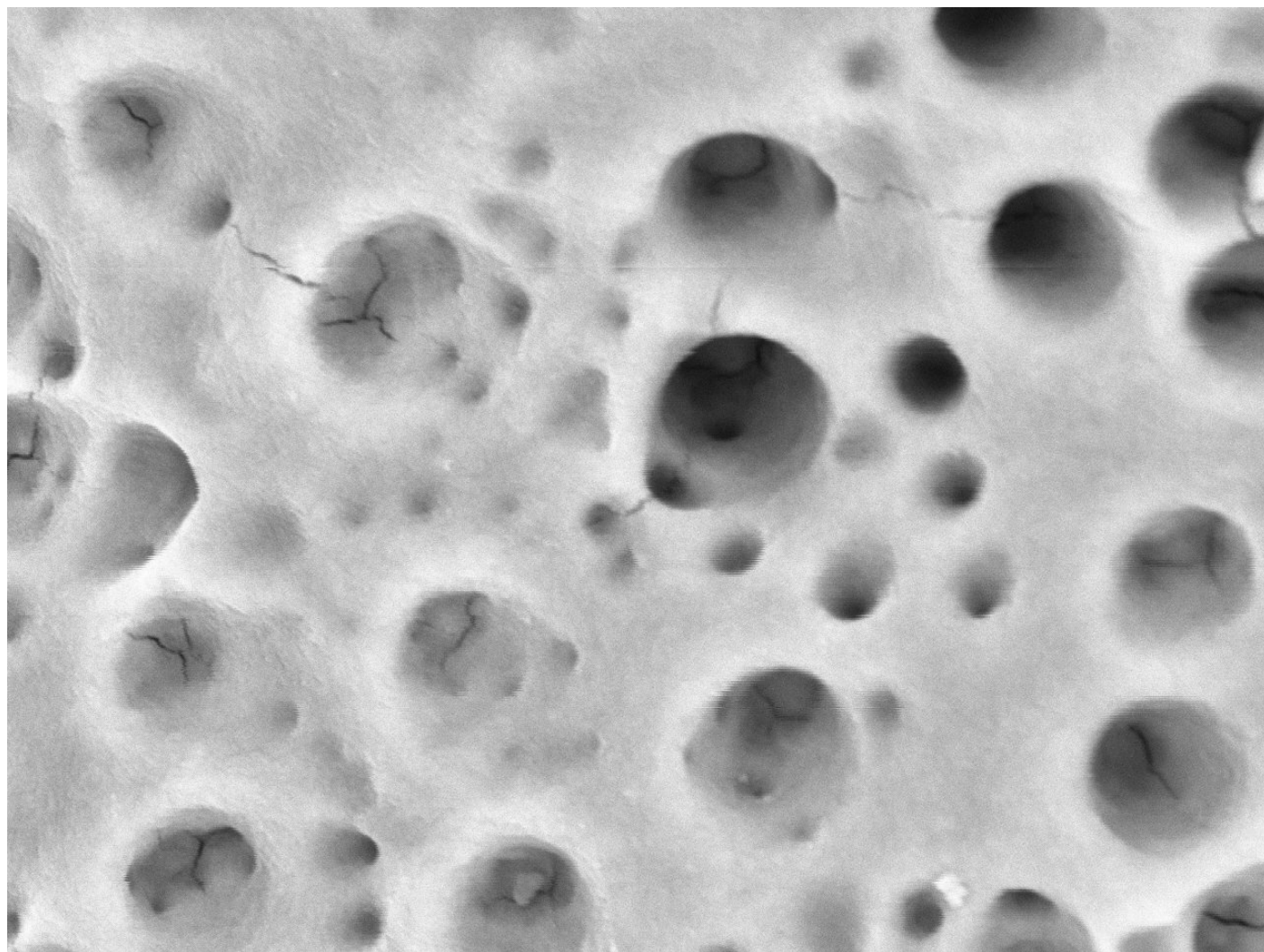
20 μ m

107) image223

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image224

image224



29952-15

2017/02/22

15:35 N

x5.0k

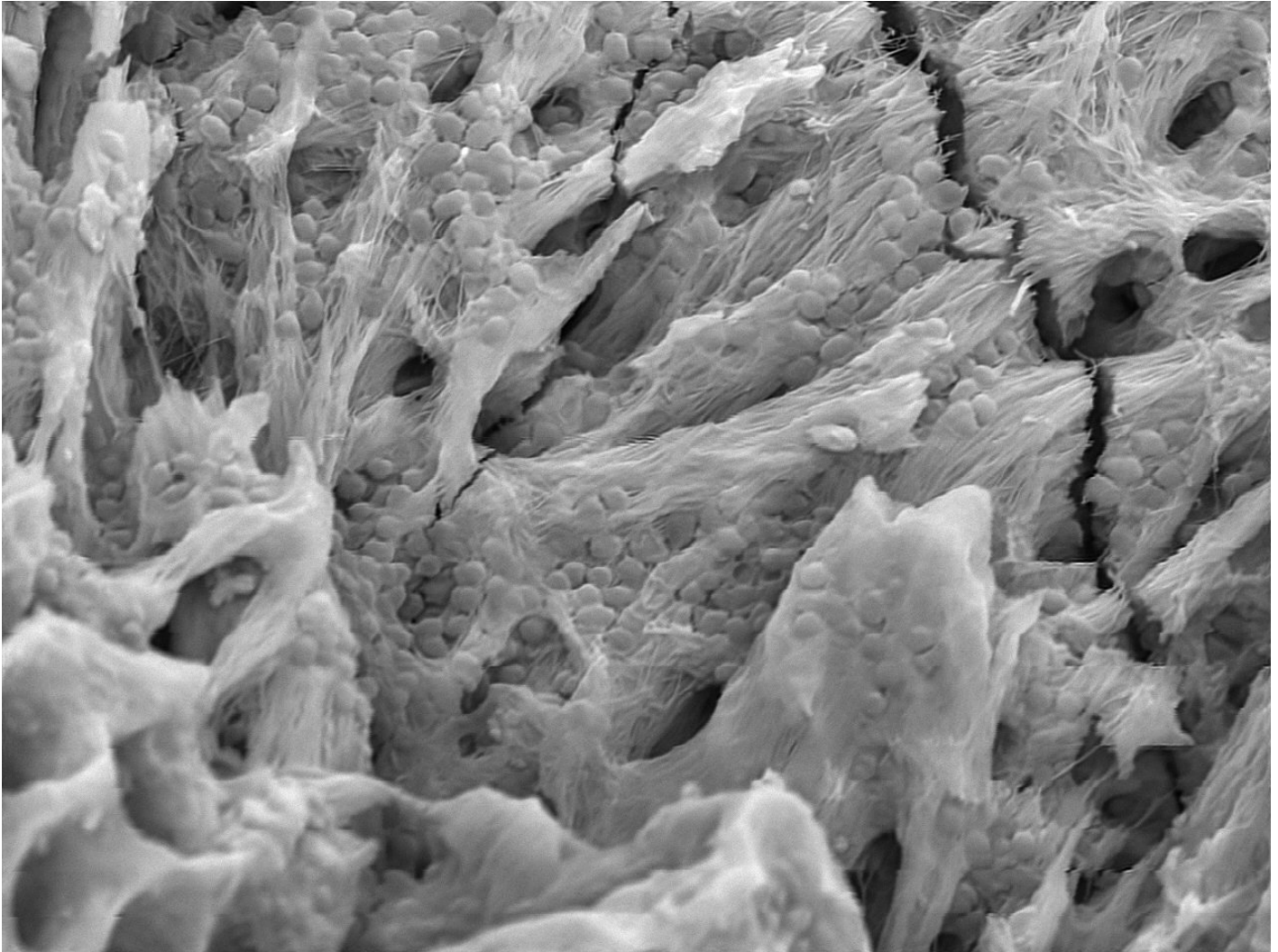
20 μ m

108) image224

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image225

image225



29965-2

2017/03/02 15:31 N

x5.0k

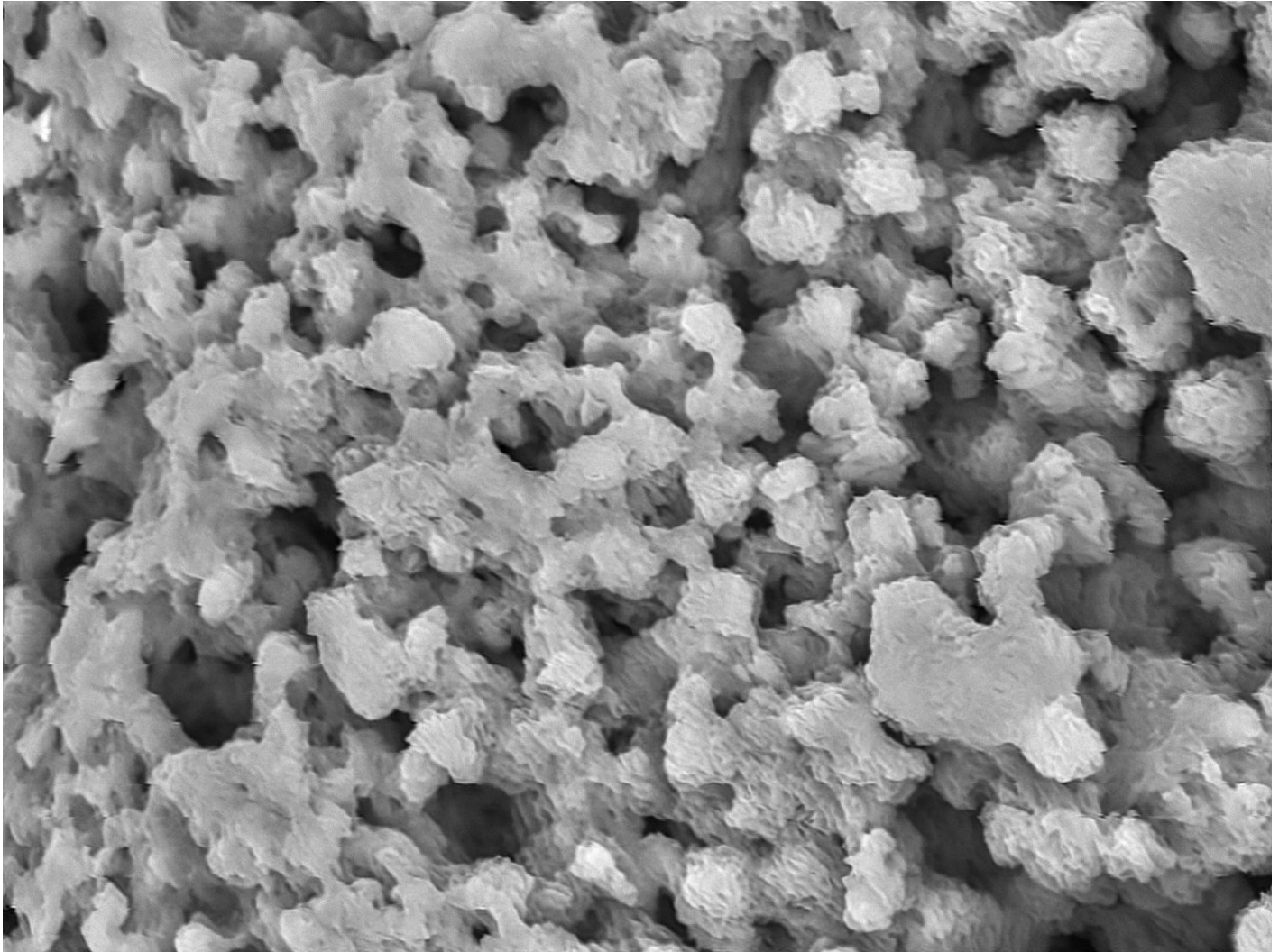
20 μm

109) image225

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image226

image226



29679-3

2017/02/27 16:22 N

x5.0k

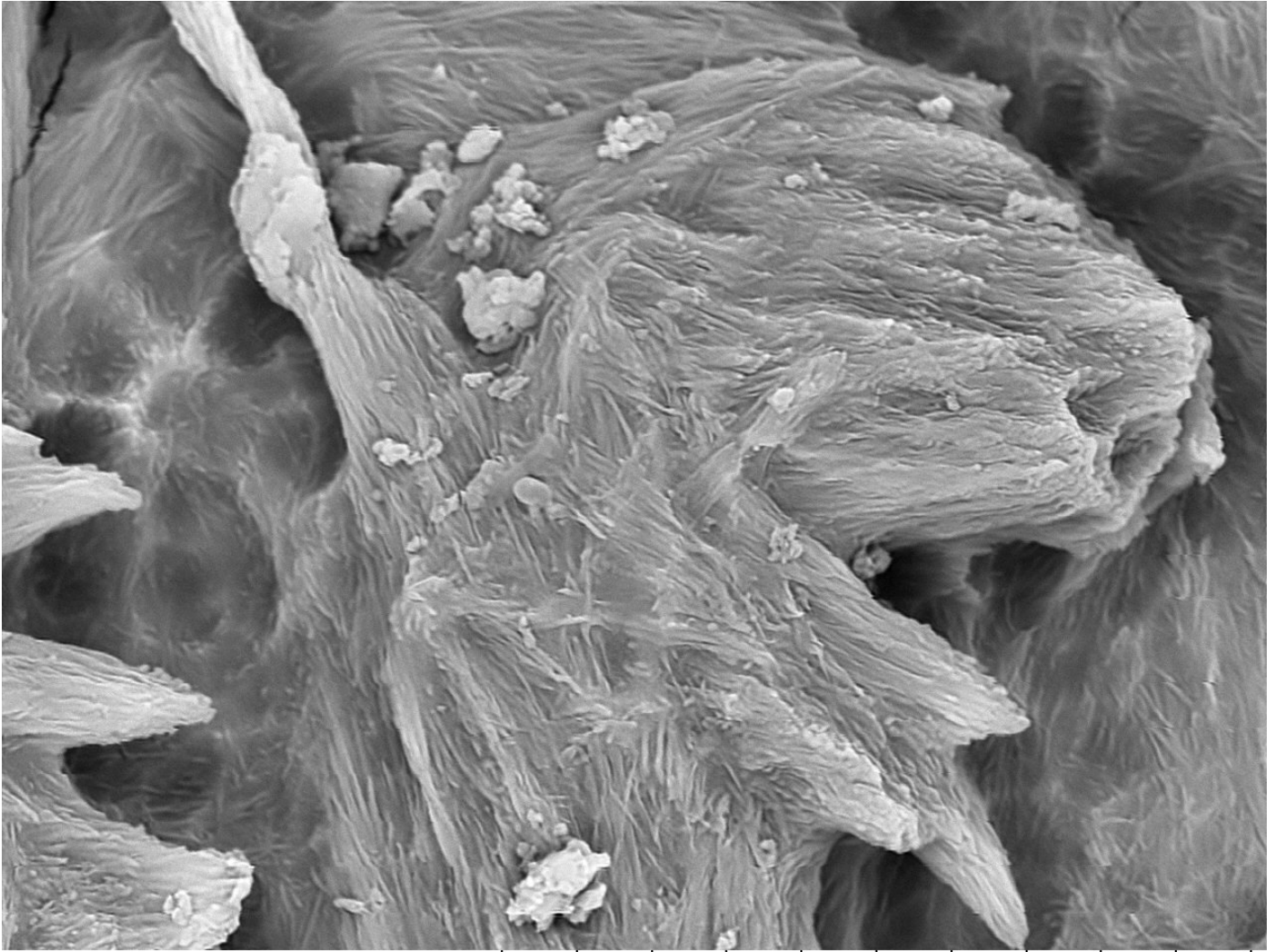
20 μ m

110) image226

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image227

image227



29052-14

2017/02/28 18:12 N

x5.0k

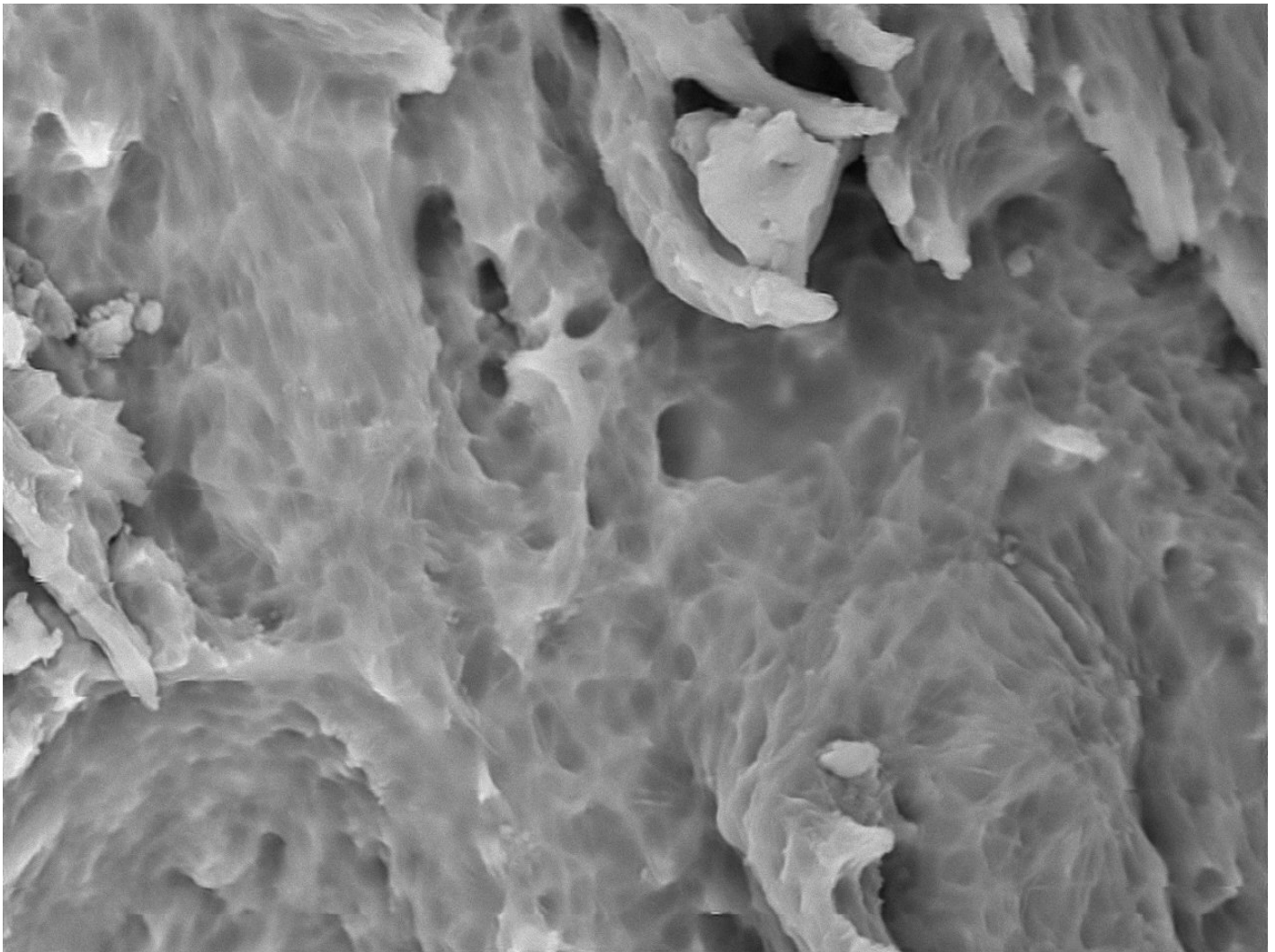
20 µm

111) image227

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image228

image228



29028-15

2017/03/04 15:32 N

x5.0k

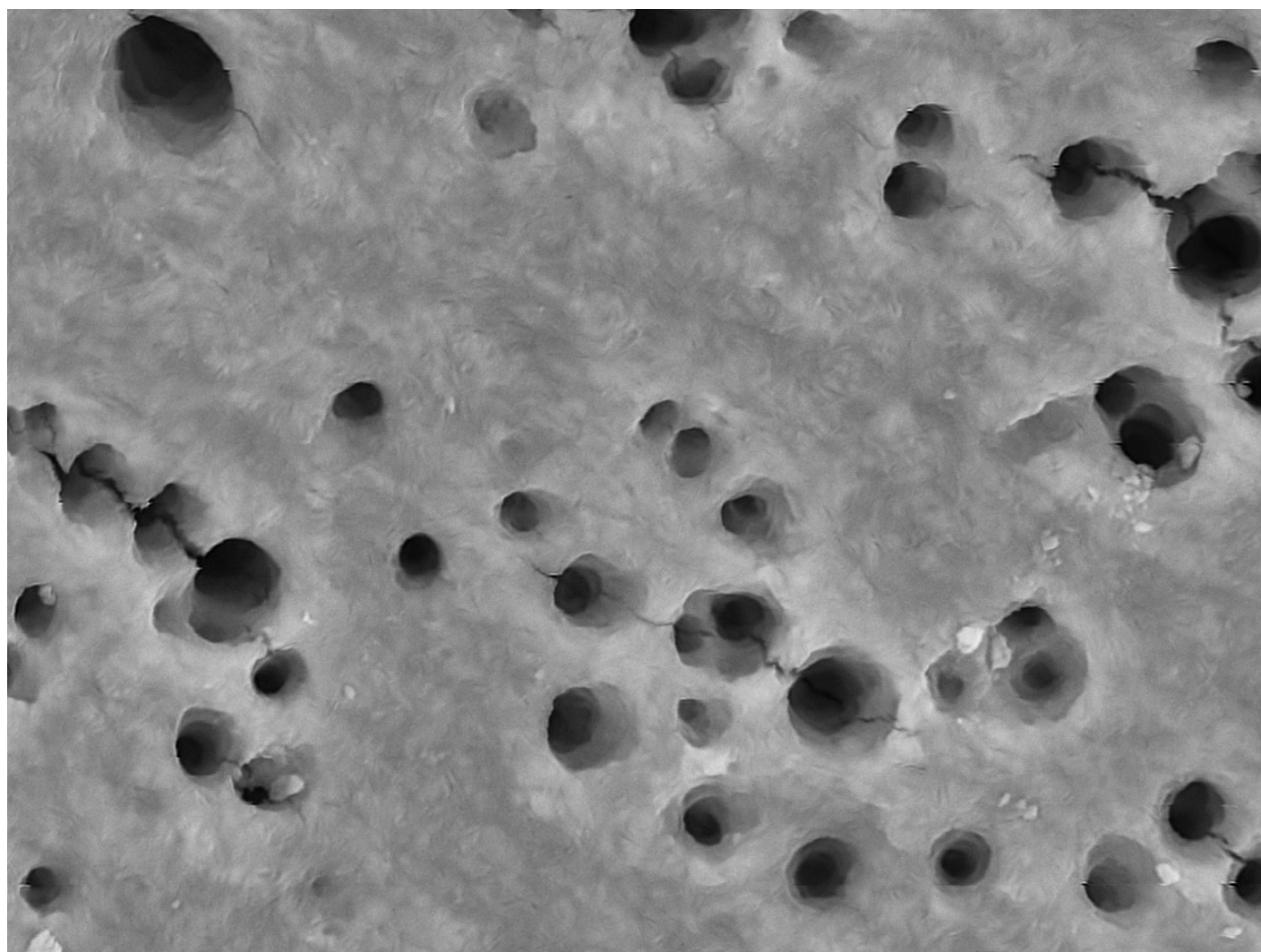
20 μ m

112) image228

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image229

image229



29052-14

2017/02/28 17:47 N

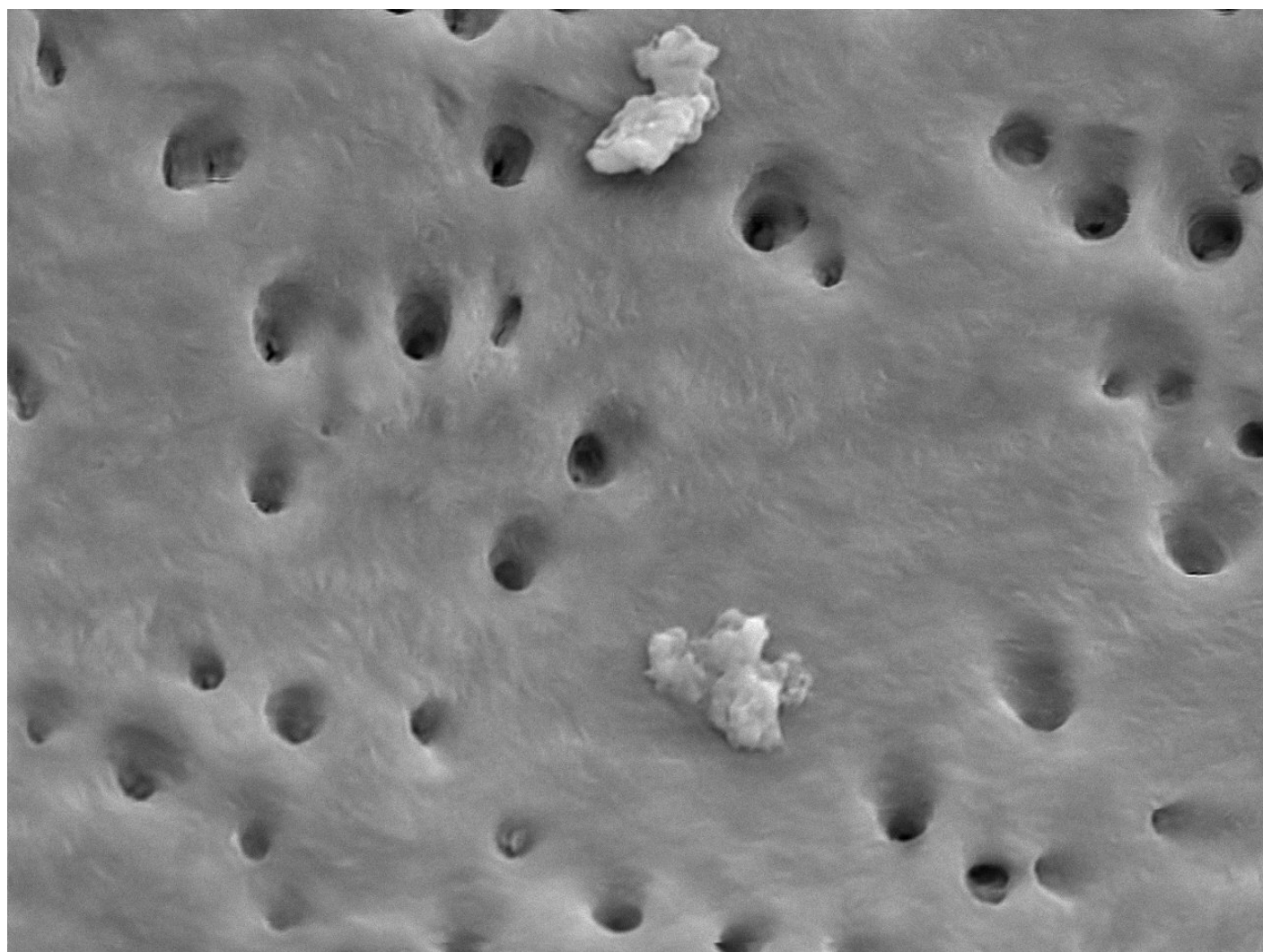
x5.0k 20 μ m

113) image229

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image230

image230



29961-2

2017/03/01 14:30 N

x5.0k

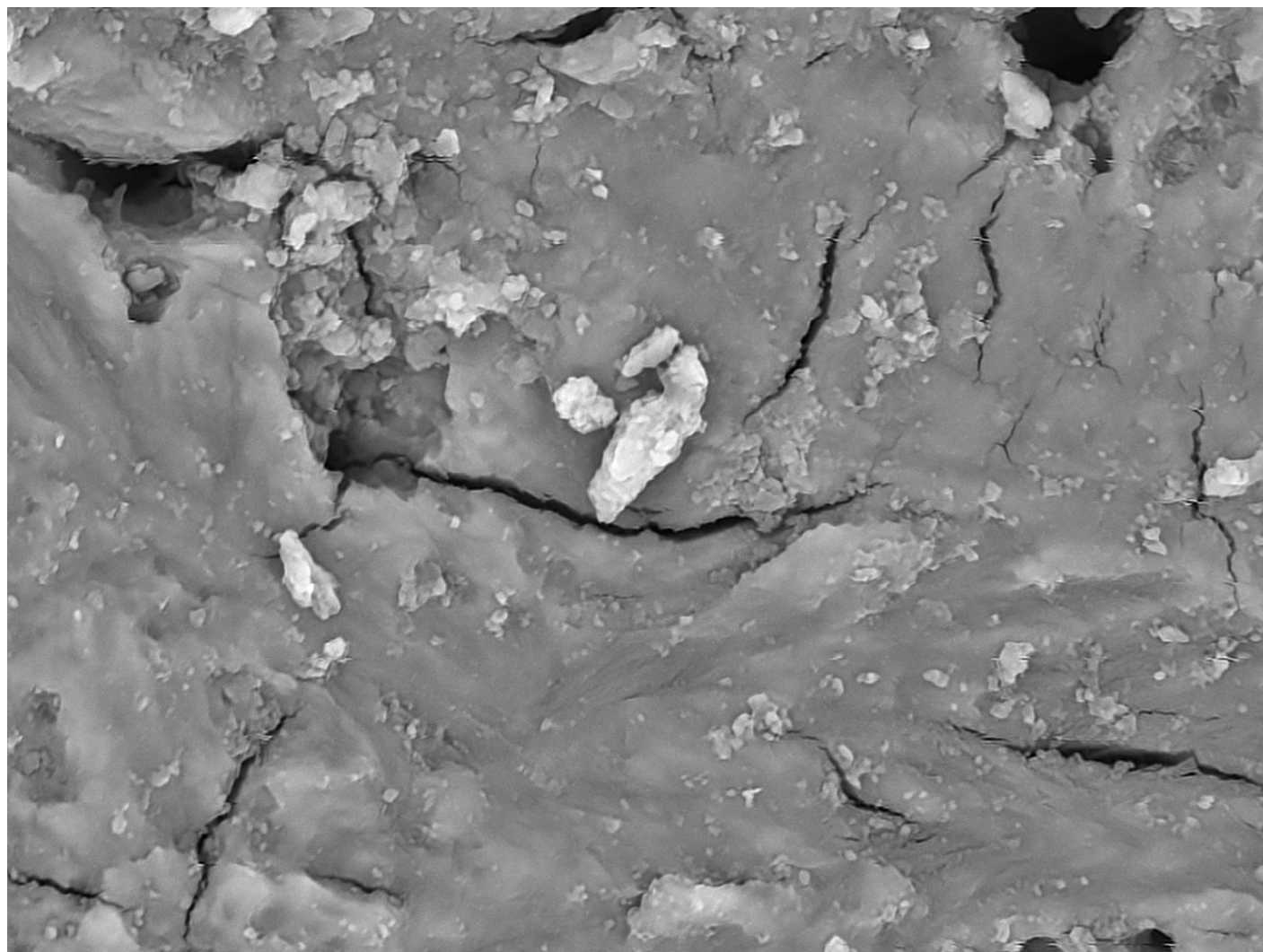
20 μm

114) image230

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image231

image231



29052-14

2017/02/28 17:29 N

x5.0k

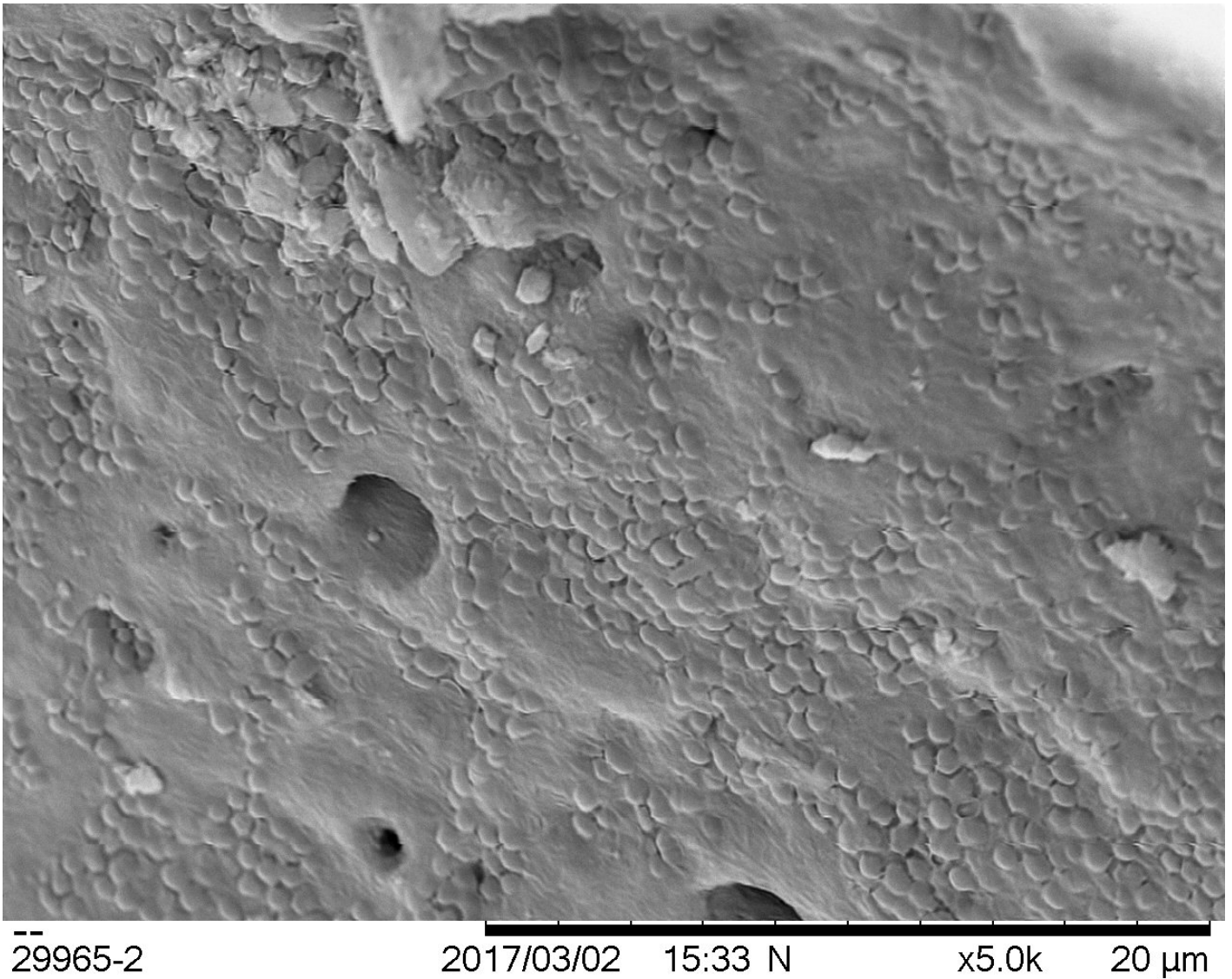
20 μm

115) image231

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image232

image232

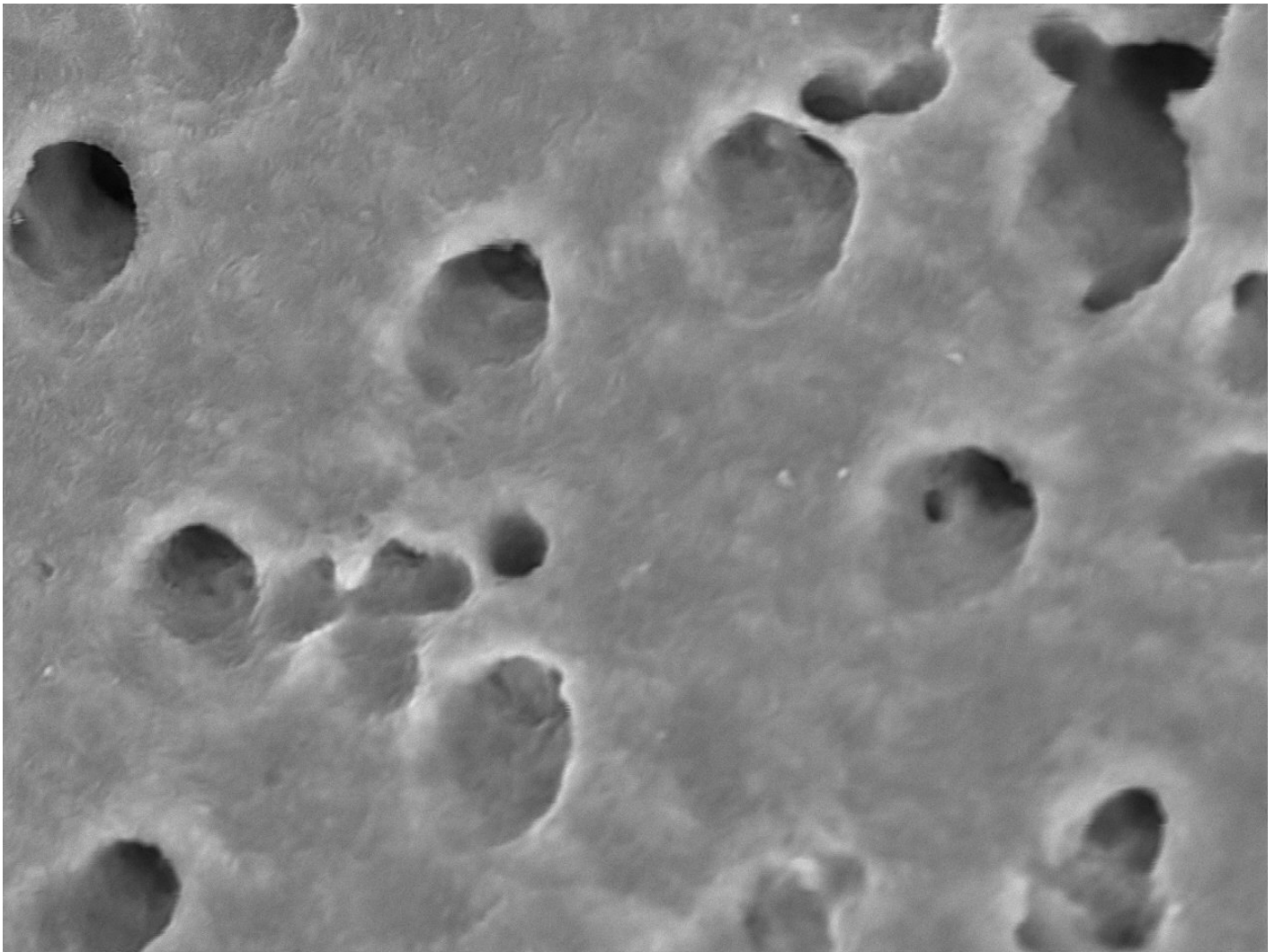


116) image232

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image233

image233



29340-18

2017/03/03 10:42 N

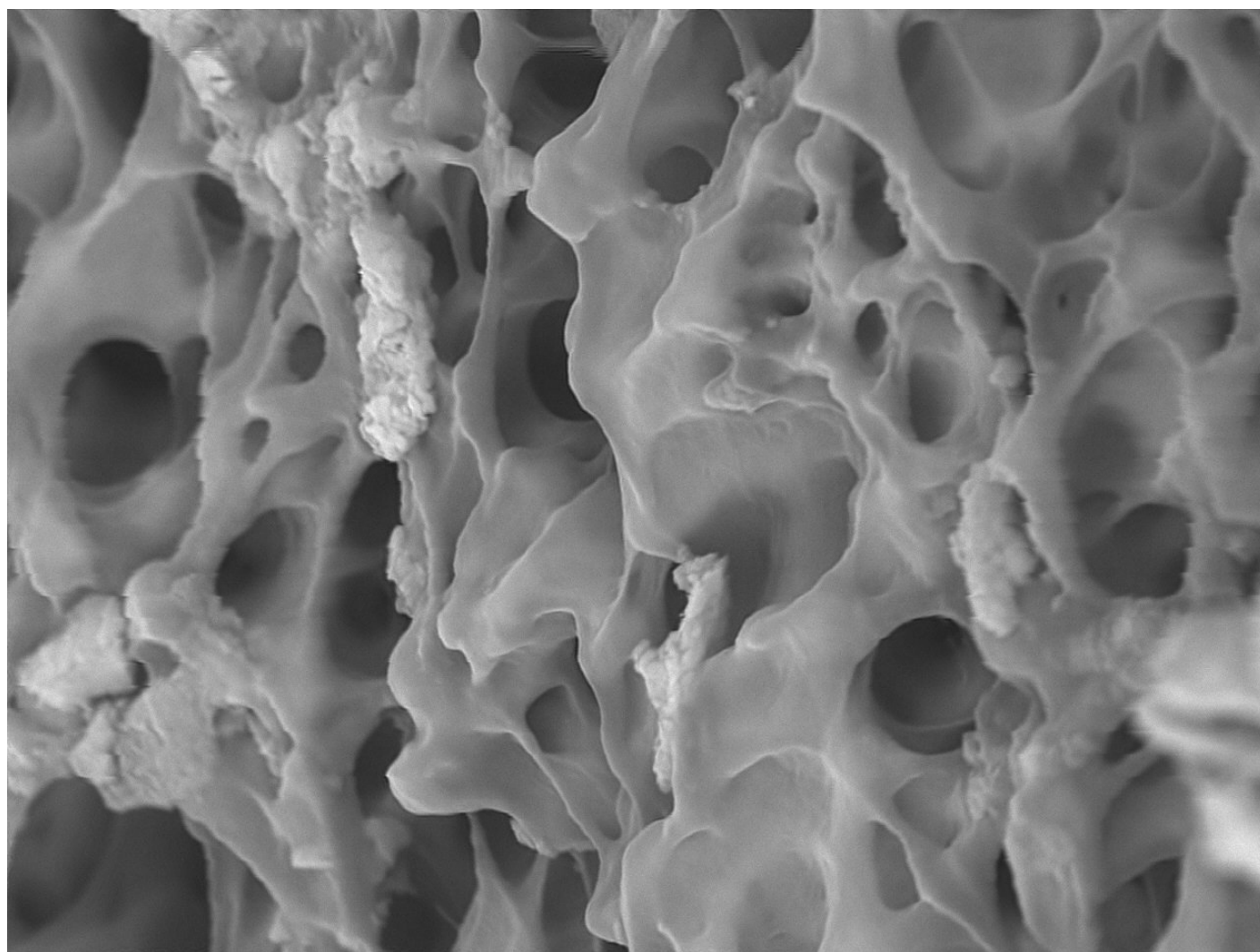
x5.0k 20 μm

117) image233

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image234

image234



29960-14

2017/03/01 10:30 N

x5.0k

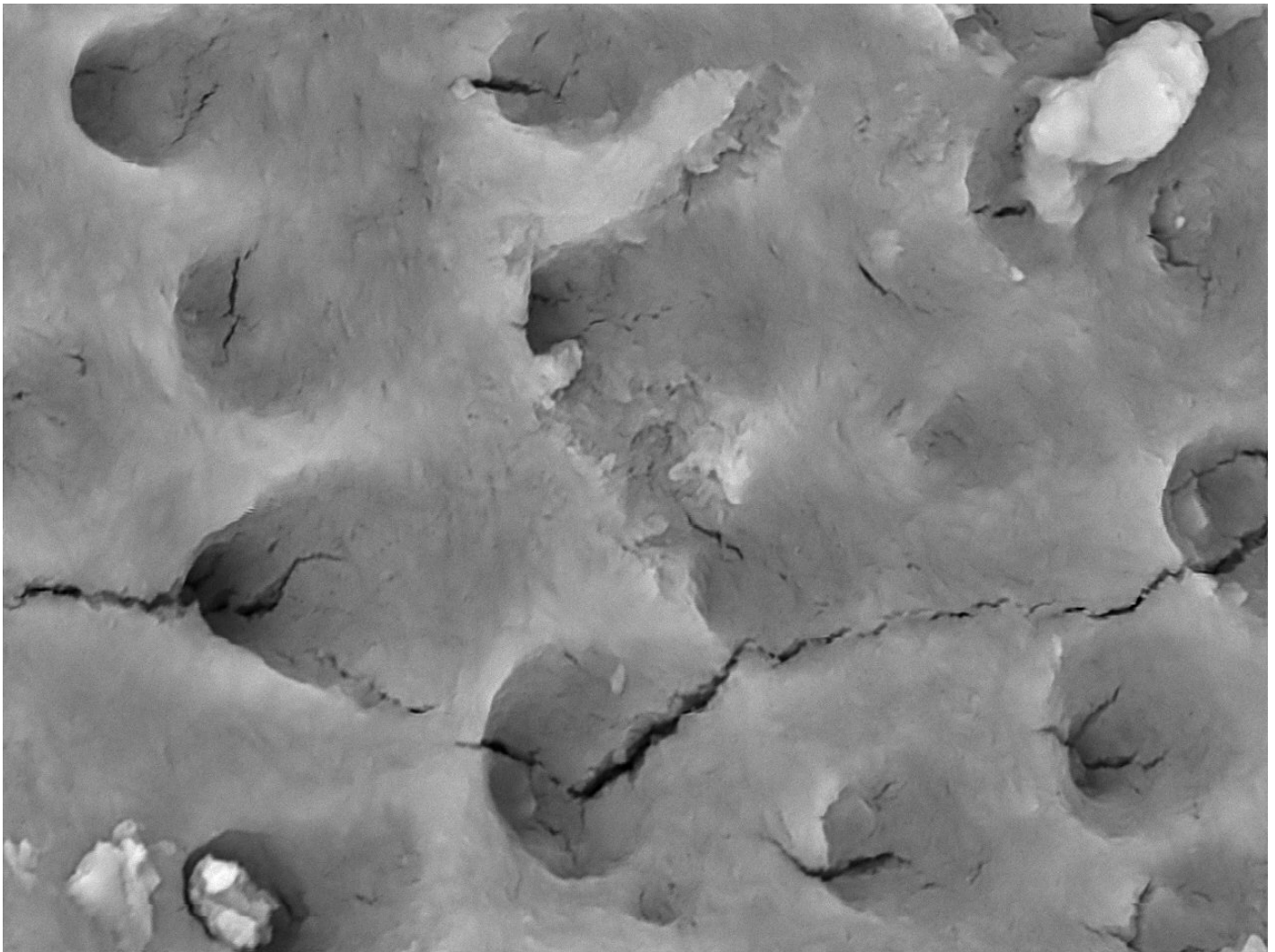
20 μ m

118) image234

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image235

image235



29179-3

2017/03/03 14:29 N

x5.0k 20 μ m

119) image235

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

Appendix C: REDCap survey, block 3

Block 3

Please complete the survey below.

Thank you!

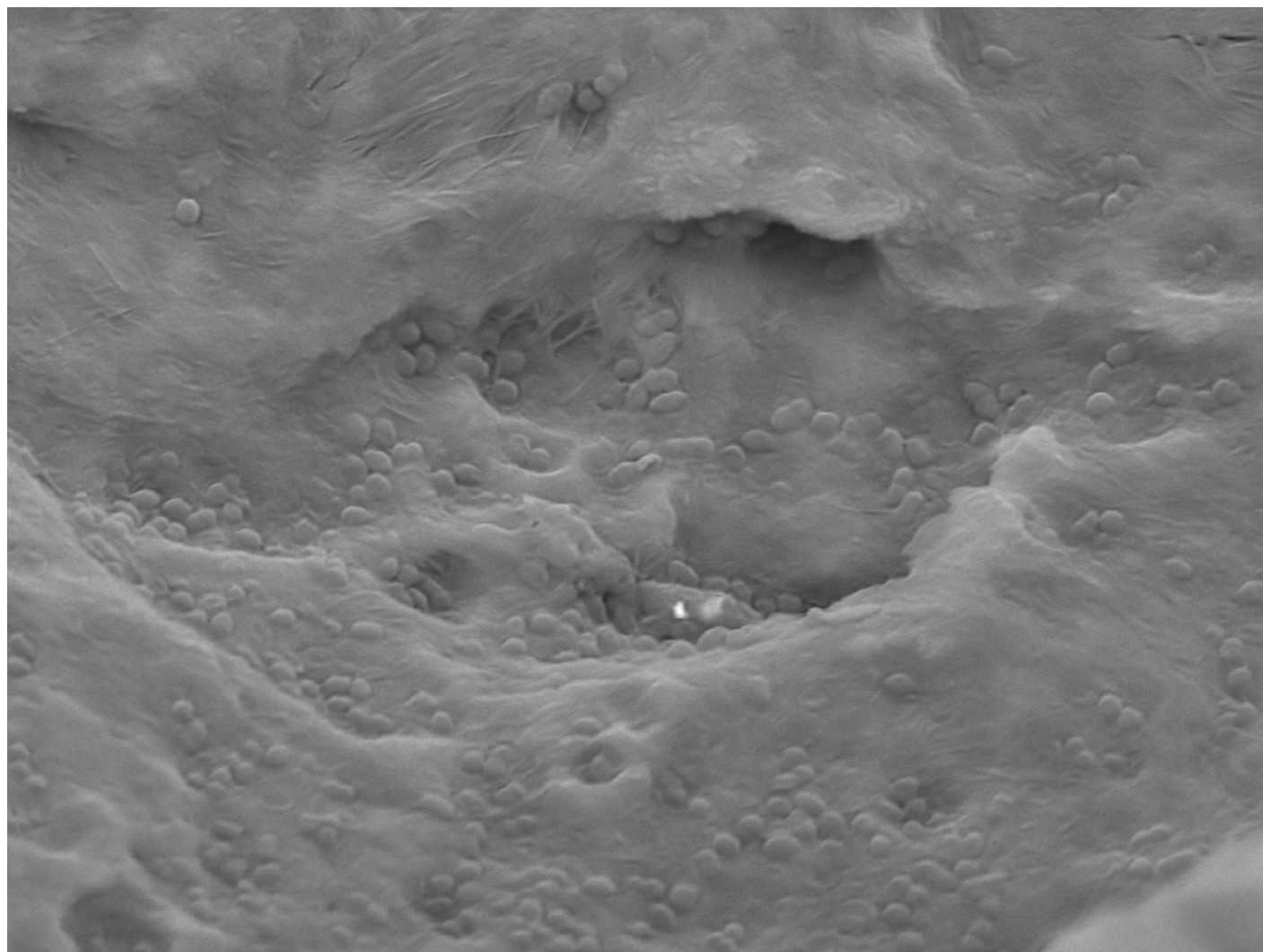
Identify rater

1) Who is rating these images?

- Garry Myers
- Vaughan Mayo
- Todd Kitten
- Cyrus Ardalan

image236

image236



29679-3

2017/02/27 09:45 N

x5.0k

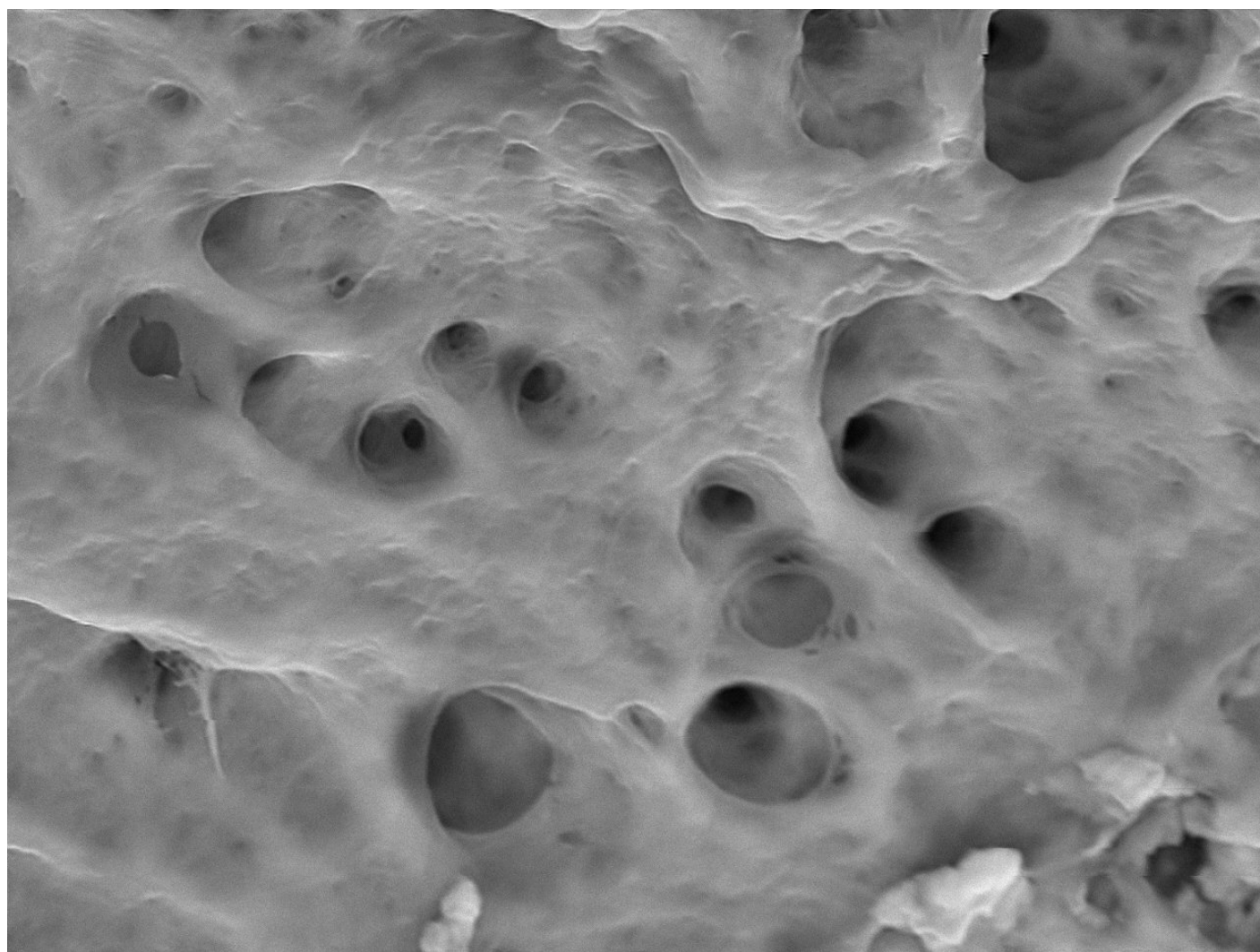
20 μ m

2) image236

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image237

image237



29961-2

2017/03/01 14:56 N

x5.0k

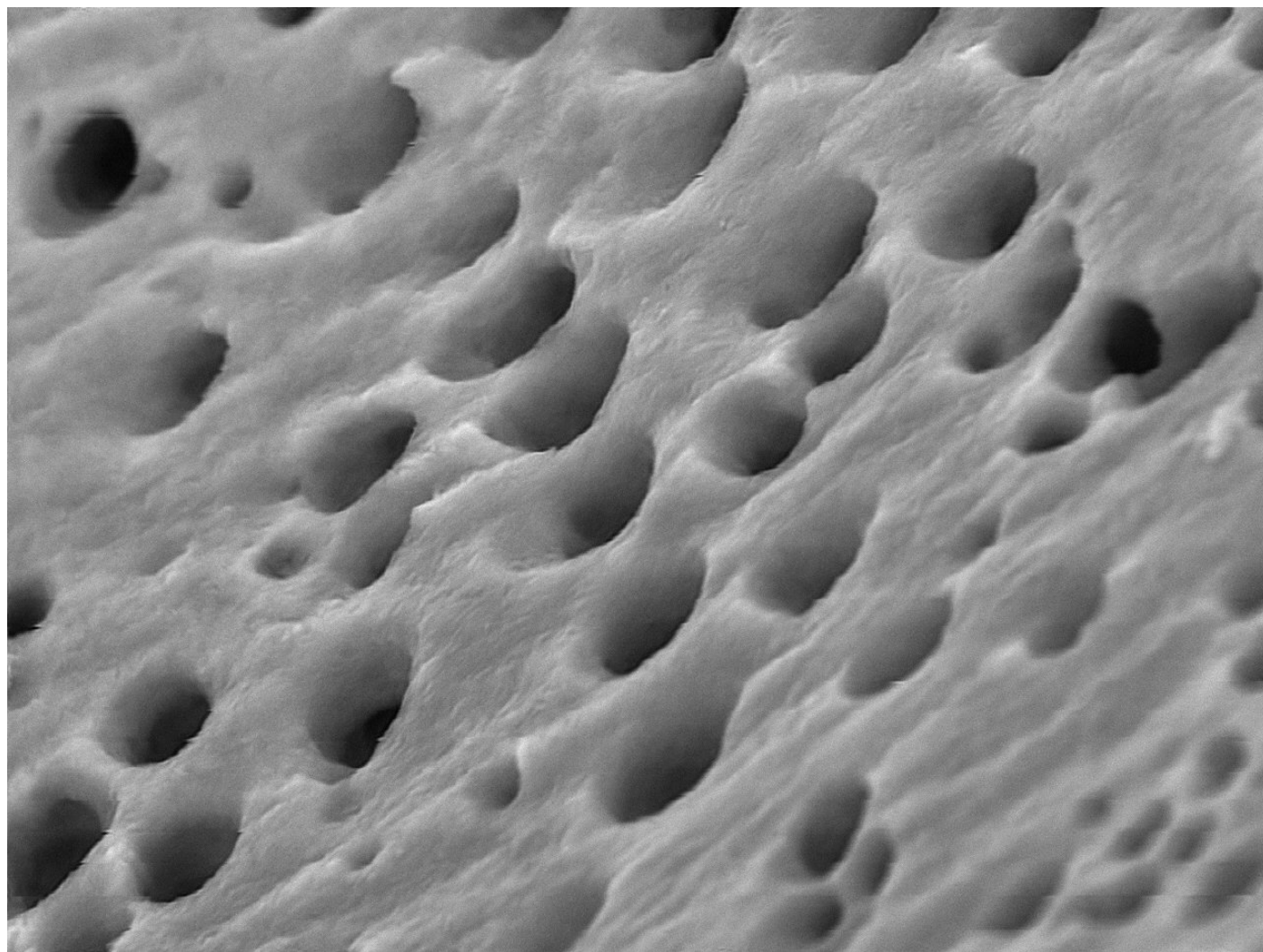
20 μ m

3) image237

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image238

image238



29009-31

2017/03/06 09:19 N

x5.0k

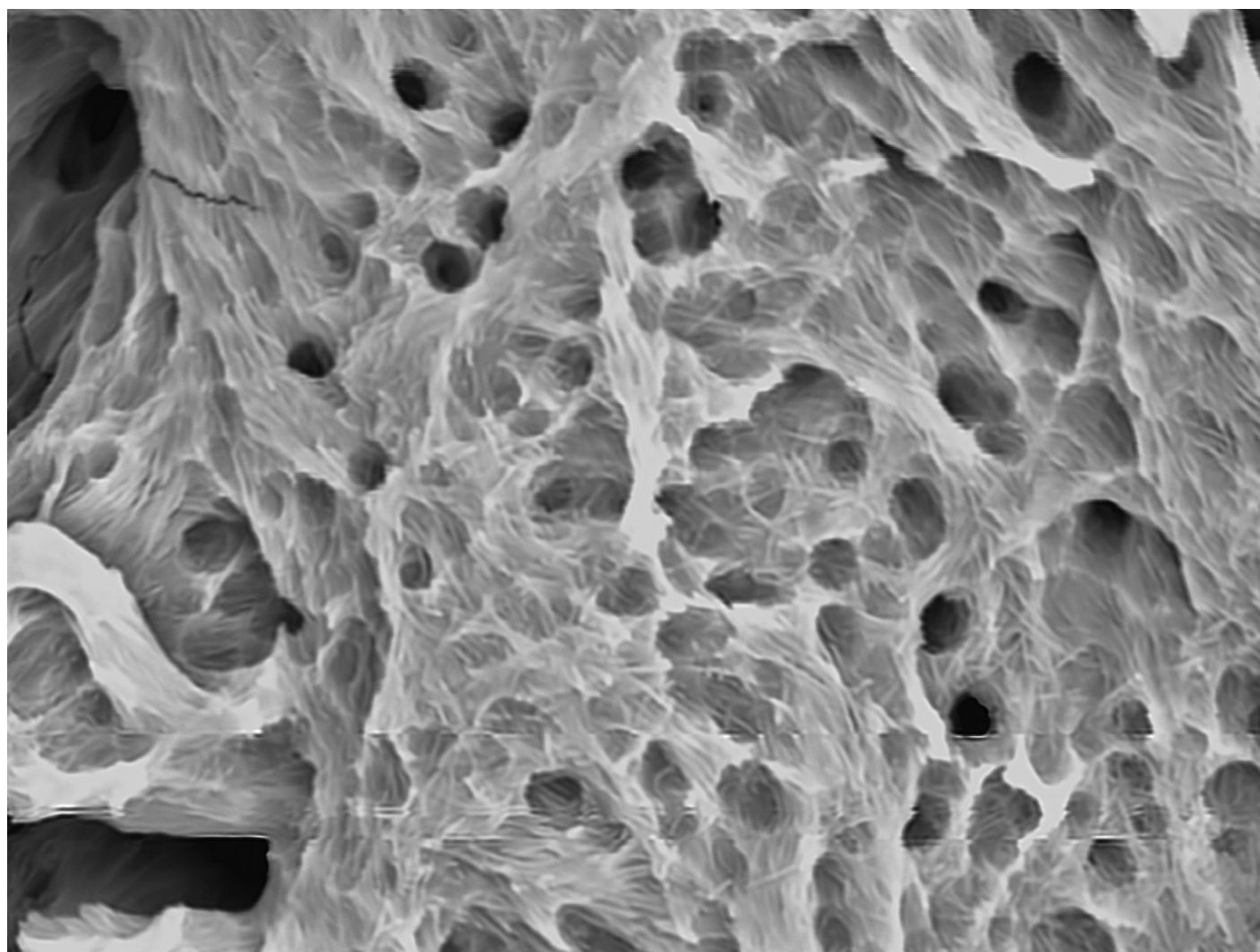
20 μ m

4) image238

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image239

image239



29805-30

2017/03/09 14:36 H

x5.0k

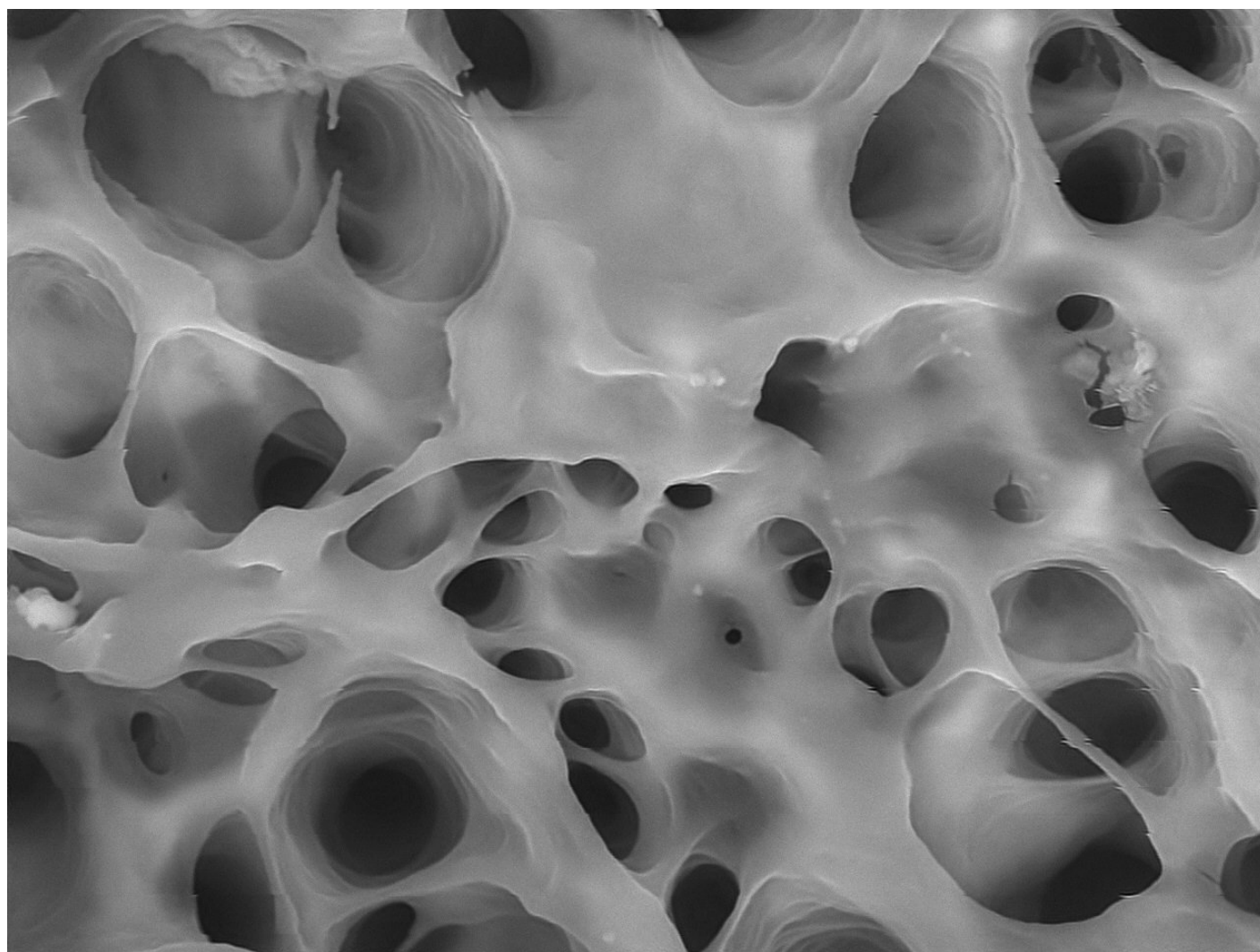
20 μ m

5) image239

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image240

image240



29960-14

2017/03/01 10:37 N

x5.0k

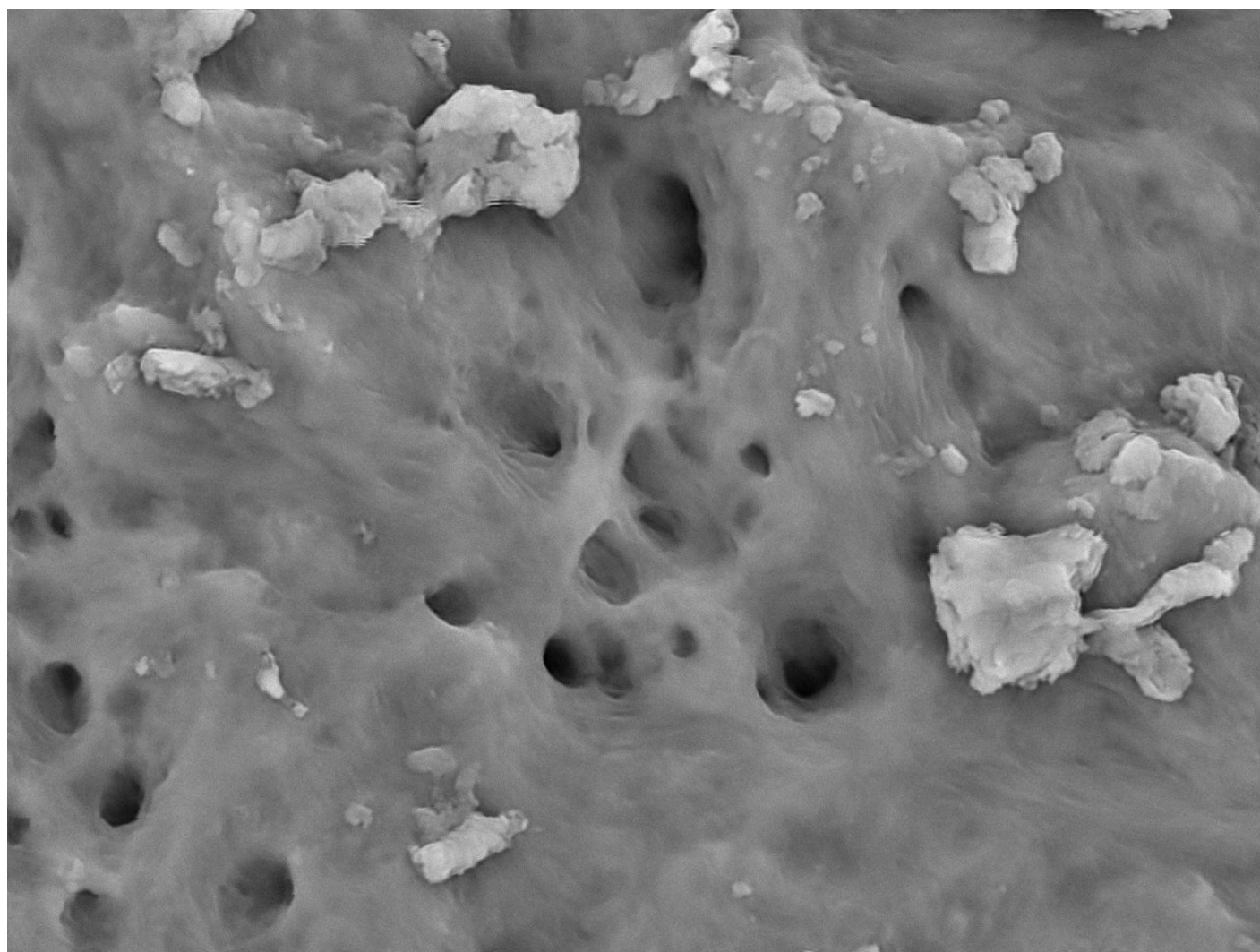
20 μ m

6) image240

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image241

image241



29961-2

2017/03/01 14:35 N

x5.0k

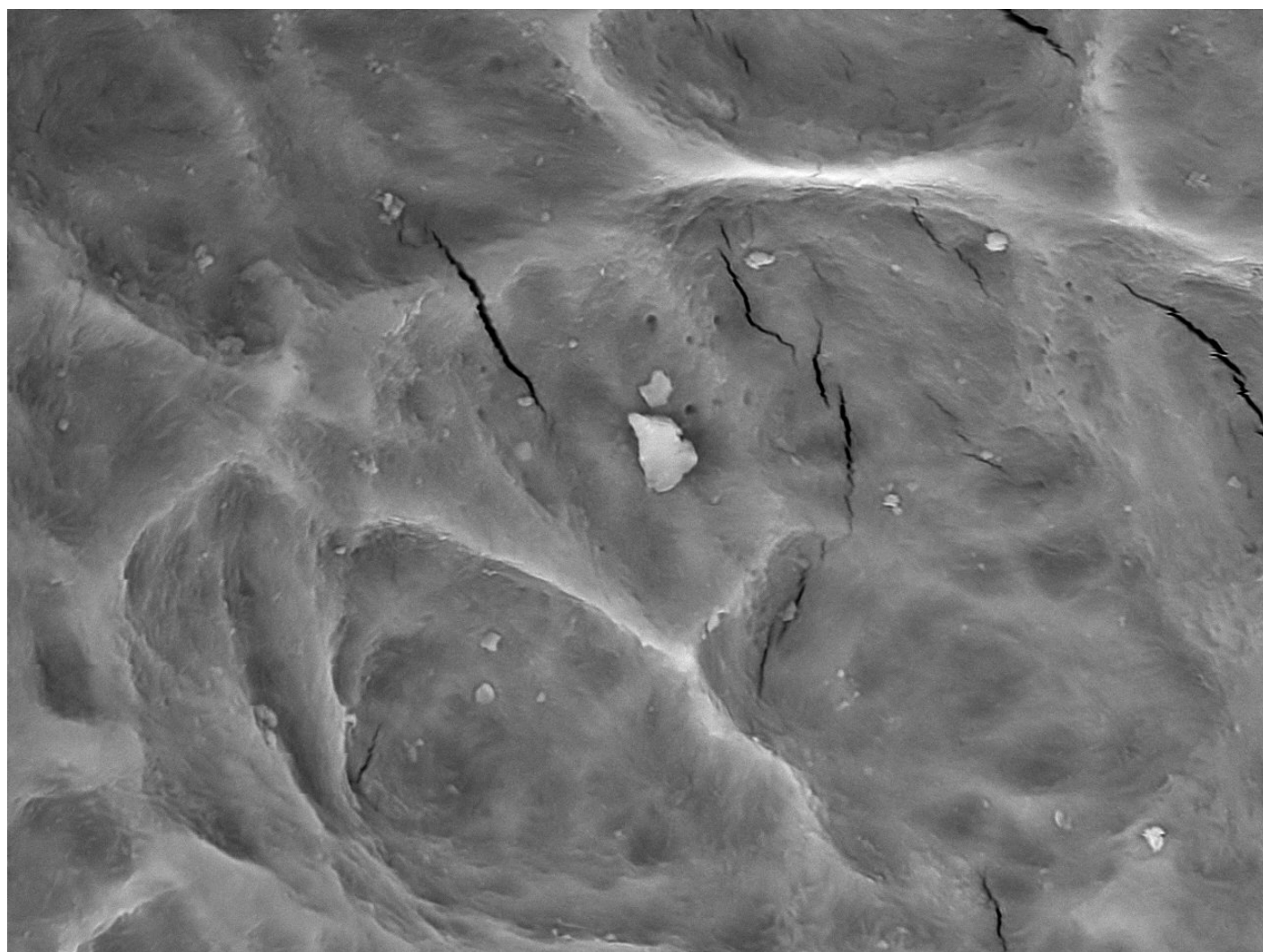
20 μ m

7) image241

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image242

image242



29052-14

2017/02/28 17:27 N

x5.0k

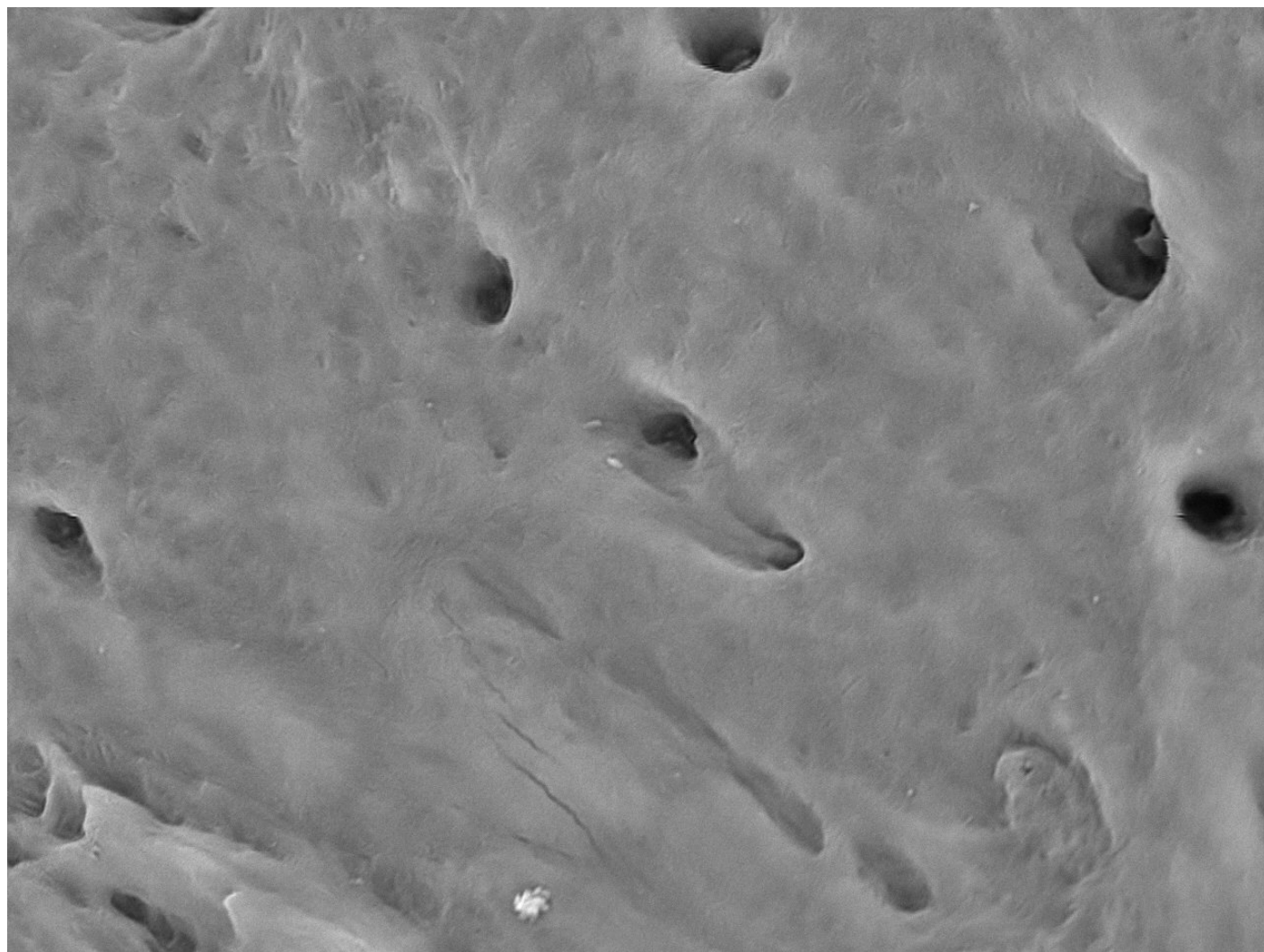
20 μ m

8) image242

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image243

image243



29576-18

2017/03/01 11:54 N

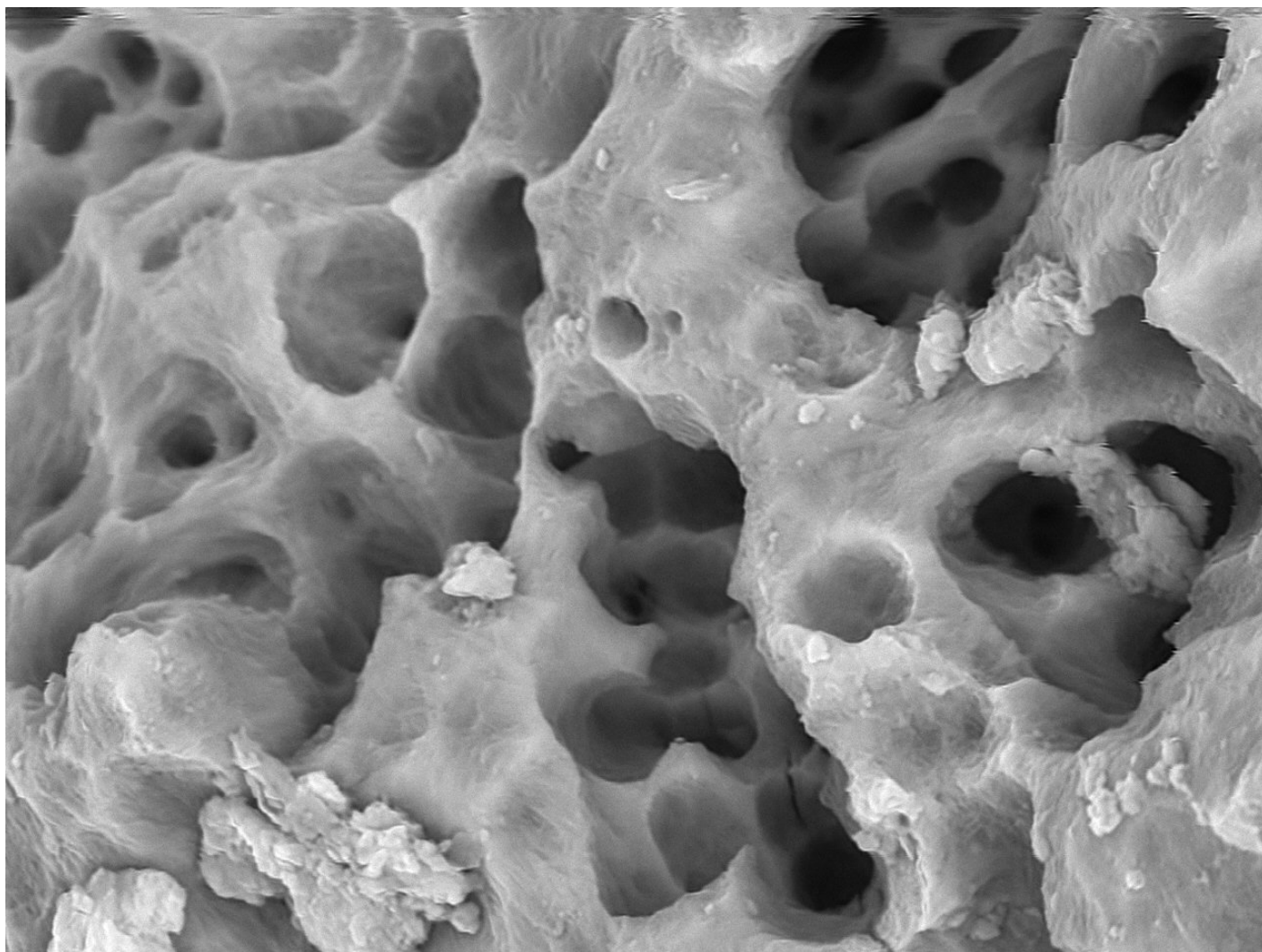
x5.0k 20 μ m

9) image243

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image244

image244



29265-2

2017/02/27 11:48 N

x5.0k

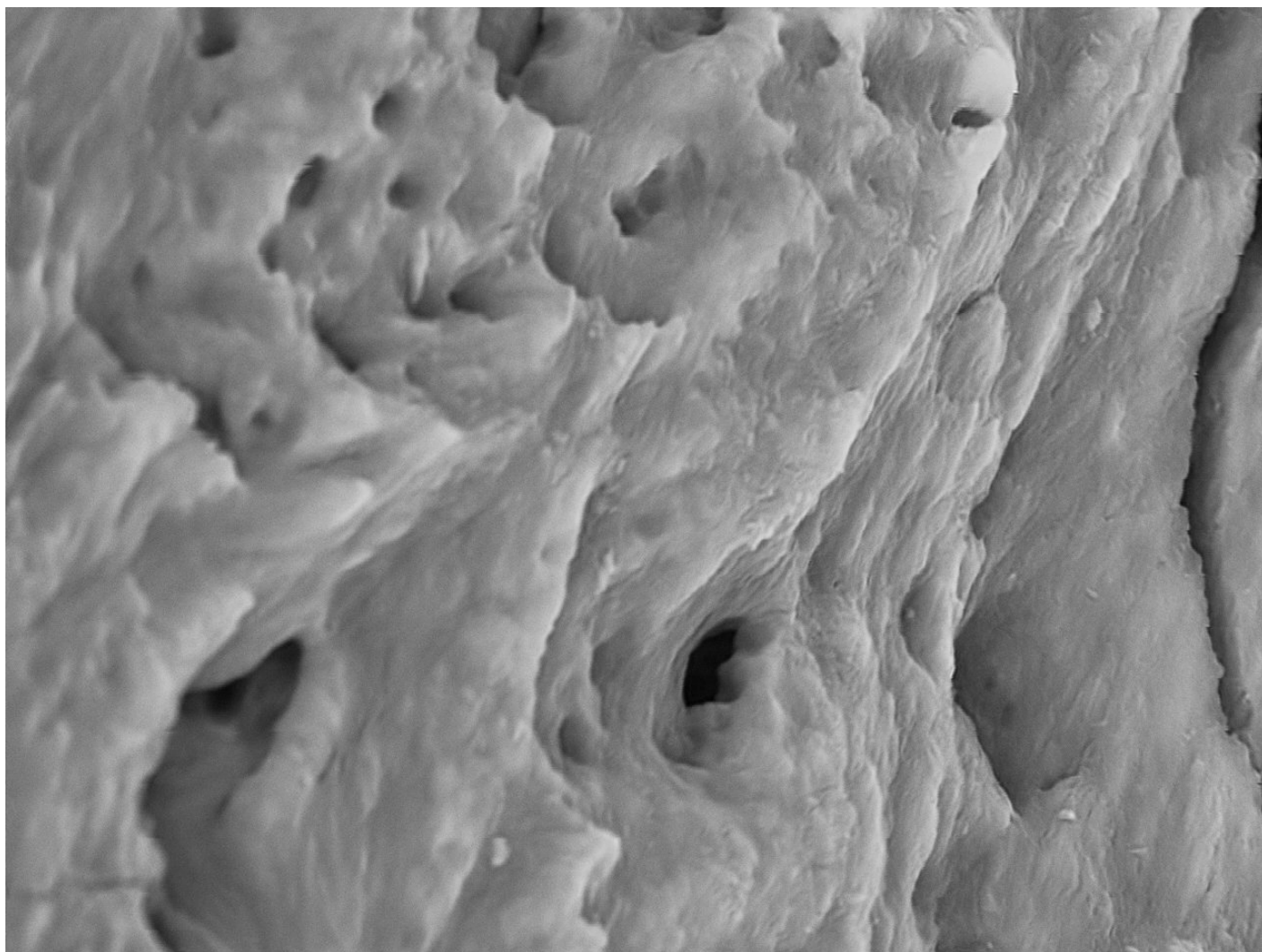
20 μ m

10) image244

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image245

image245



29576-18

2017/03/01 11:59 N

x5.0k

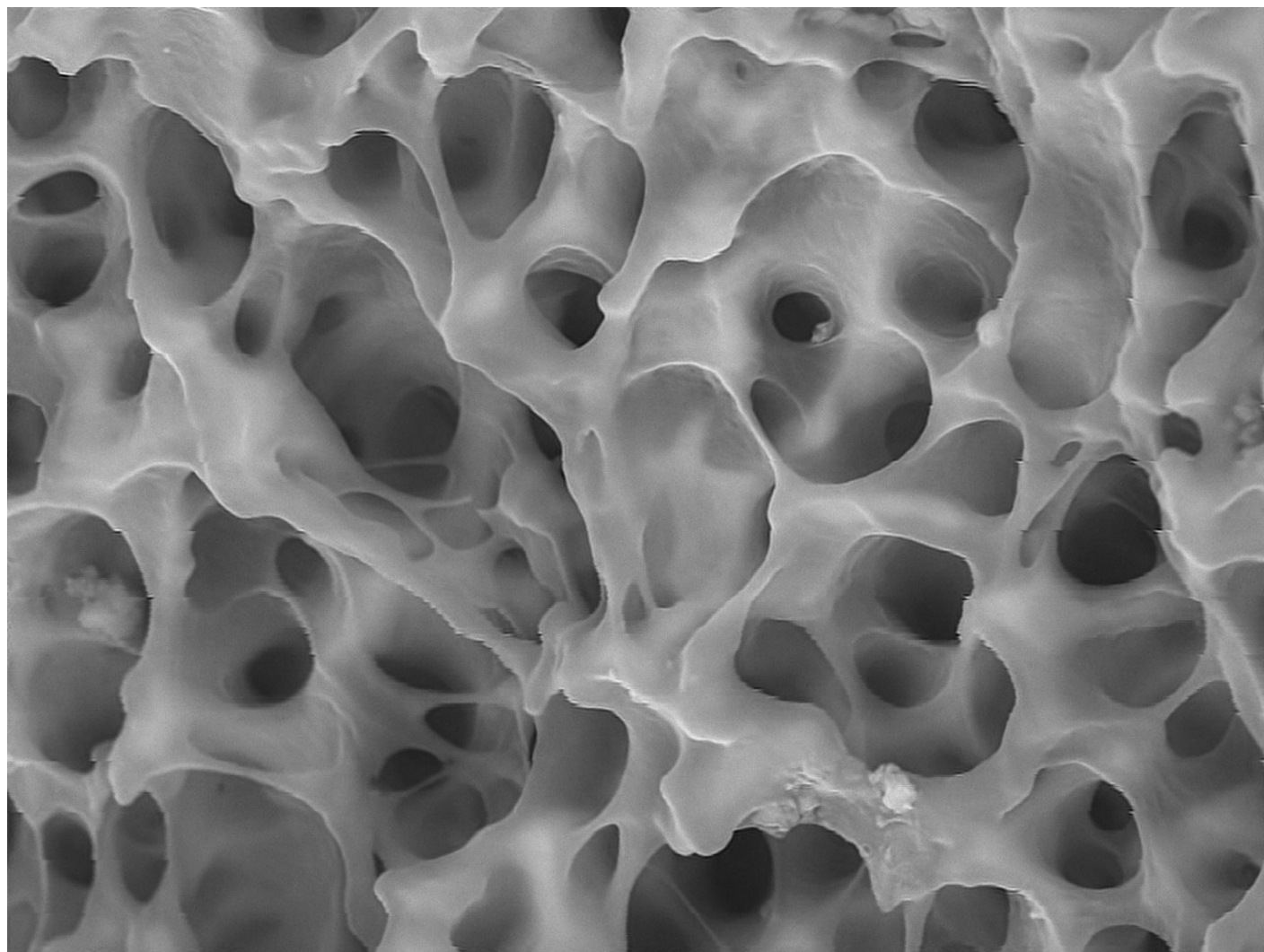
20 μm

11) image245

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image246

image246



29960-14

2017/03/01 10:32 N

x5.0k

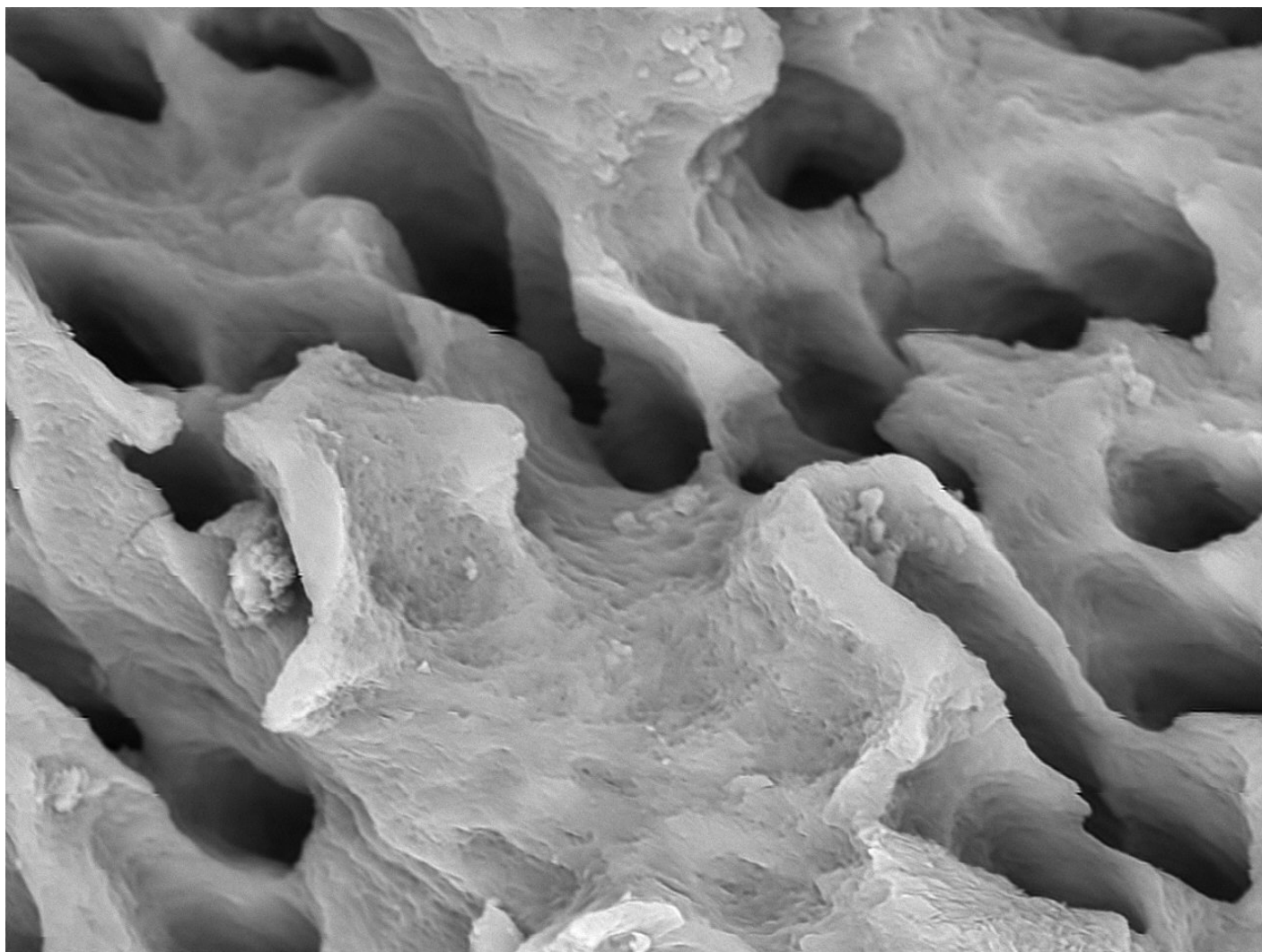
20 μ m

12) image246

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image247

image247



29576-18

2017/03/01 11:26 N

x5.0k

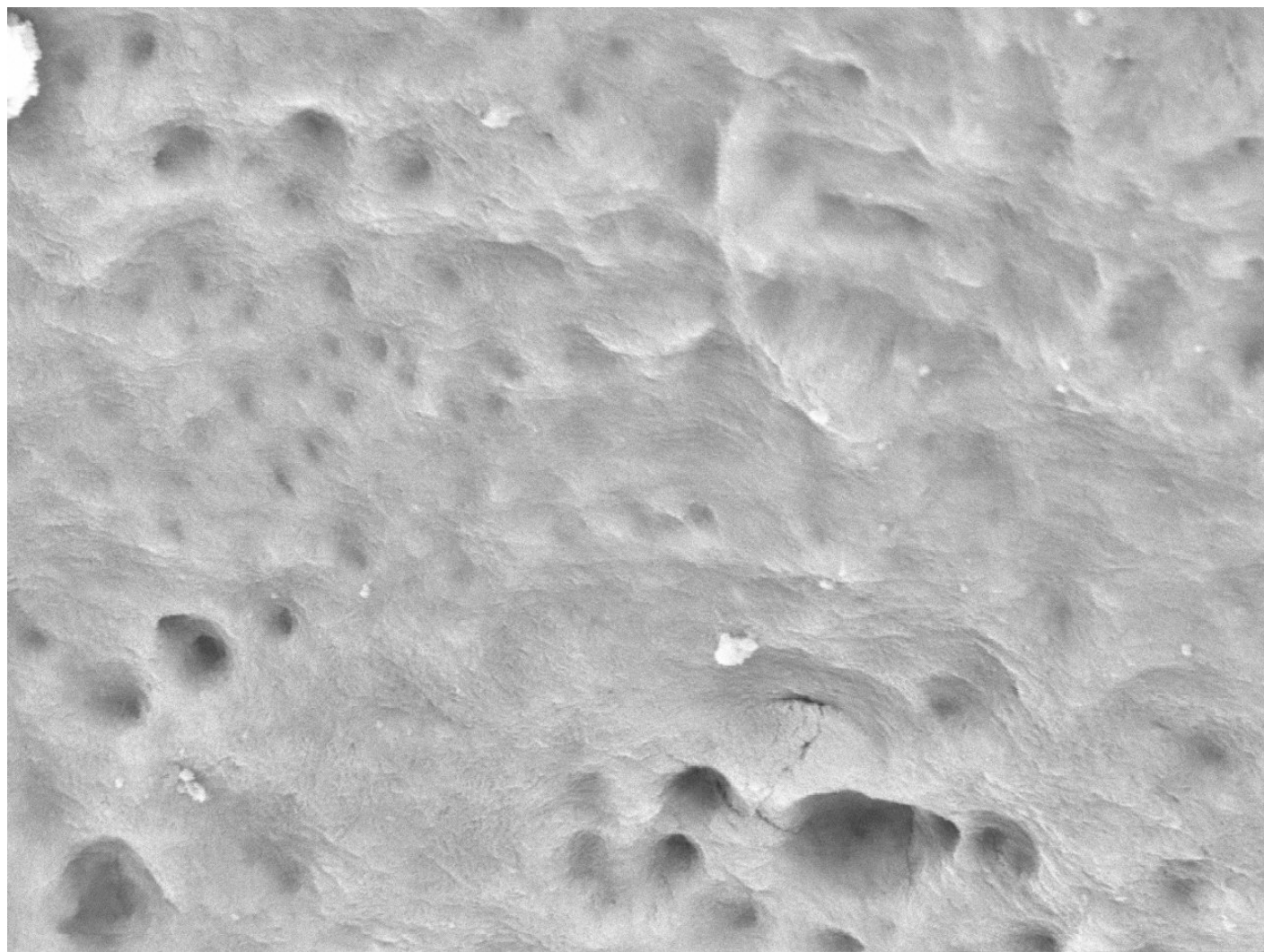
20 μm

13) image247

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image248

image248



29952-15

2017/02/22 15:37 N

x5.0k

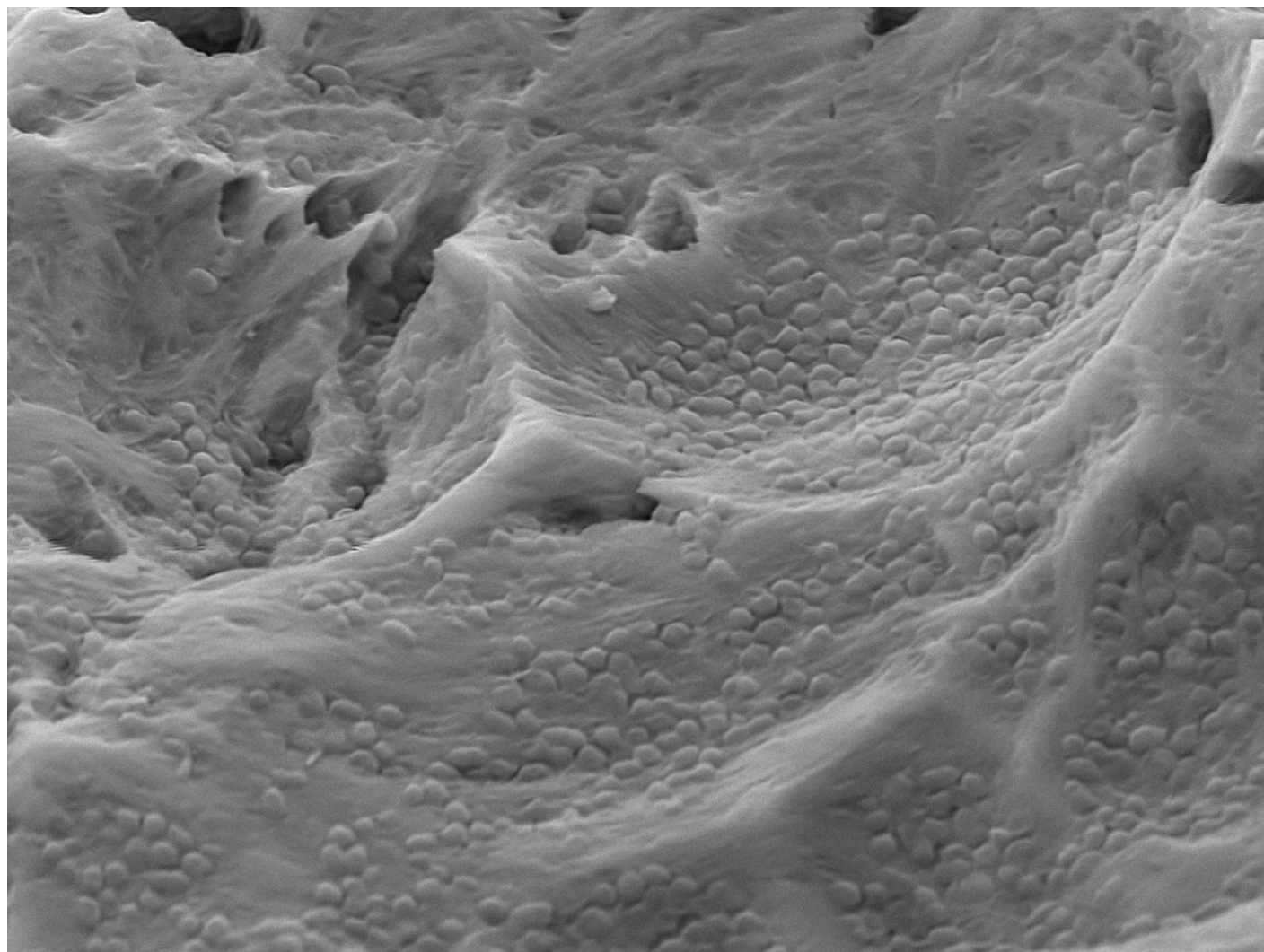
20 μ m

14) image248

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image249

image249



29679-3

2017/02/27 10:04 N

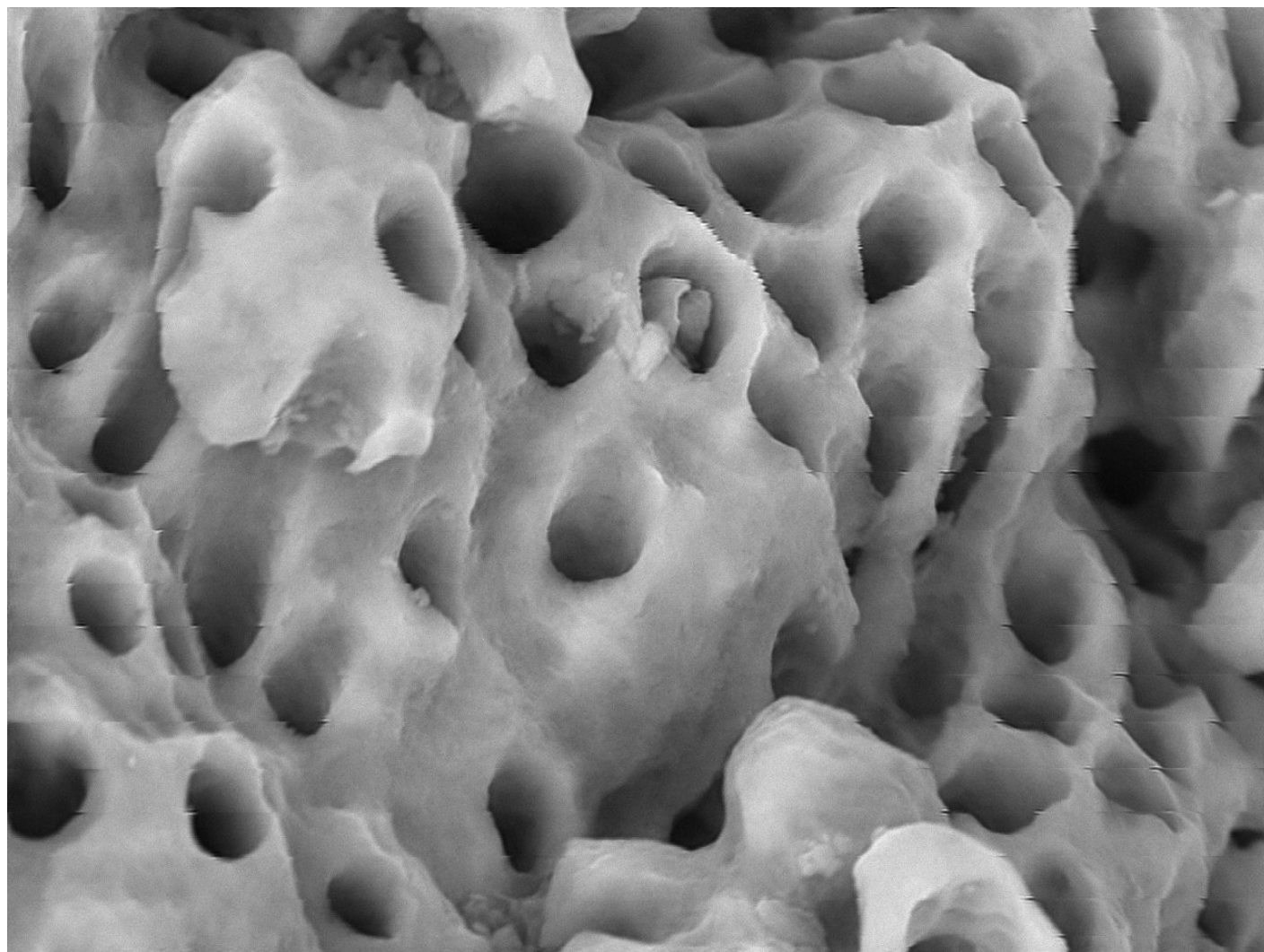
x5.0k 20 μ m

15) image249

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image250

image250



29179-3

2017/03/03 11:57 N

x5.0k

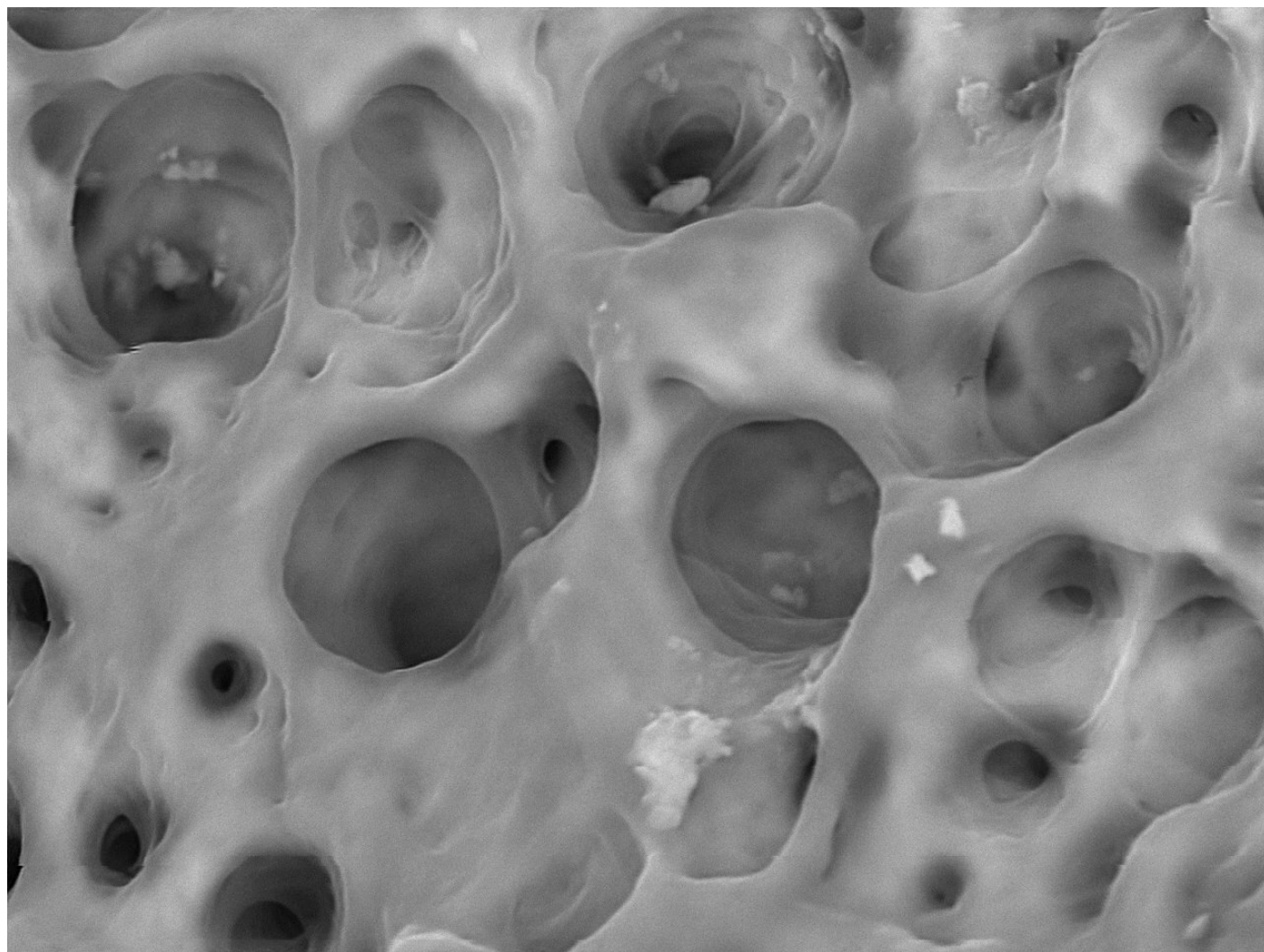
20 μm

16) image250

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image251

image251



29963-15

2017/03/01 10:14 N

x5.0k

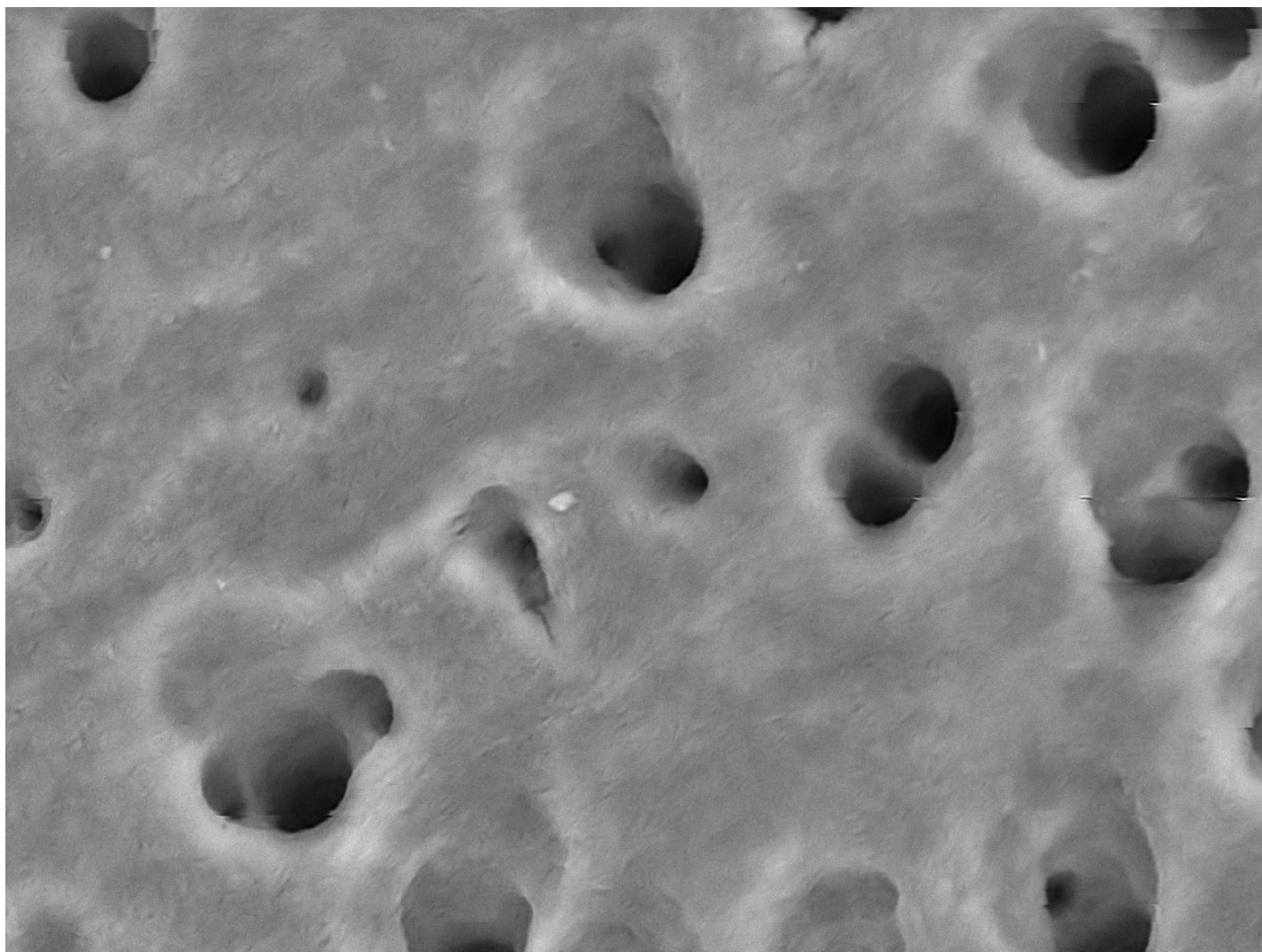
20 μ m

17) image251

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image252

image252



29009-31

2017/03/06 09:23 N

x5.0k

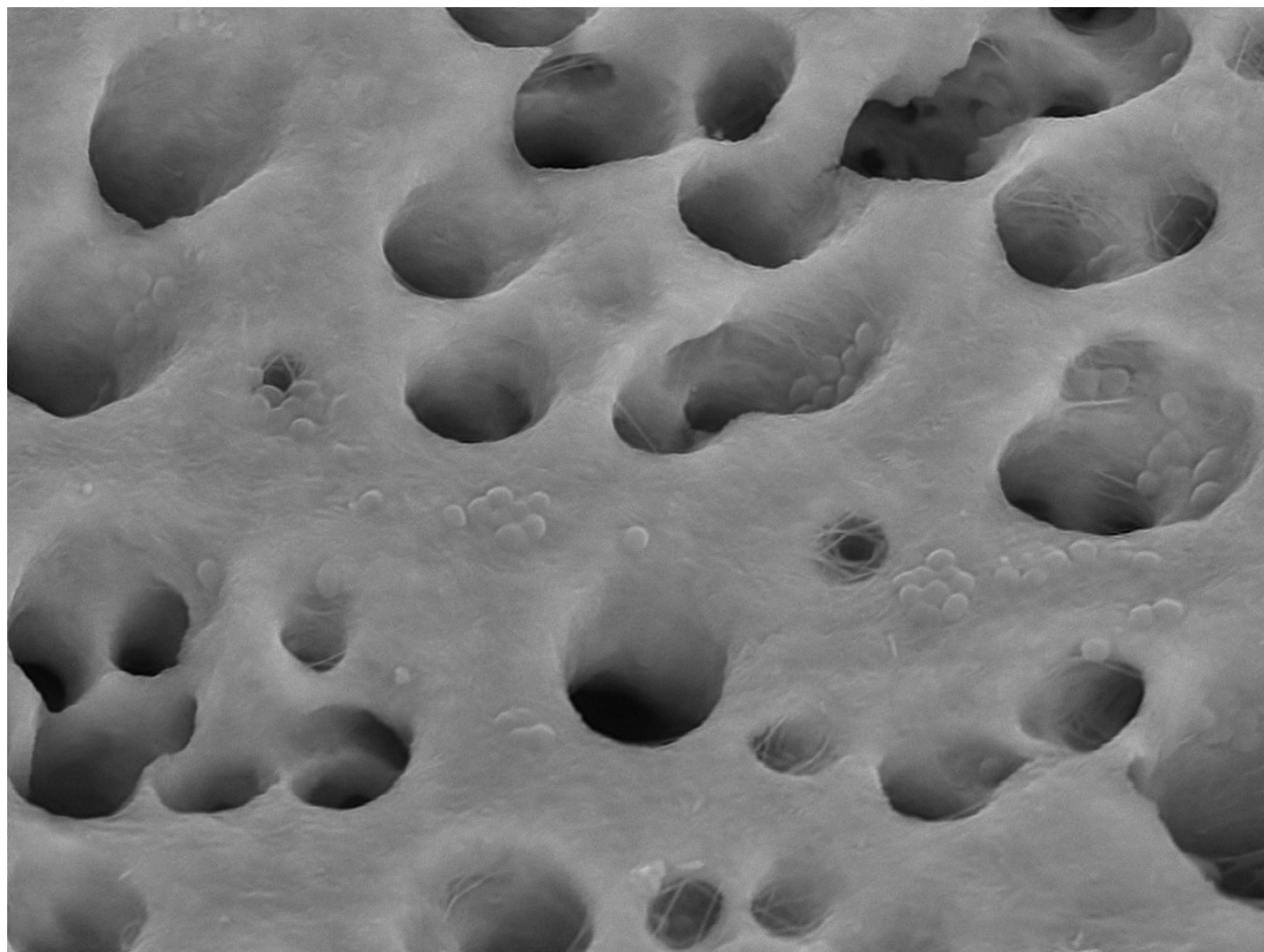
20 μ m

18) image252

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image253

image253



29679-3

2017/02/24 15:21 N

x5.0k

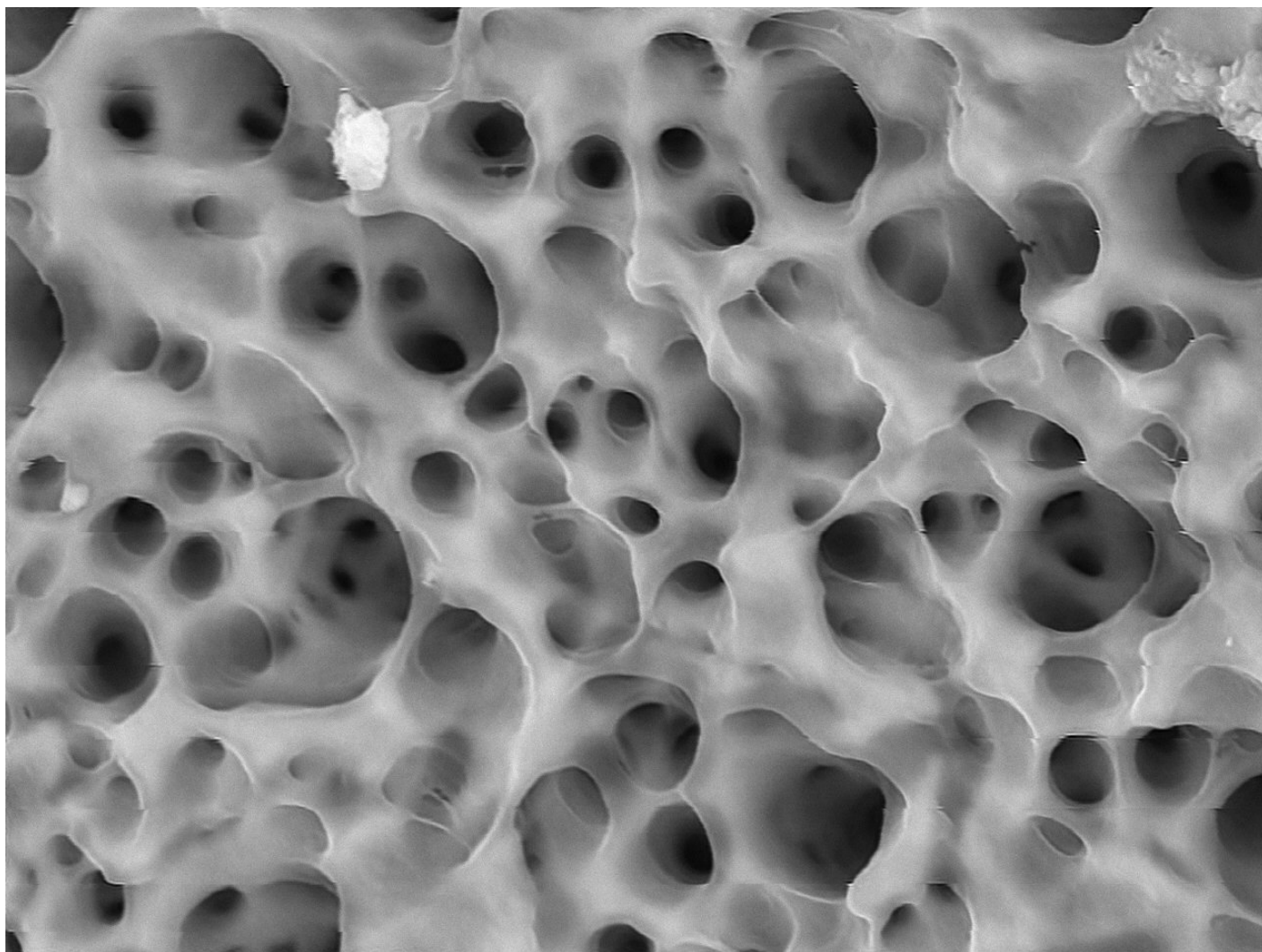
20 μ m

19) image253

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image254

image254



29961-2

2017/03/01 14:48 N

x5.0k

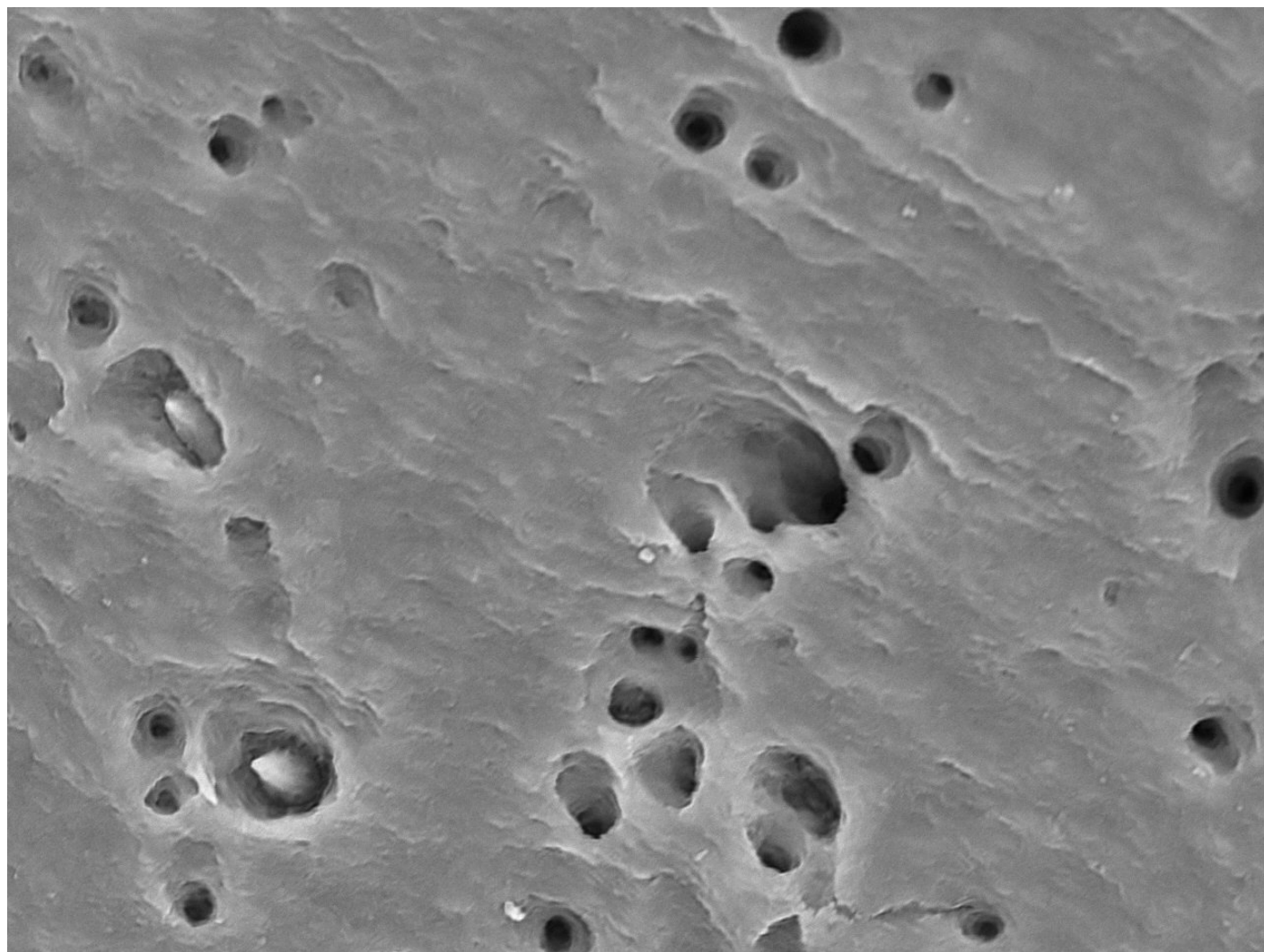
20 μ m

20) image254

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image255

image255



29211-18

2017/03/04 13:53 N

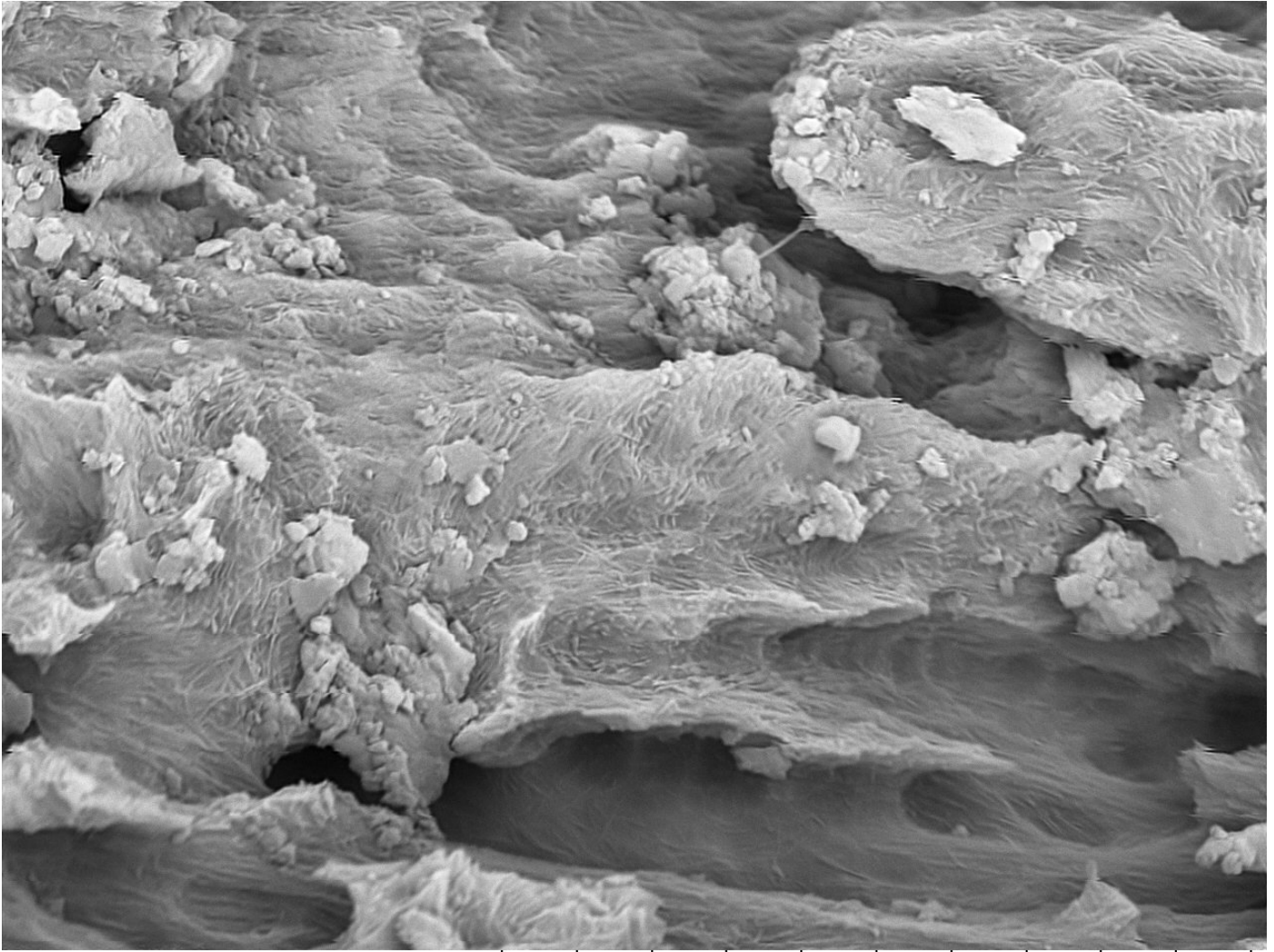
x5.0k 20 μ m

21) image255

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image256

image256



29211-18

2017/03/03 16:20 N

x5.0k

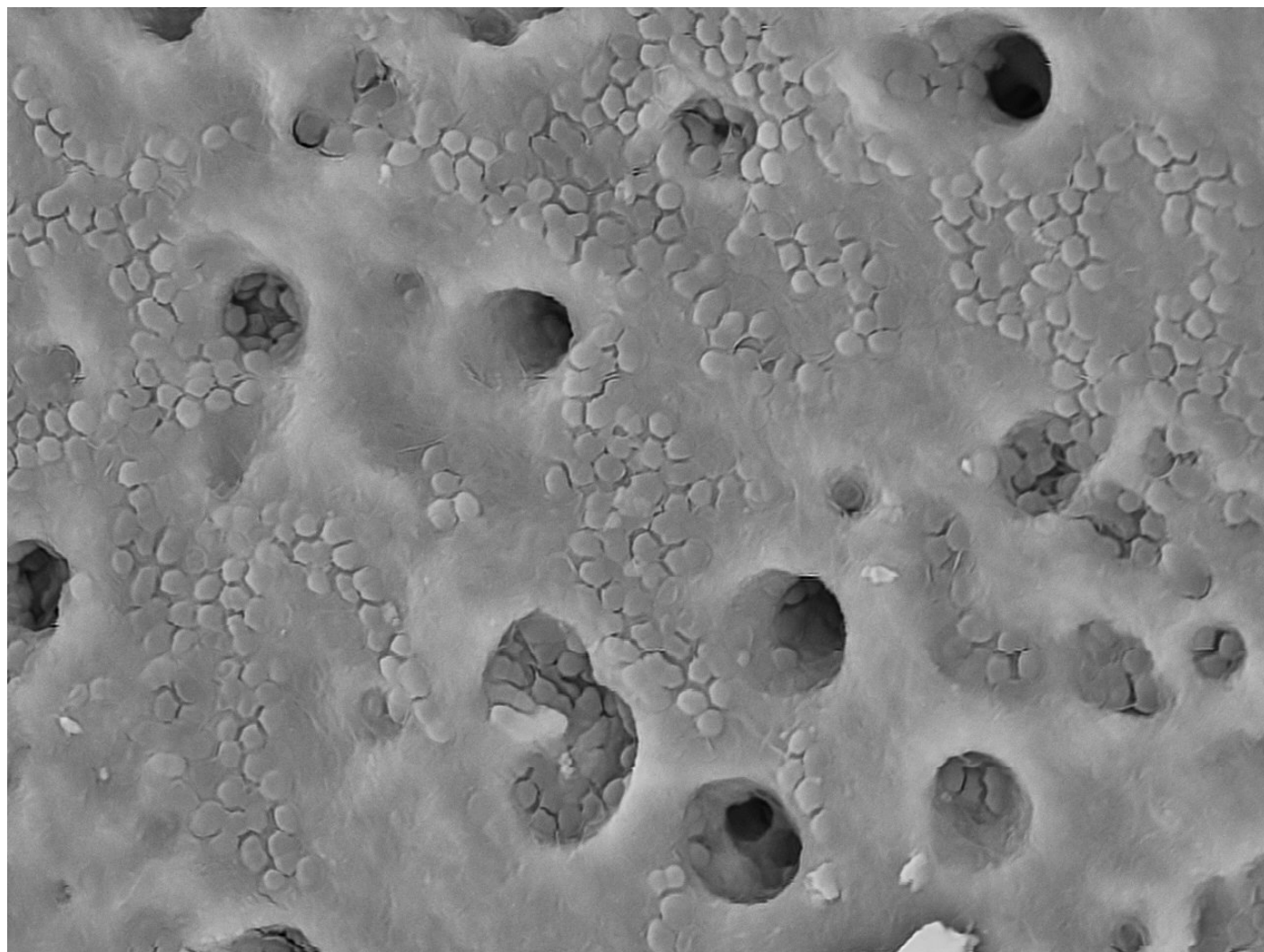
20 μ m

22) image256

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image257

image257



29965-2

2017/03/02 15:35 N

x5.0k

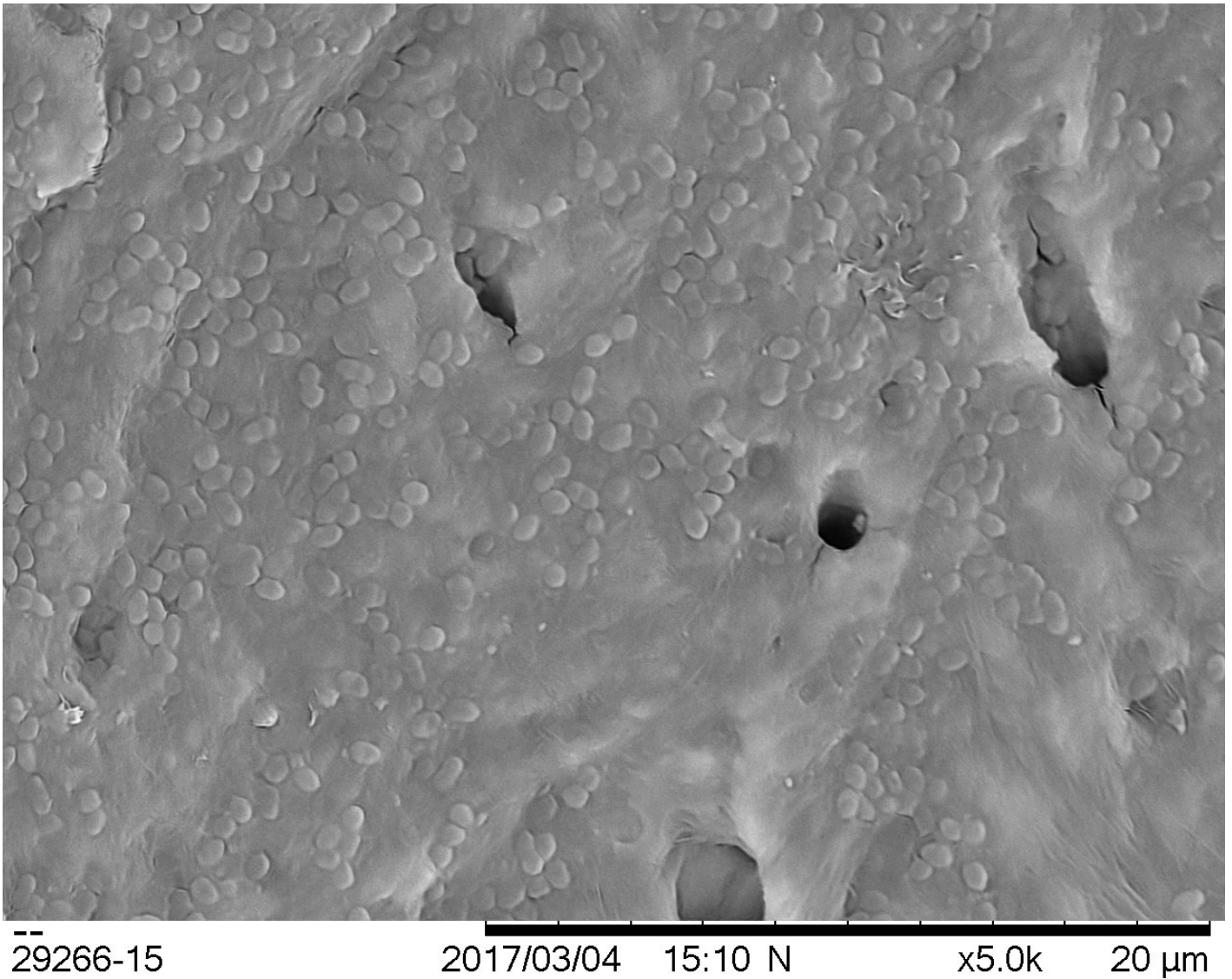
20 μ m

23) image257

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image258

image258

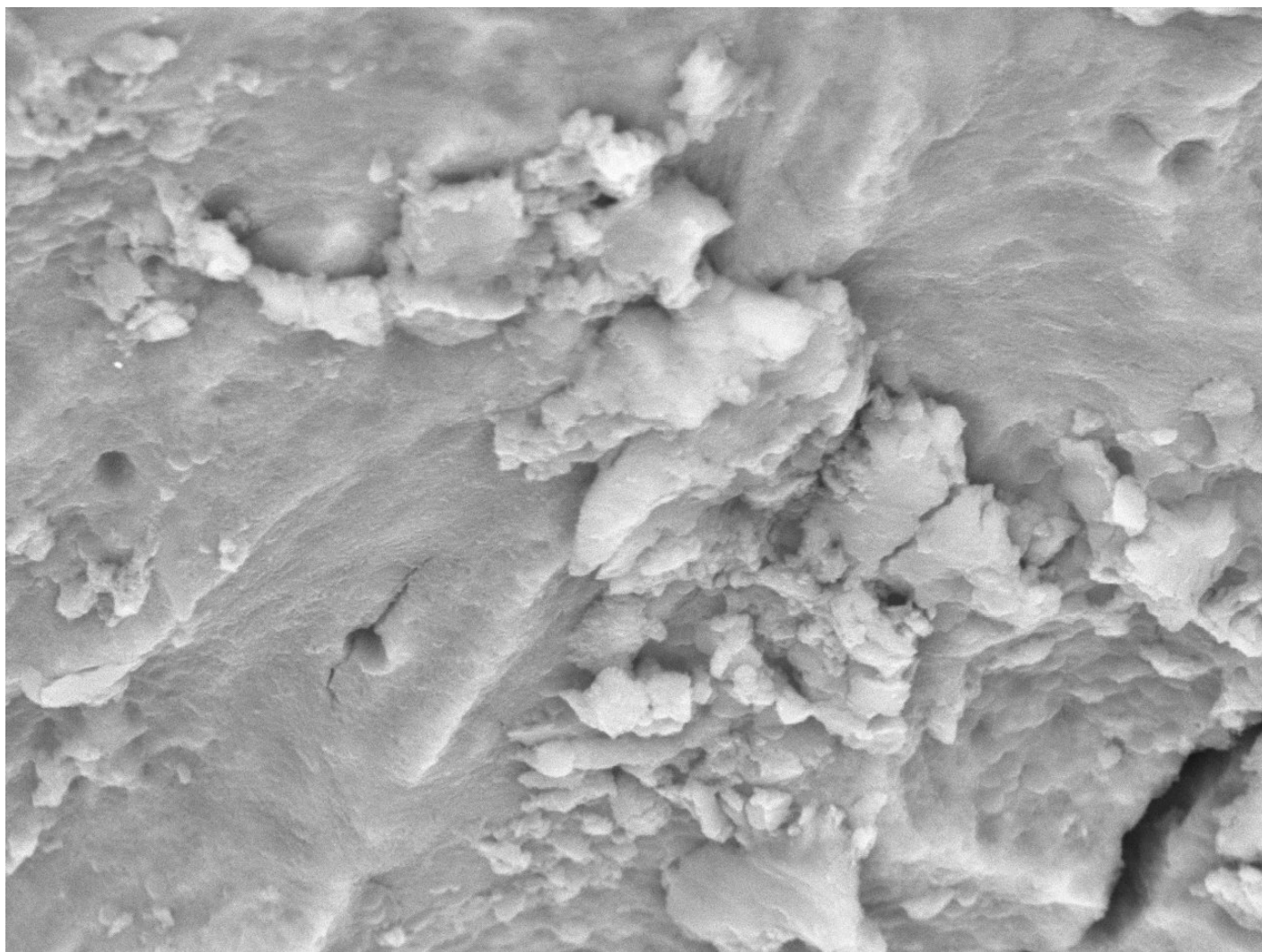


24) image258

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image259

image259



29856-30

2017/02/22 14:01 N

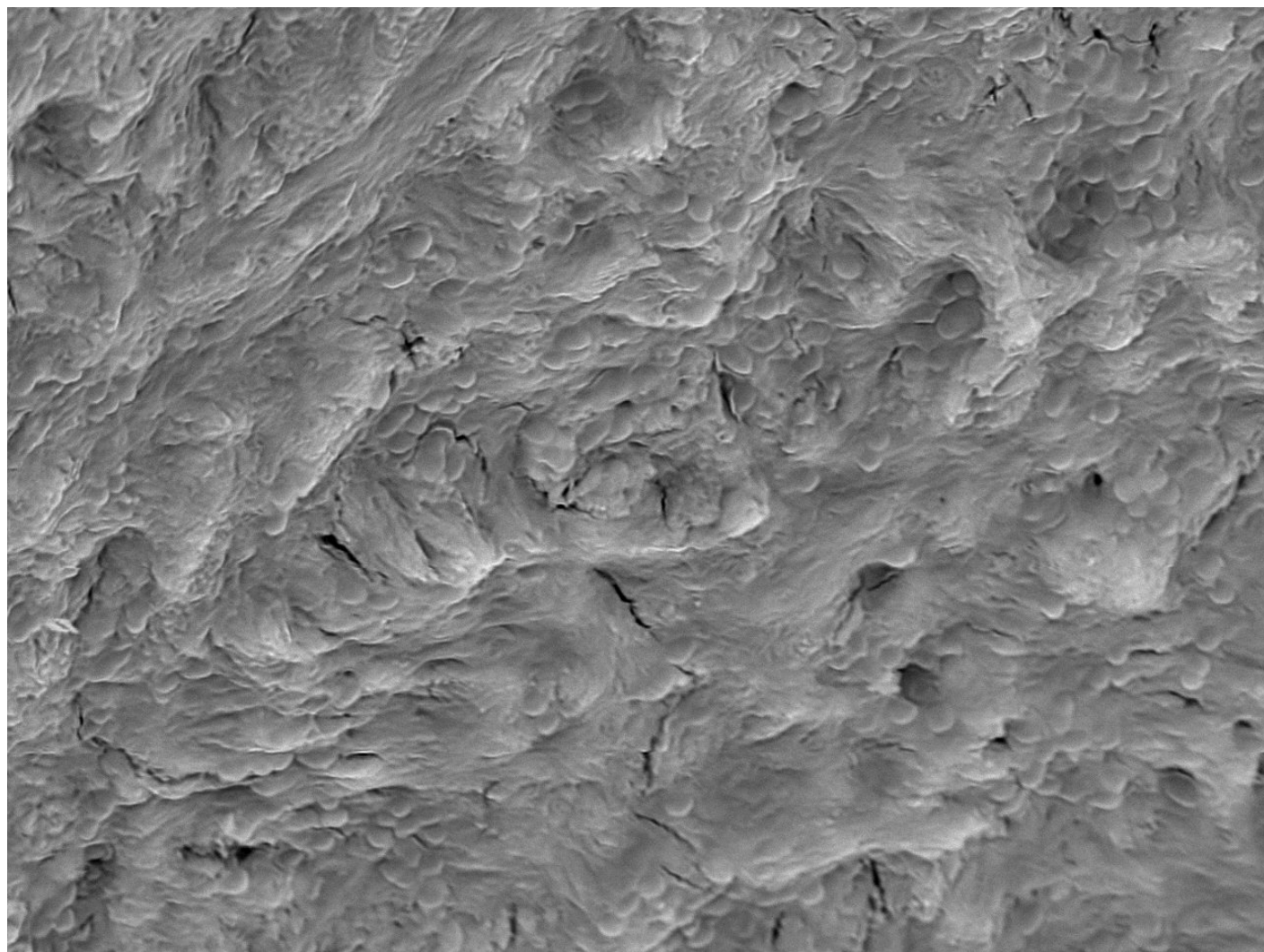
x5.0k 20 μ m

25) image259

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image260

image260



29679-3

2017/02/27 16:38 N

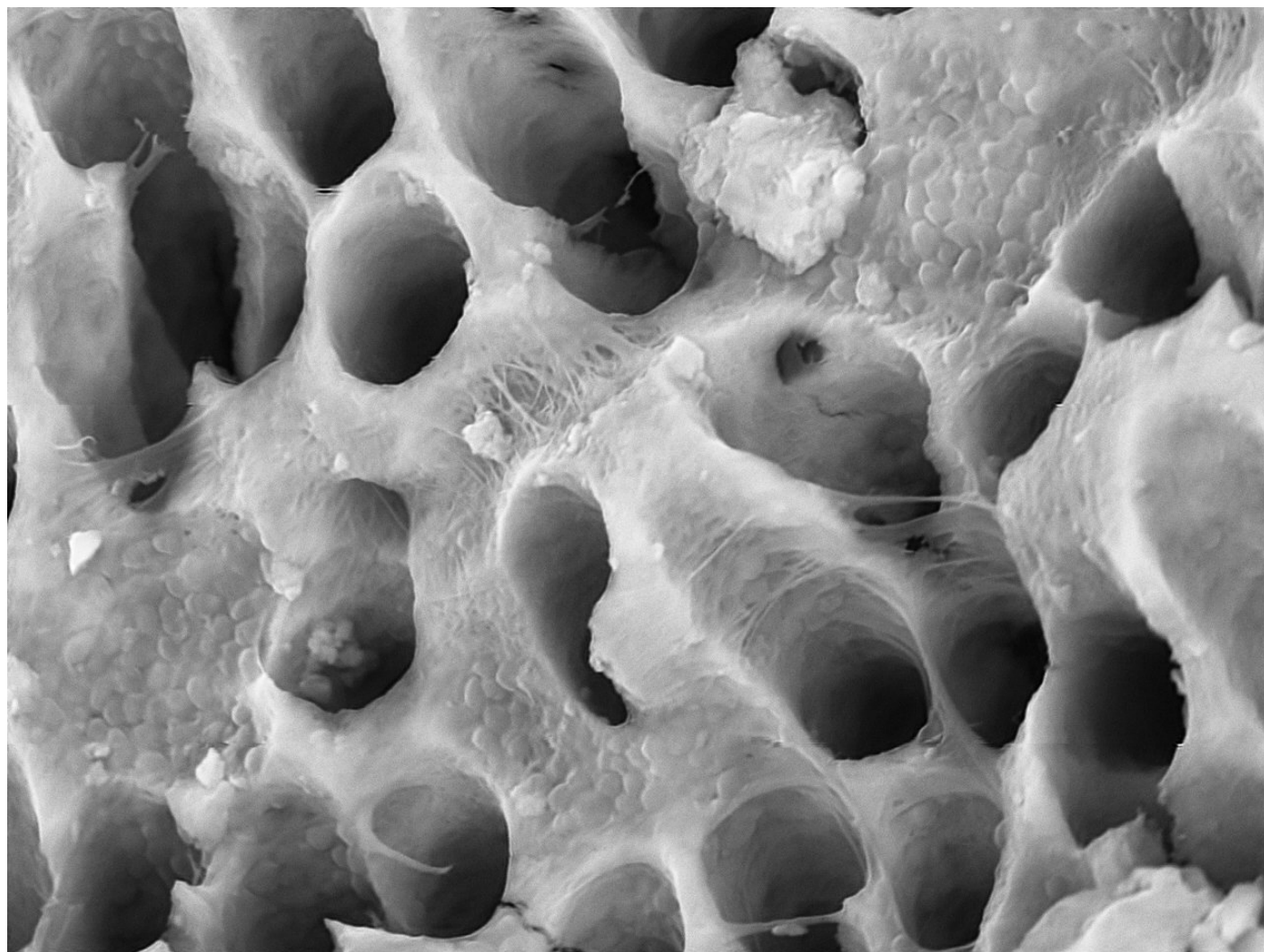
x5.0k 20 μm

26) image260

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image261

image261



29694-2

2017/02/28 16:39 N

x5.0k

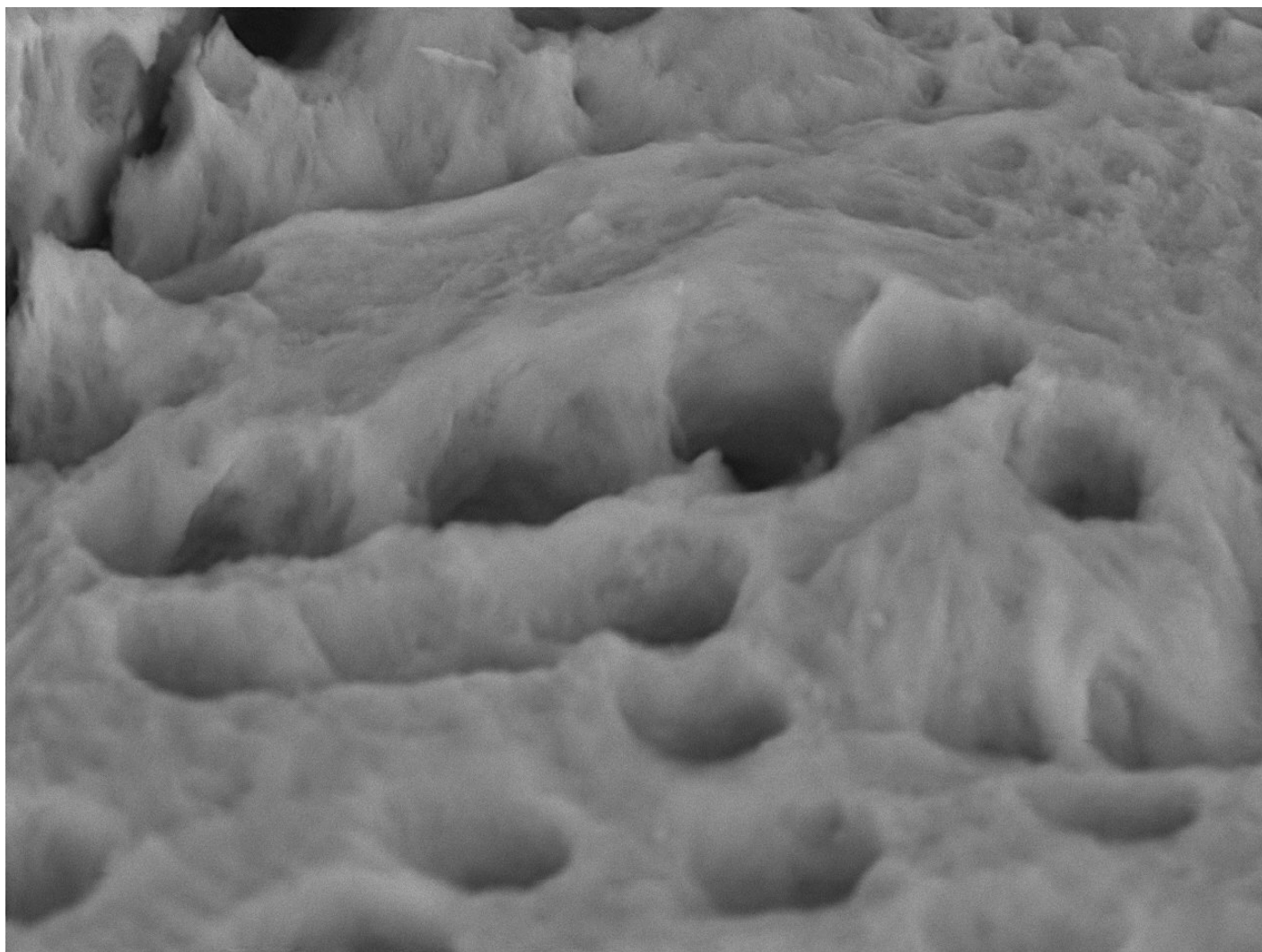
20 μ m

27) image261

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image262

image262



29009-31

2017/03/06 09:01 N

x5.0k

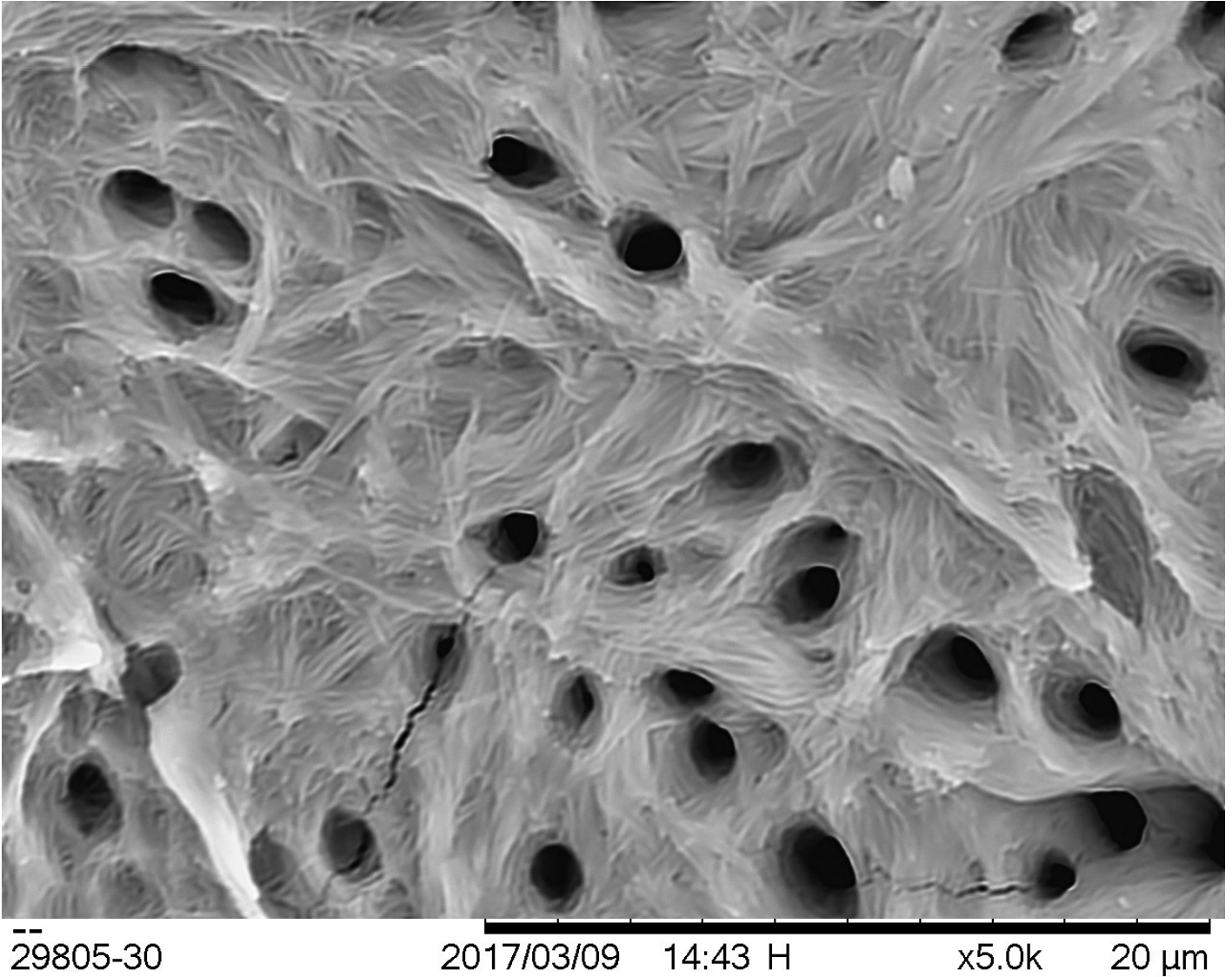
20 μ m

28) image262

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image263

image263

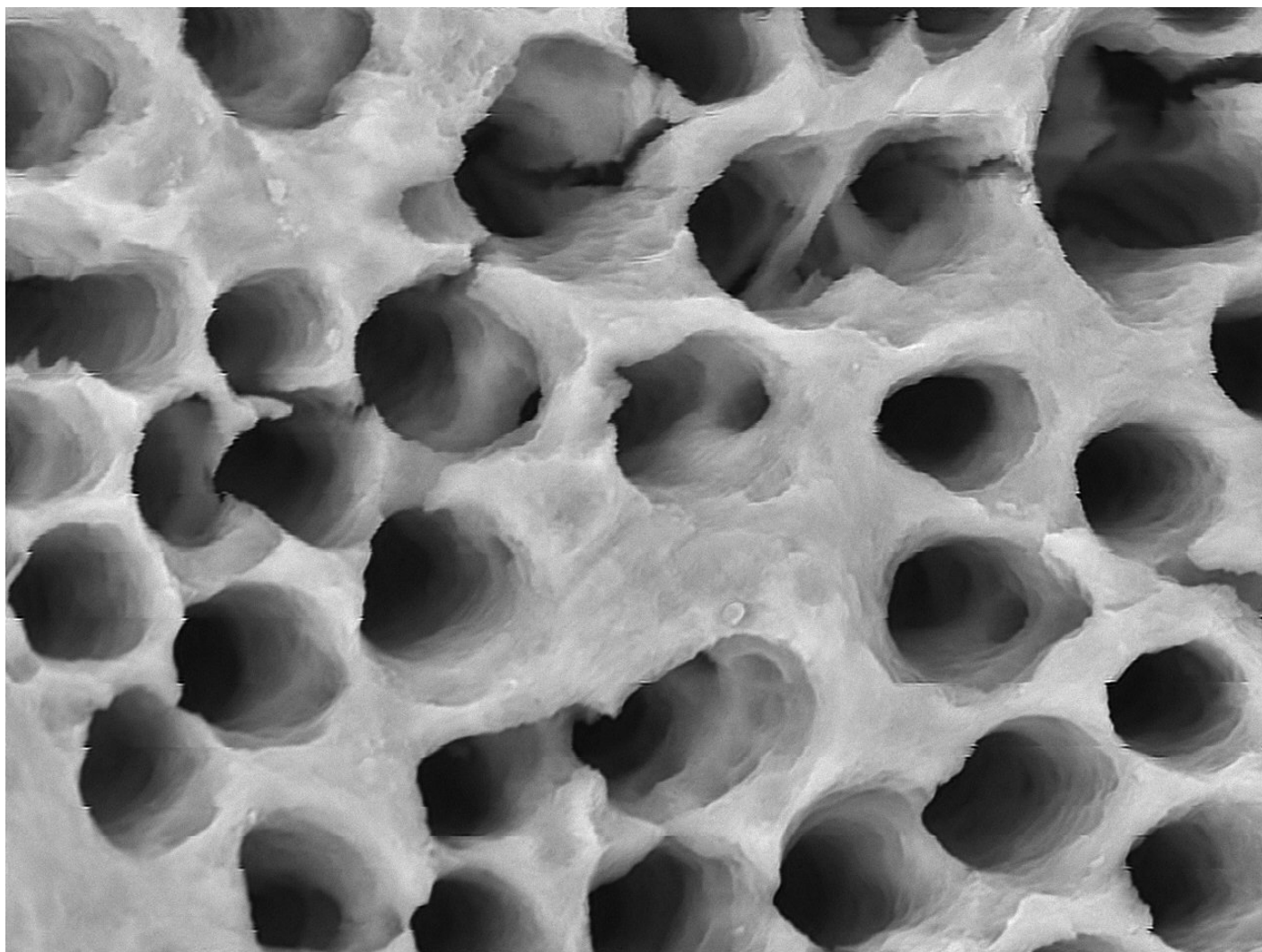


29) image263

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image264

image264



29340-18

2017/03/03 10:56 N

x5.0k

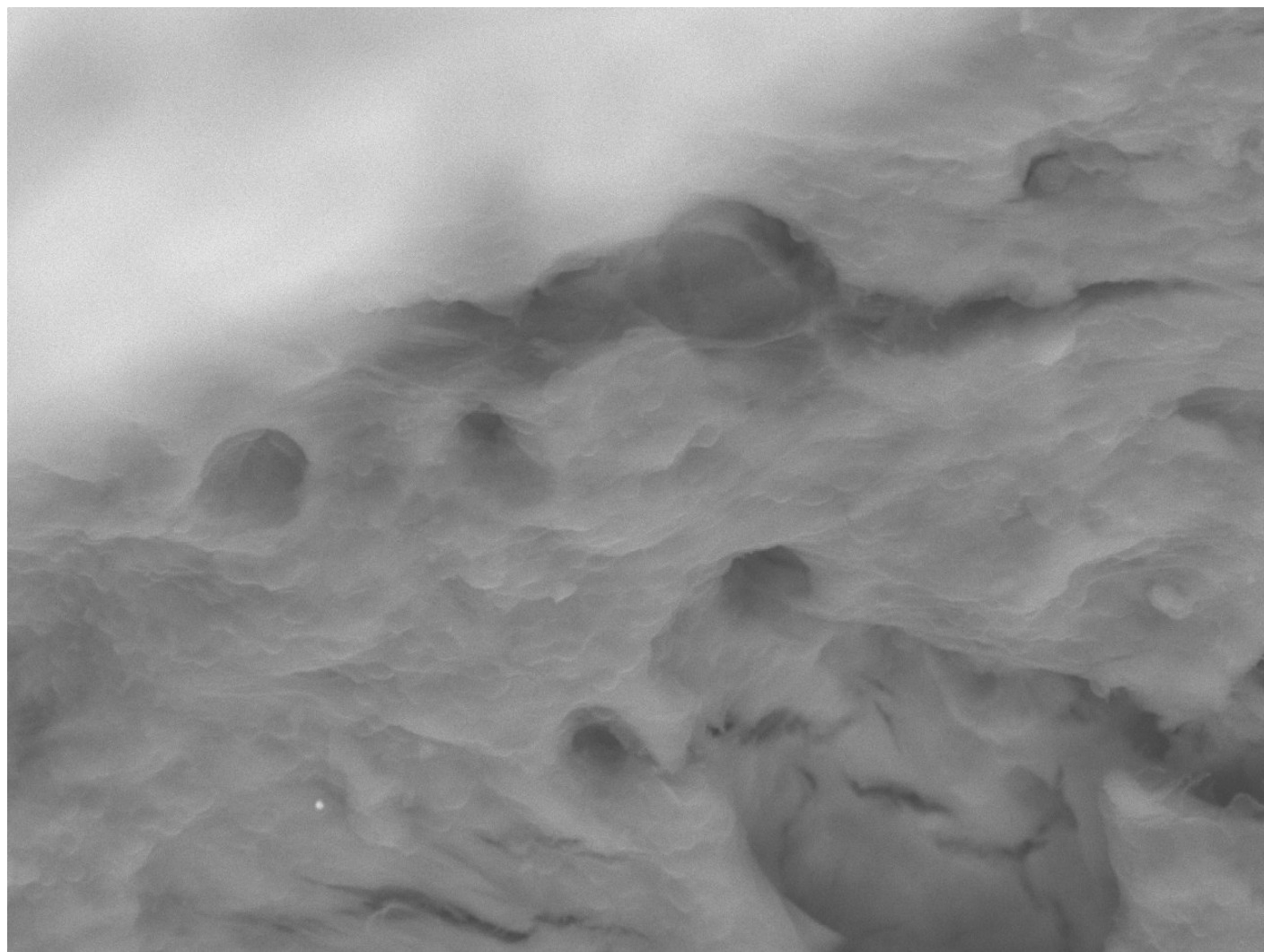
20 μ m

30) image264

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image265

image265



29856-30

2017/02/22 13:32 N

x5.0k

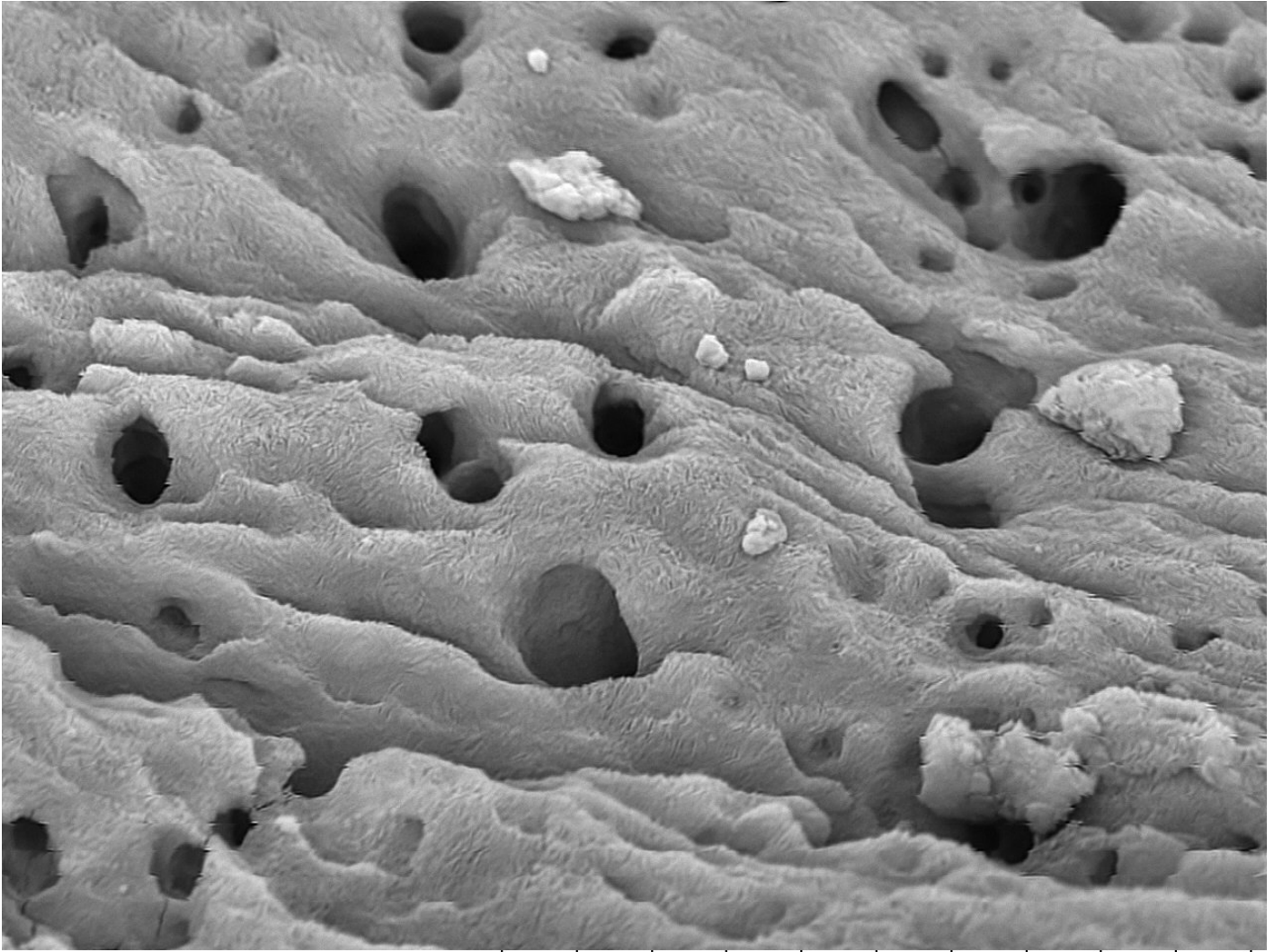
20 μ m

31) image265

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image266

image266



29179-3

2017/03/03 14:12 N

x5.0k

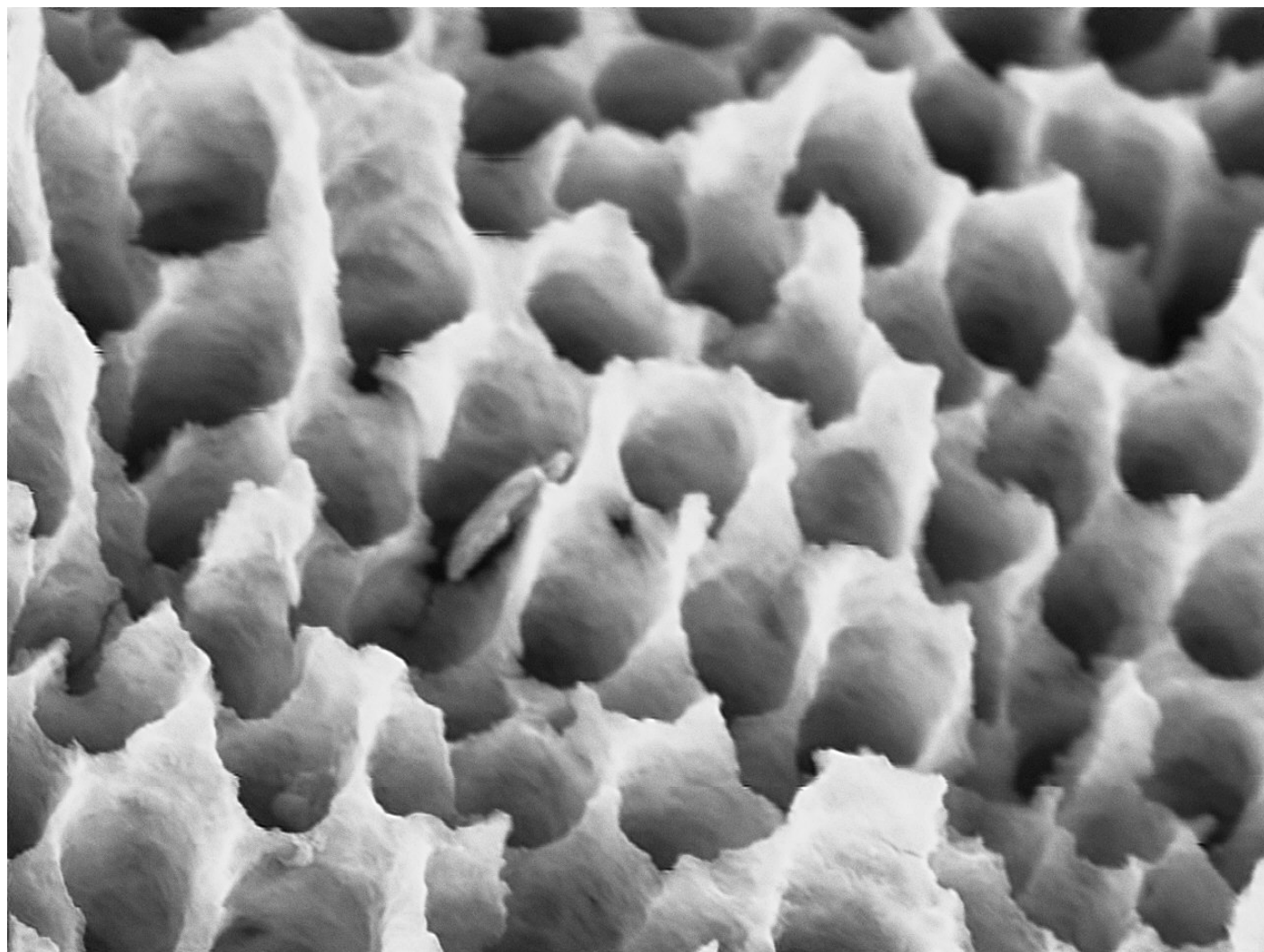
20 μm

32) image266

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image267

image267



29340-18

2017/03/03 10:21 N

x5.0k

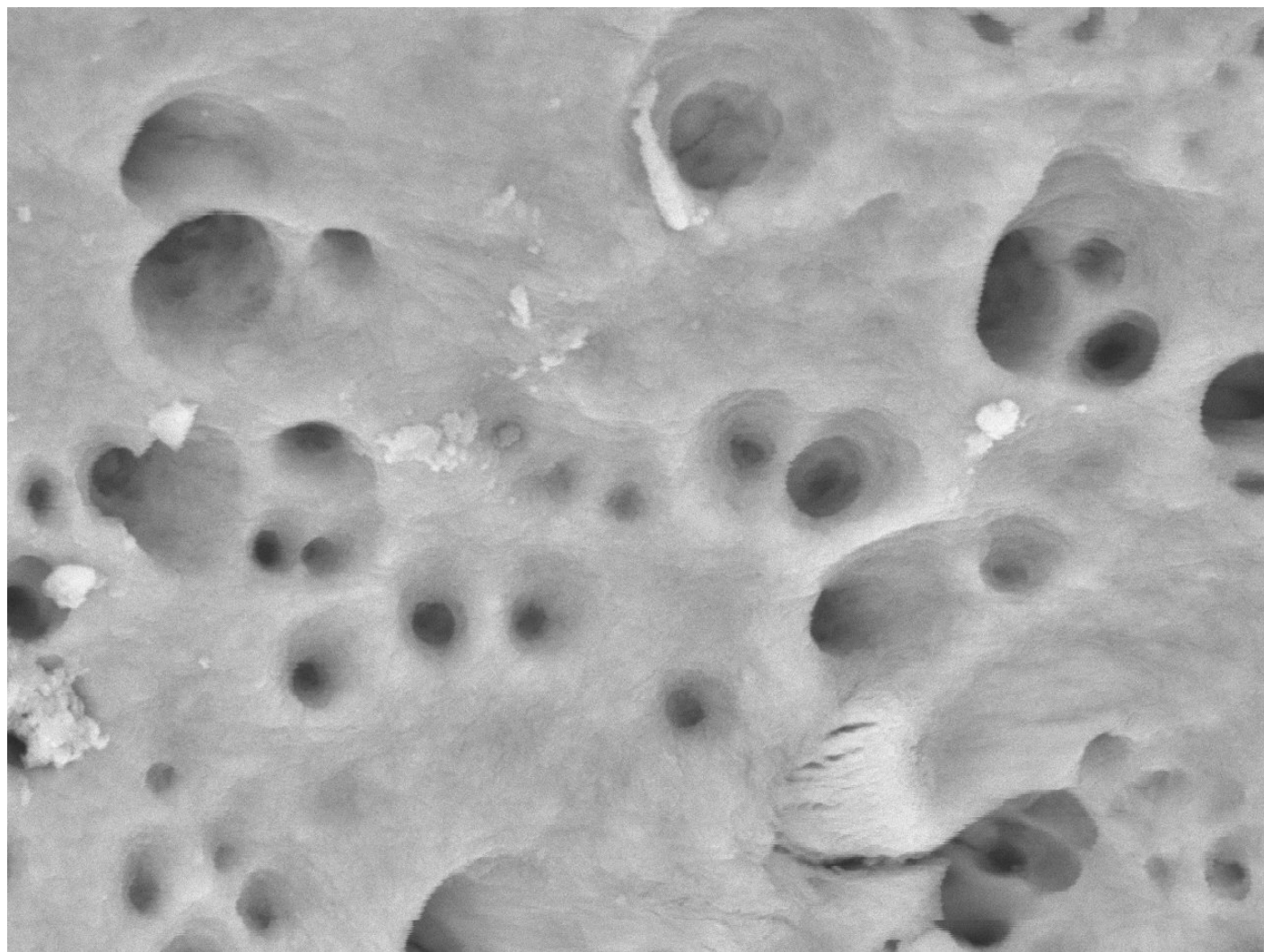
20 μ m

33) image267

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image268

image268



29952-15

2017/02/22 15:45 N

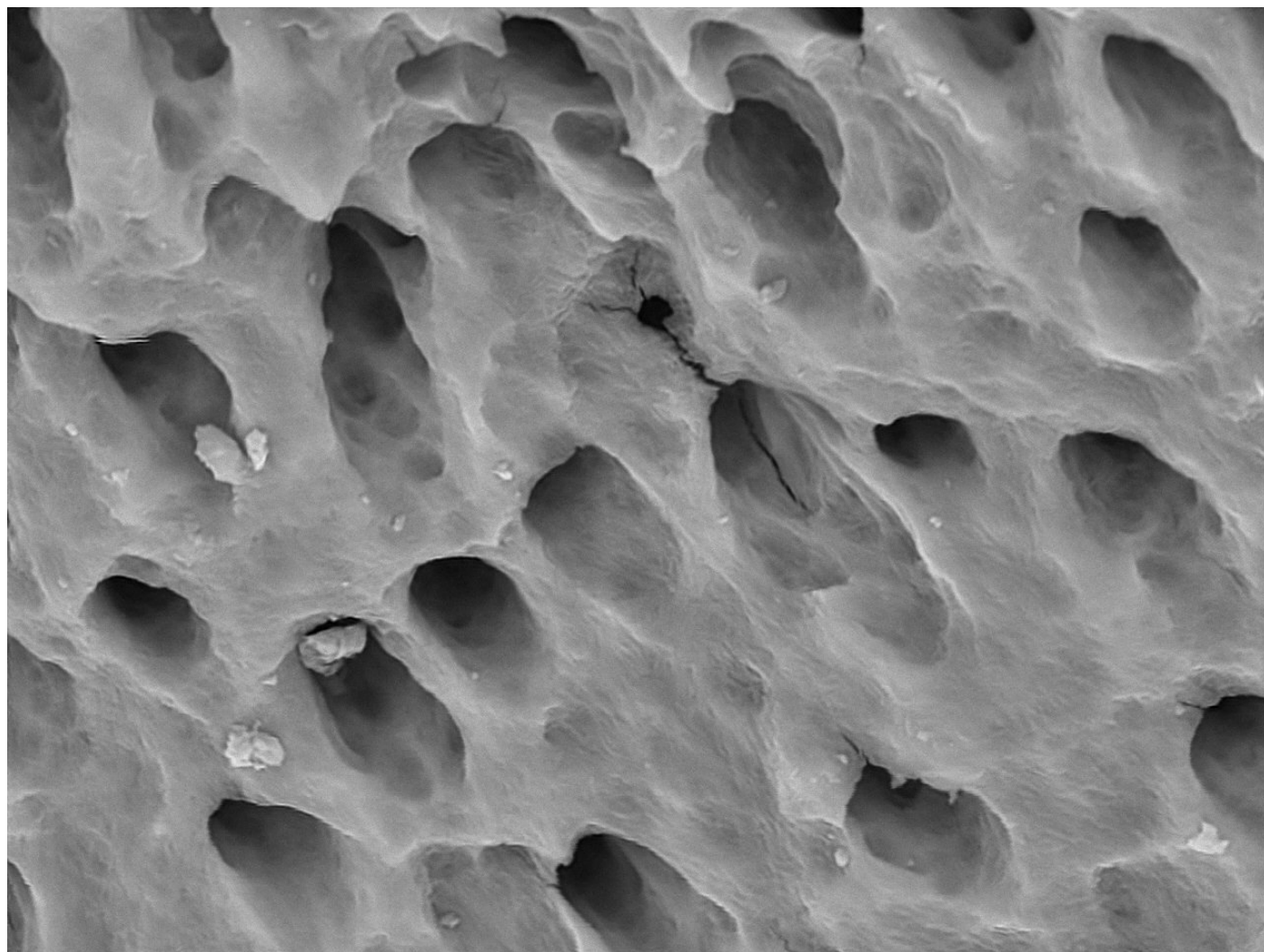
x5.0k 20 μ m

34) image268

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image269

image269



29463-3

2017/02/27 14:50 N

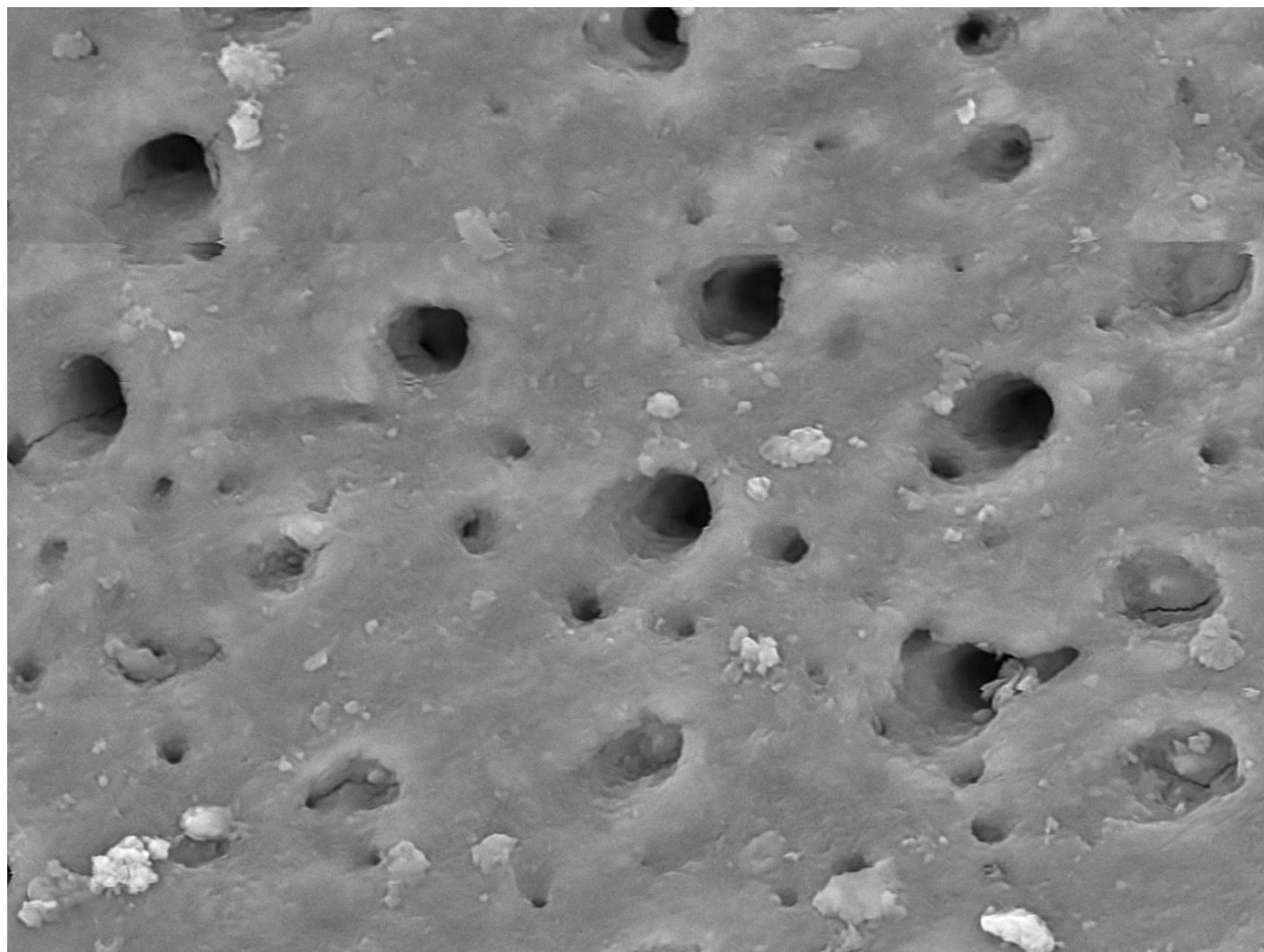
x5.0k 20 μm

35) image269

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image270

image270



29679-3

2017/02/27 15:23 N

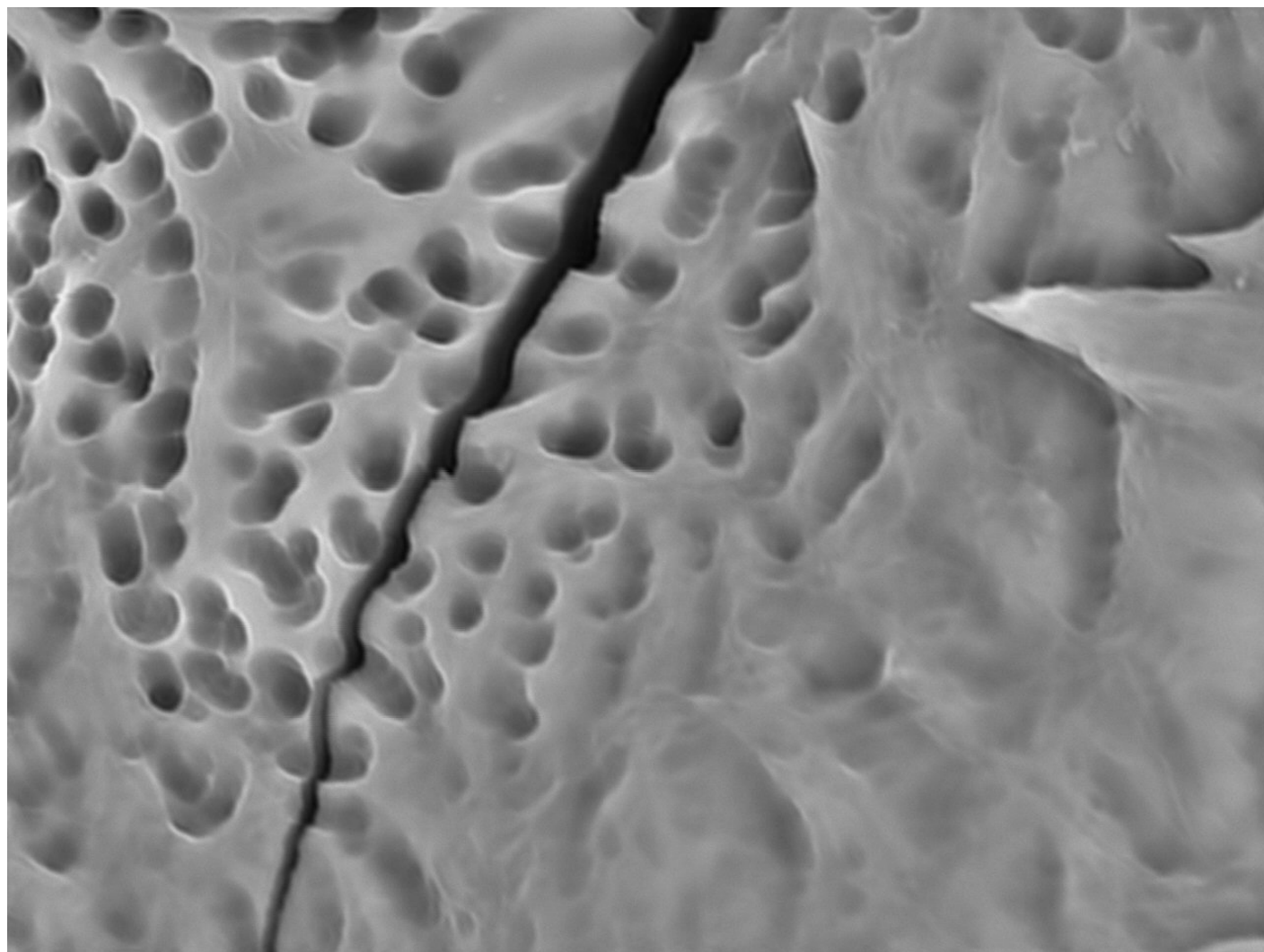
x5.0k 20 μm

36) image270

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image271

image271



29009-31

2017/03/08 14:43 H

x5.0k

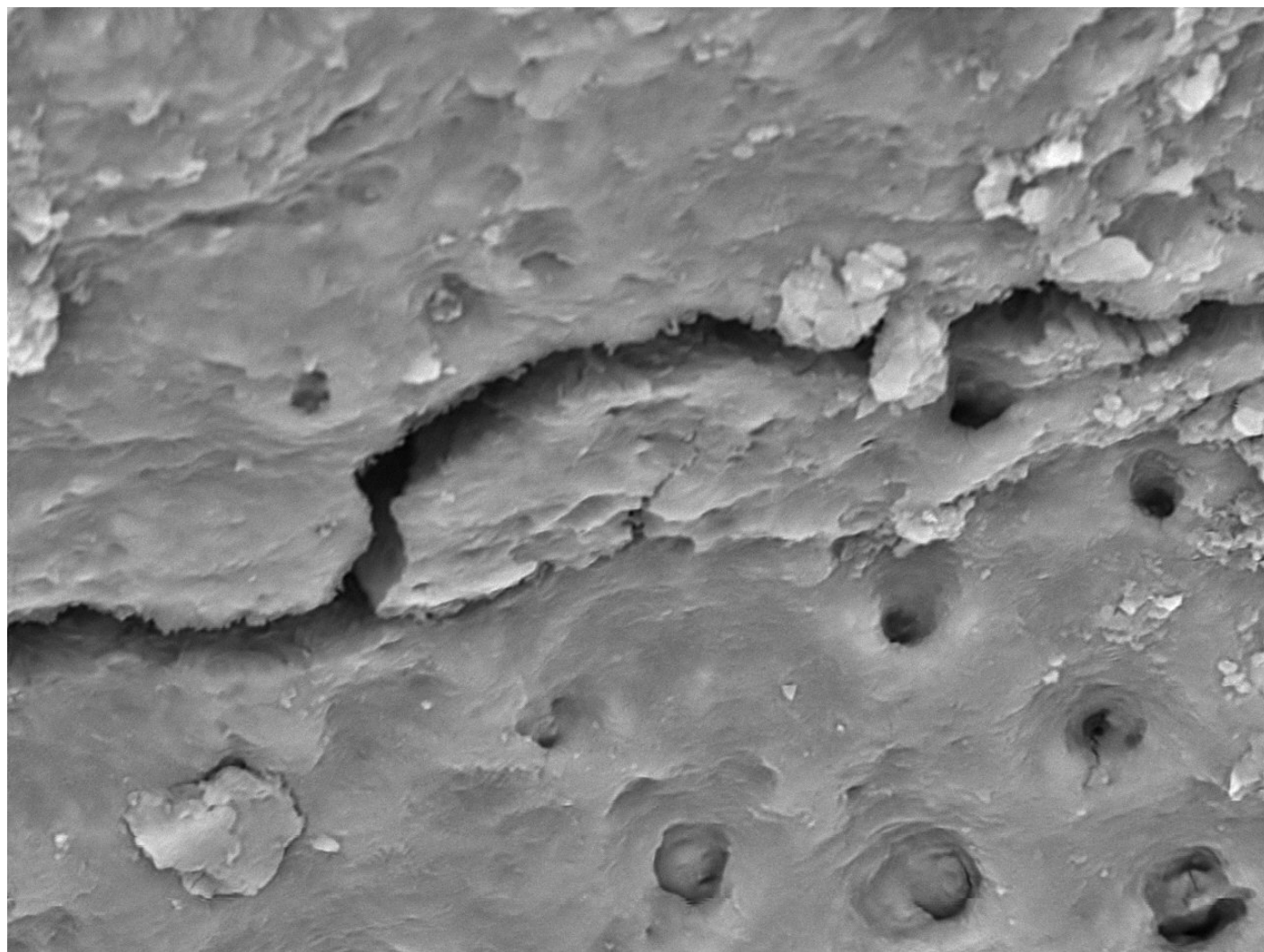
20 μm

37) image271

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image272

image272



29679-3

2017/02/27 15:21 N

x5.0k

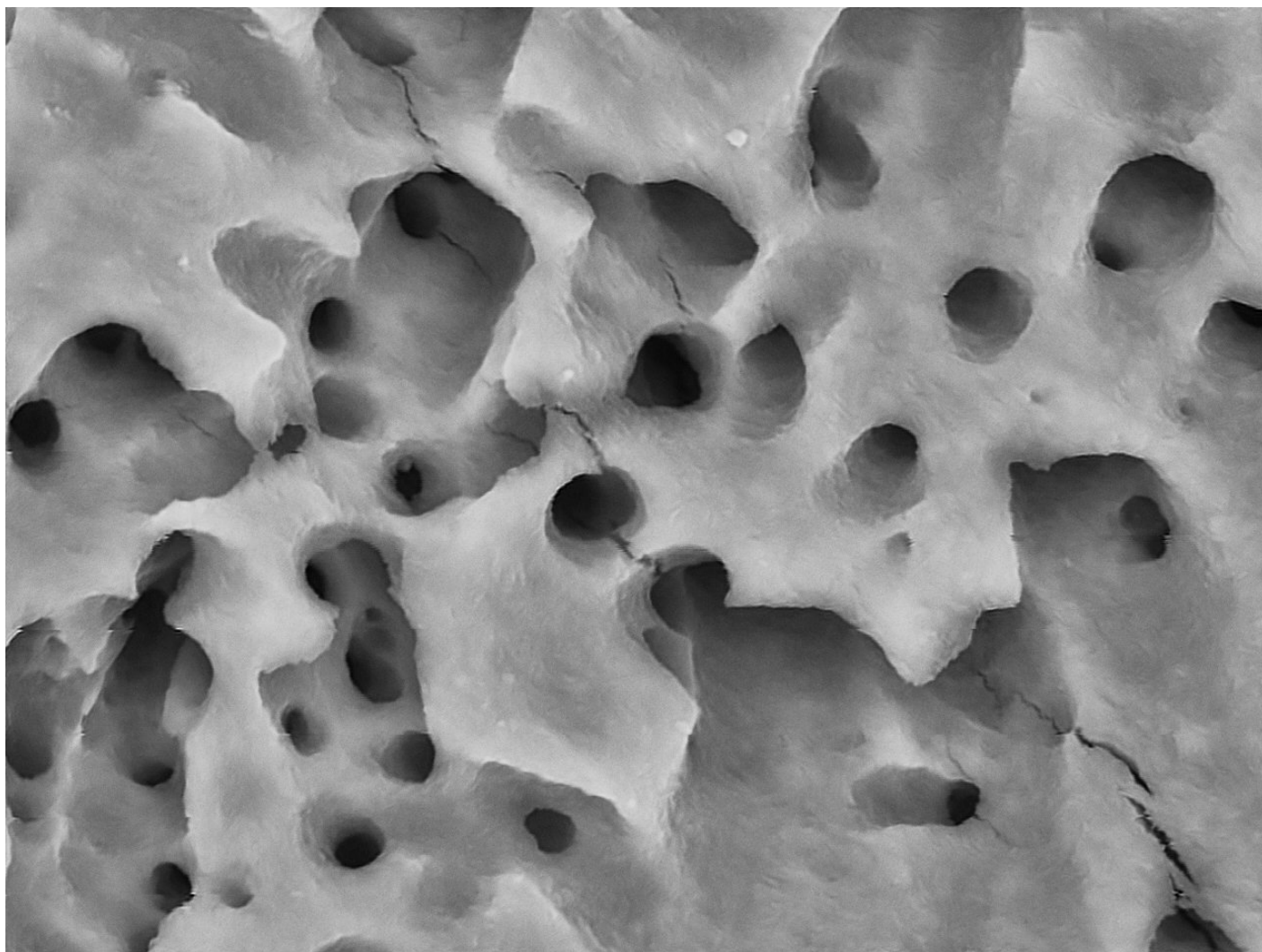
20 μ m

38) image272

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image273

image273



29963-15

2017/03/01 14:16 N

x5.0k

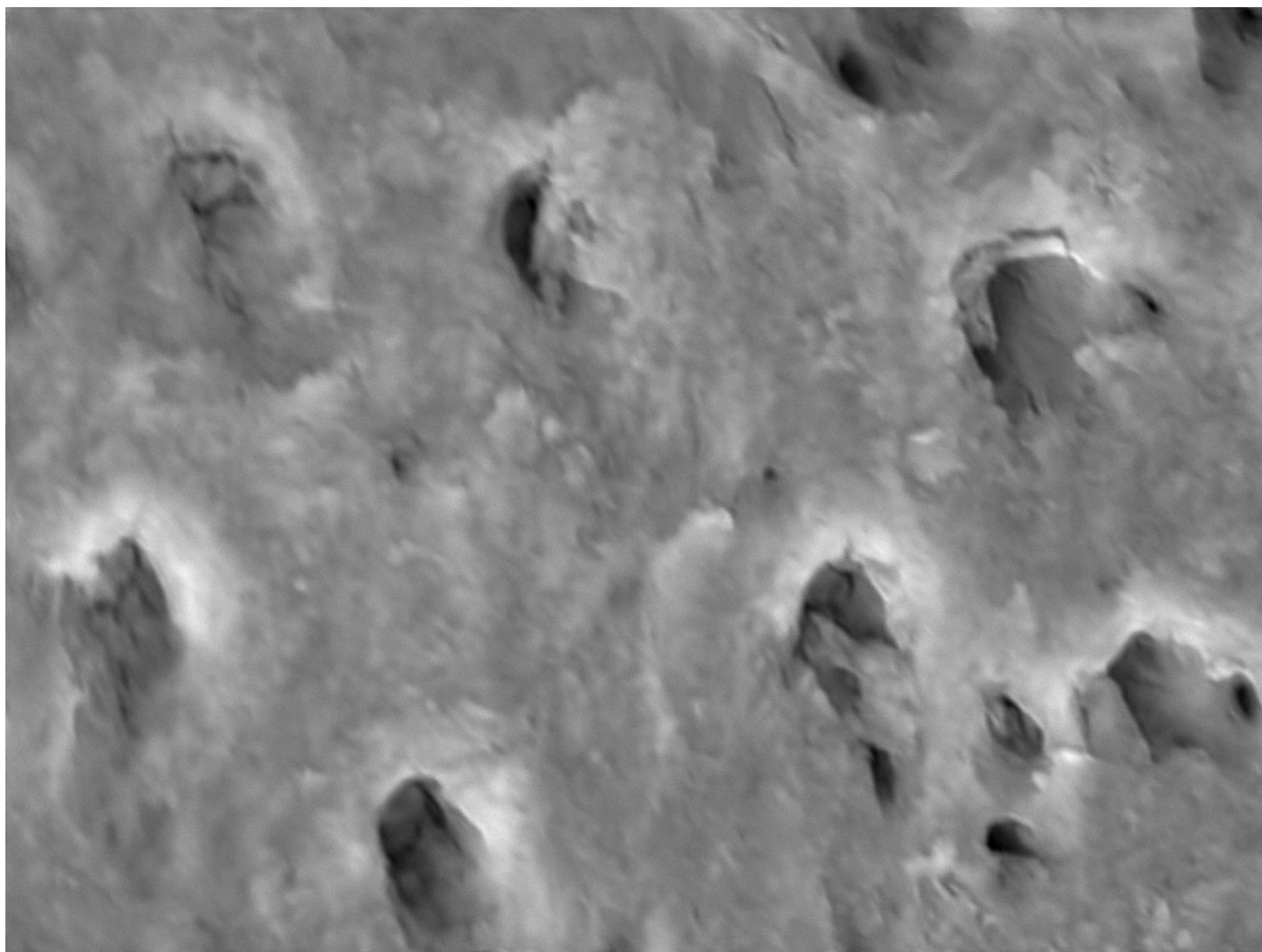
20 μm

39) image273

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image274

image274



29009-31

2017/03/08 15:04 H

x5.0k

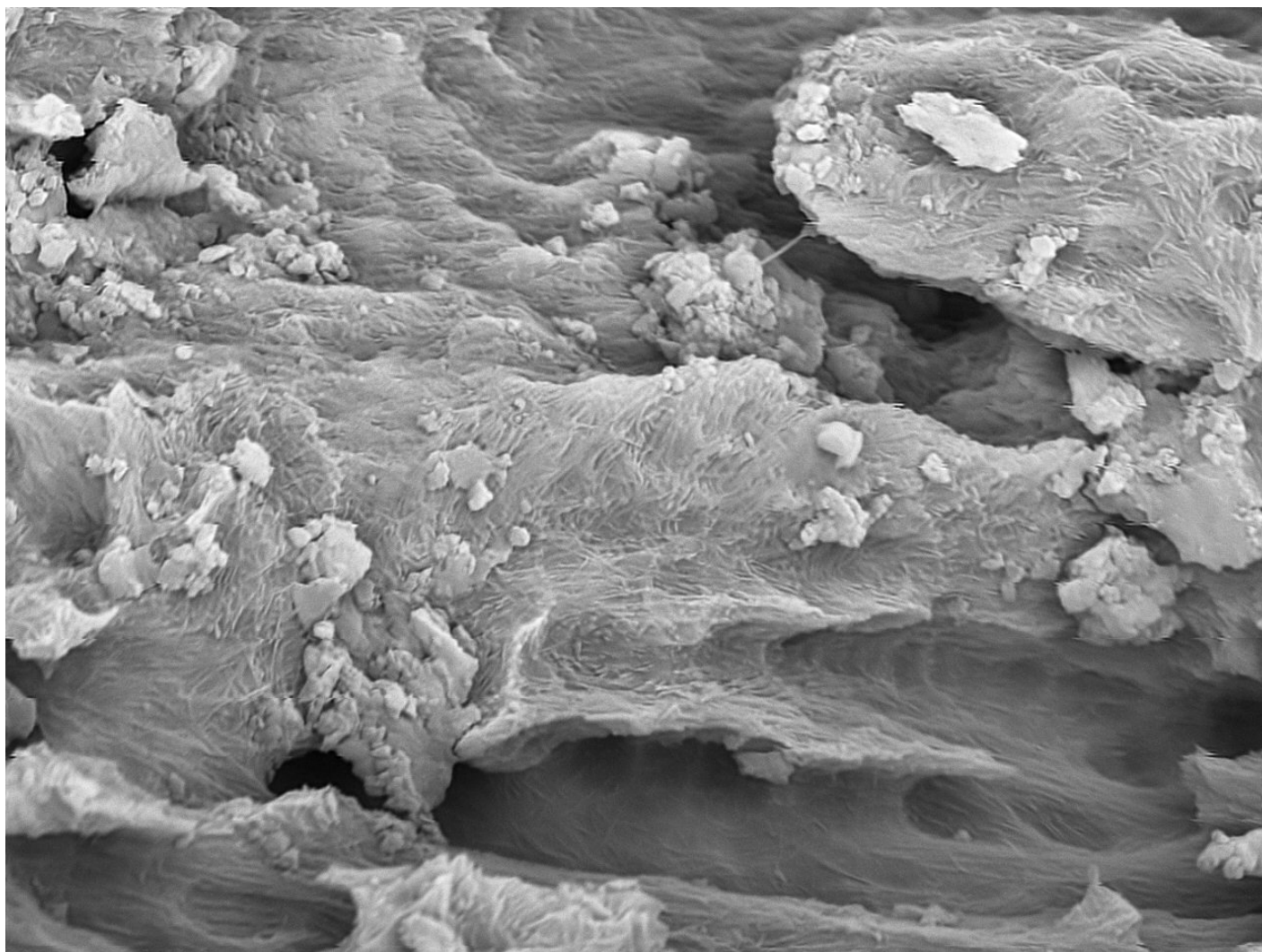
20 μ m

40) image274

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image275

image275



29211-18

2017/03/03 16:20 N

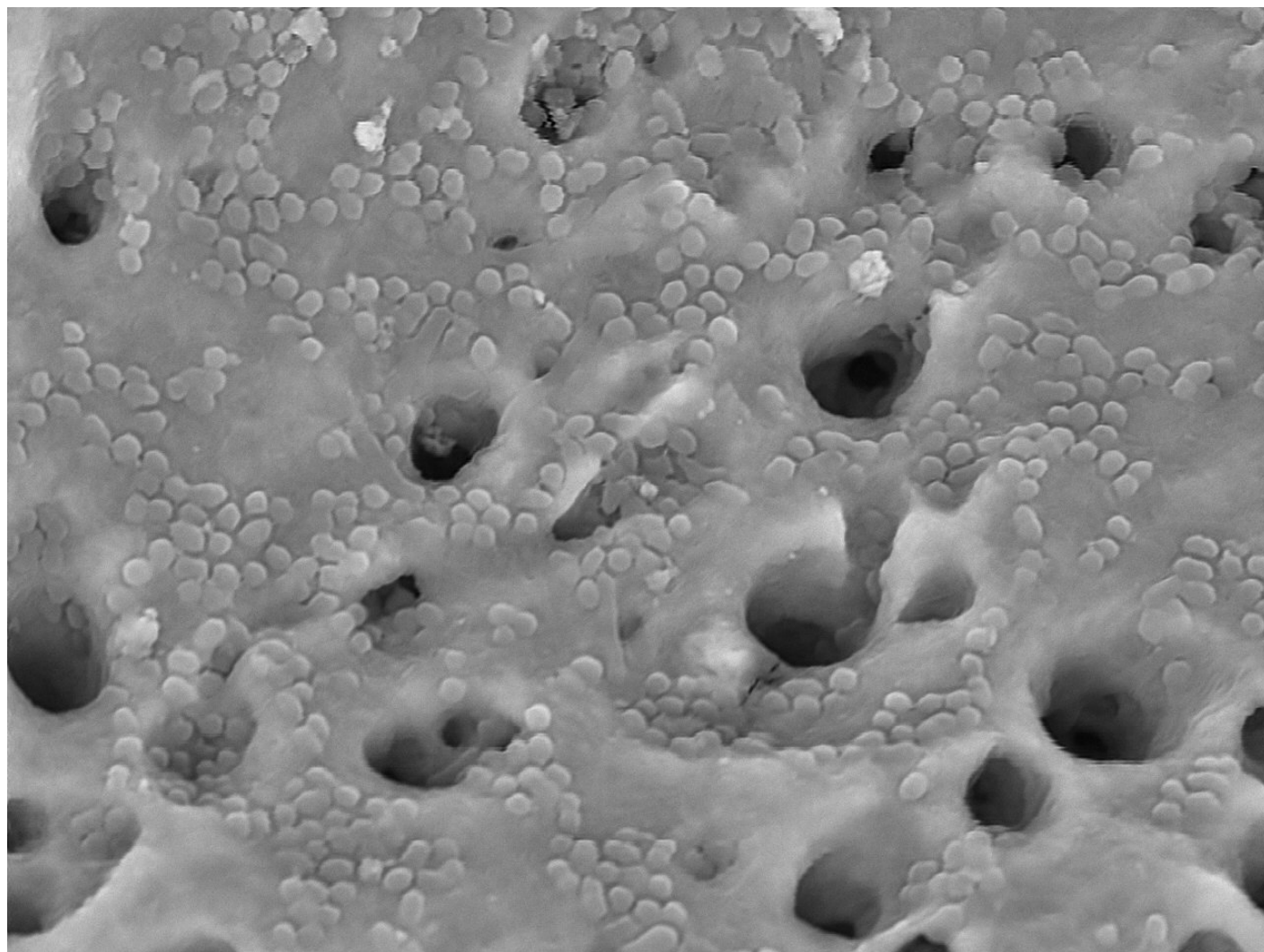
x5.0k 20 μ m

41) image275

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image276

image276



29965-2

2017/03/02 15:25 N

x5.0k

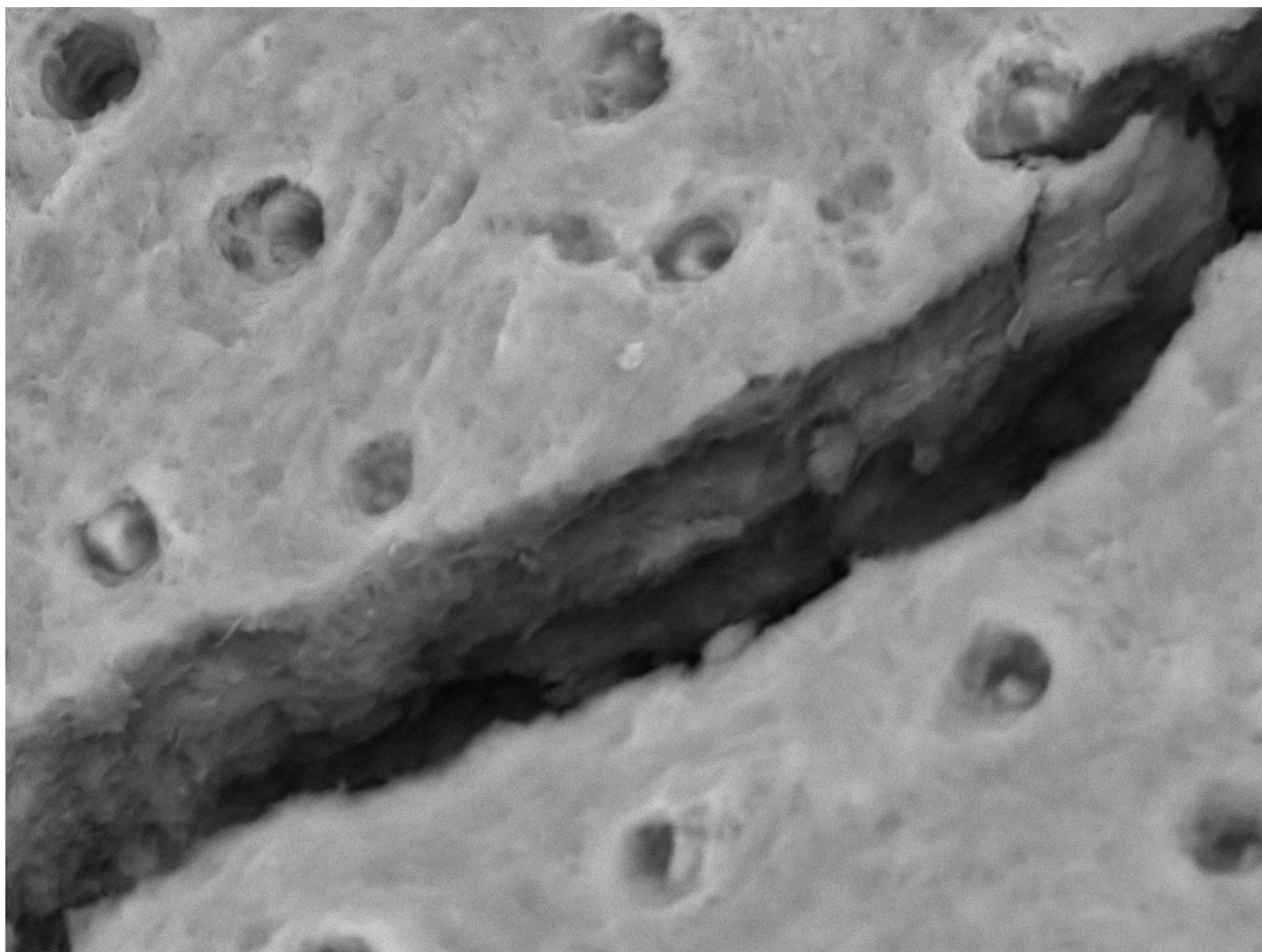
20 μm

42) image276

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image277

image277



29211-18

2017/03/04 14:01 N

x5.0k

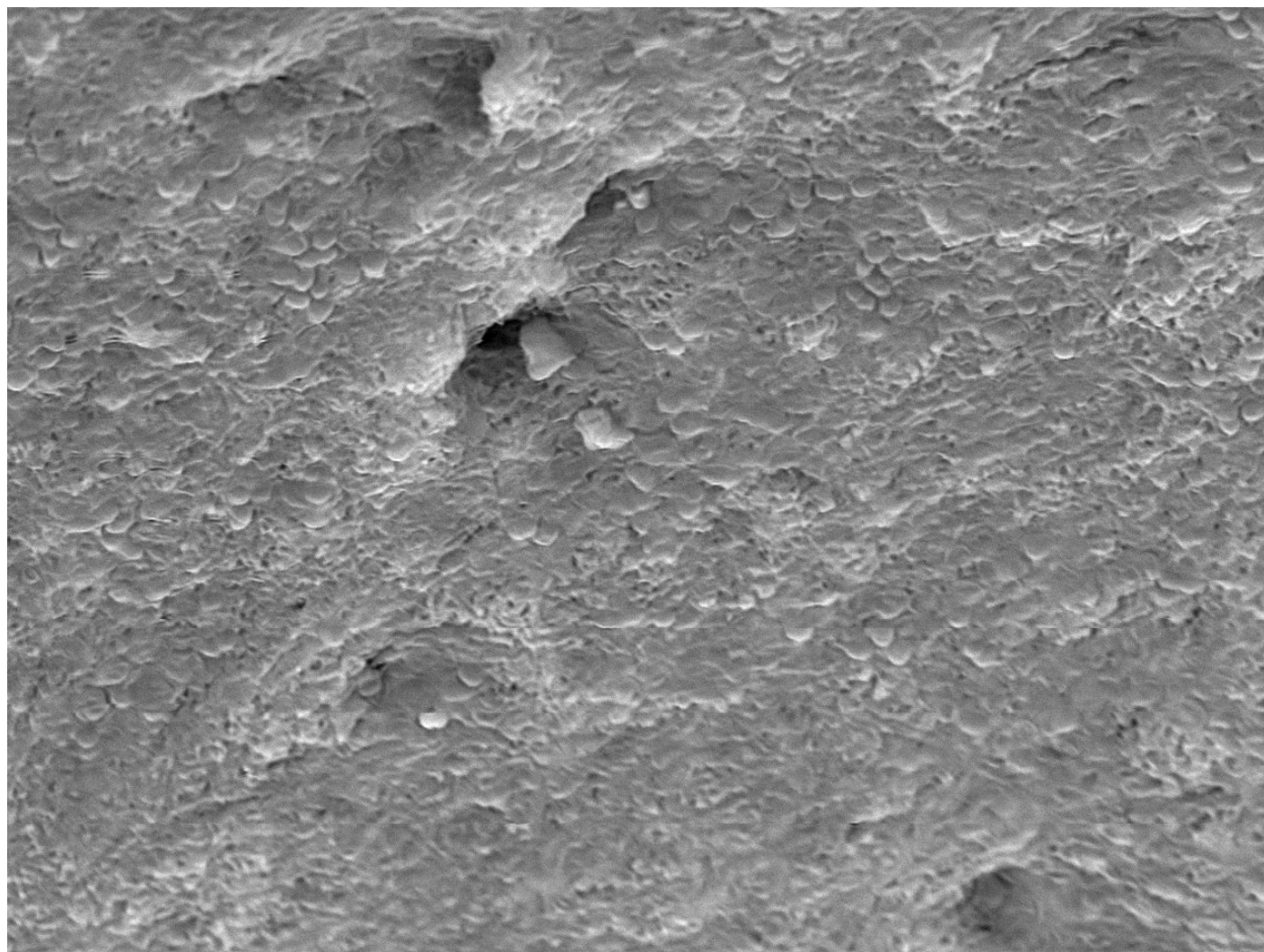
20 μ m

43) image277

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image278

image278



29965-2

2017/03/02 17:36 N

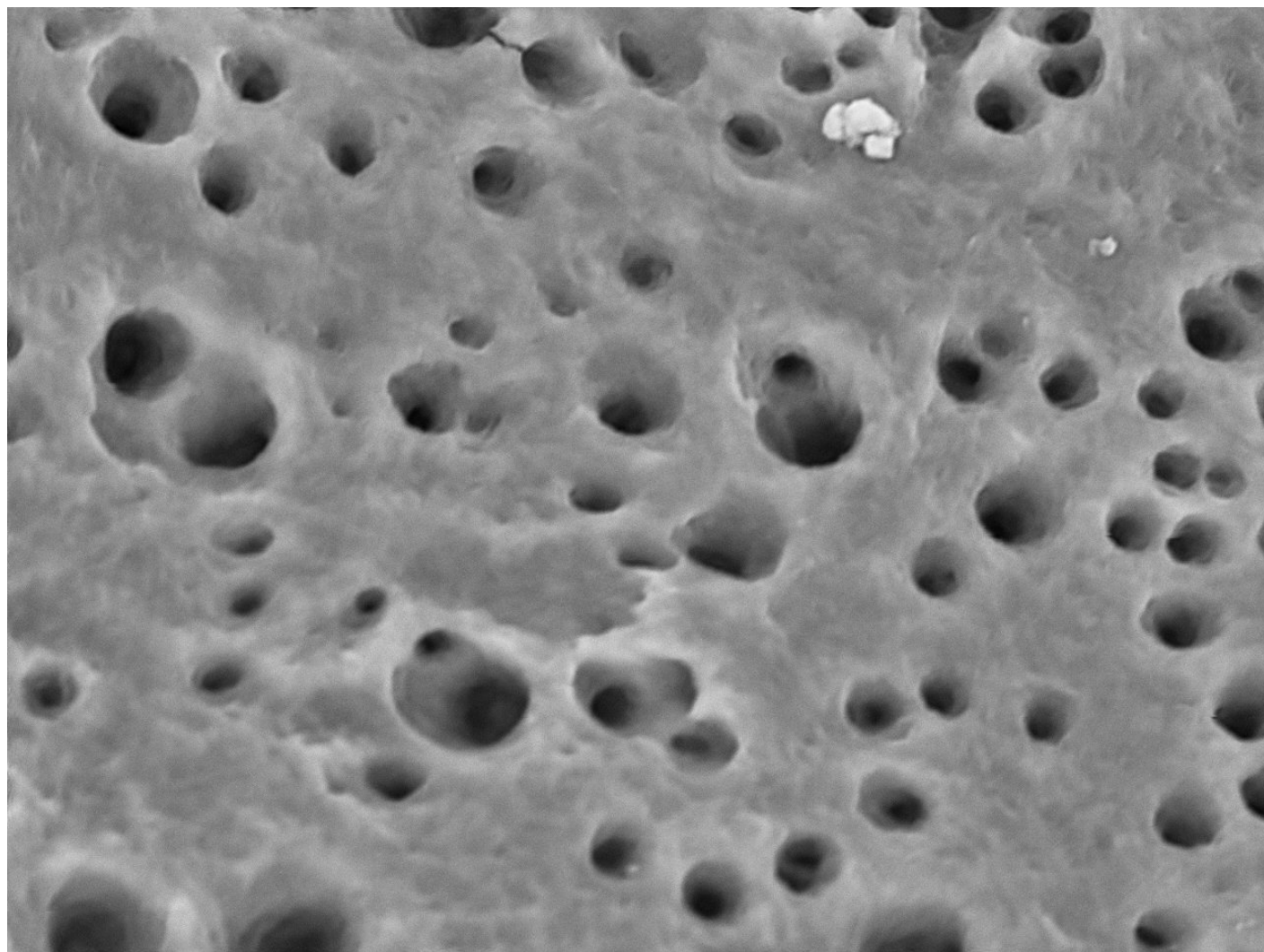
x5.0k 20 μ m

44) image278

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image279

image279



29265-2

2017/02/27 11:01 N

x5.0k

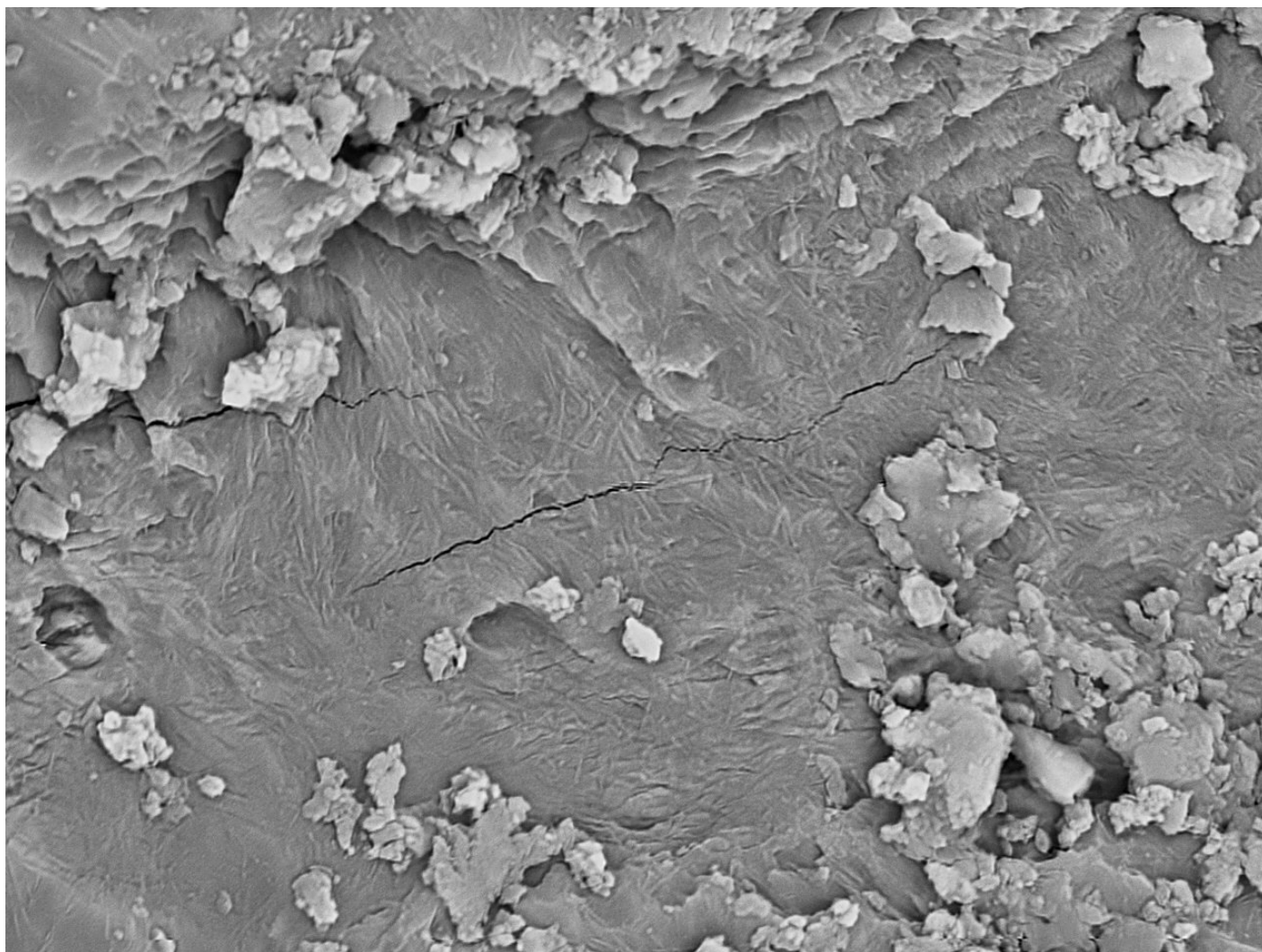
20 μ m

45) image279

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image280

image280



29211-18

2017/03/03 16:22 N

x5.0k

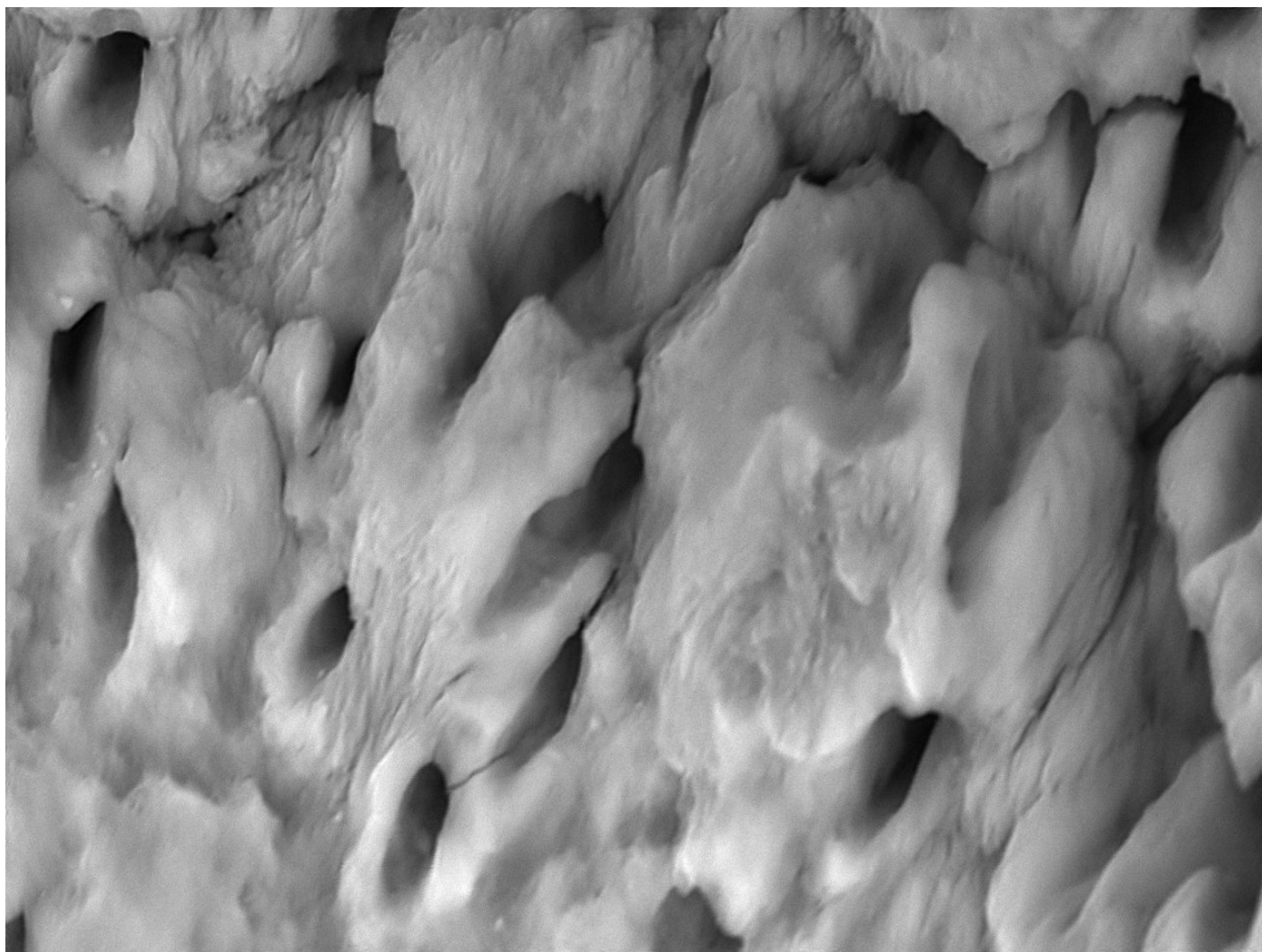
20 μ m

46) image280

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image281

image281



29340-18

2017/03/03 09:36 N

x5.0k

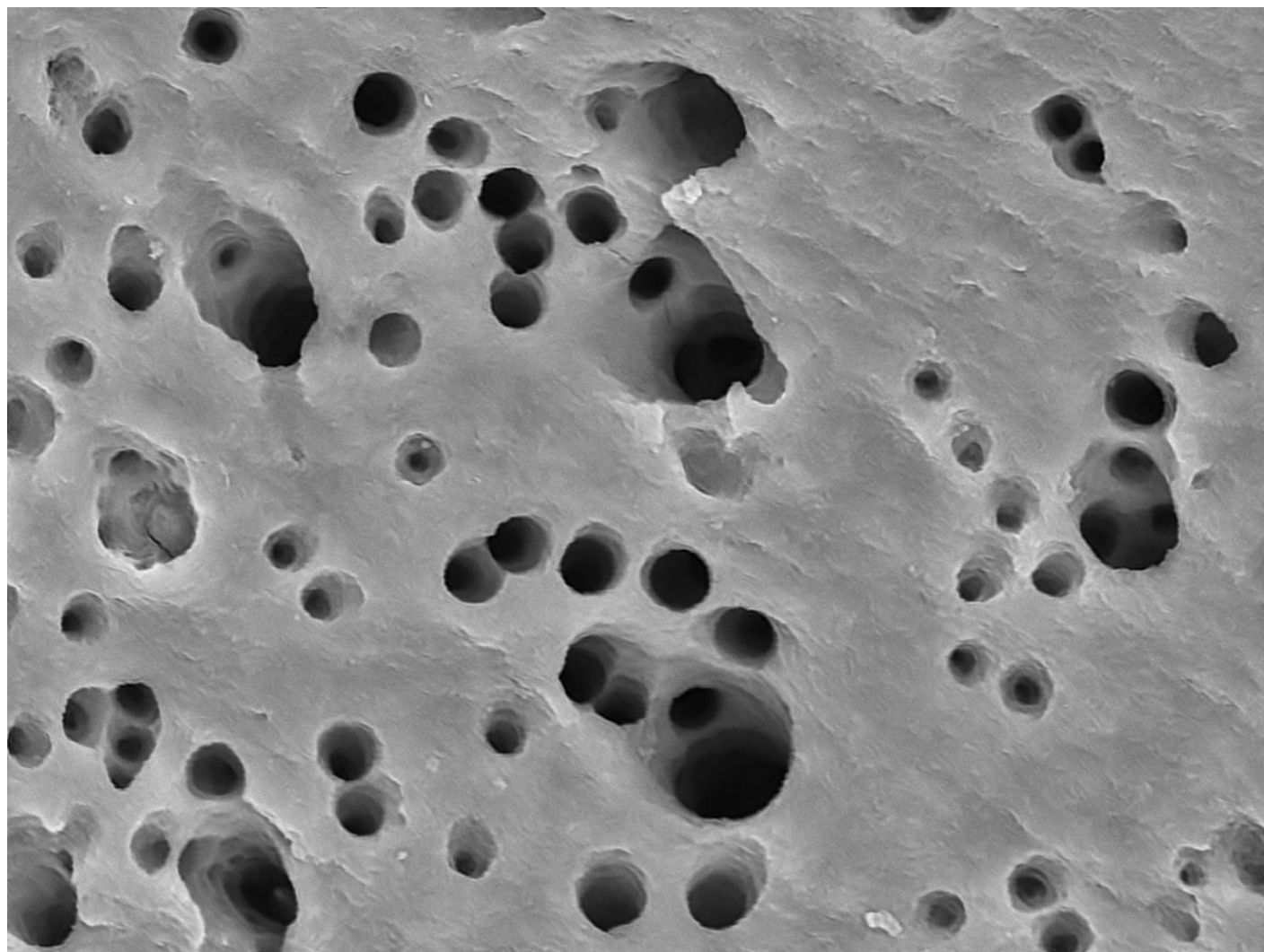
20 μ m

47) image281

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image282

image282



29211-18

2017/03/04 13:55 N

x5.0k

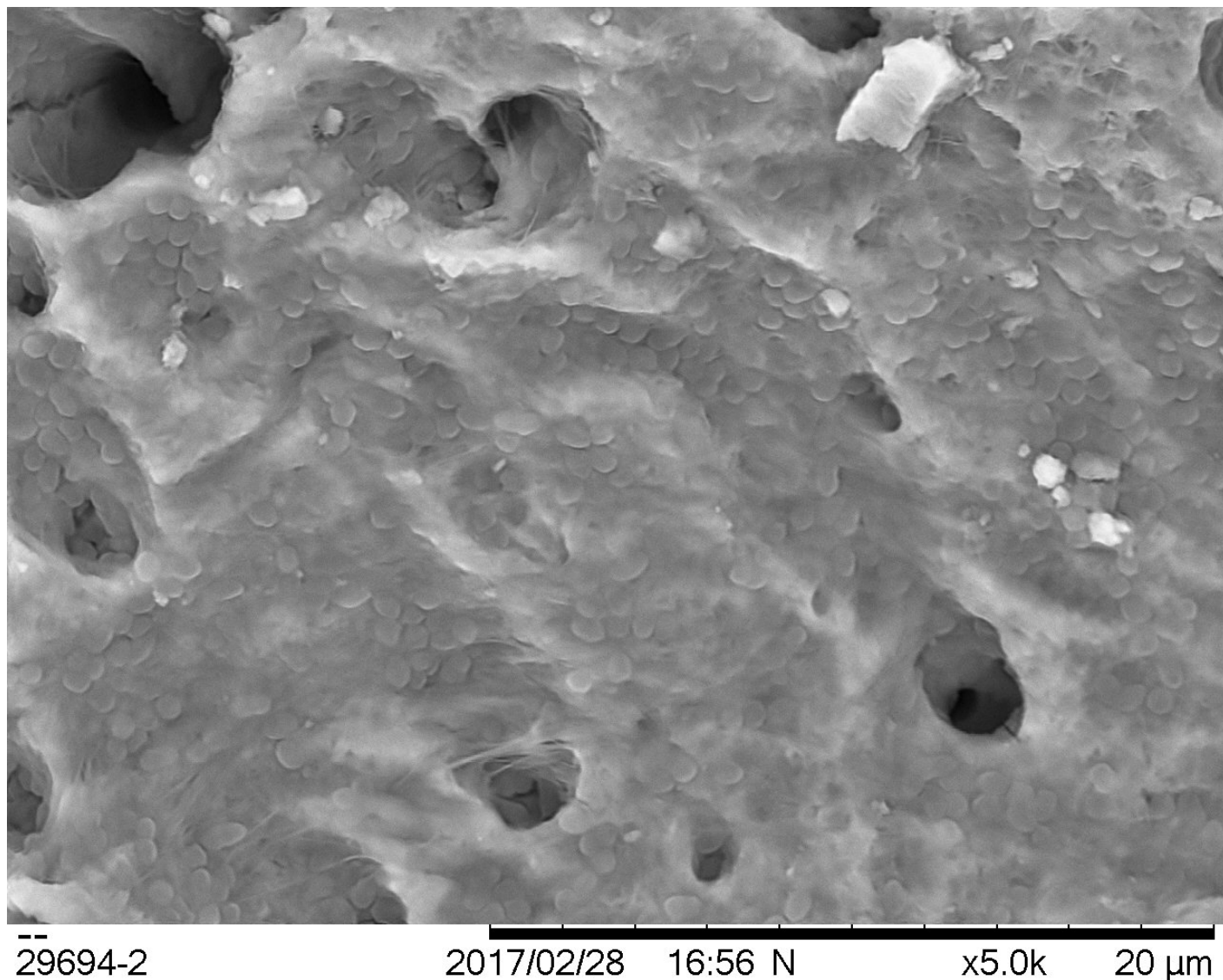
20 μm

48) image282

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image283

image283

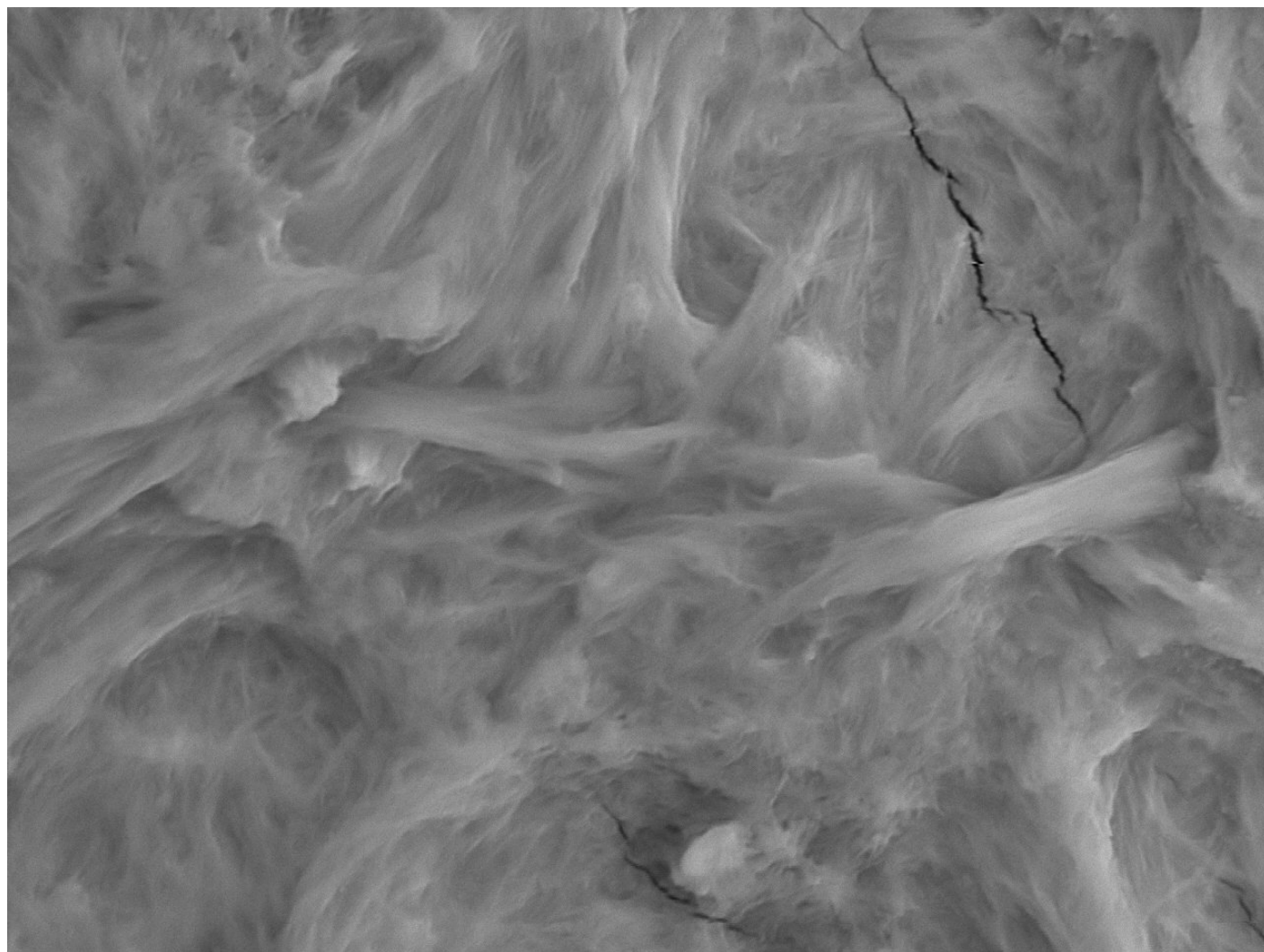


49) image283

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image284

image284



29028-15

2017/03/04 15:31 N

x5.0k

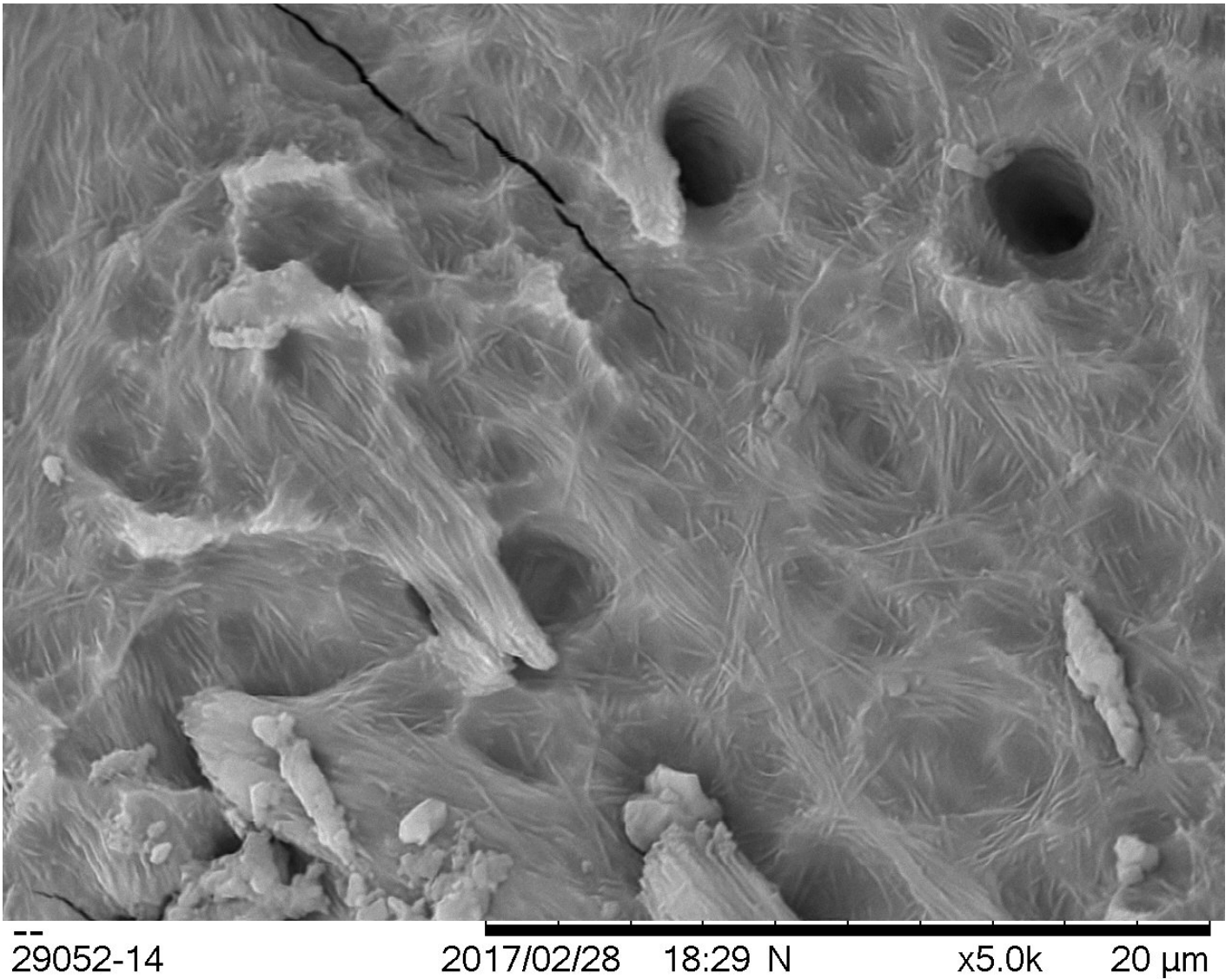
20 μm

50) image284

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image285

image285

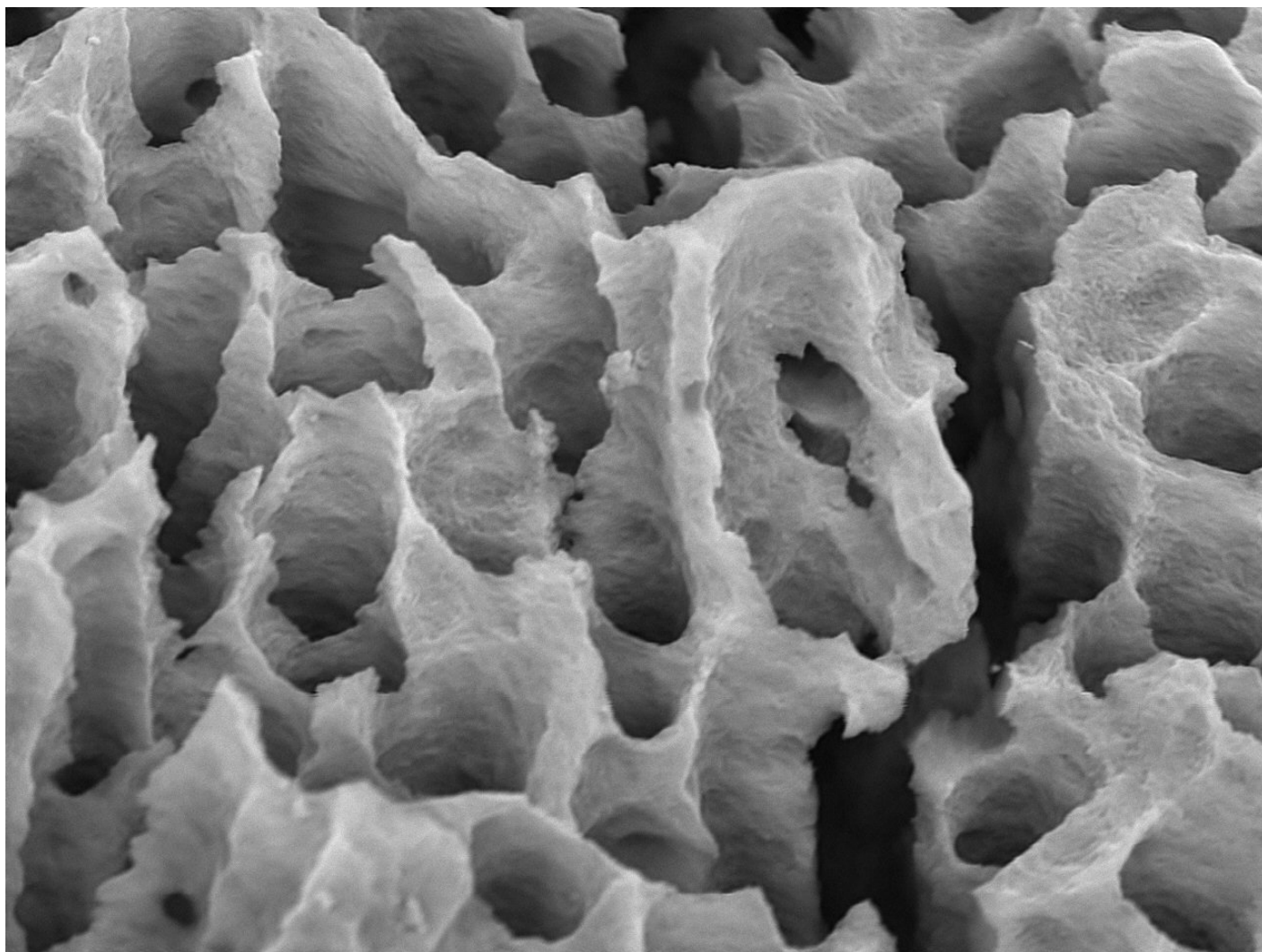


51) image285

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image286

image286



29340-18

2017/03/03 10:27 N

x5.0k

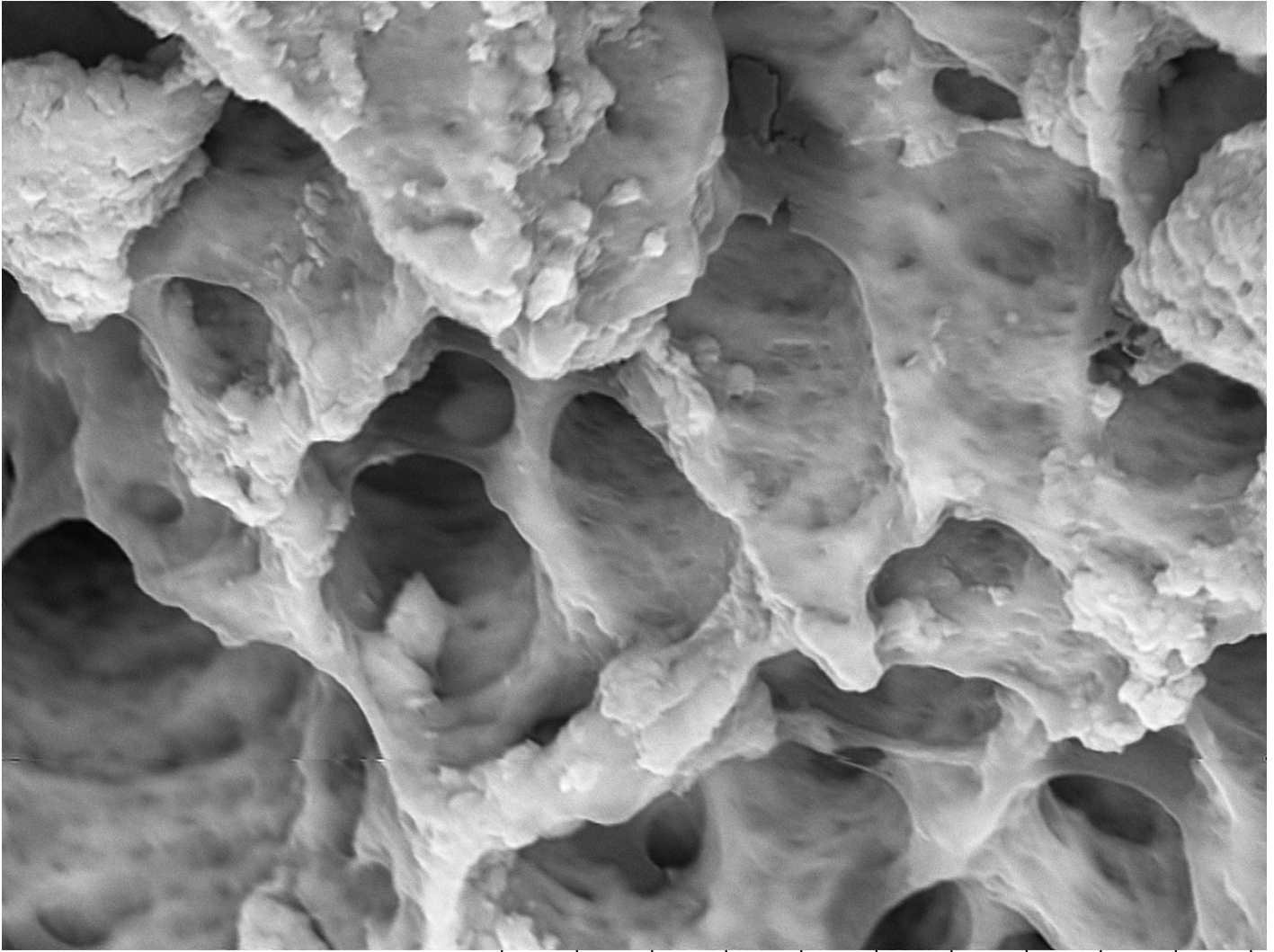
20 μ m

52) image286

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image287

image287



29009-31

2017/03/08 10:36 N

x5.0k

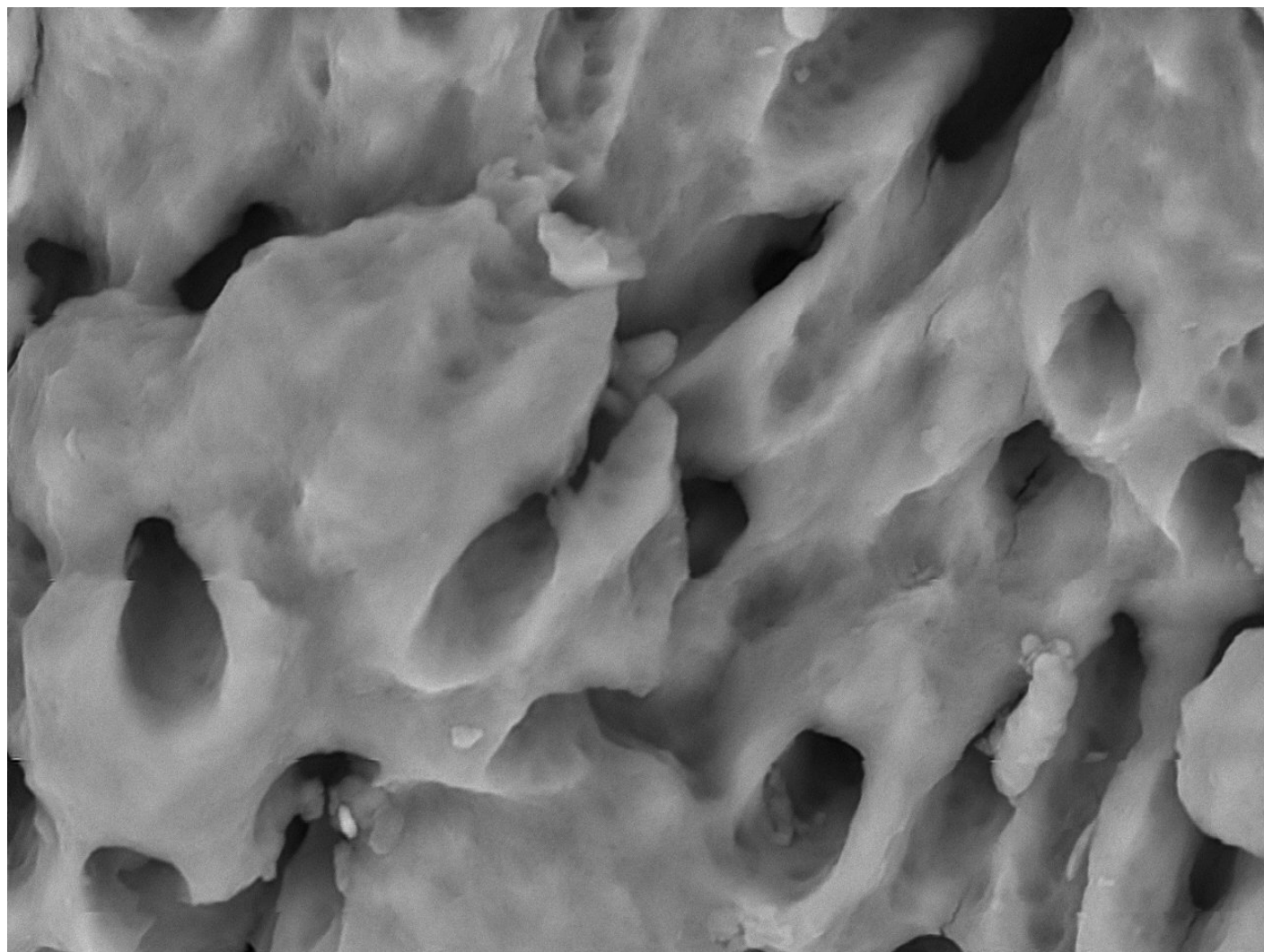
20 µm

53) image287

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image288

image288



29179-3

2017/03/03 12:00 N

x5.0k

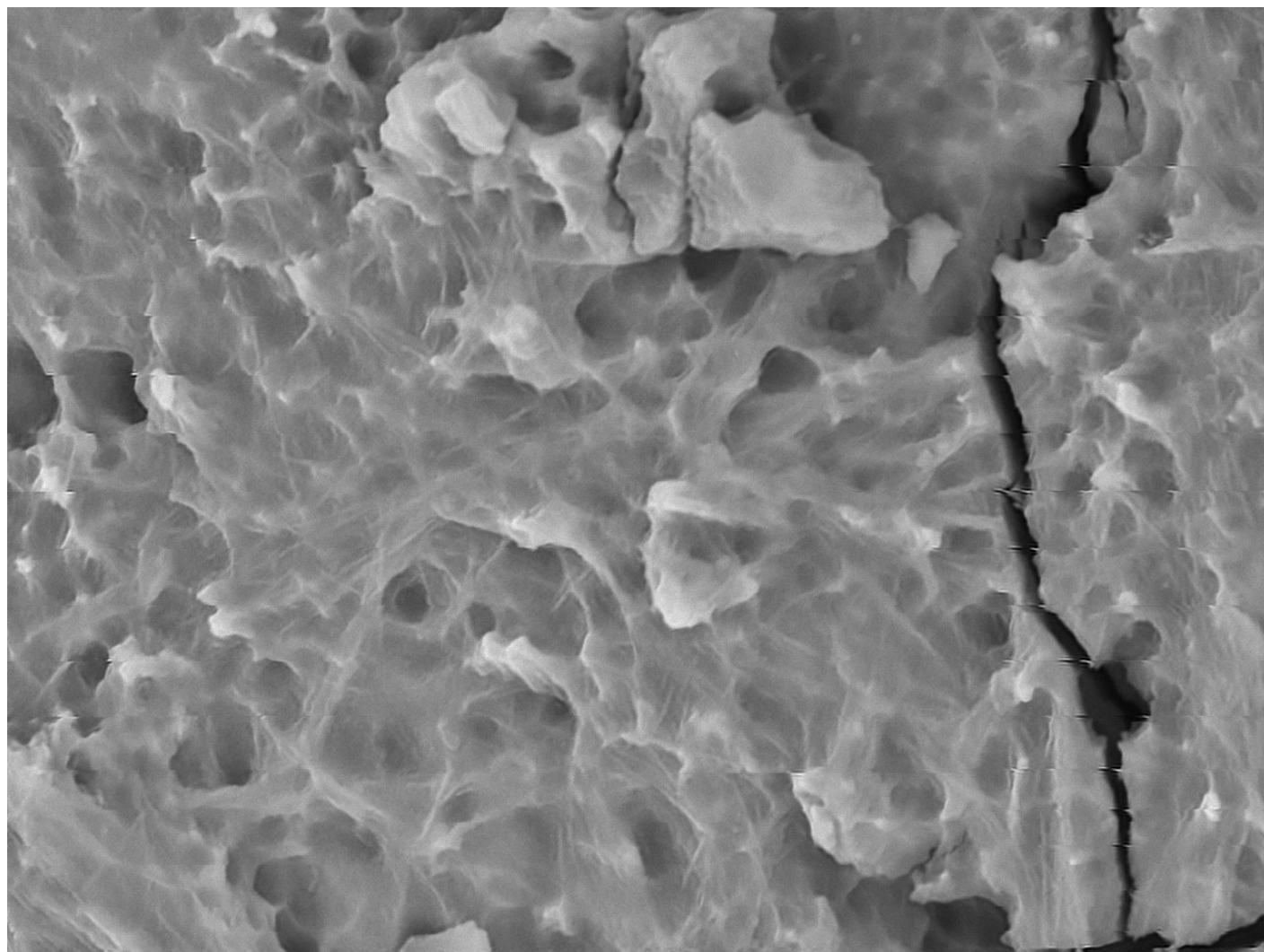
20 μ m

54) image288

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image289

image289



29028-15

2017/03/04 15:42 N

x5.0k

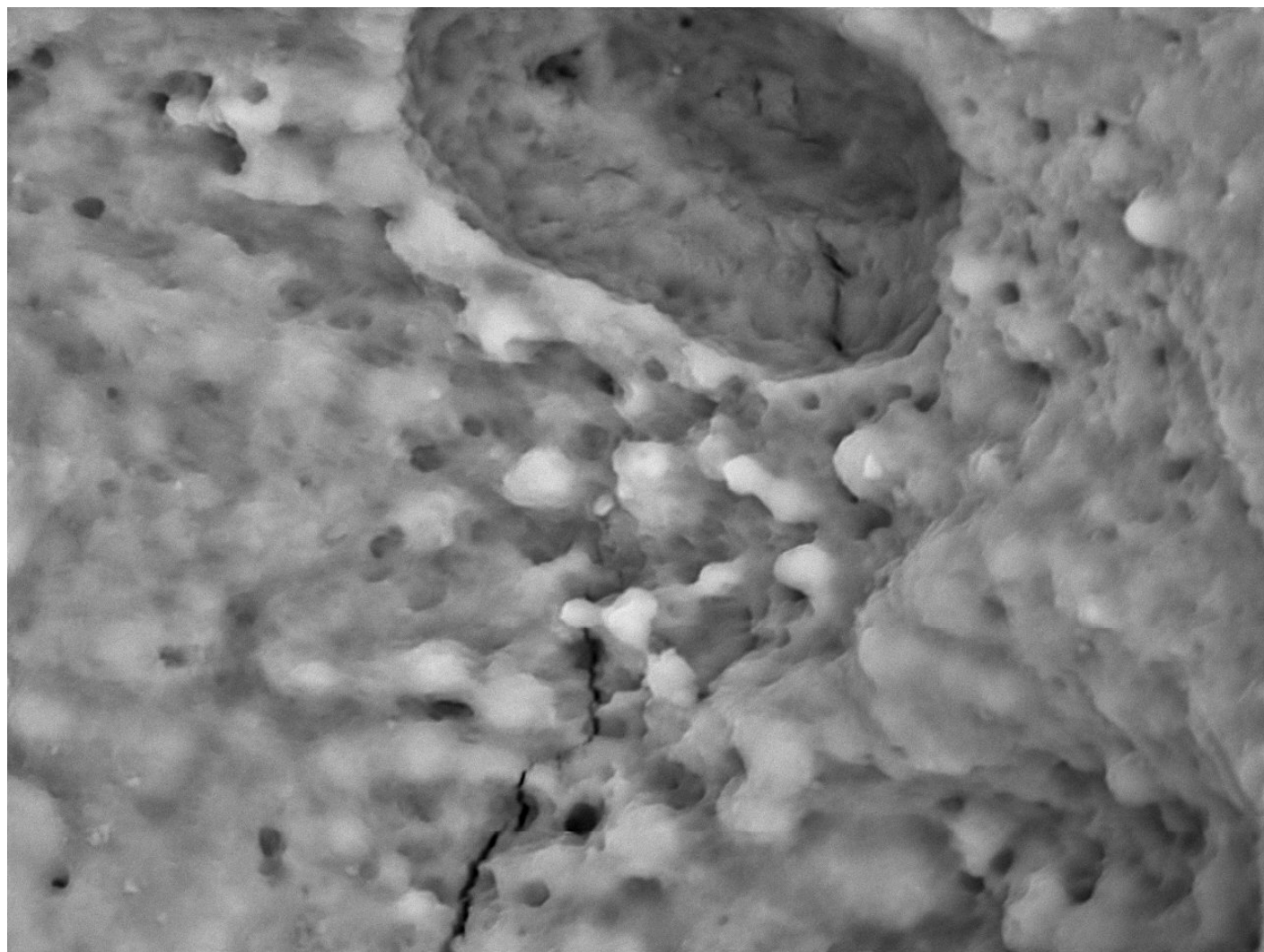
20 μm

55) image289

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image290

image290



29679-3

2017/02/27 16:09 N

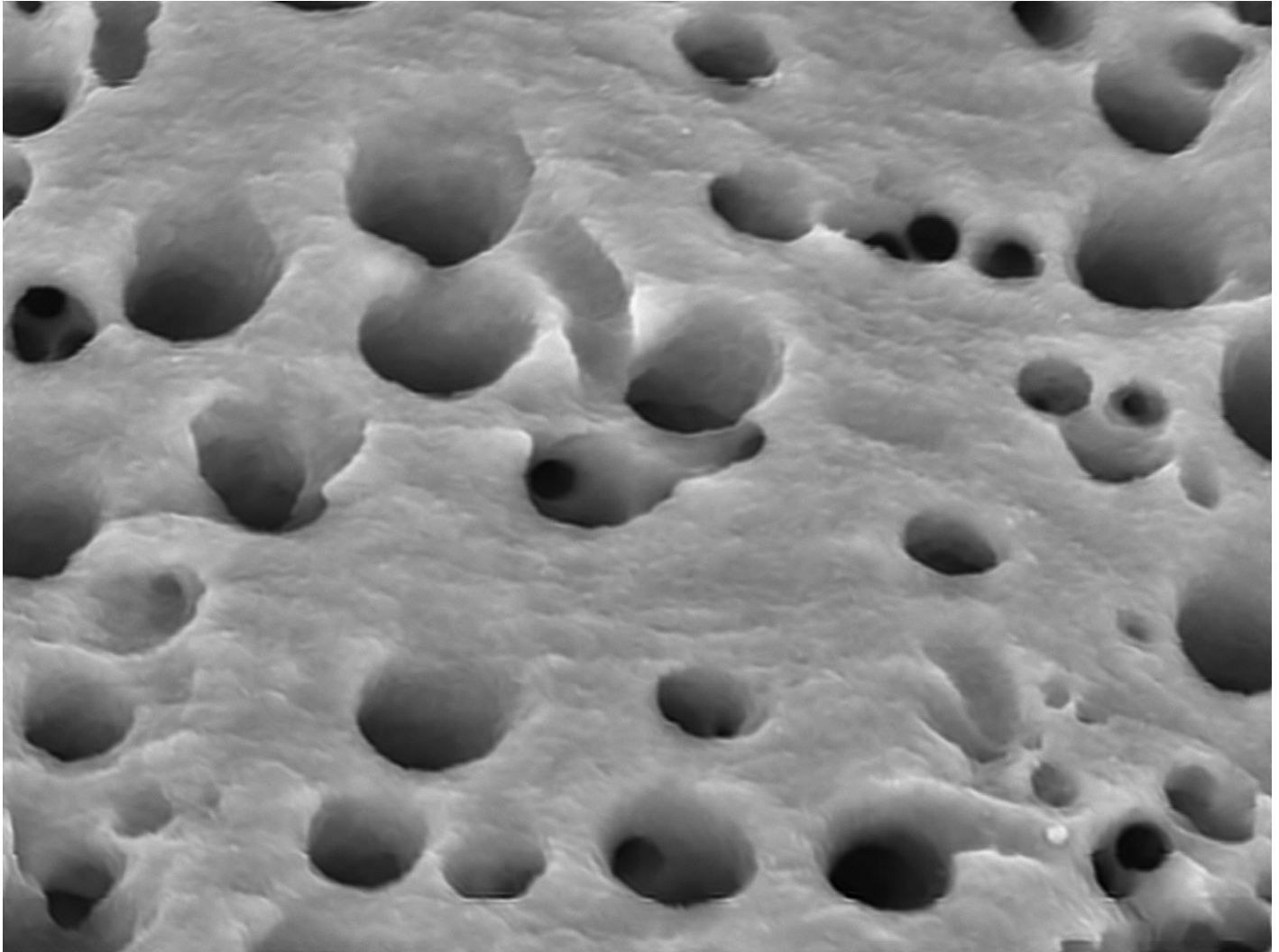
x5.0k 20 μ m

56) image290

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image291

image291



29805-30

2017/03/08 17:13 H

x5.0k

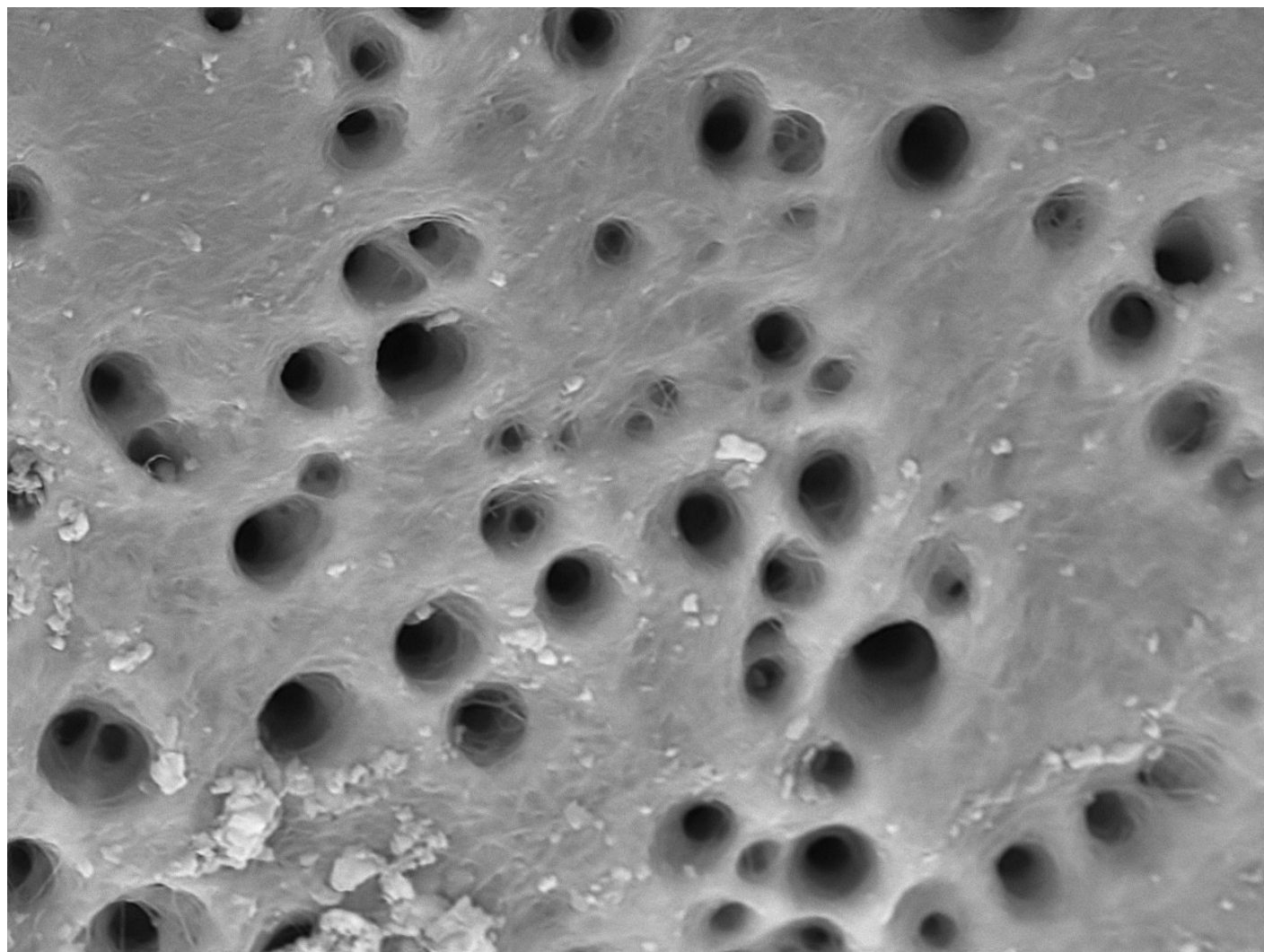
20 μm

57) image291

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image292

image292



29694-2

2017/02/28 16:28 N

x5.0k

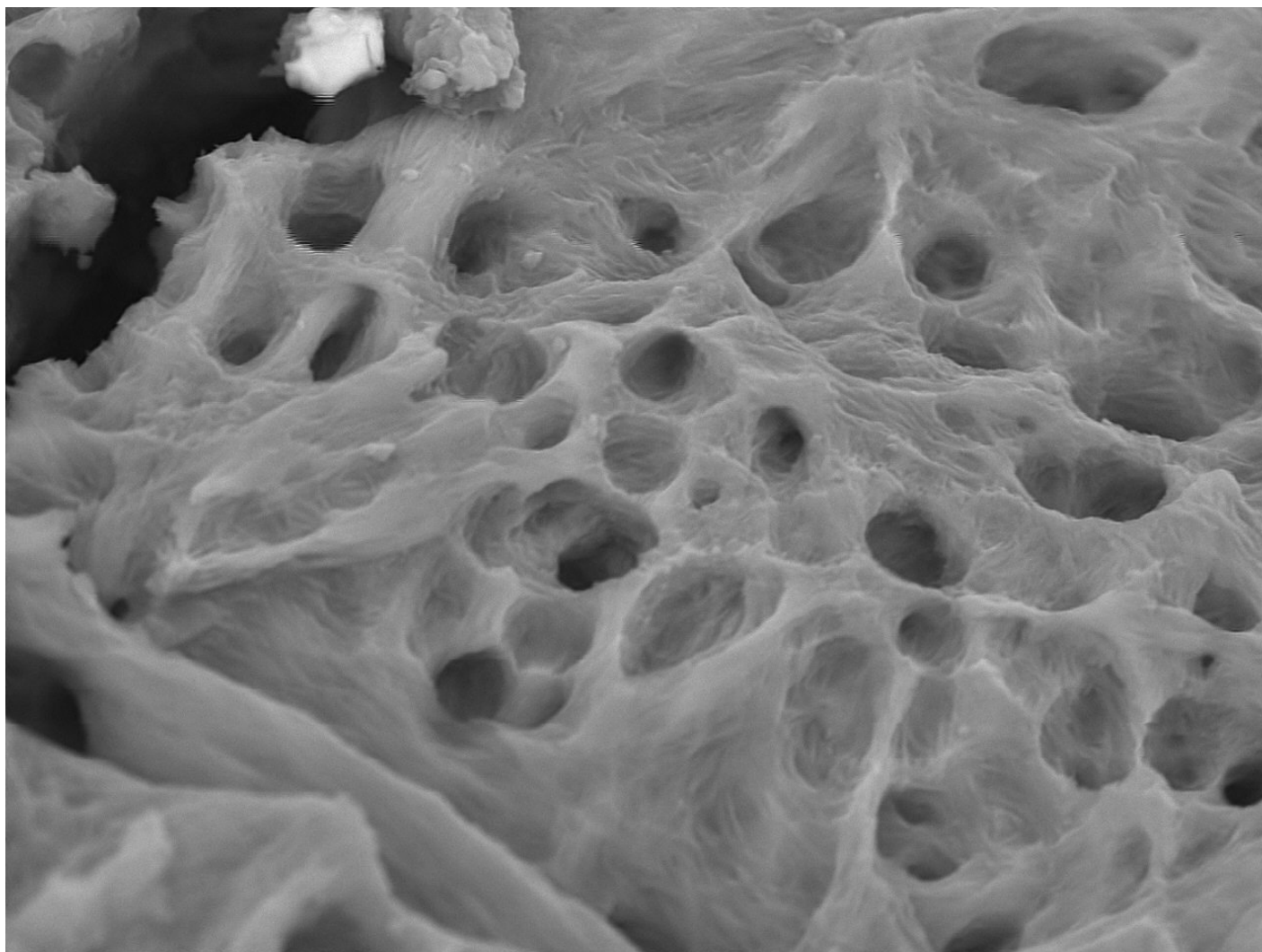
20 μm

58) image292

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image293

image293



29265-2

2017/02/27 11:35 N

x5.0k

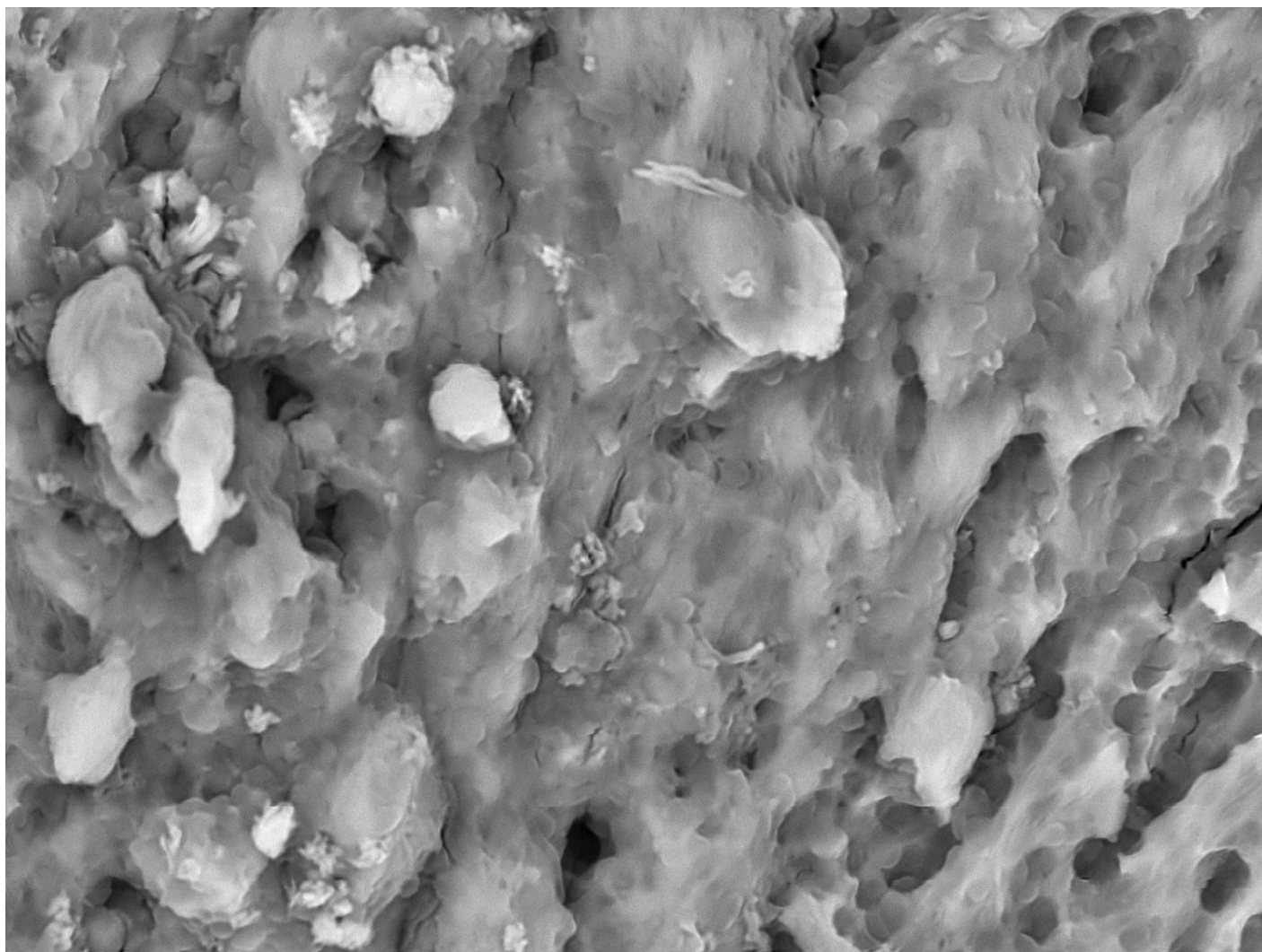
20 μ m

59) image293

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image294

image294



29856-30

2017/02/22 11:07 N

x5.0k

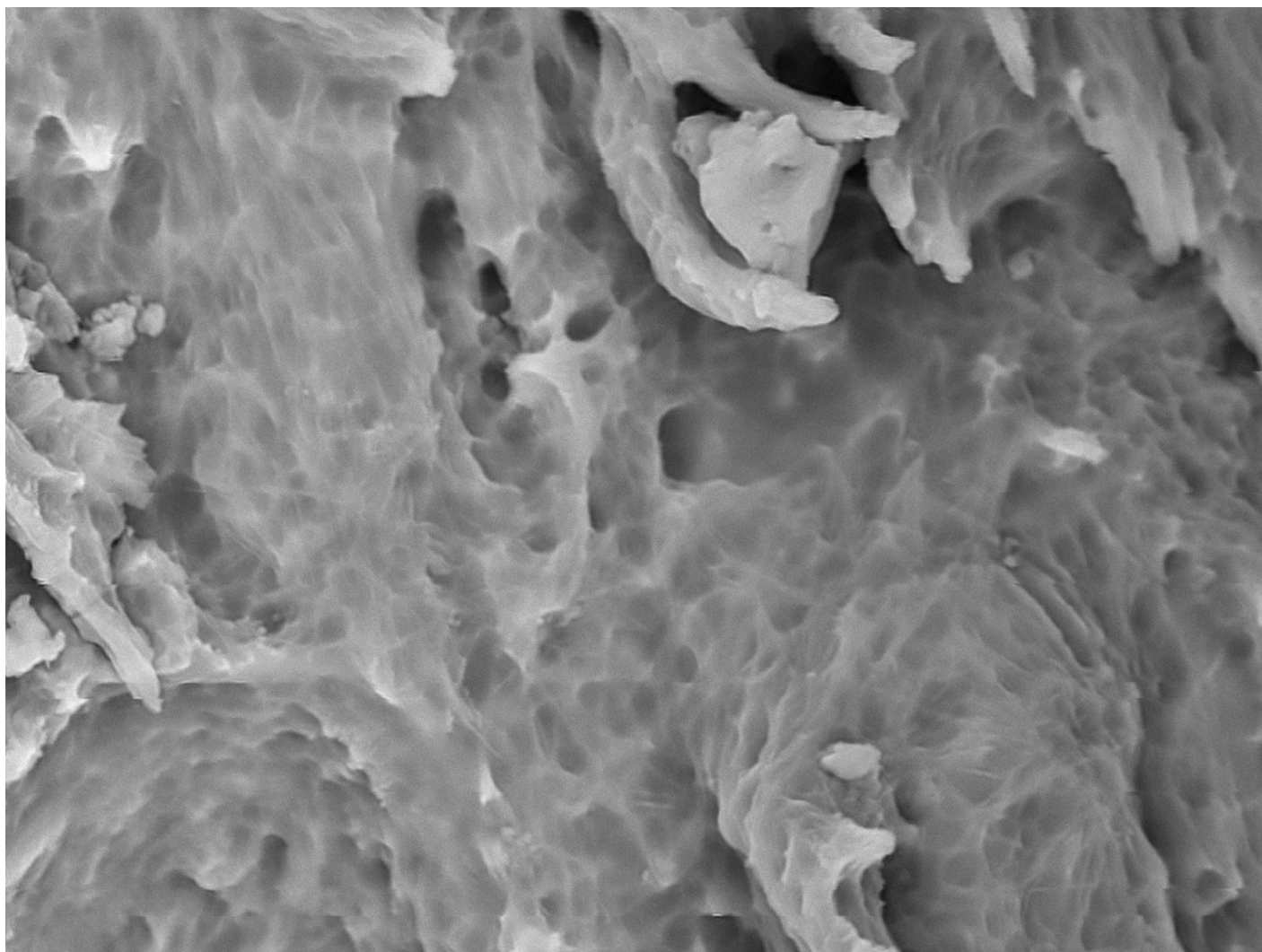
20 μm

60) image294

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image295

image295



29028-15

2017/03/04 15:32 N

x5.0k

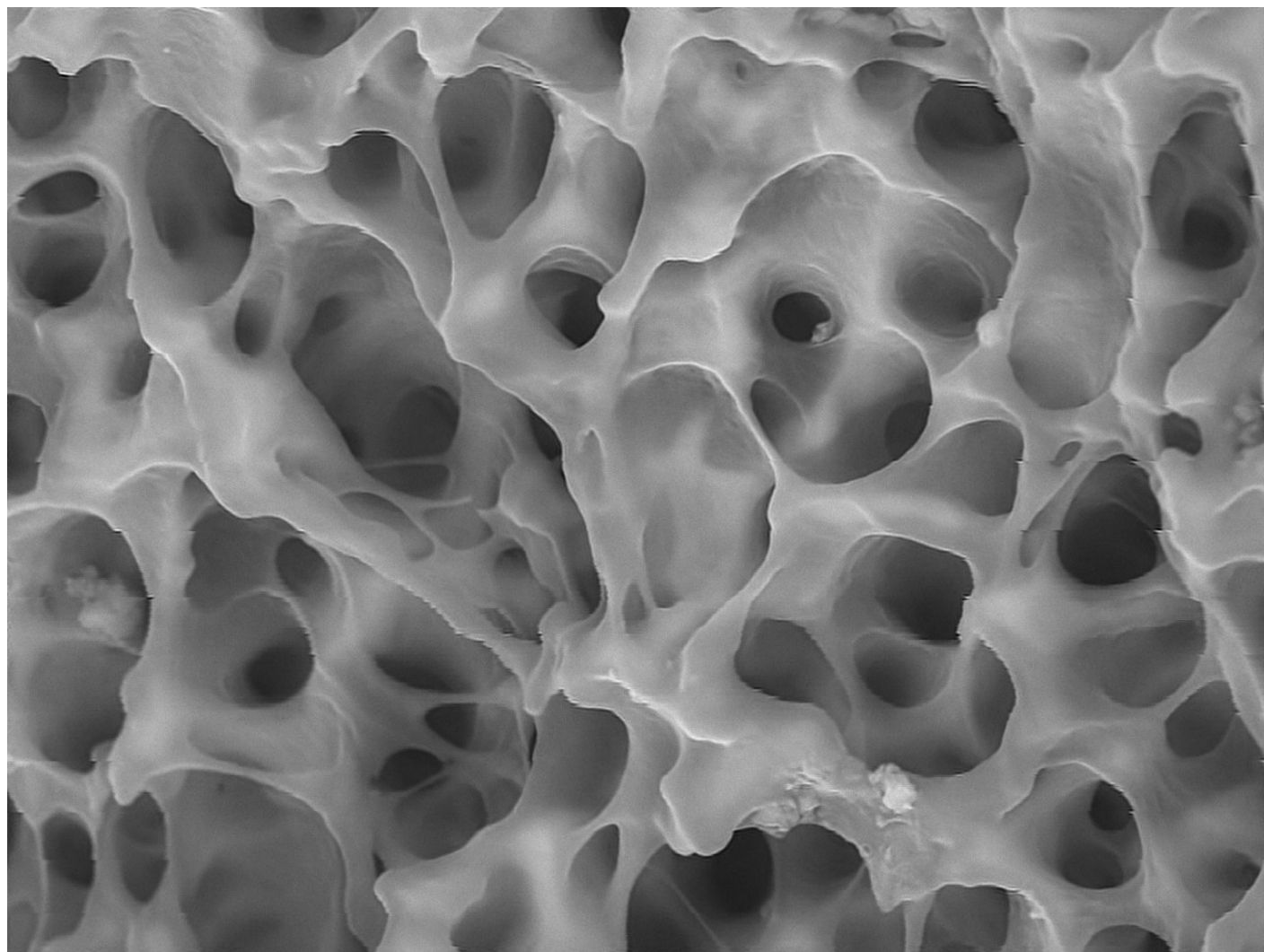
20 μ m

61) image295

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image296

image296



29960-14

2017/03/01 10:32 N

x5.0k

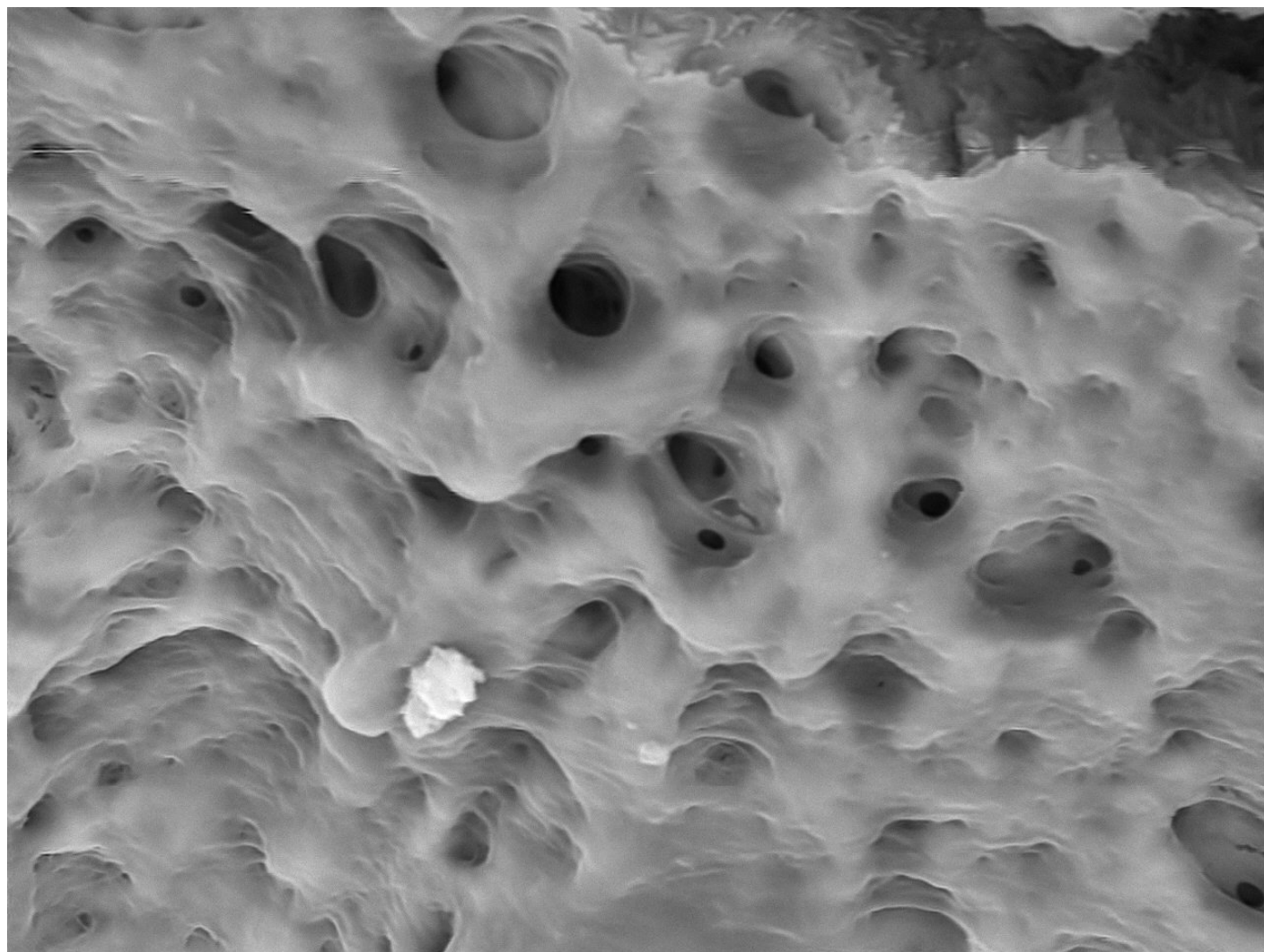
20 μ m

62) image296

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image297

image297



29963-15

2017/03/01 10:07 N

x5.0k

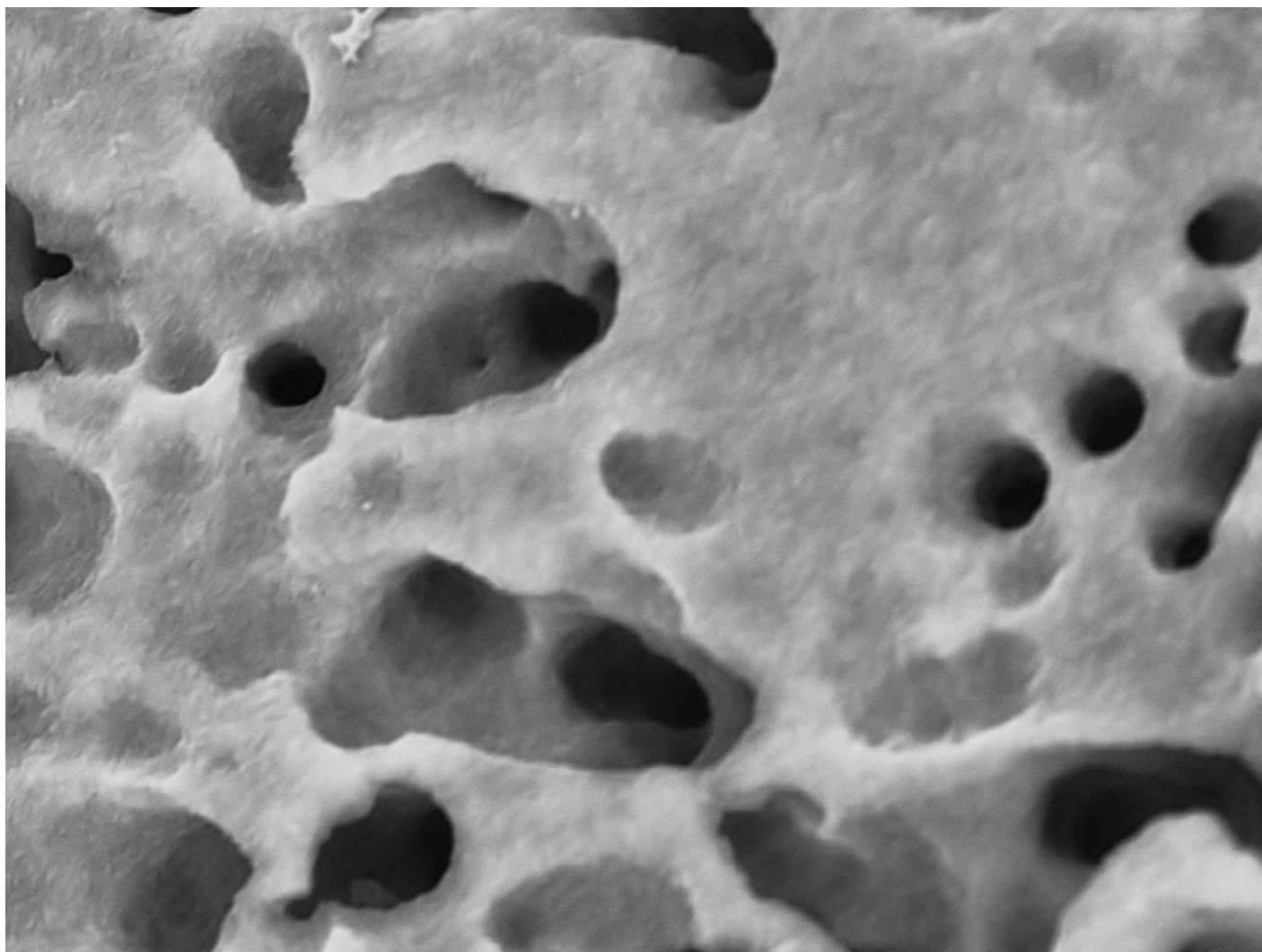
20 μm

63) image297

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image298

image298



29211-18

2017/03/03 15:54 N

x5.0k

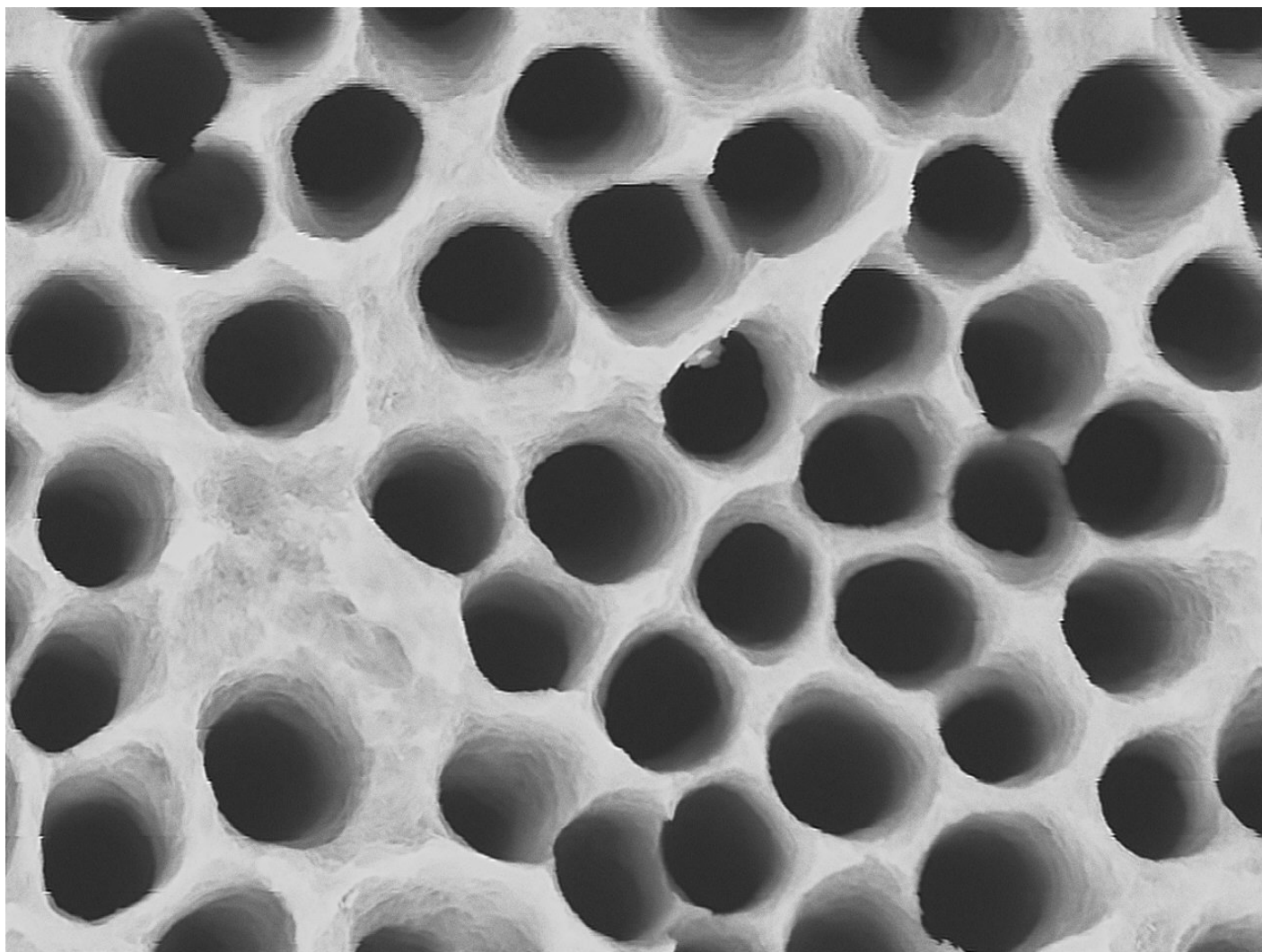
20 μ m

64) image298

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image299

image299



29340-18

2017/03/03 10:20 N

x5.0k

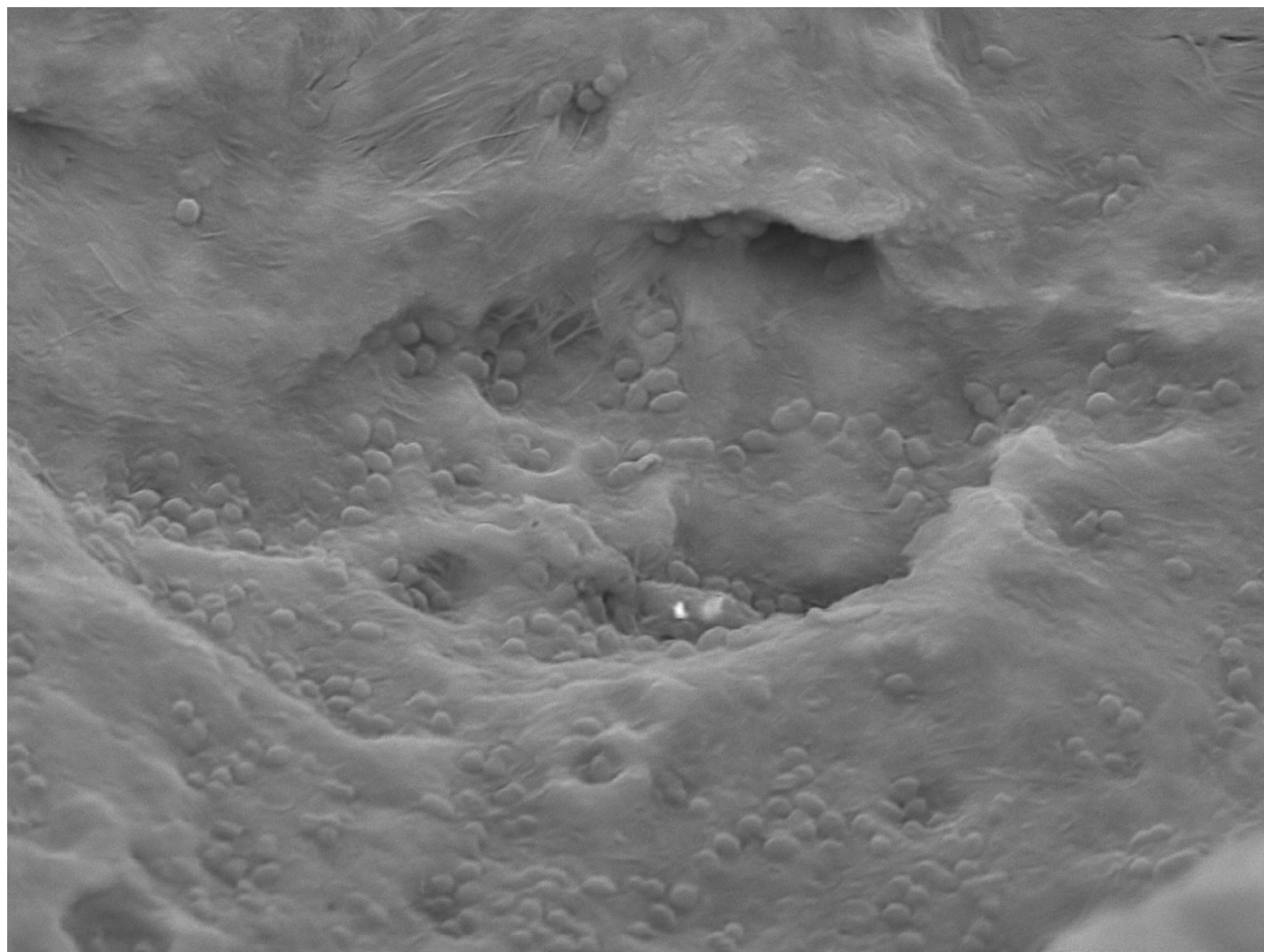
20 μ m

65) image299

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image300

image300



29679-3

2017/02/27 09:45 N

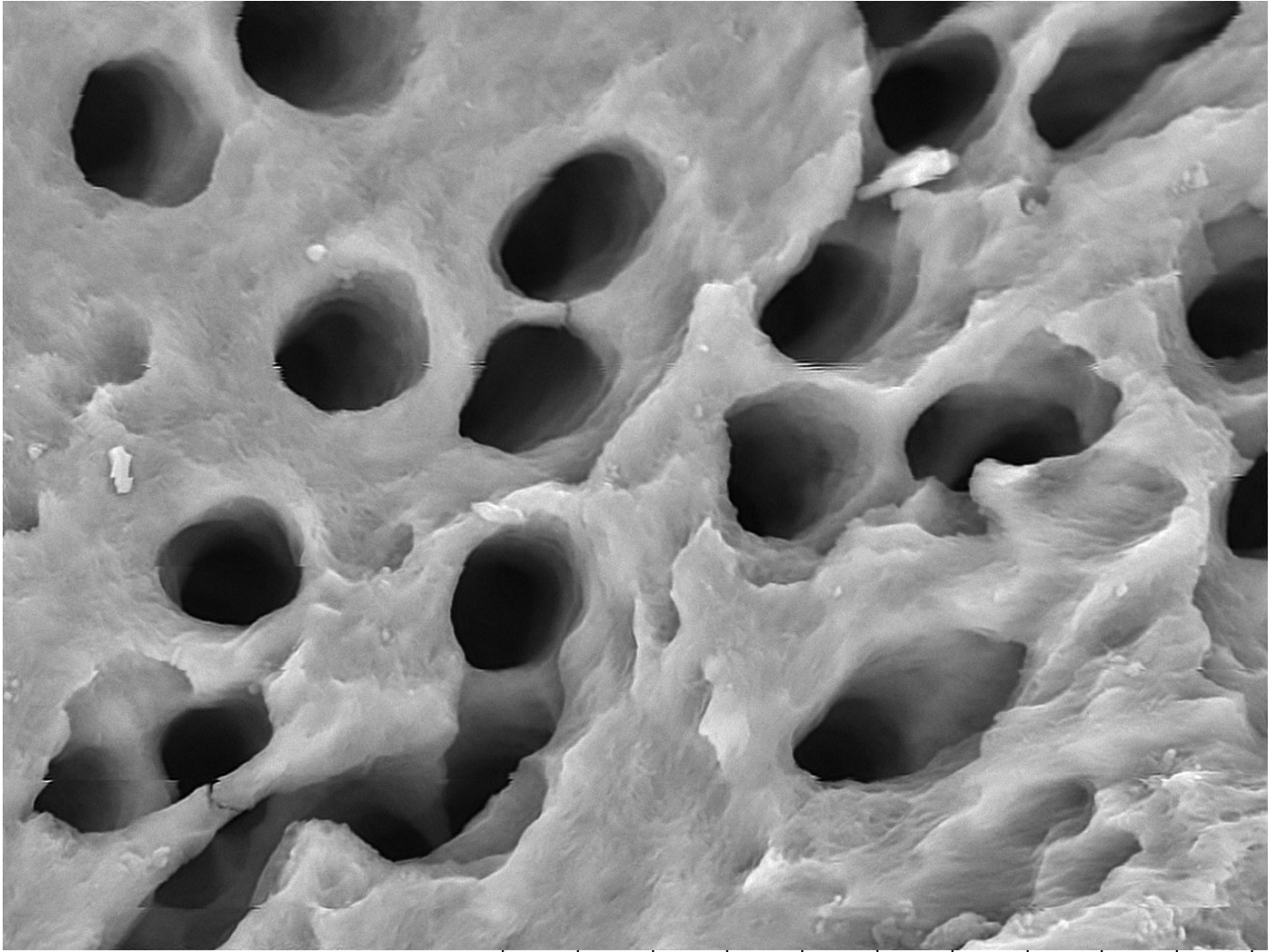
x5.0k 20 μm

66) image300

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image301

image301



29340-18

2017/03/03 10:57 N

x5.0k

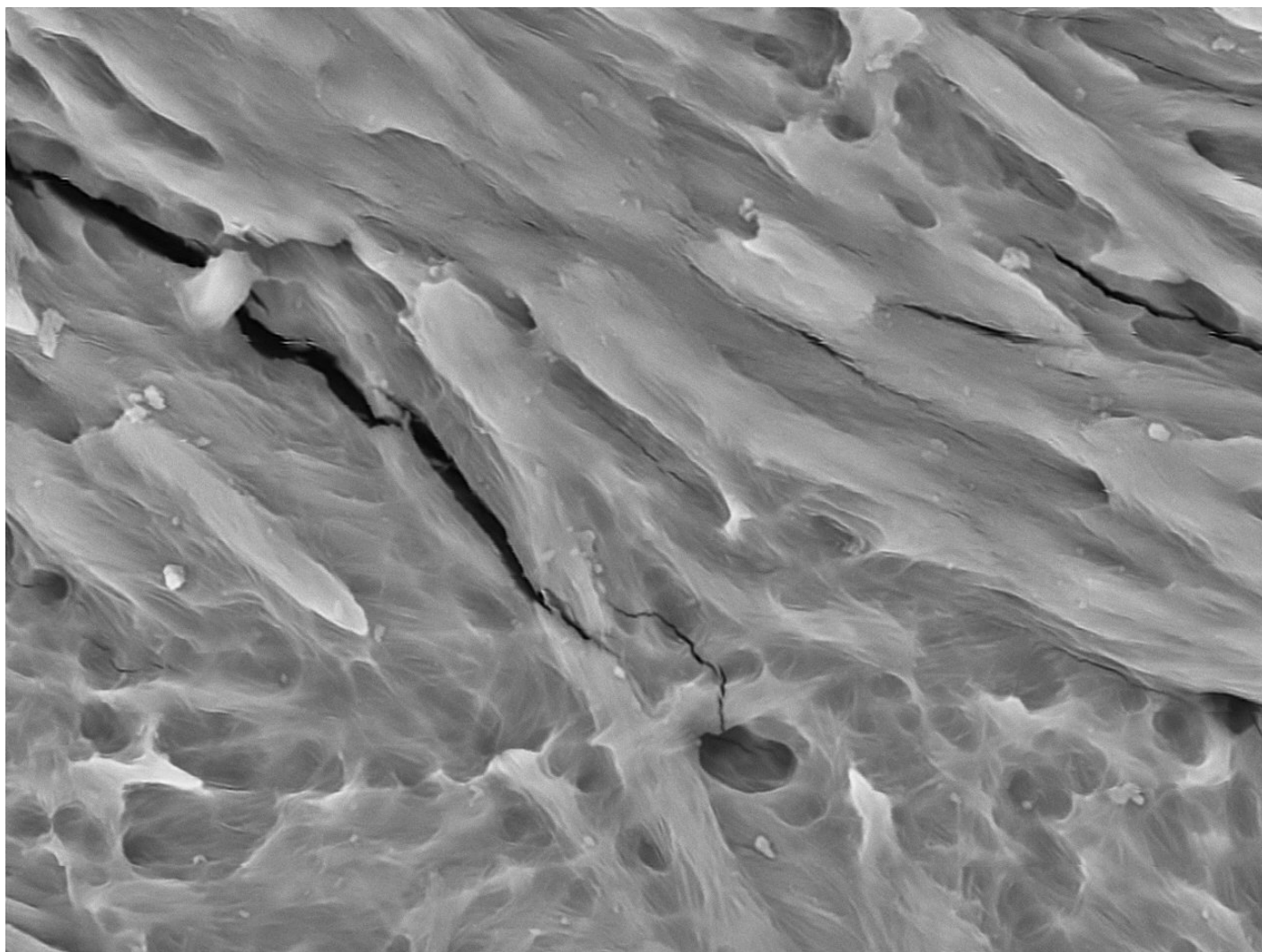
20 μ m

67) image301

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image302

image302



29679-3

2017/02/27 15:30 N

x5.0k

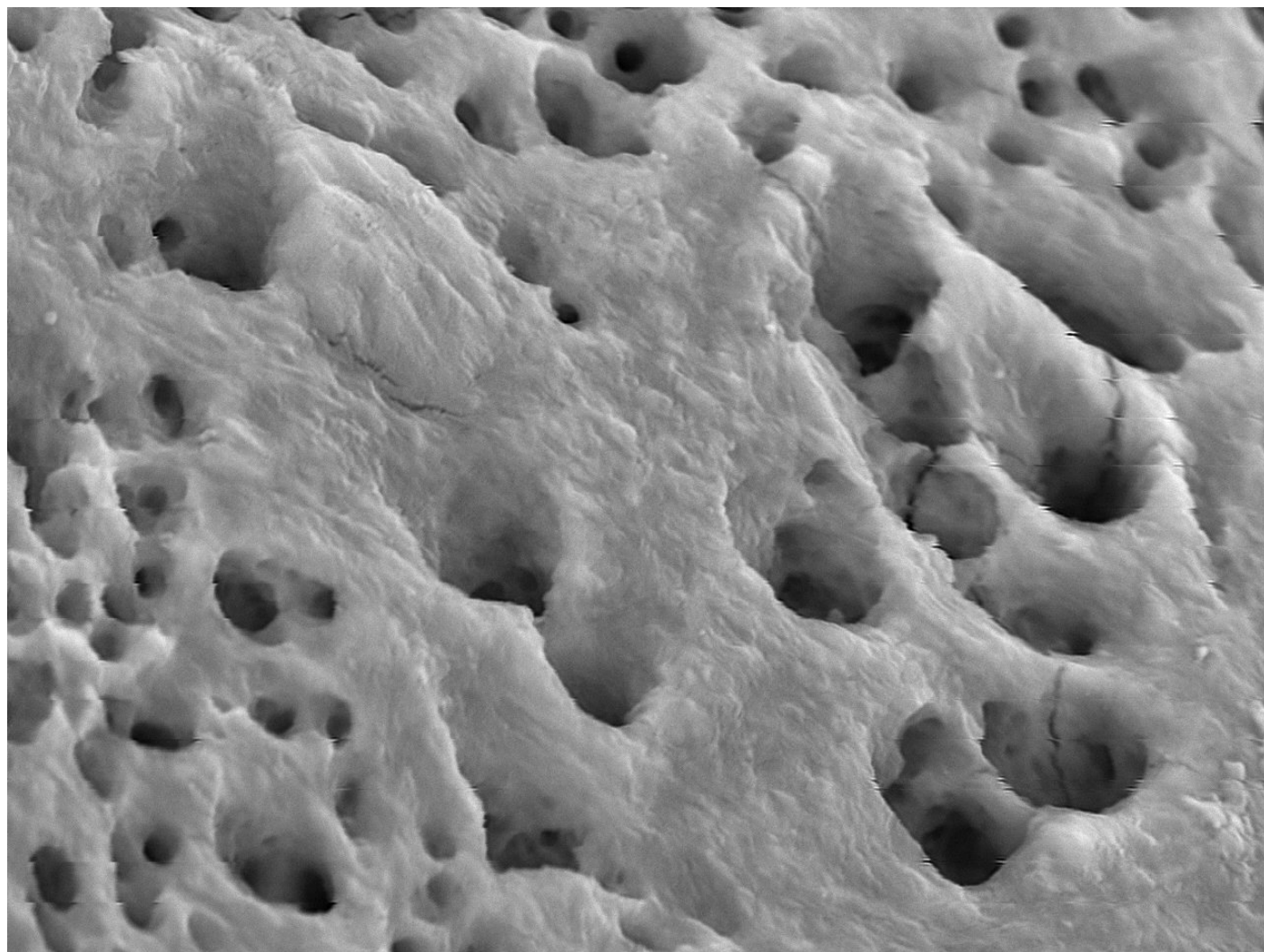
20 μm

68) image302

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image303

image303



29052-14

2017/02/28 17:46 N

x5.0k

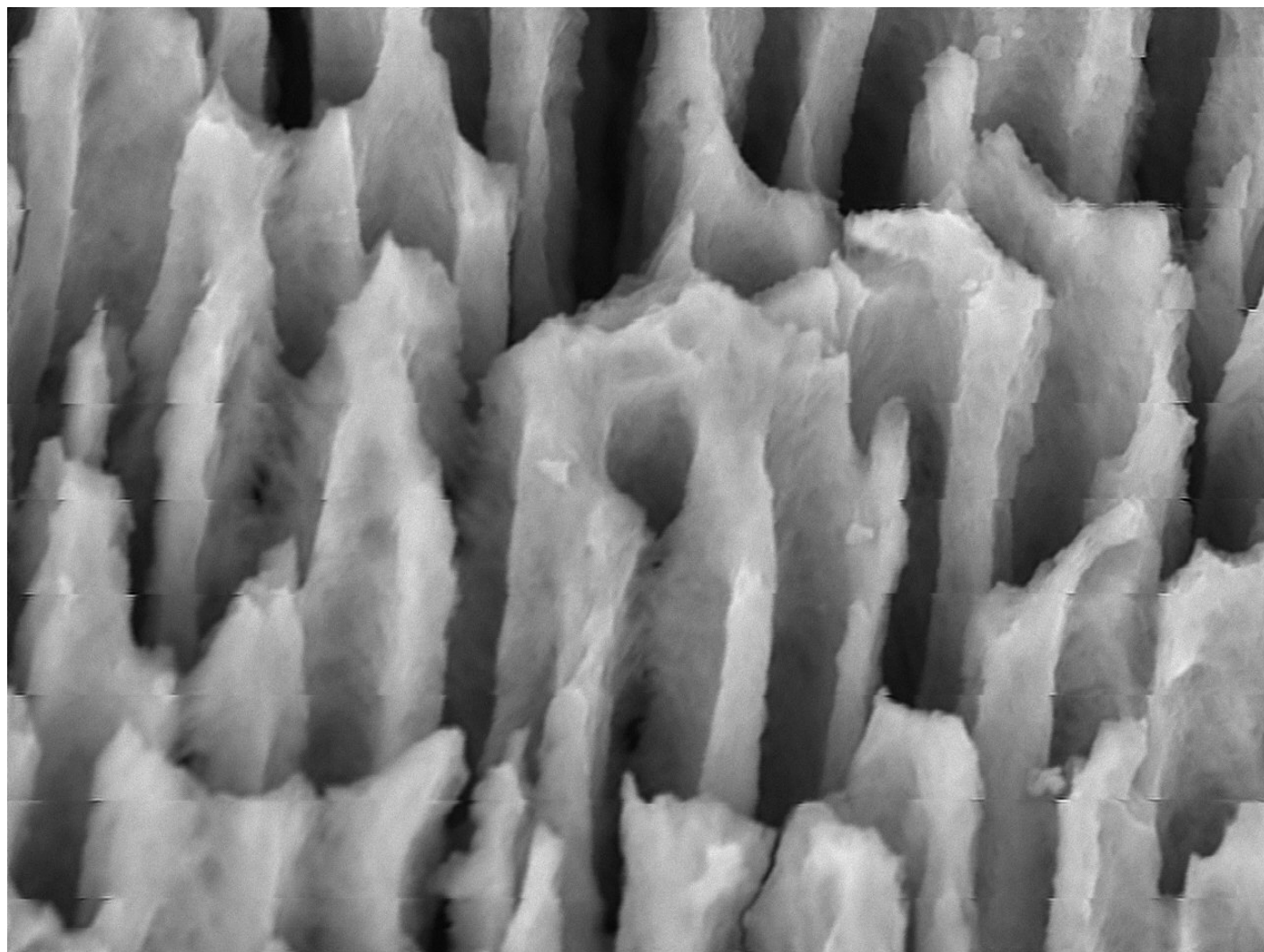
20 μ m

69) image303

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image304

image304



29340-18

2017/03/03 10:50 N

x5.0k

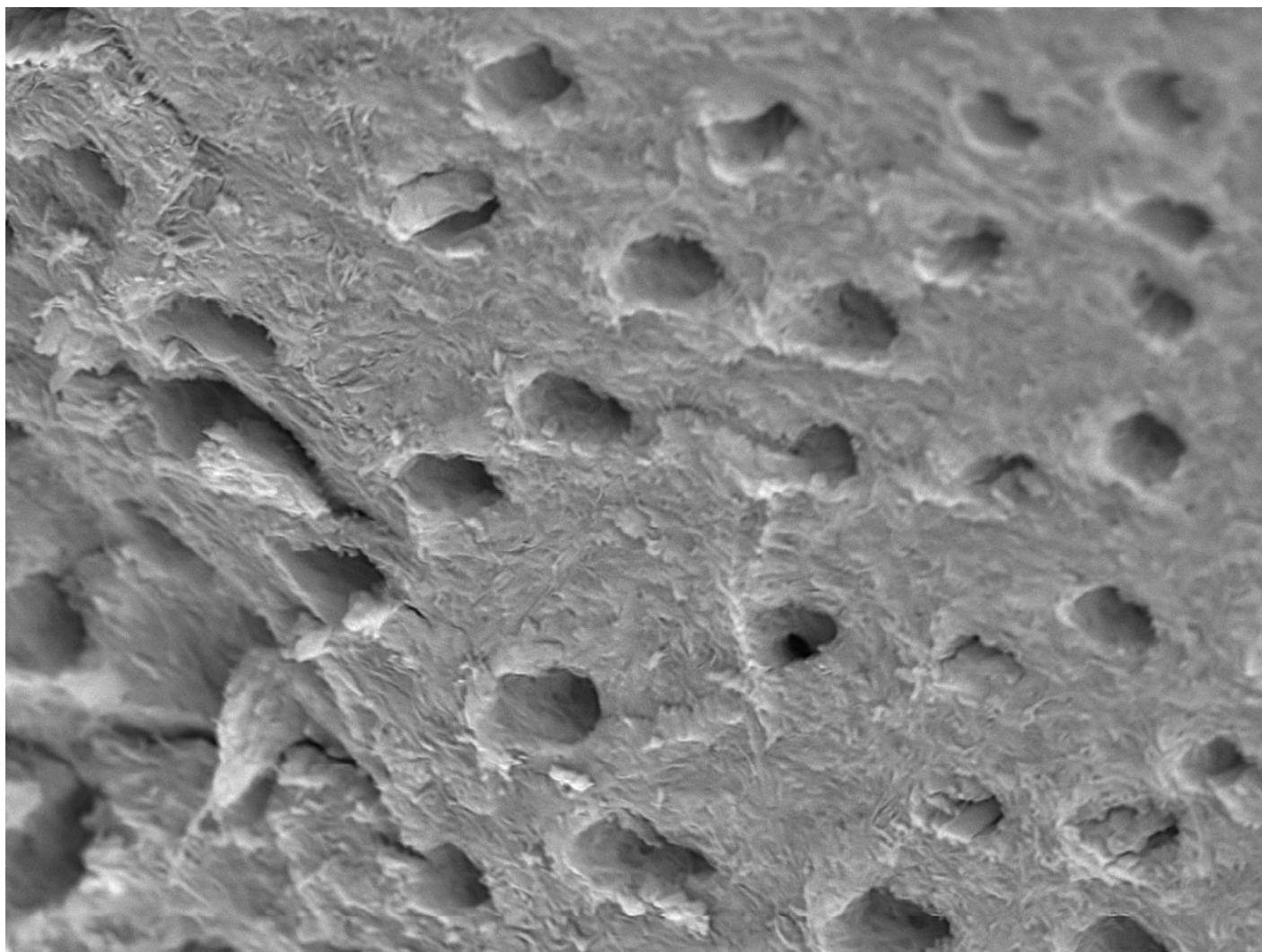
20 μ m

70) image304

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image305

image305



29565-15

2017/02/28 15:32 N

x5.0k

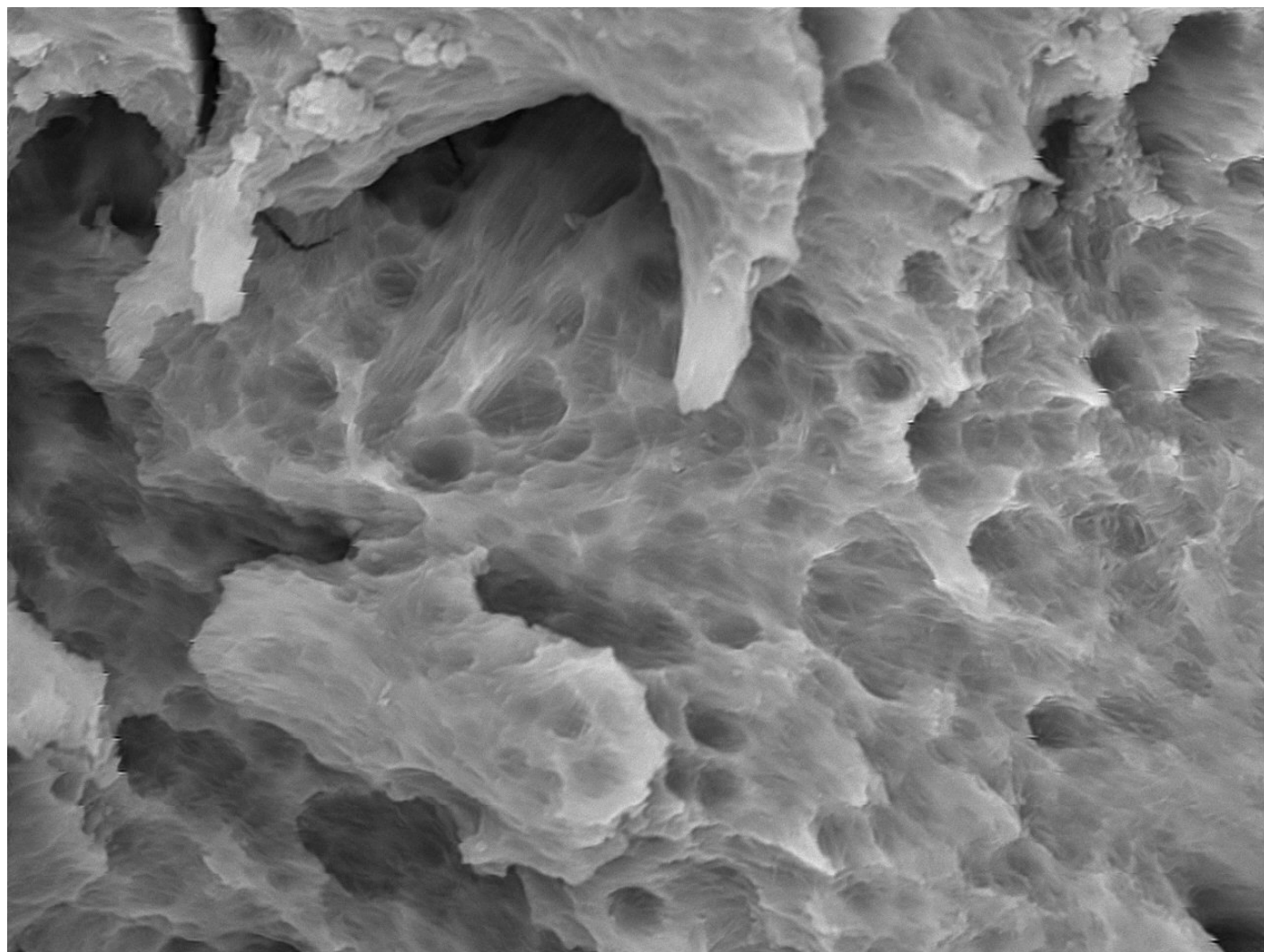
20 μm

71) image305

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image306

image306



29211-18

2017/03/03 16:32 N

x5.0k

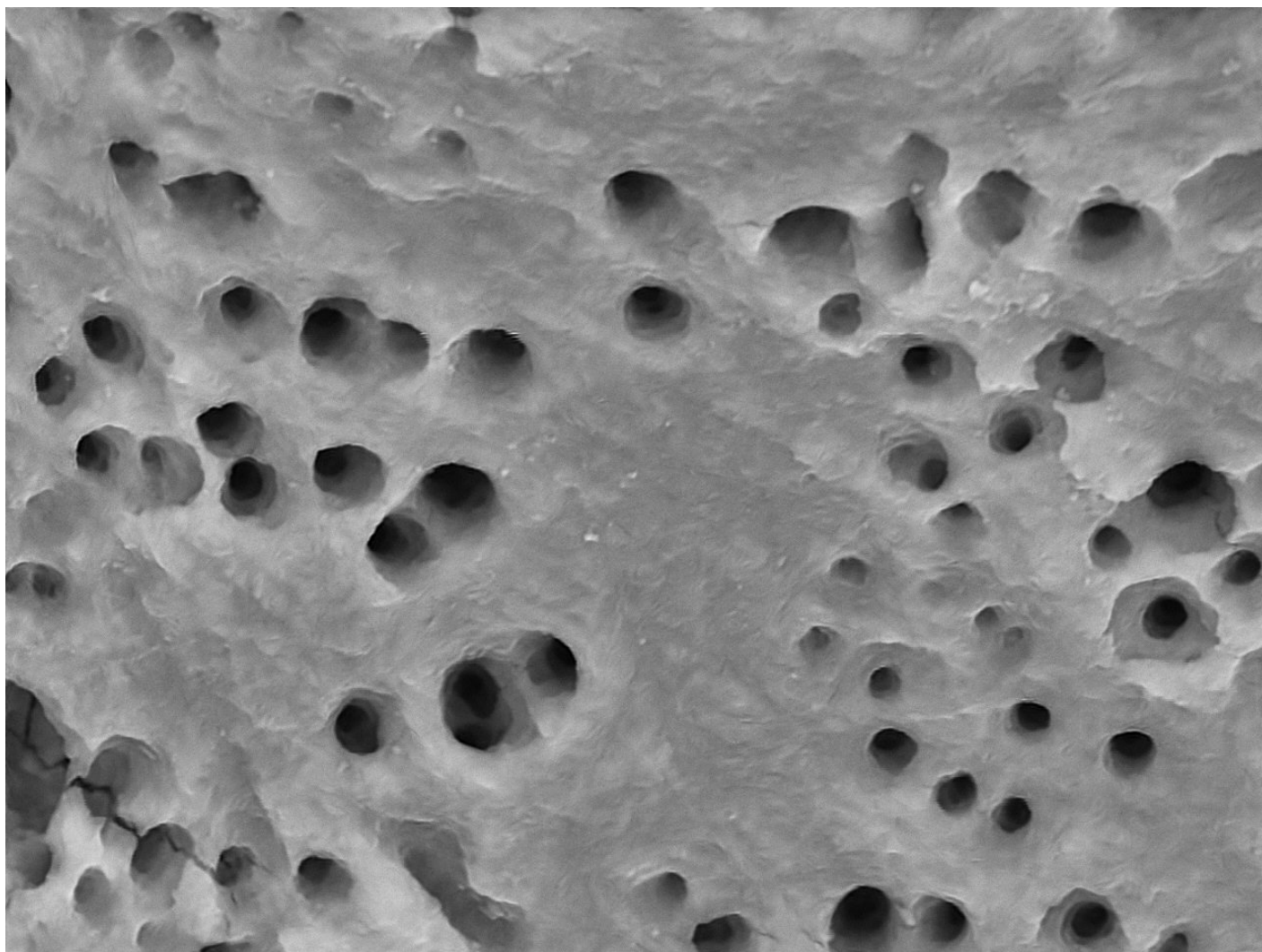
20 μ m

72) image306

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image307

image307



29052-14

2017/02/28 17:53 N

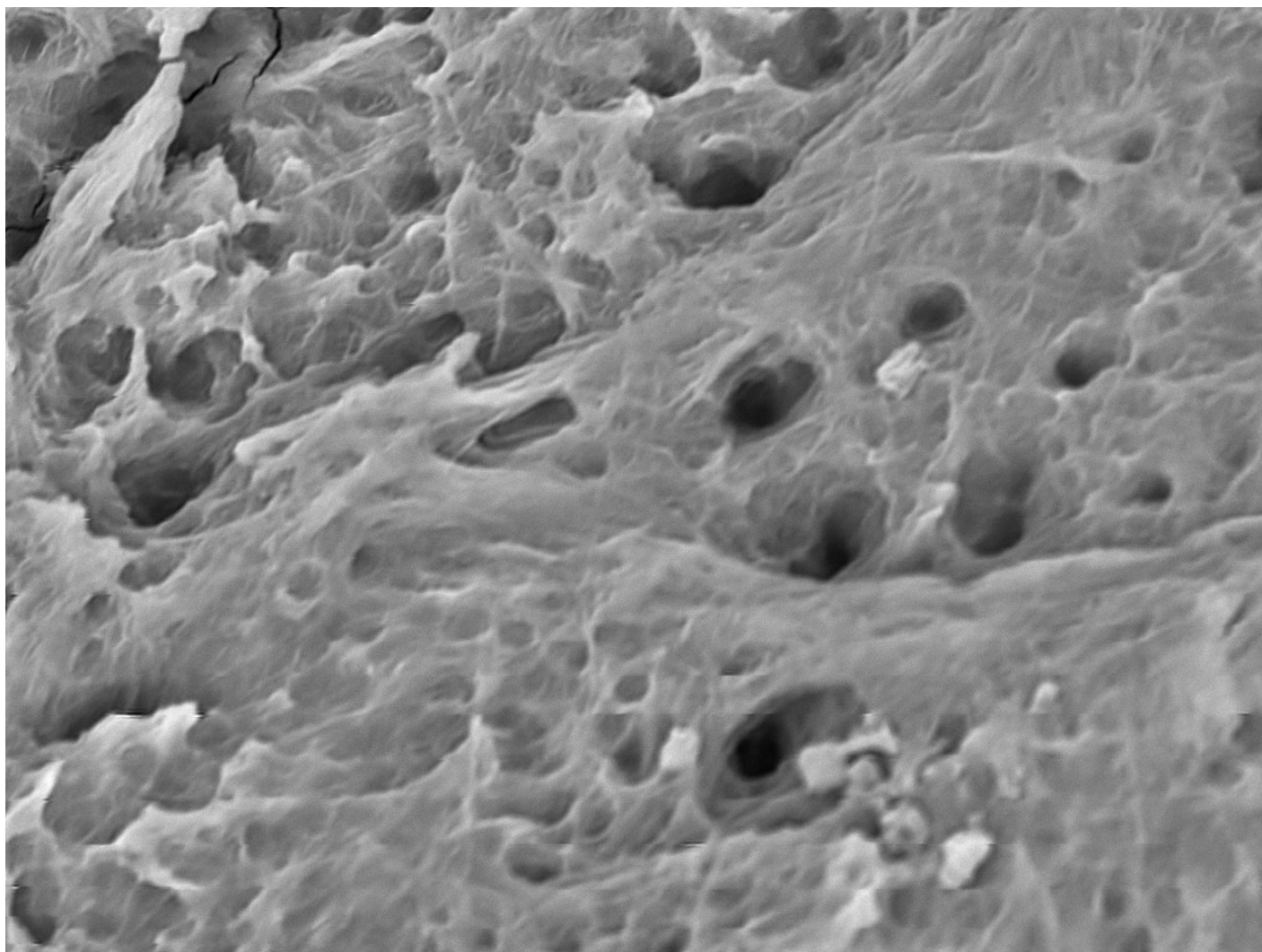
x5.0k 20 μ m

73) image307

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image308

image308



29028-15

2017/03/04 15:35 N

x5.0k

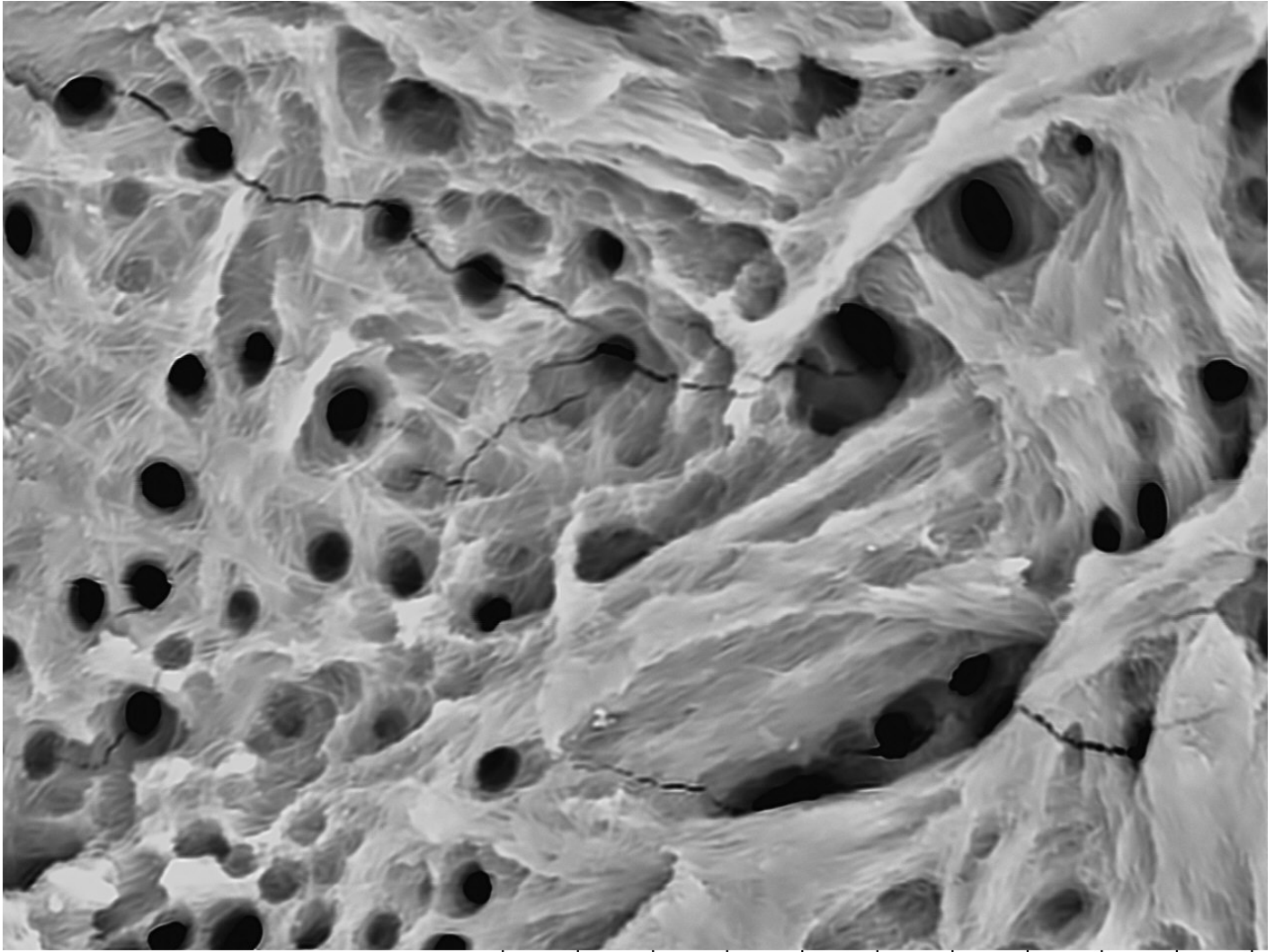
20 μ m

74) image308

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image309

image309



29805-30

2017/03/09 14:37 H

x5.0k

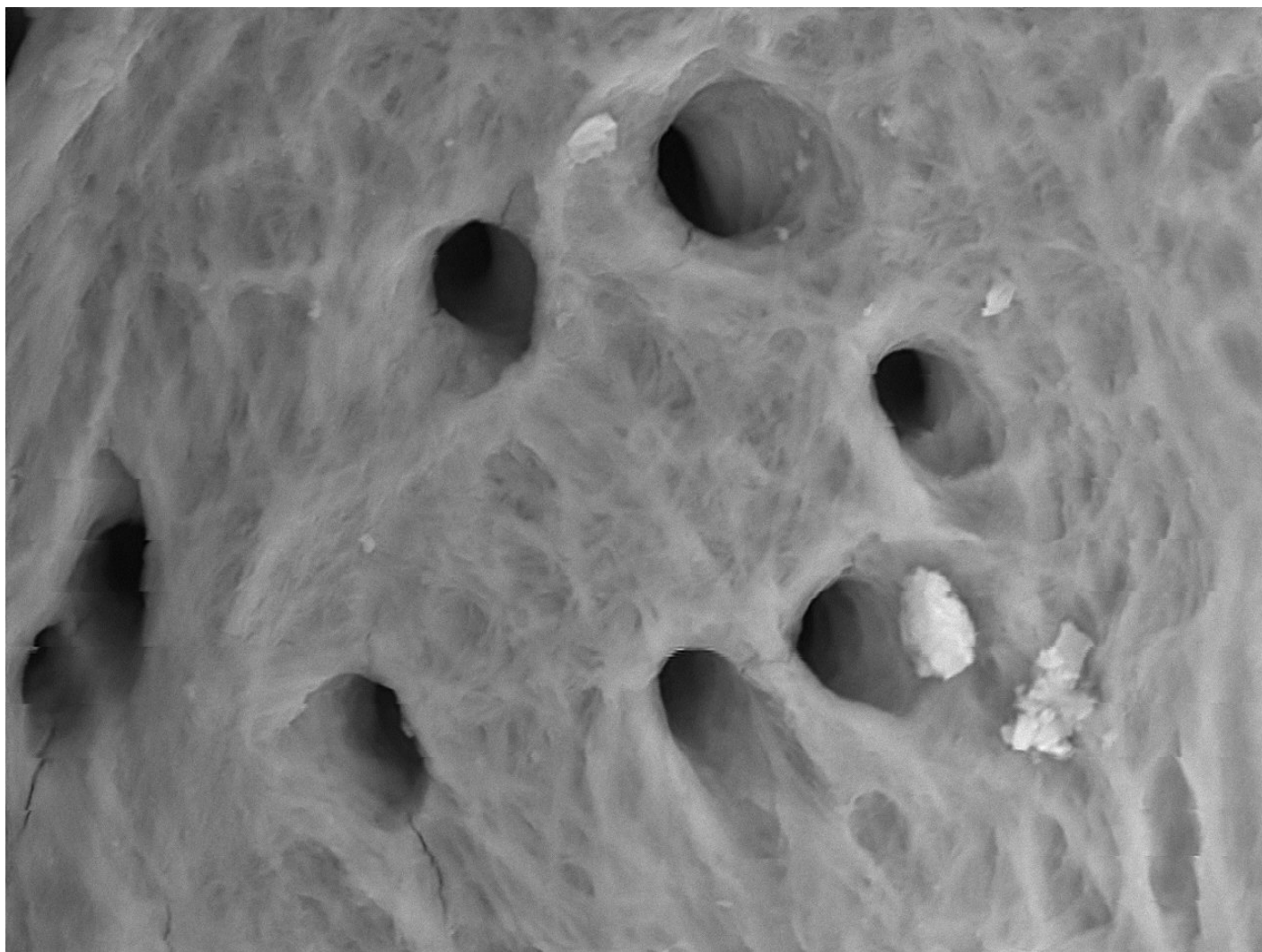
20 μm

75) image309

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image310

image310



29179-3

2017/03/03 11:51 N

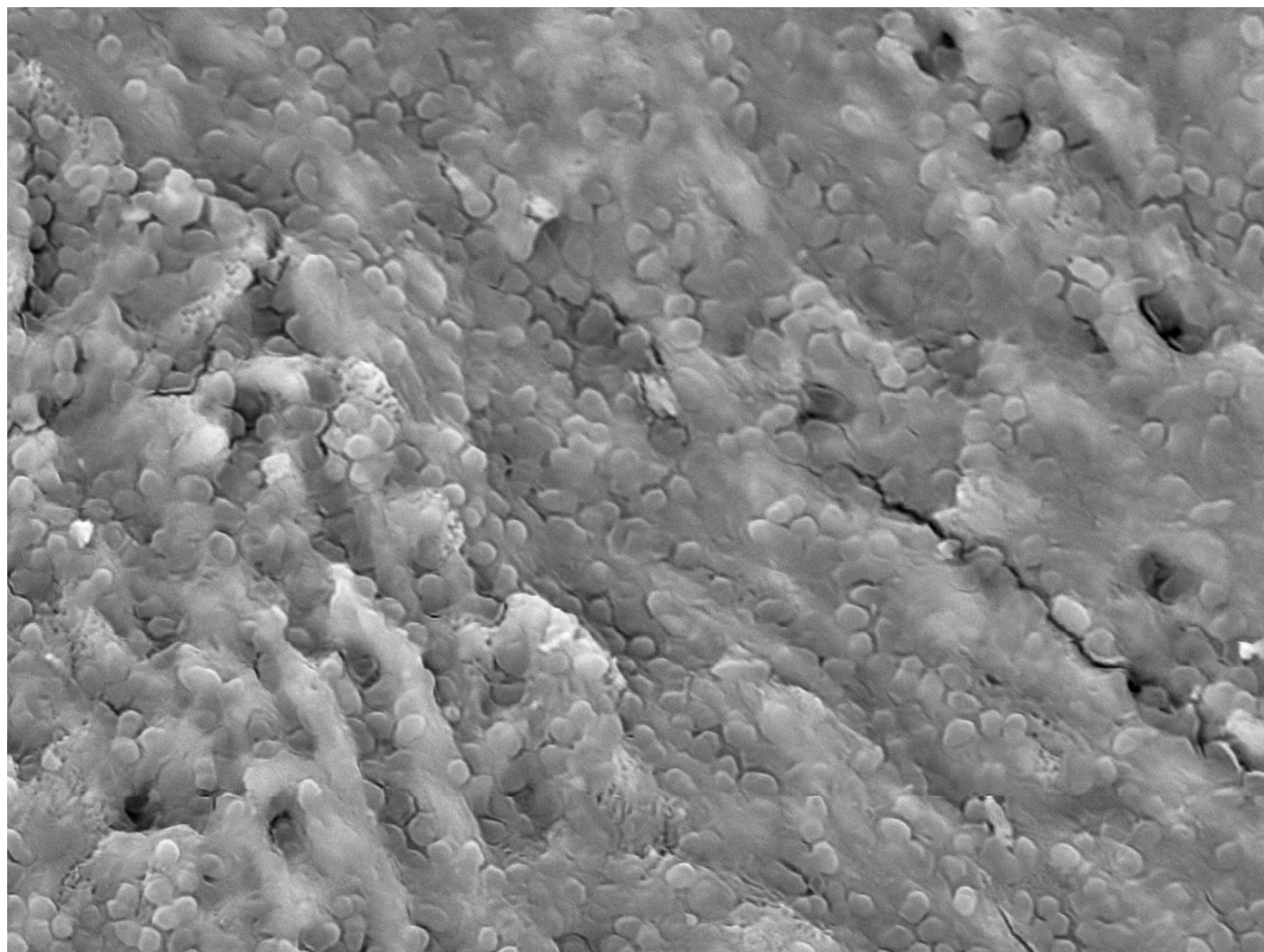
x5.0k 20 μ m

76) image310

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image311

image311



29965-2

2017/03/02 17:47 N

x5.0k

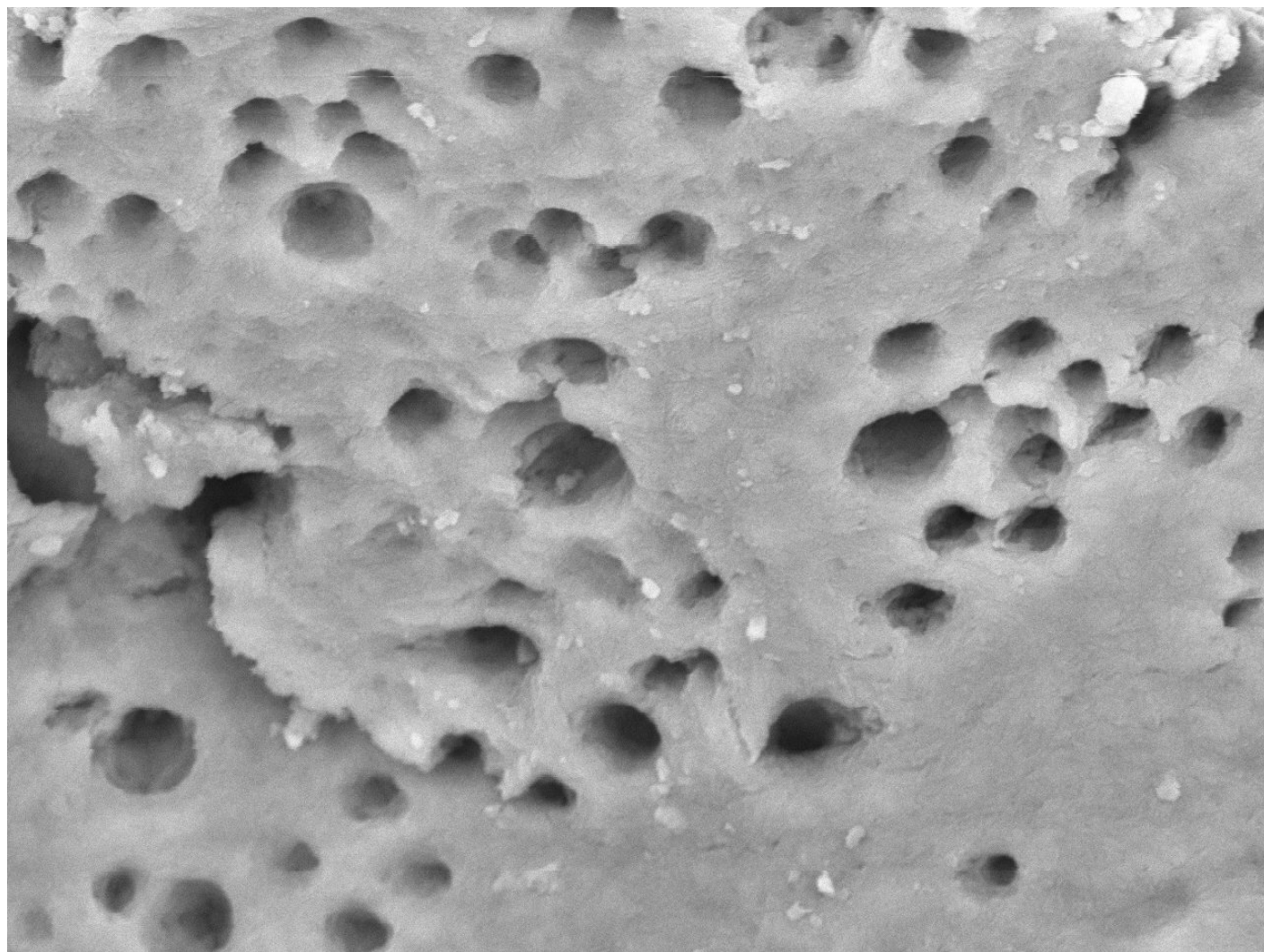
20 μ m

77) image311

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image312

image312



29952-15

2017/02/22 16:01 N

x5.0k

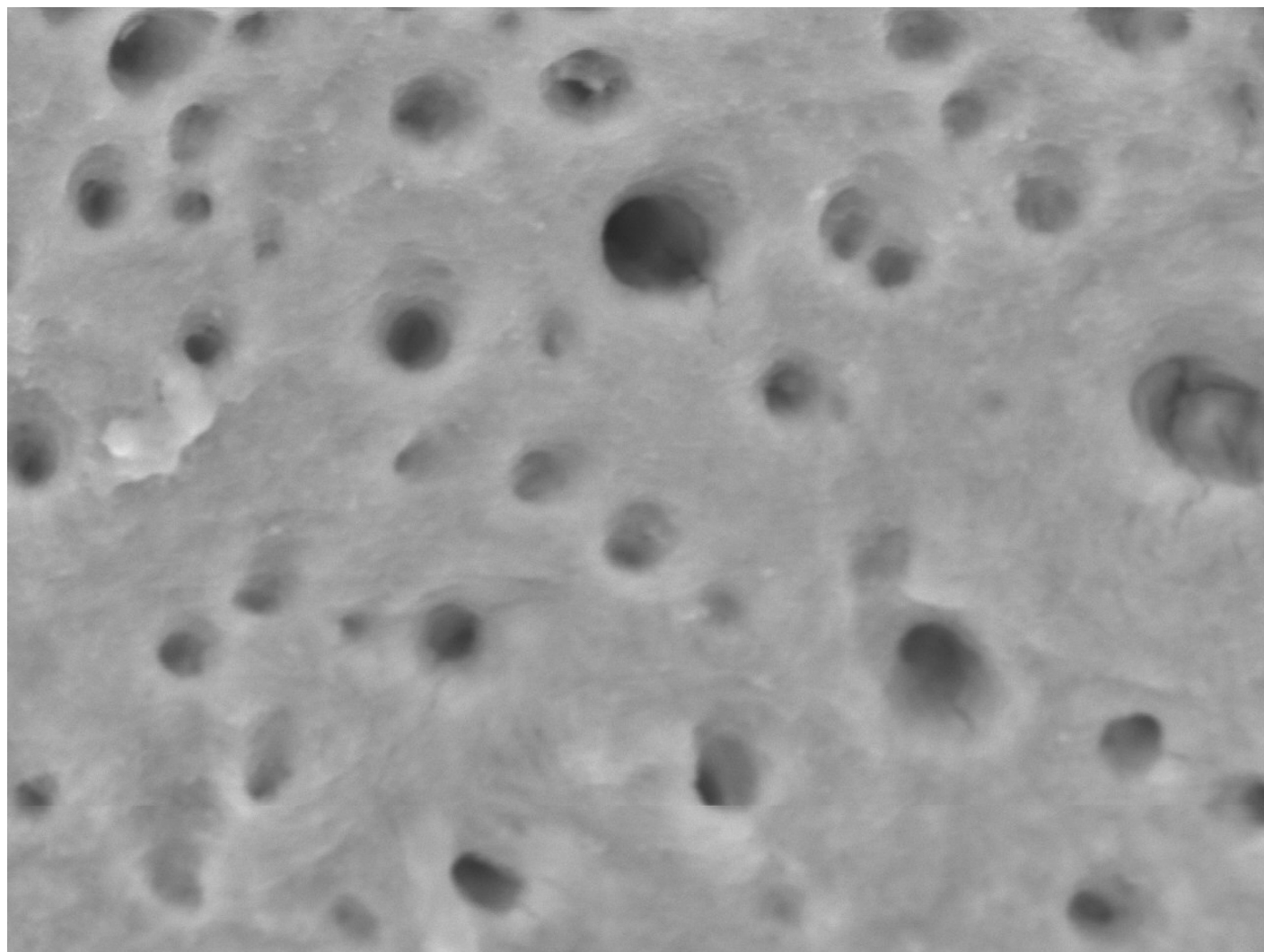
20 μ m

78) image312

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image313

image313



29856-30

2017/02/22 11:51 H

x5.0k

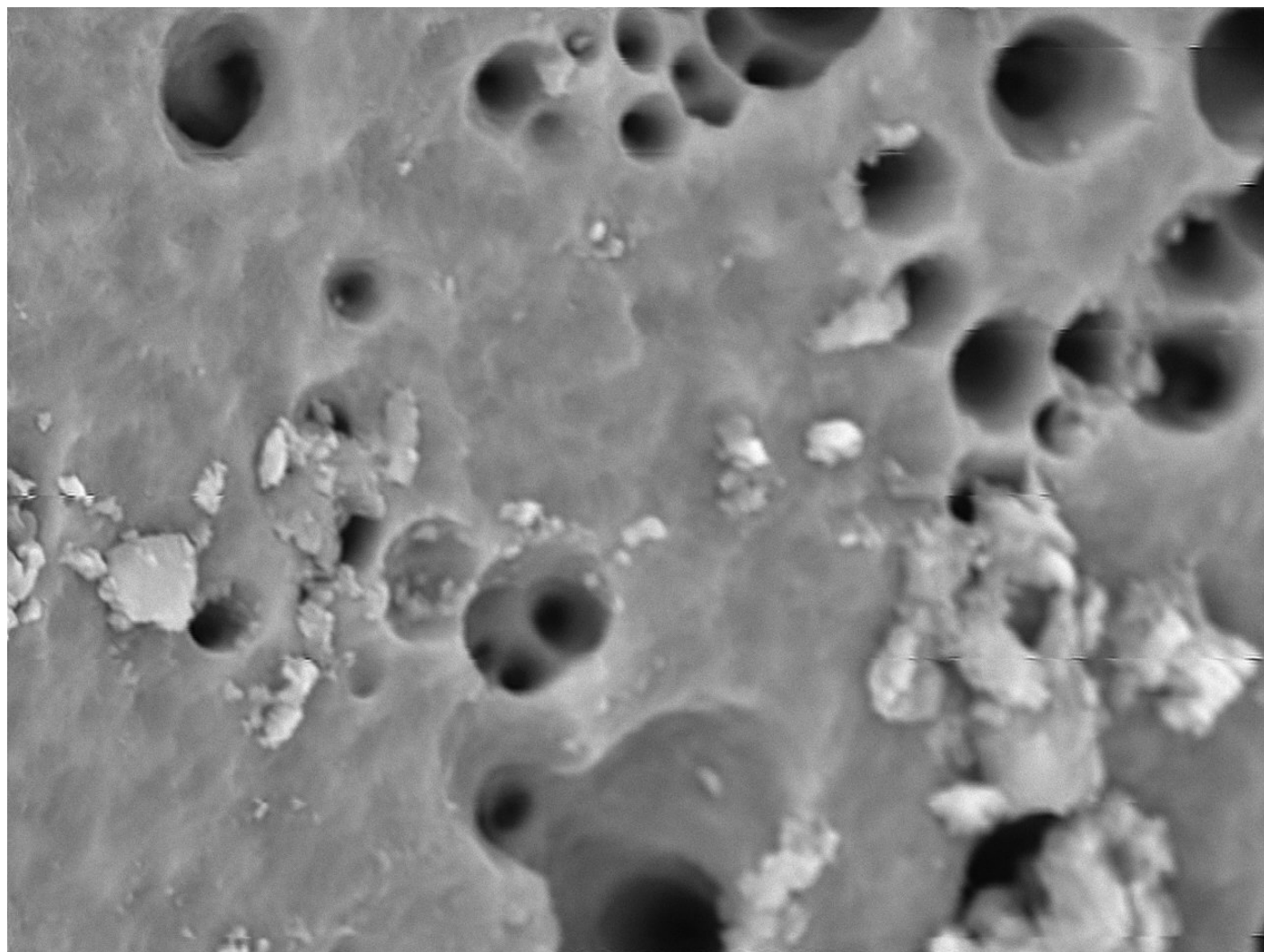
20 μ m

79) image313

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image314

image314



29211-18

2017/03/03 16:11 N

x5.0k

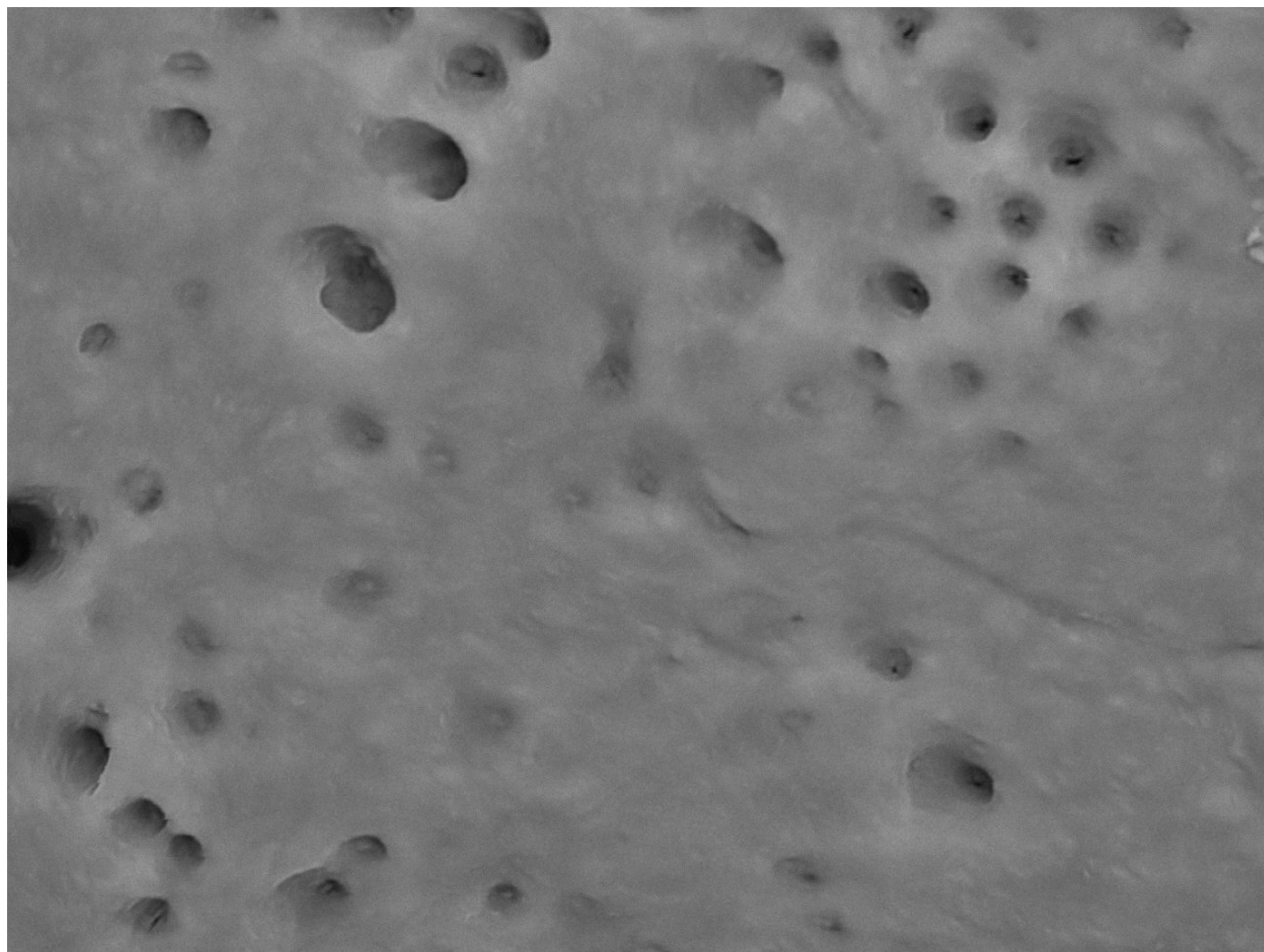
20 μm

80) image314

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image315

image315



29961-2

2017/03/01 14:27 N

x5.0k

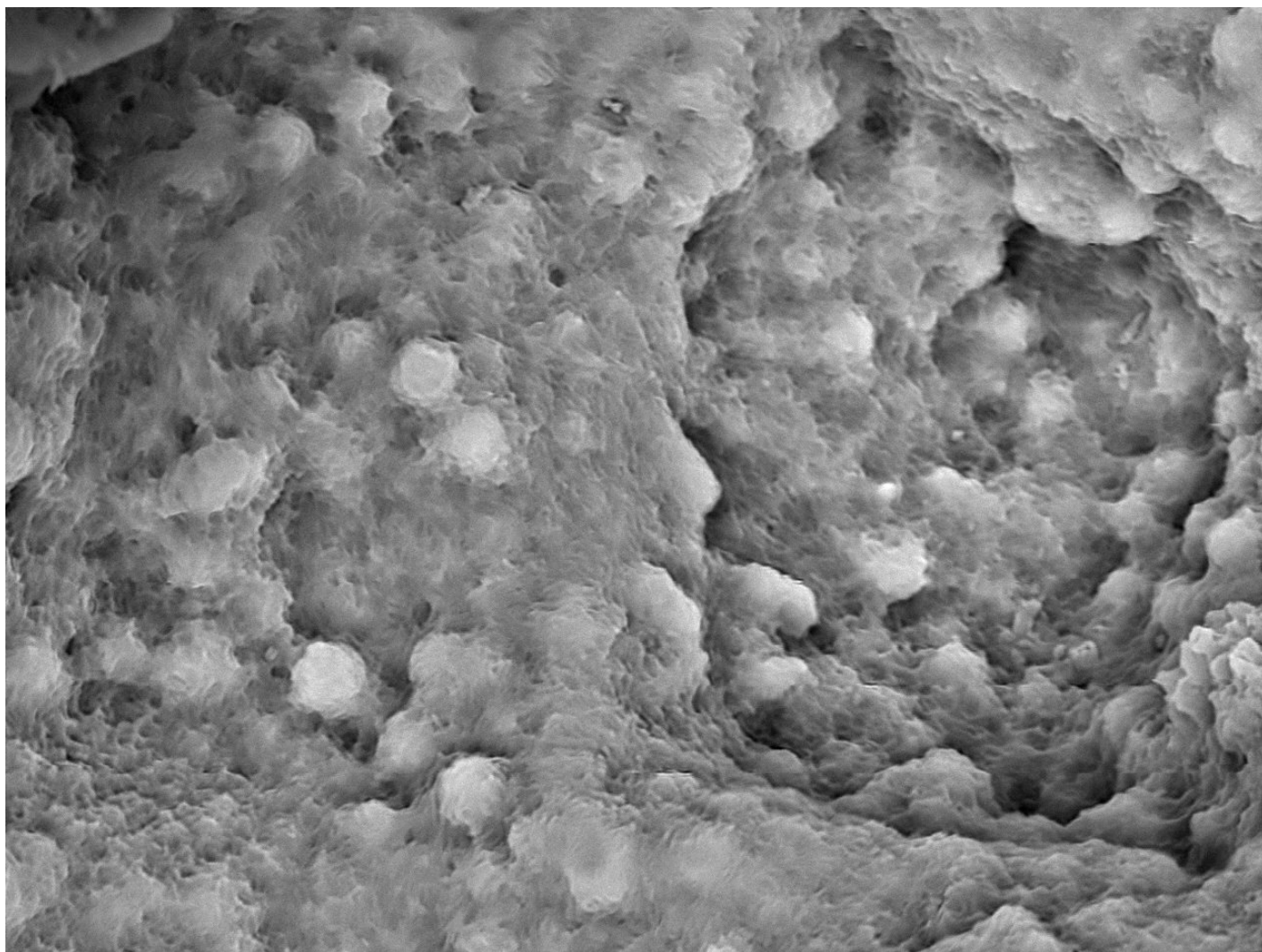
20 μ m

81) image315

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image316

image316



29679-3

2017/02/27 16:29 N

x5.0k

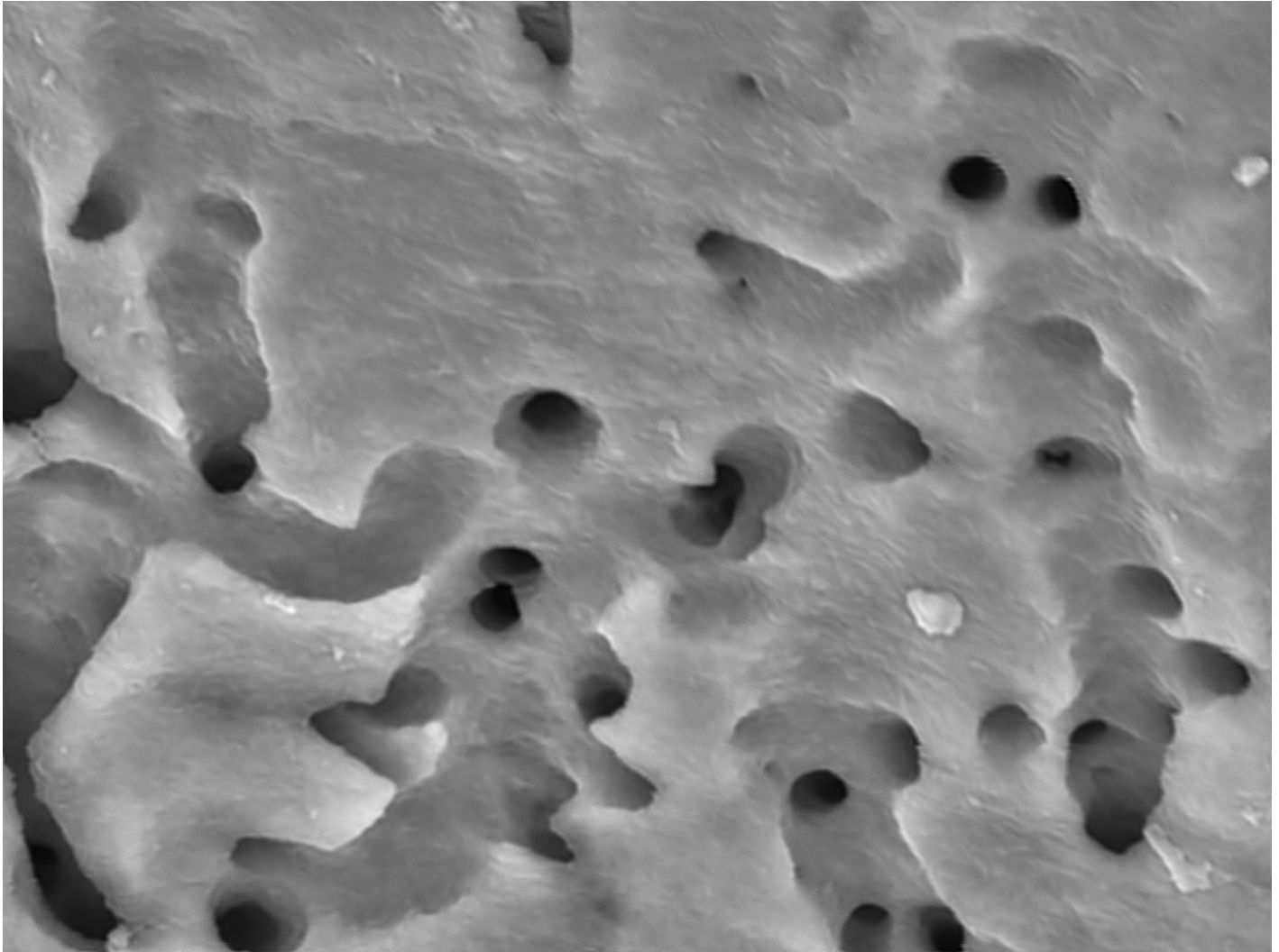
20 μ m

82) image316

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image317

image317



29805-30

2017/03/09 14:52 H

x5.0k

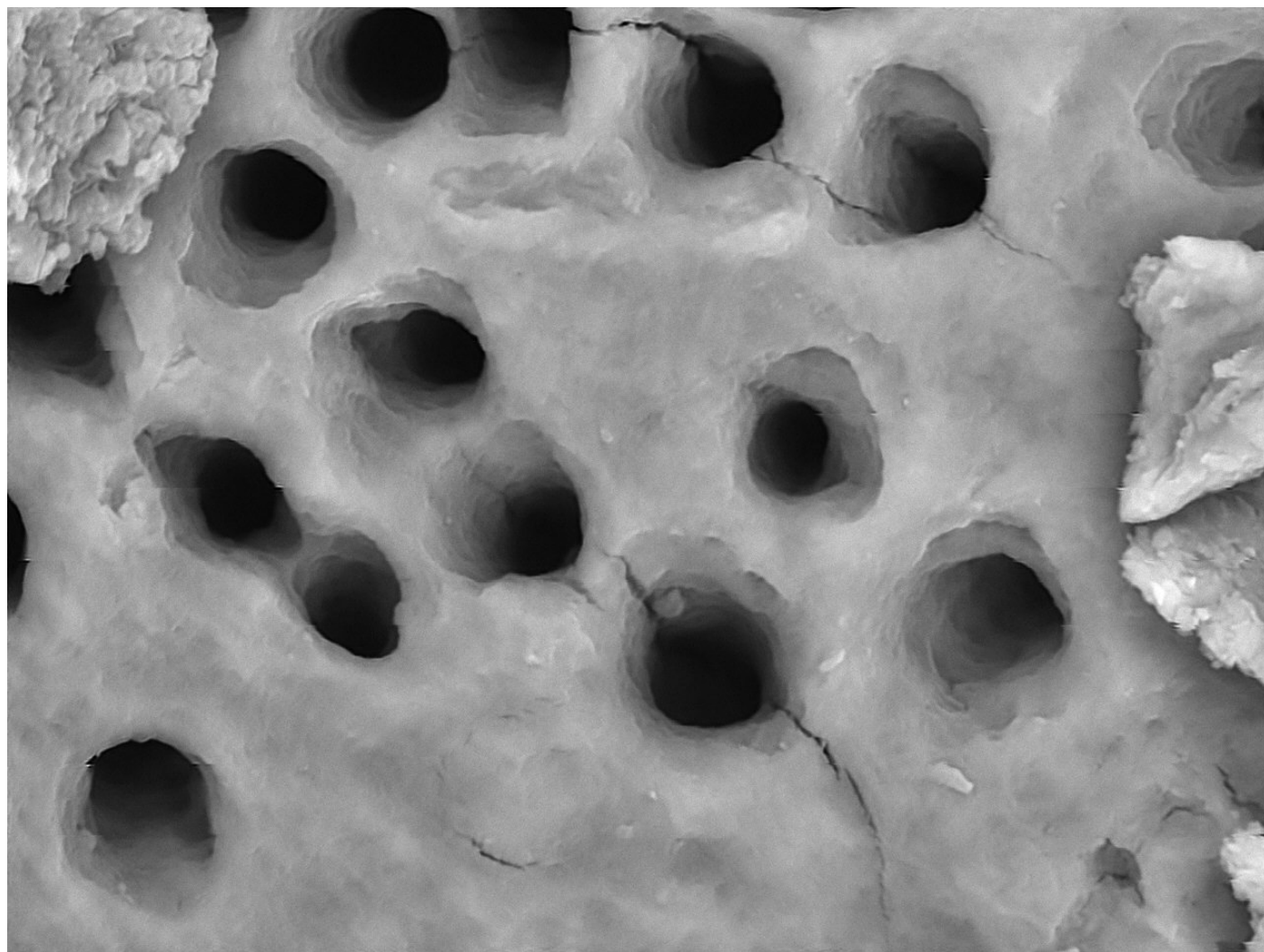
20 μm

83) image317

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image318

image318



29565-15

2017/02/28 15:31 N

x5.0k 20 μ m

84) image318

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image319

image319



29266-15

2017/03/04 14:33 N

x5.0k

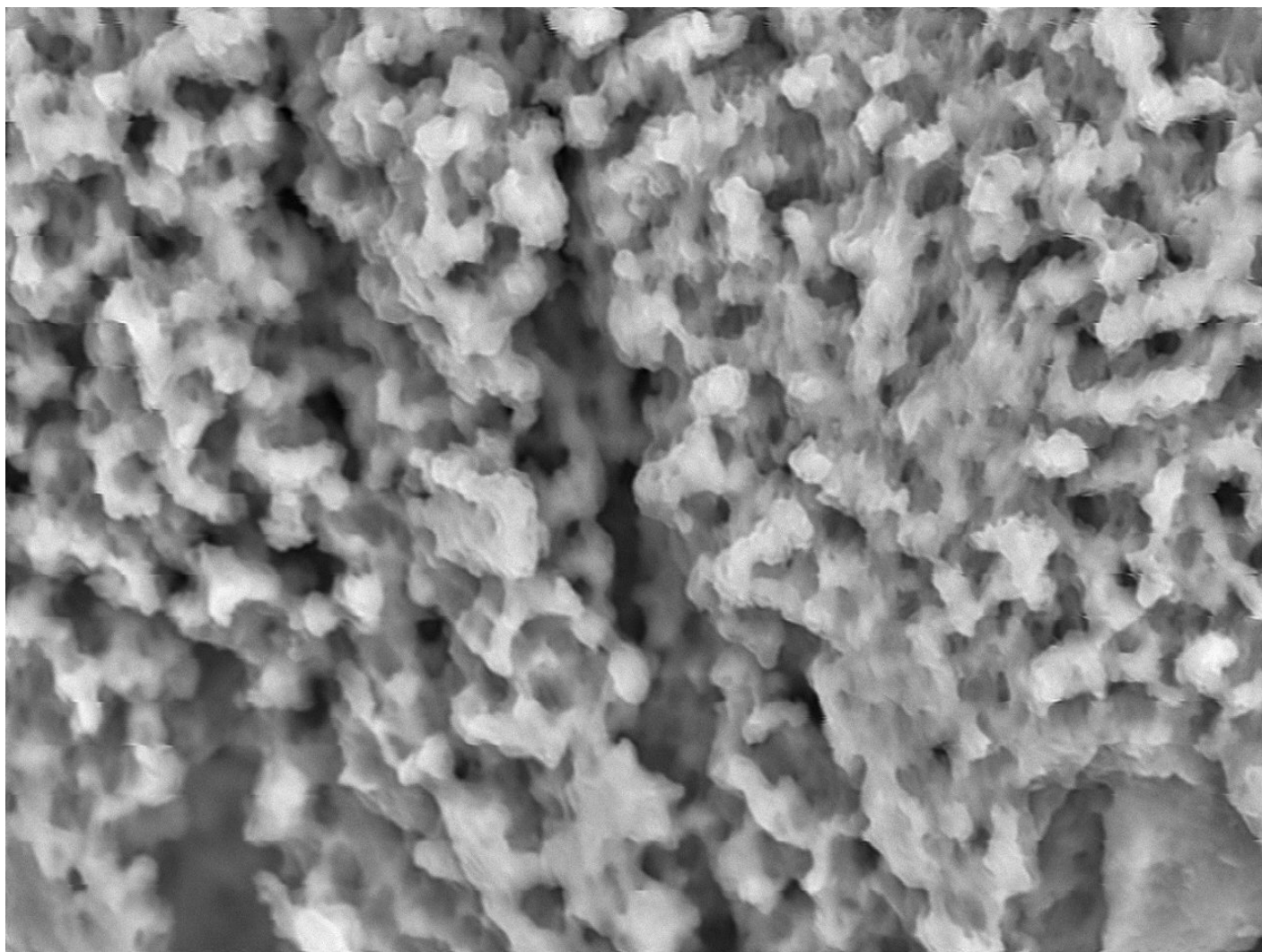
20 μm

85) image319

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image320

image320



29679-3

2017/02/27 16:14 N

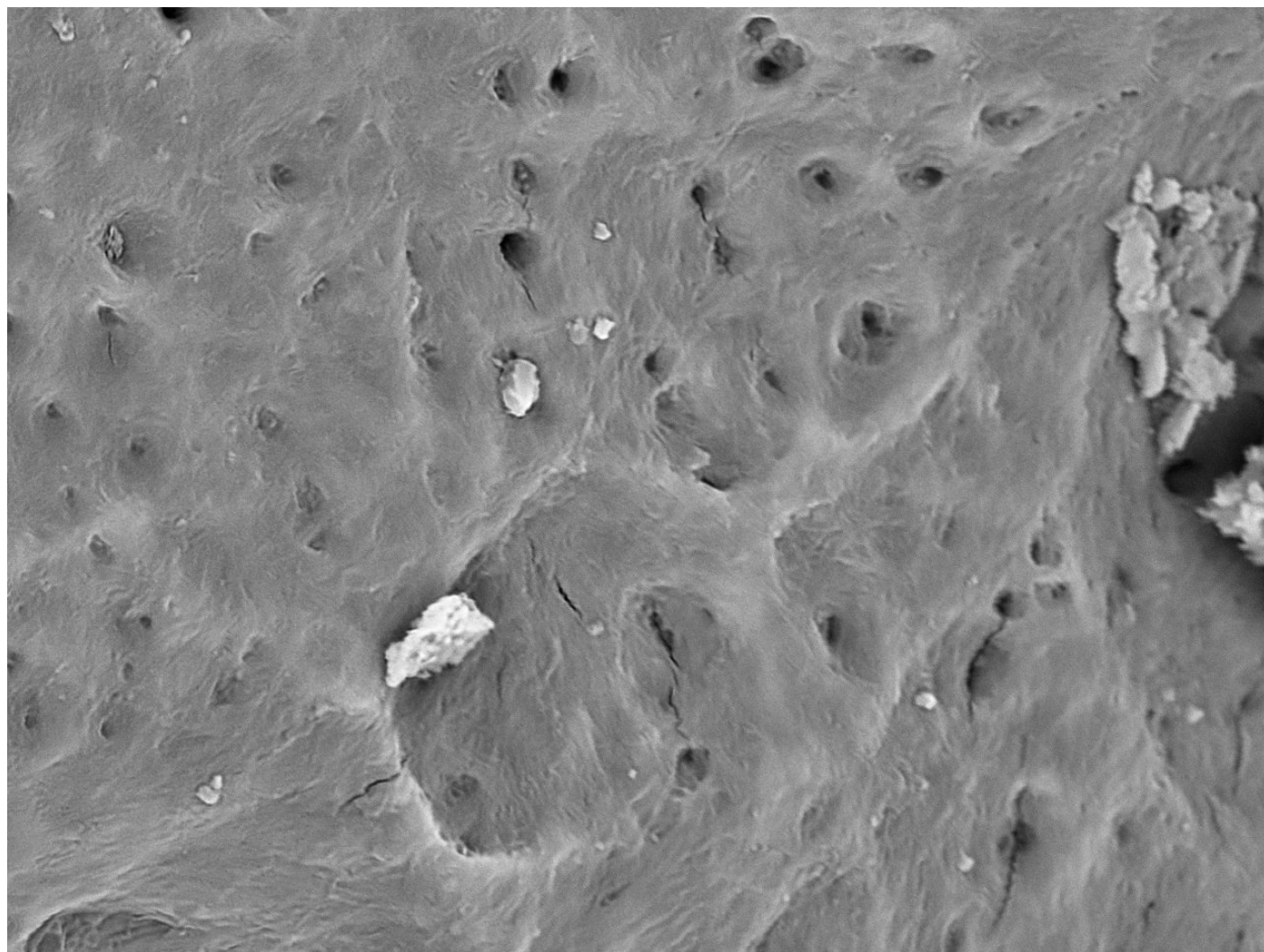
x5.0k 20 μm

86) image320

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image321

image321



29009-31

2017/03/06 10:07 N

x5.0k

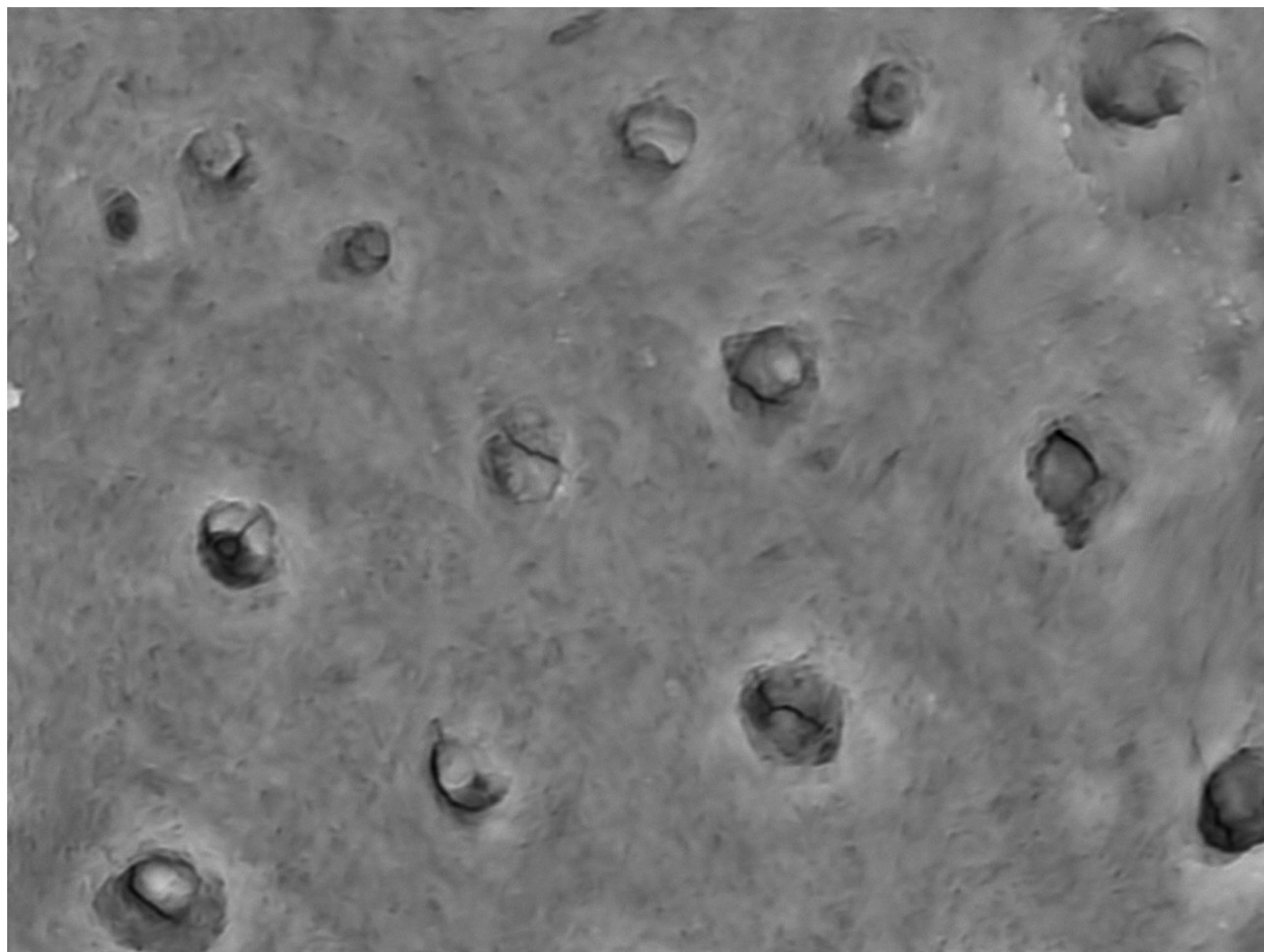
20 μm

87) image321

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image322

image322



29009-31

2017/03/08 14:59 H

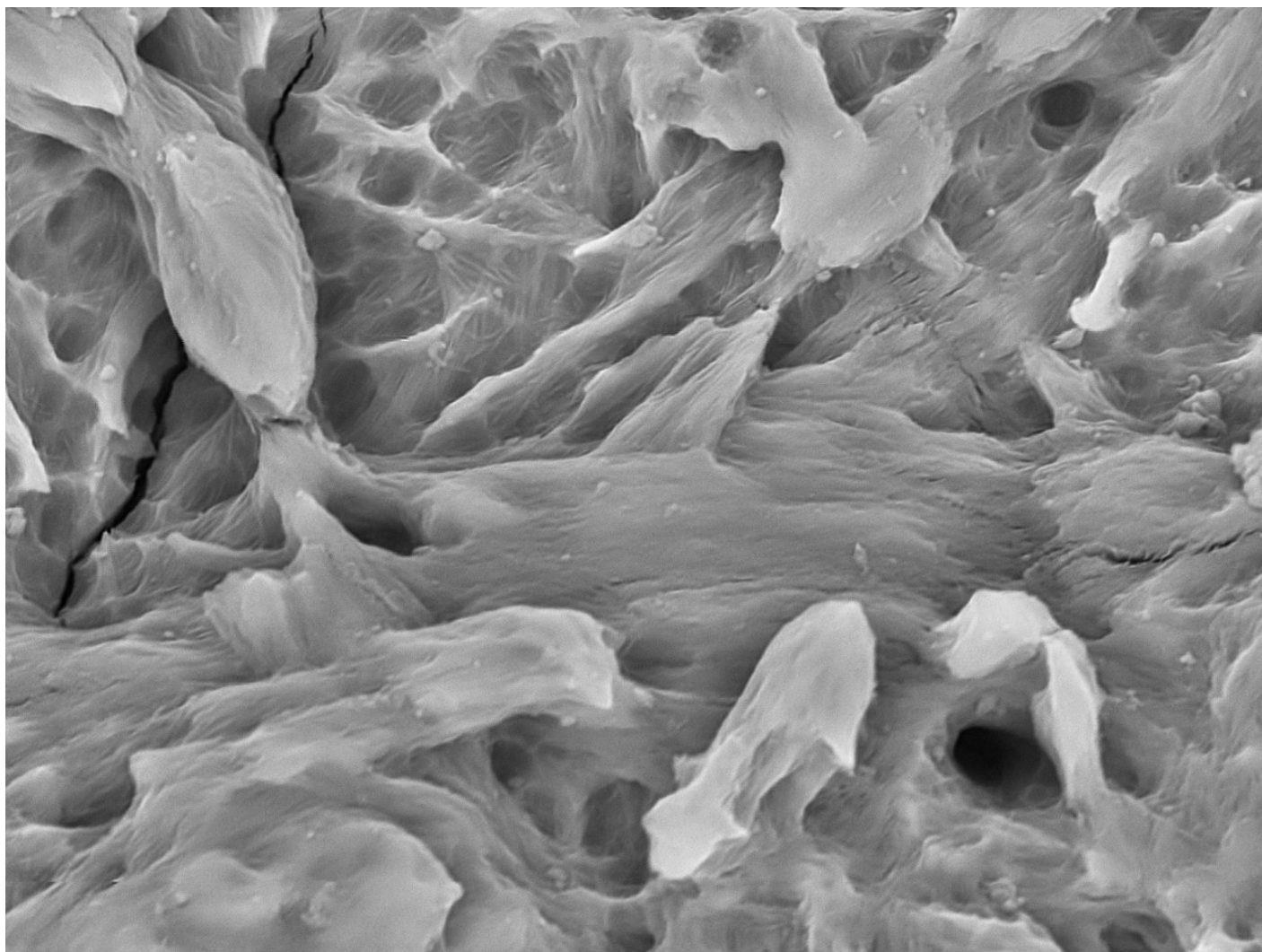
x5.0k 20 μ m

88) image322

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image323

image323



29679-3

2017/02/27 15:34 N

x5.0k

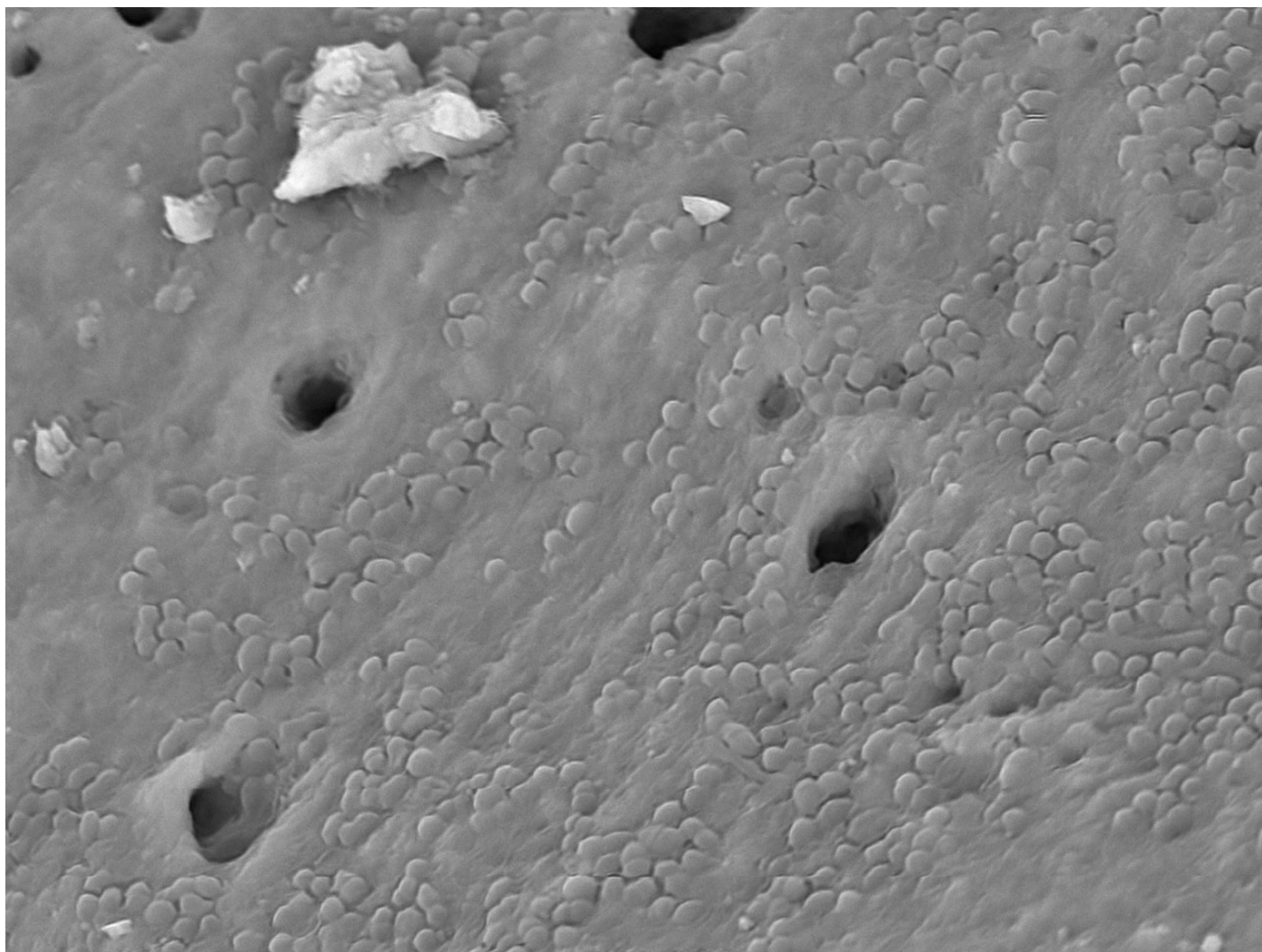
20 μm

89) image323

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image324

image324



29965-2

2017/03/02 15:22 N

x5.0k

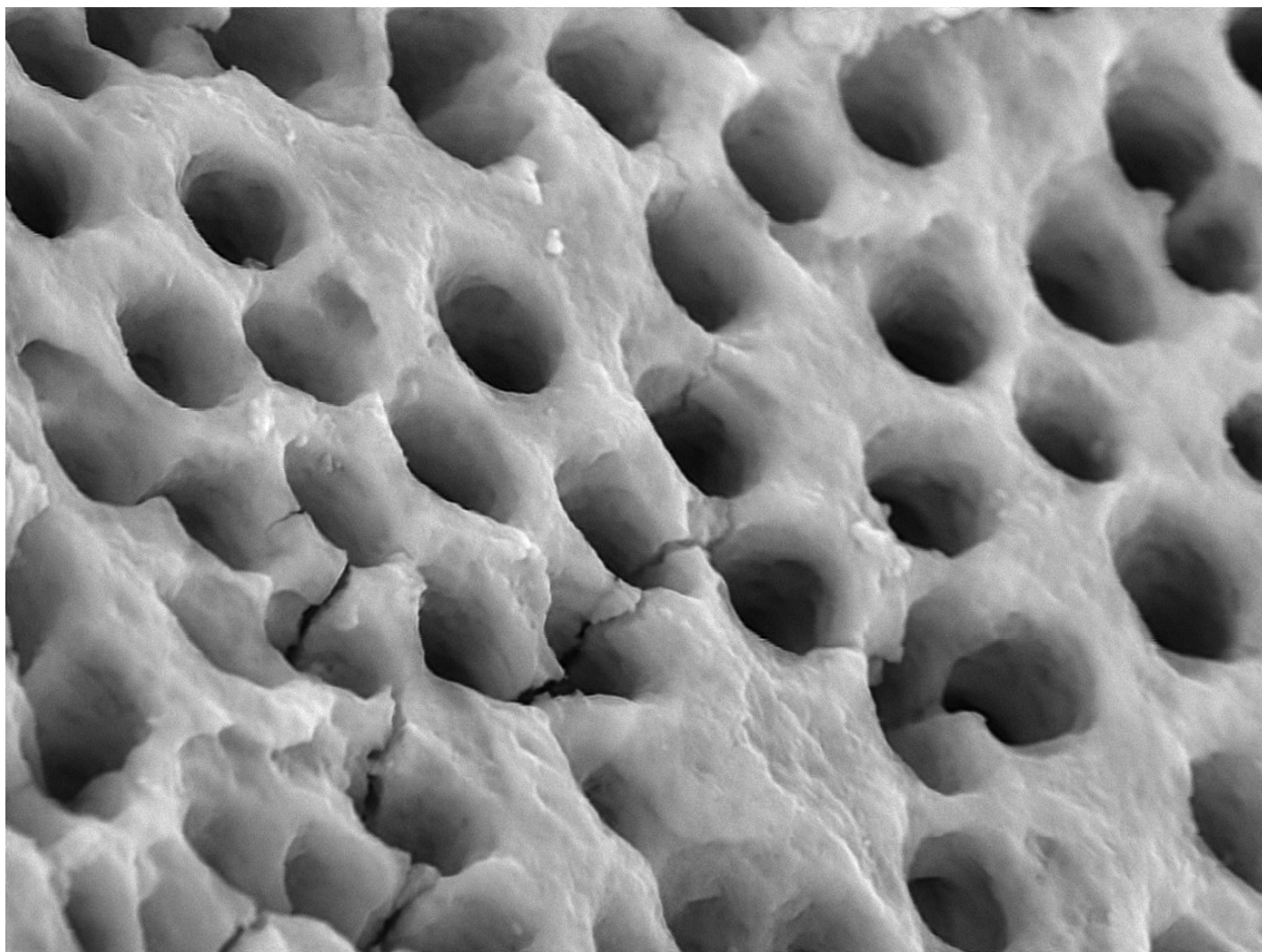
20 μm

90) image324

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image325

image325



29565-15

2017/02/28 15:30 N

x5.0k

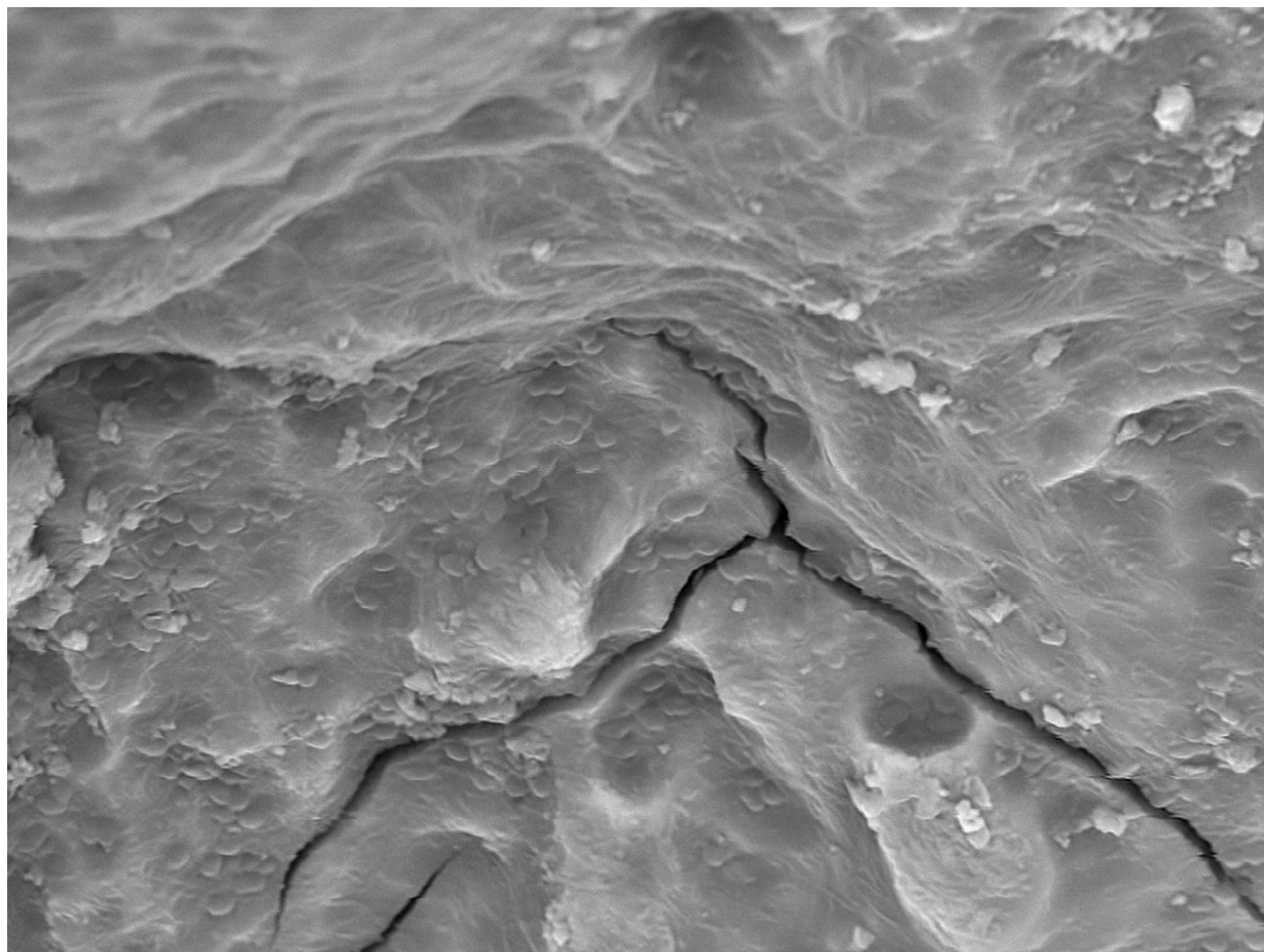
20 μ m

91) image325

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image326

image326



29052-14

2017/02/28 17:39 N

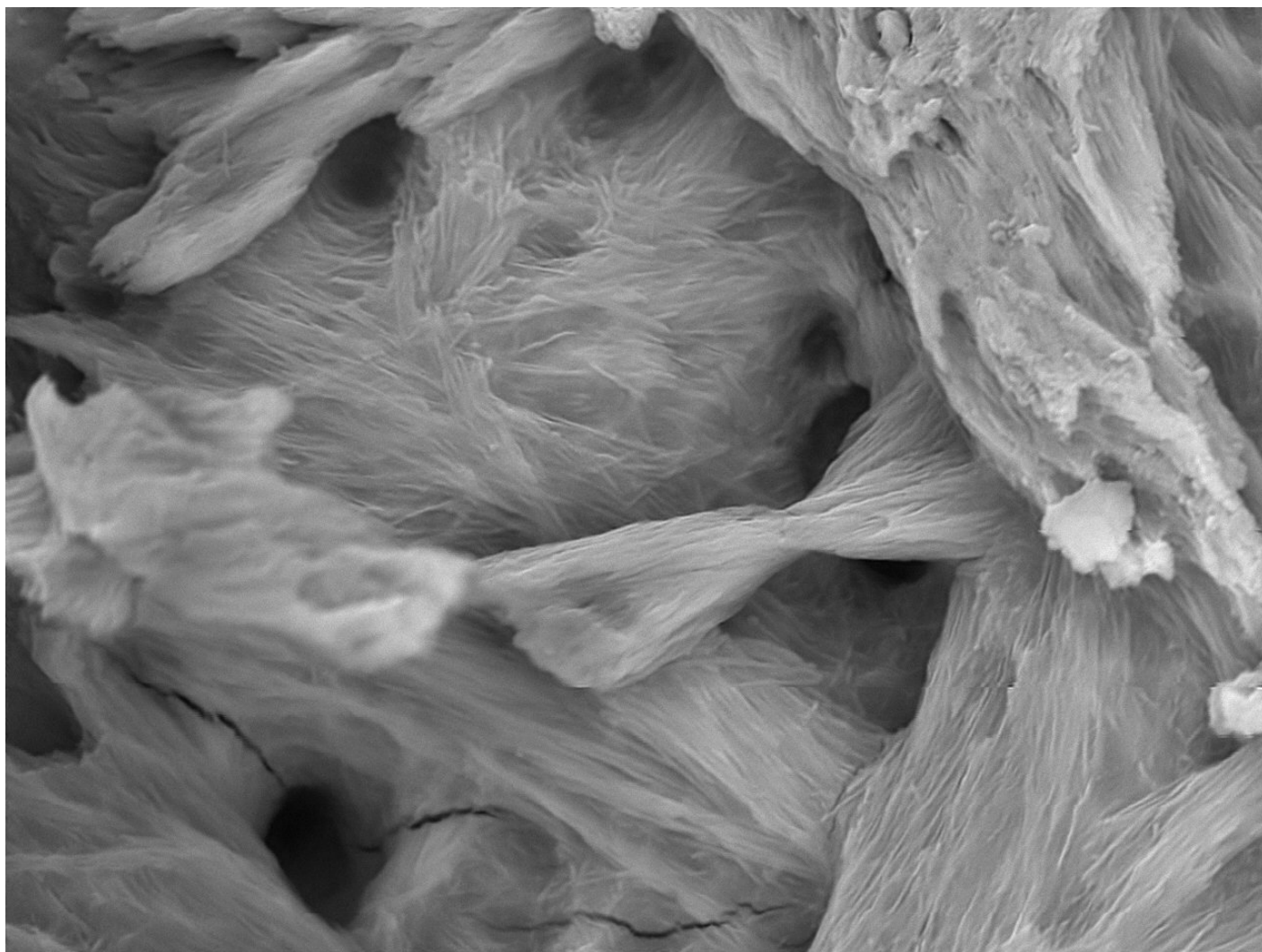
x5.0k 20 μ m

92) image326

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image327

image327



29052-14

2017/02/28 18:31 N

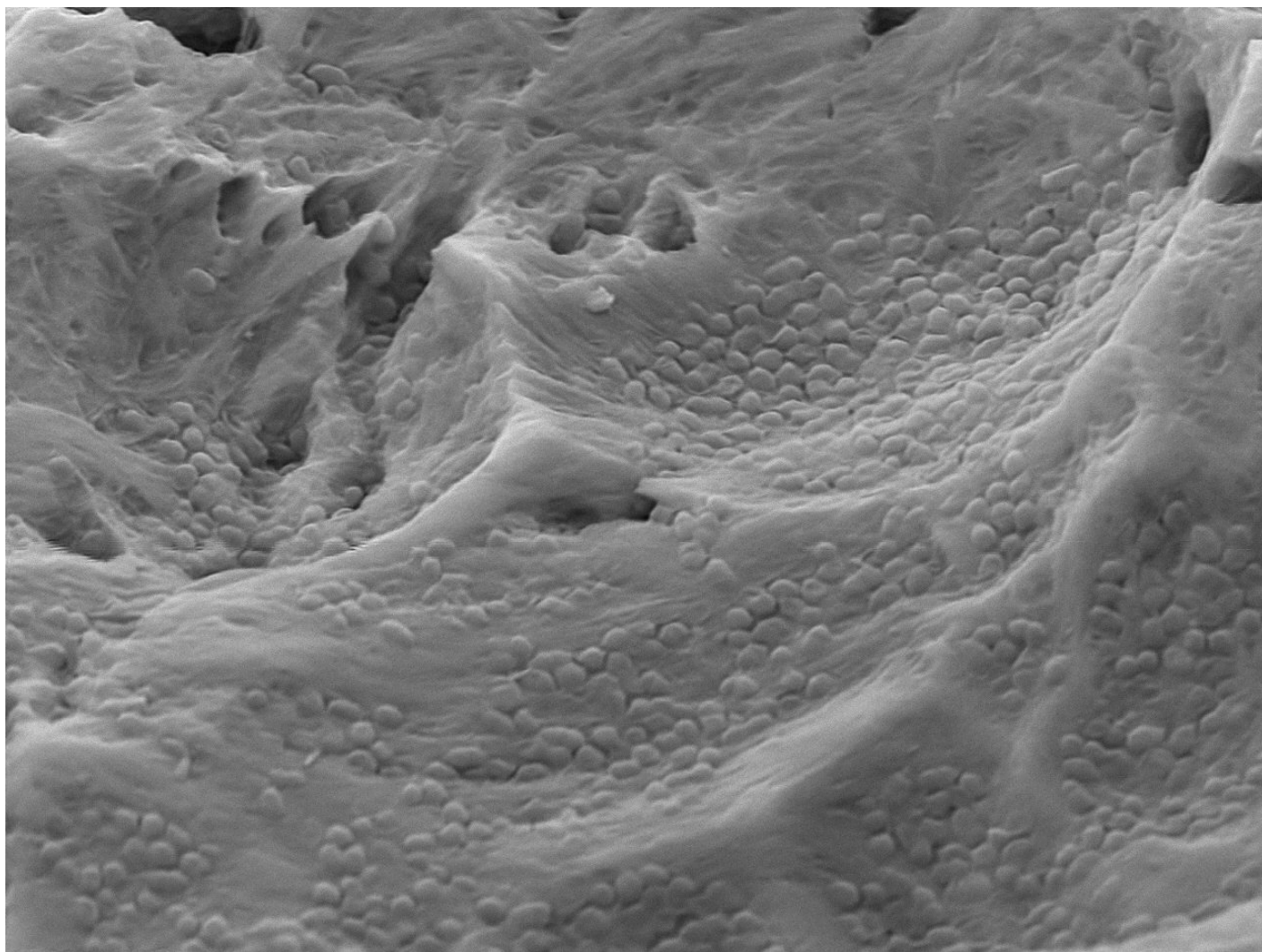
x5.0k 20 μm

93) image327

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image328

image328



29679-3

2017/02/27 10:04 N

x5.0k

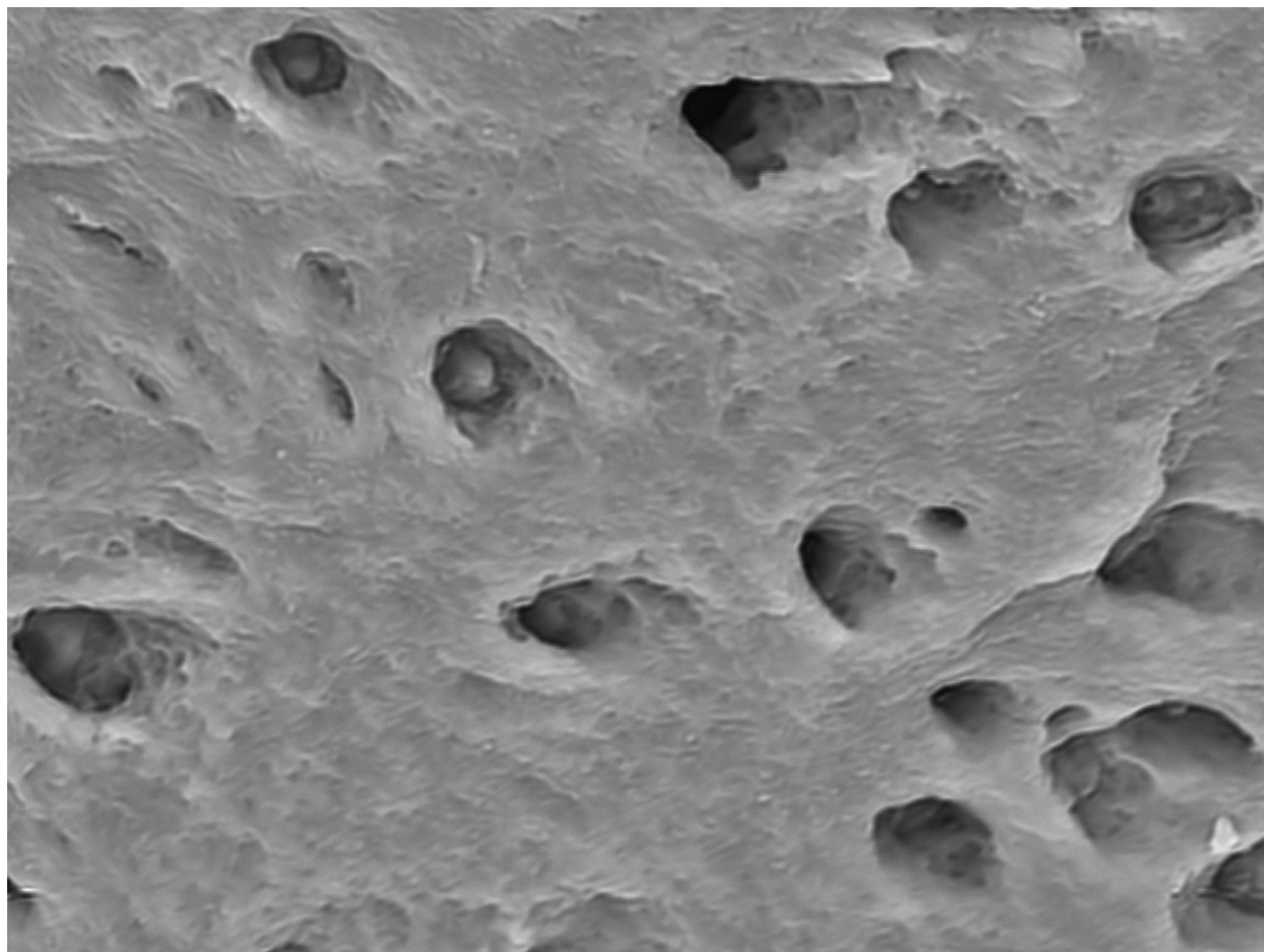
20 μ m

94) image328

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image329

image329



29009-31

2017/03/08 14:37 H

x5.0k

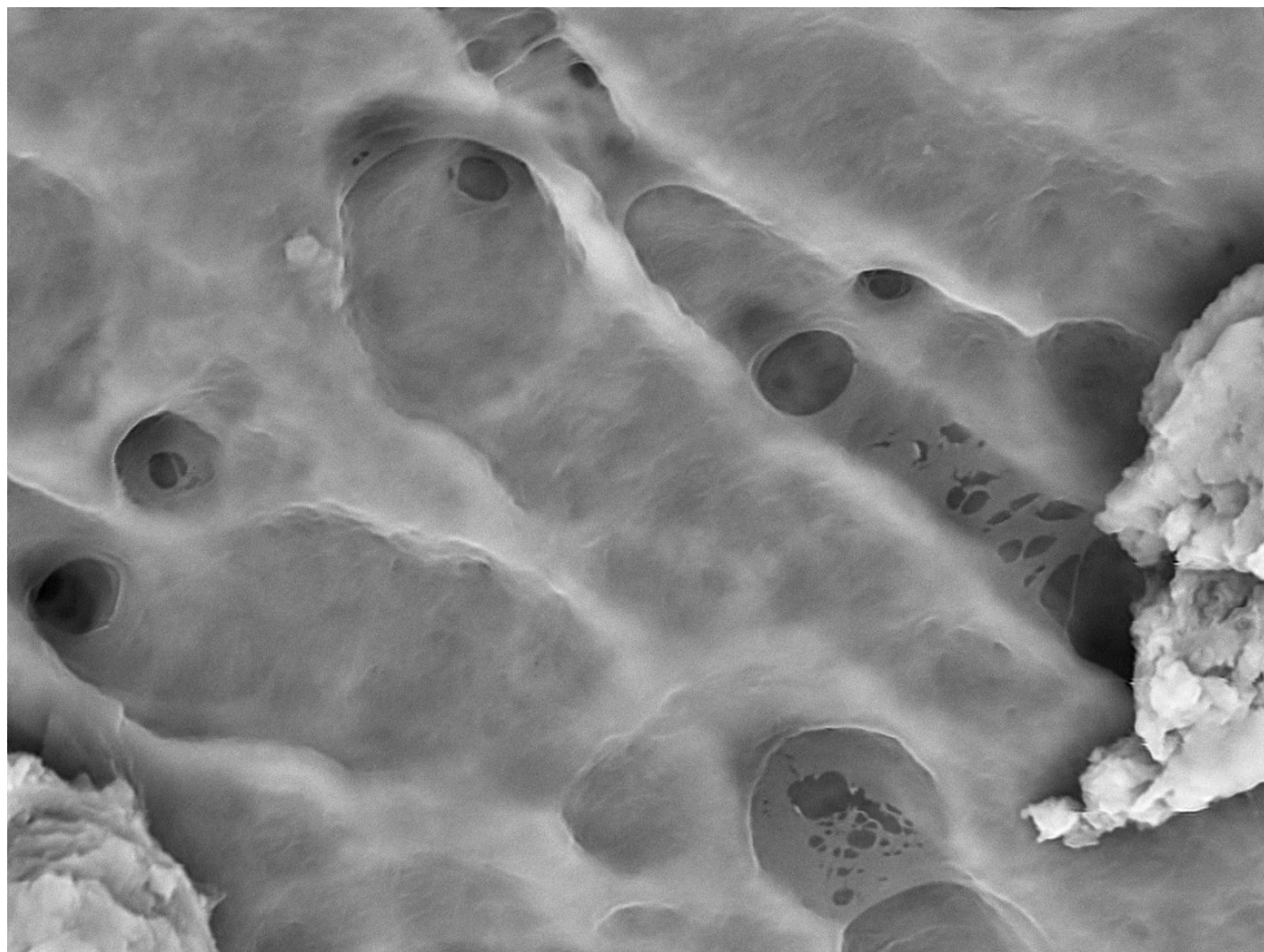
20 μm

95) image329

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image330

image330



29961-2

2017/03/01 14:55 N

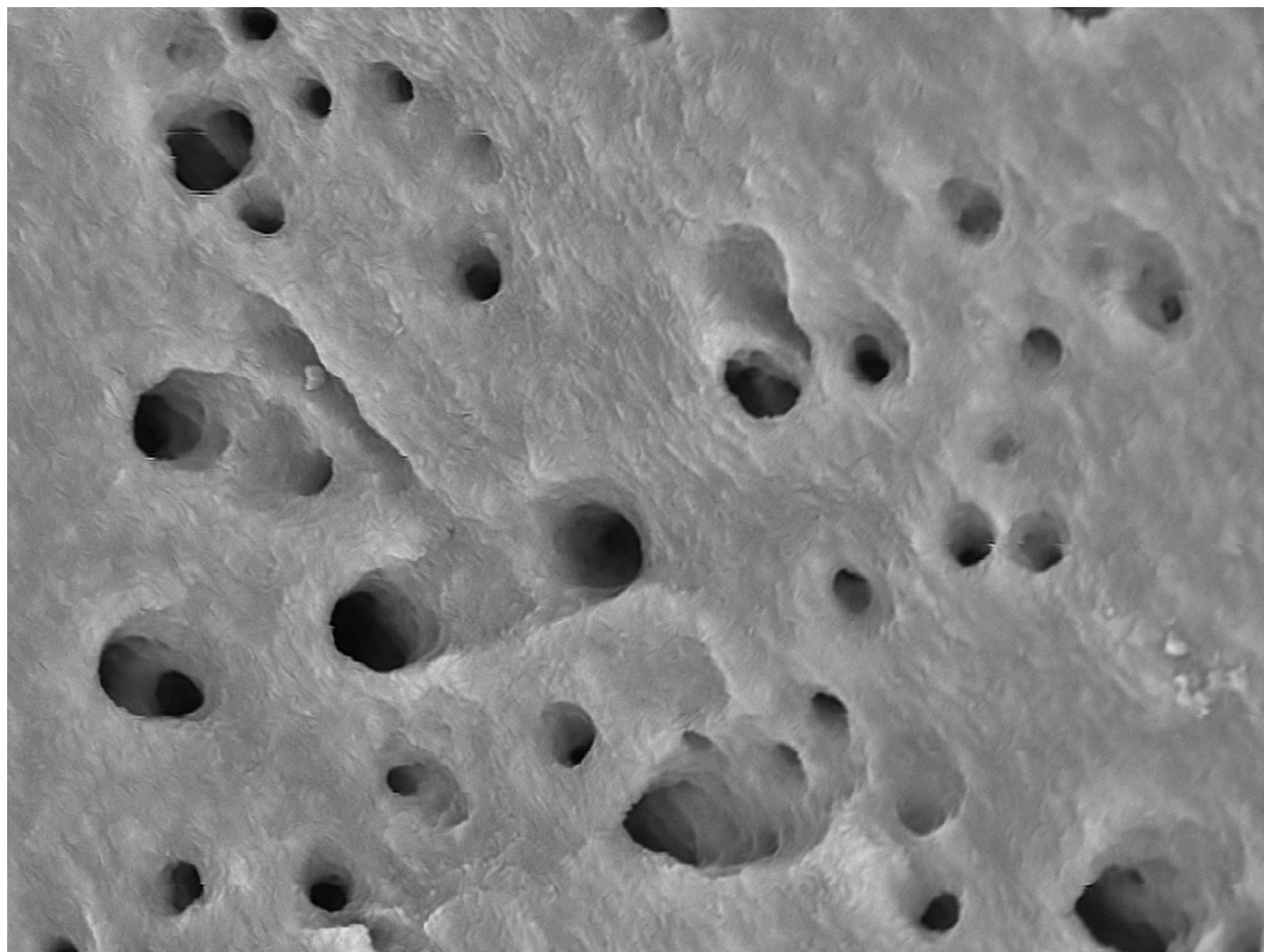
x5.0k 20 μ m

96) image330

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image331

image331



29576-18

2017/03/01 11:45 N

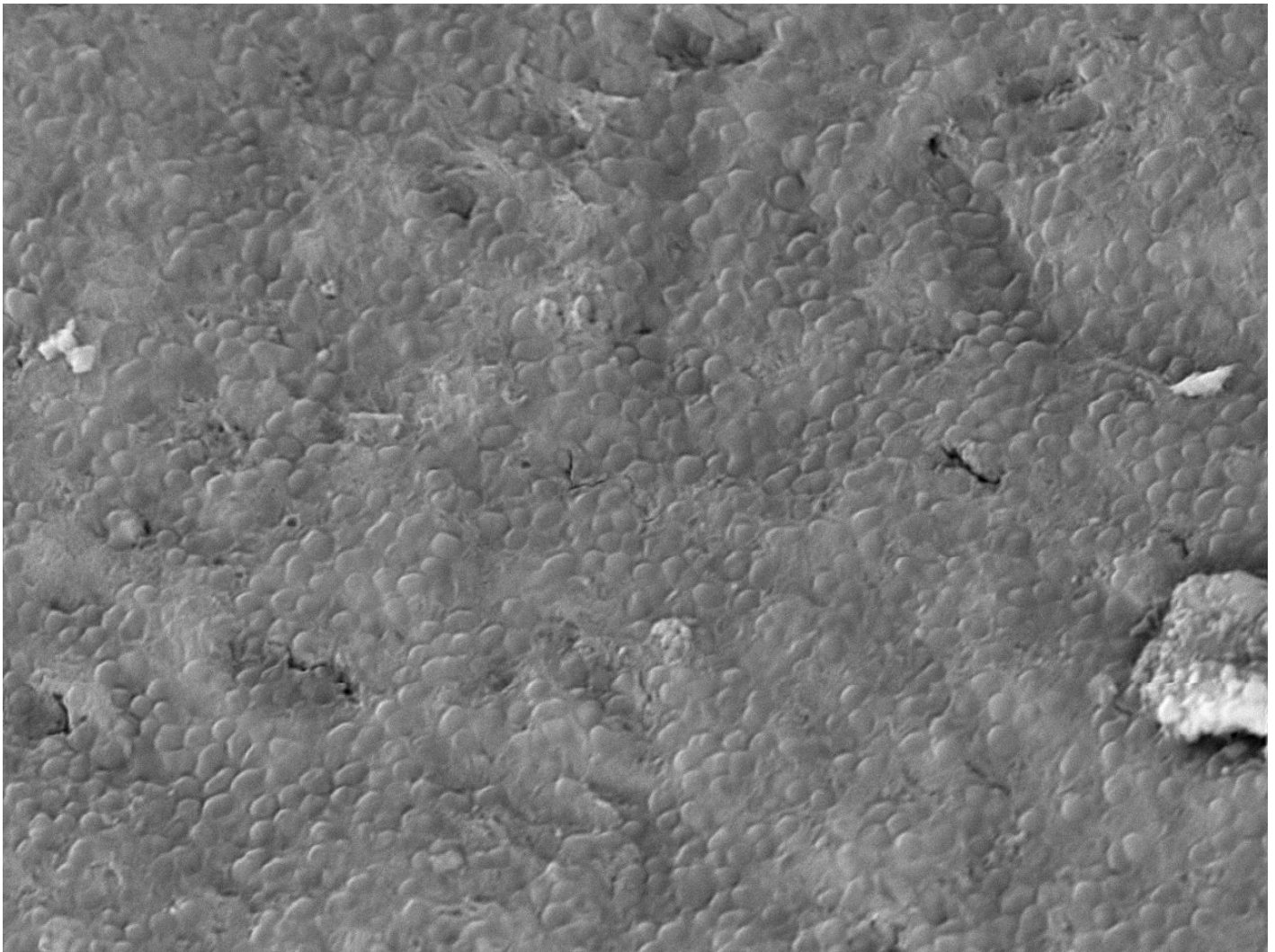
x5.0k 20 μm

97) image331

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image332

image332



29266-15

2017/03/04 14:38 N

x5.0k

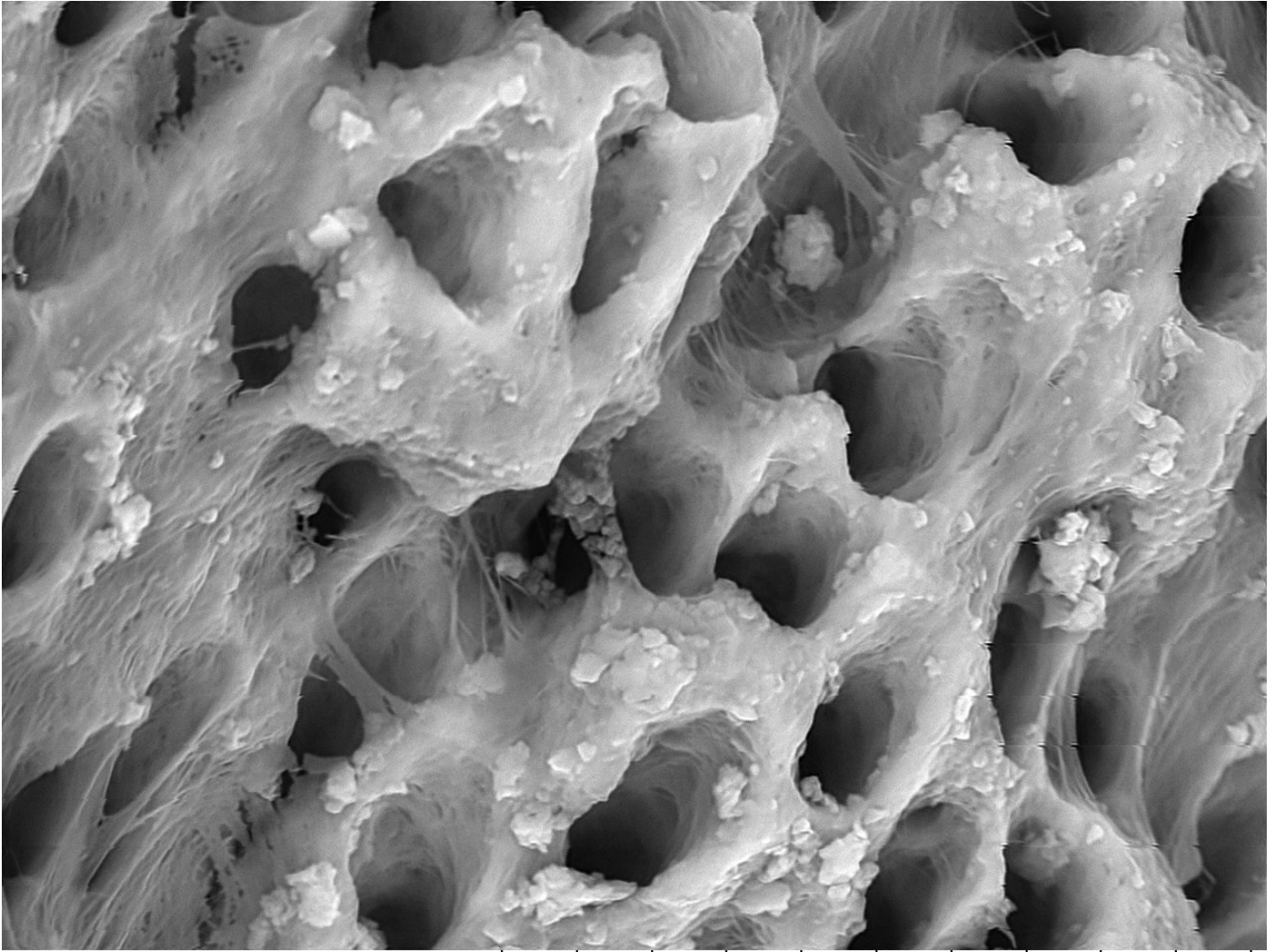
20 μ m

98) image332

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image333

image333



29694-2

2017/02/28 16:12 N

x5.0k

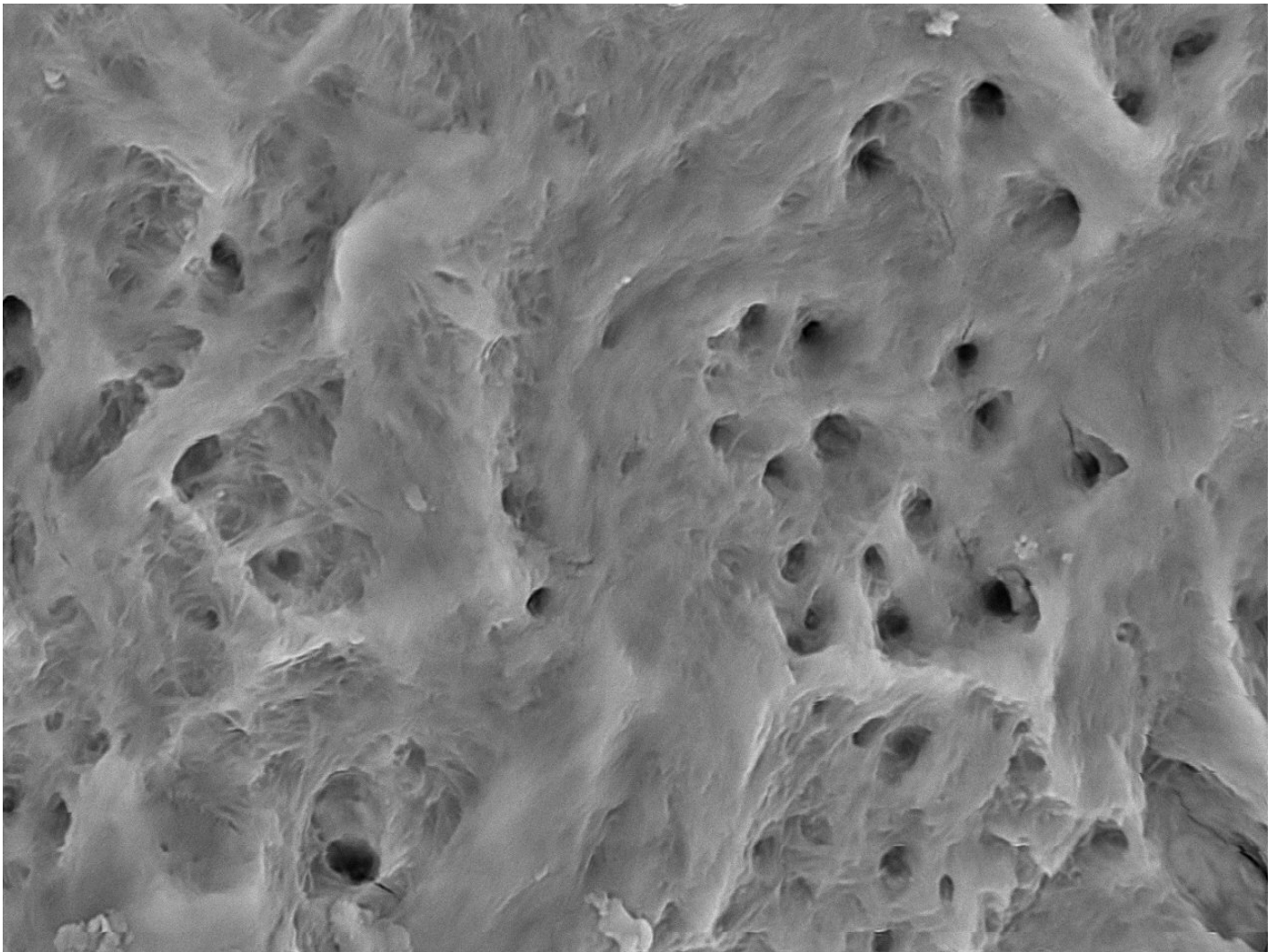
20 μm

99) image333

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image334

image334



29009-31

2017/03/06 10:14 N

x5.0k

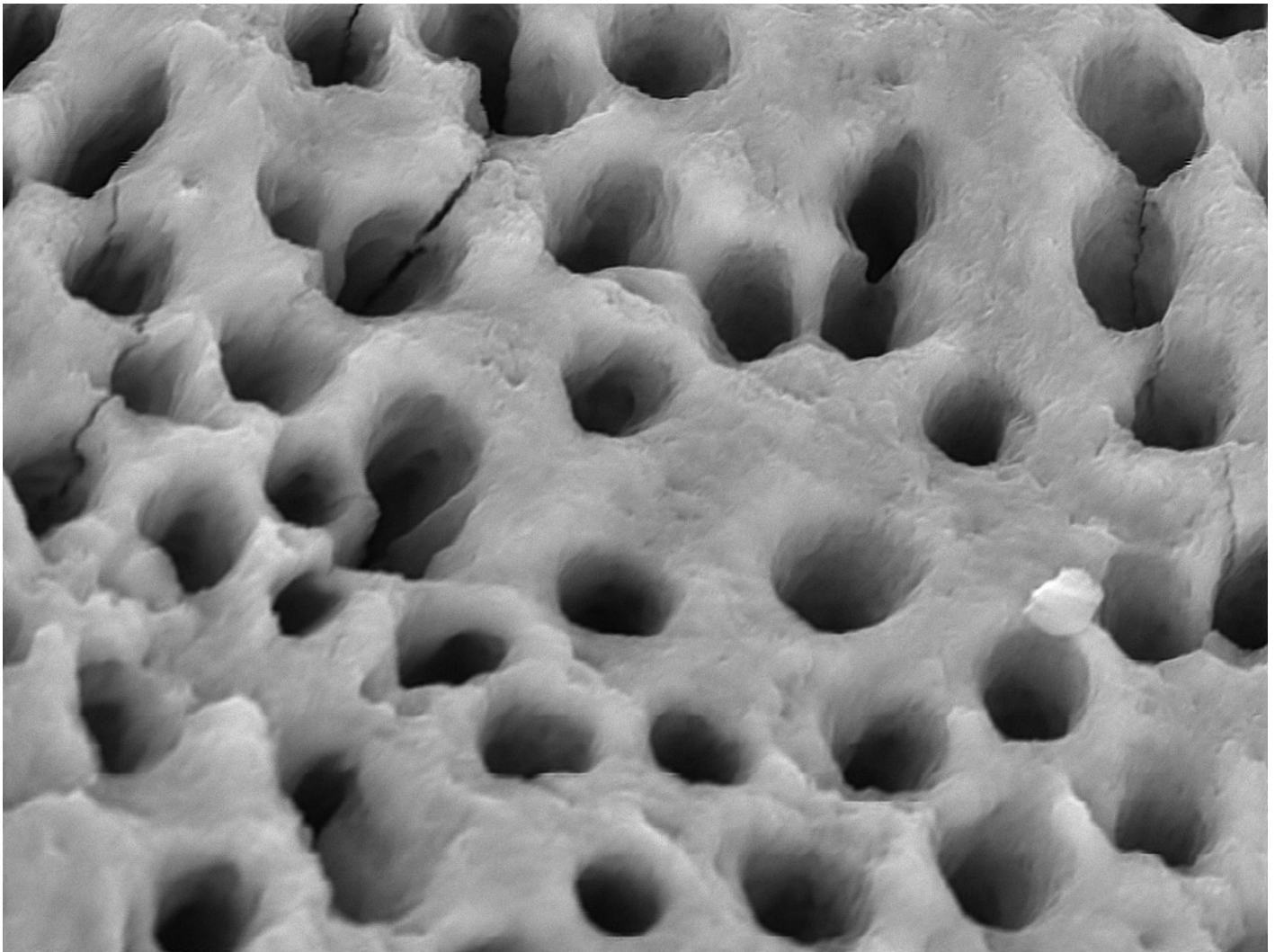
20 μ m

100) image334

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image335

image335



29340-18

2017/03/03 09:43 N

x5.0k

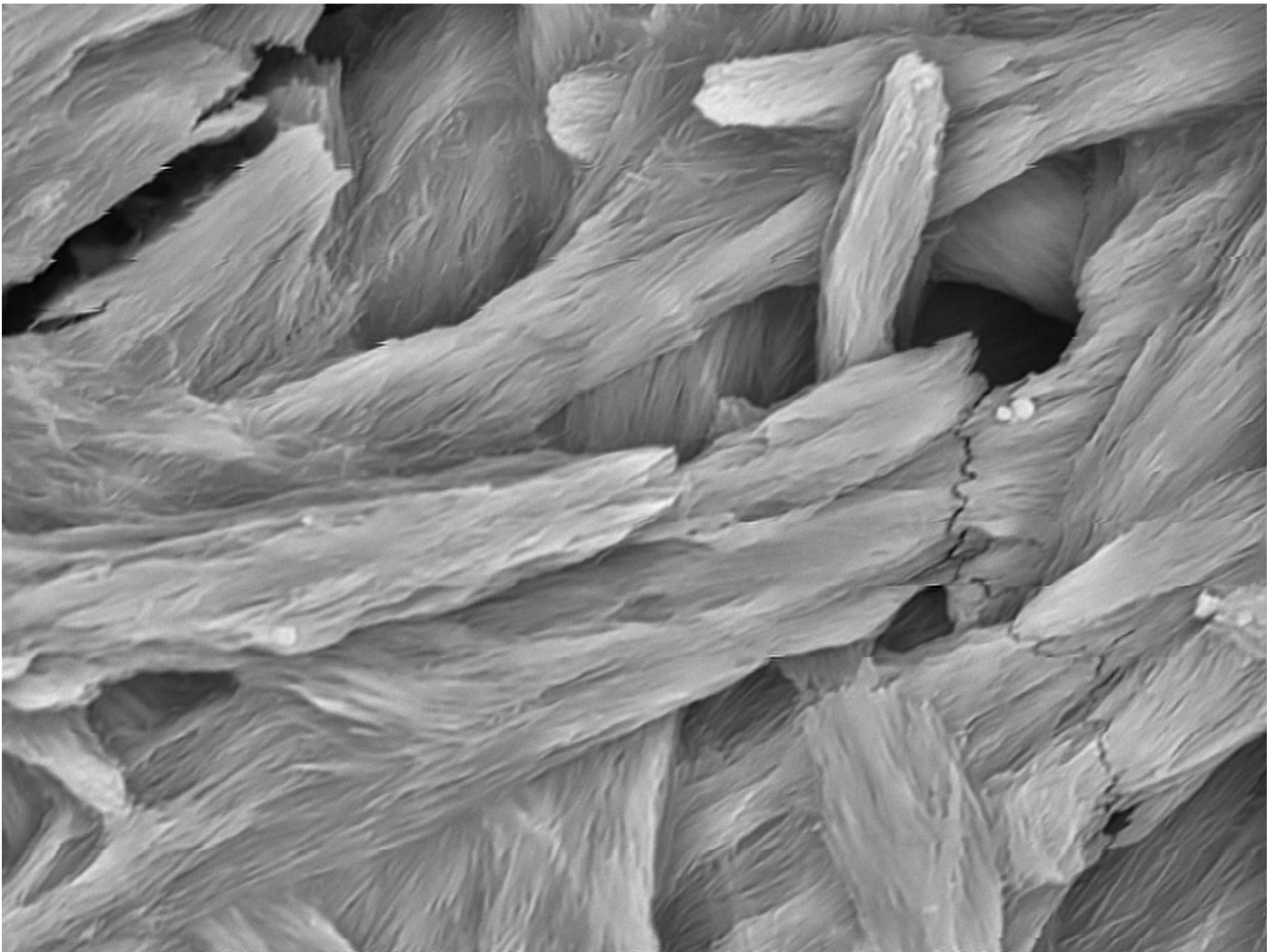
20 µm

101) image335

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image336

image336



29052-14

2017/02/28 18:15 N

x5.0k

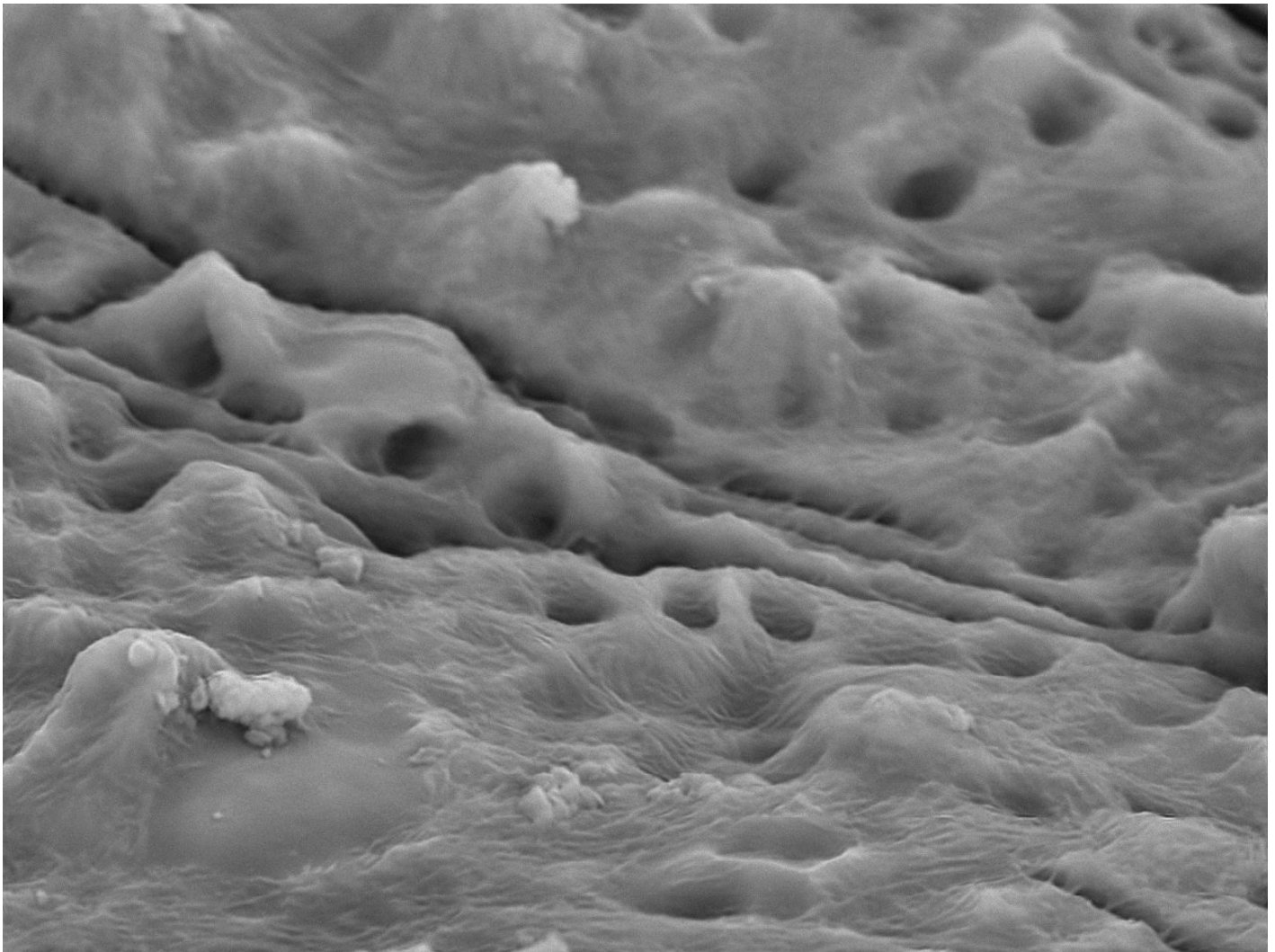
20 μ m

102) image336

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image337

image337



29961-2

2017/03/01 14:33 N

x5.0k

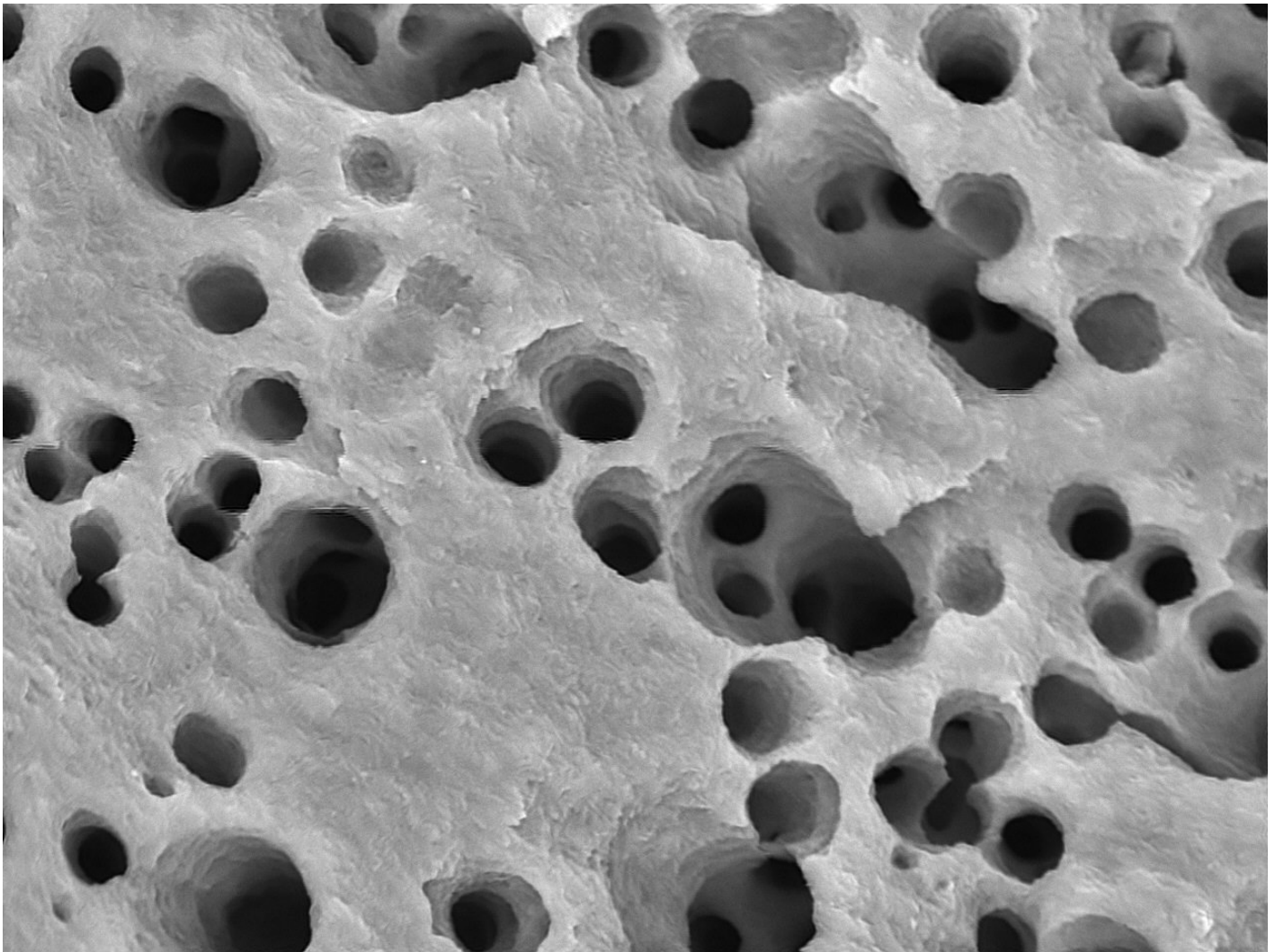
20 μ m

103) image337

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image338

image338



29211-18

2017/03/04 13:56 N

x5.0k

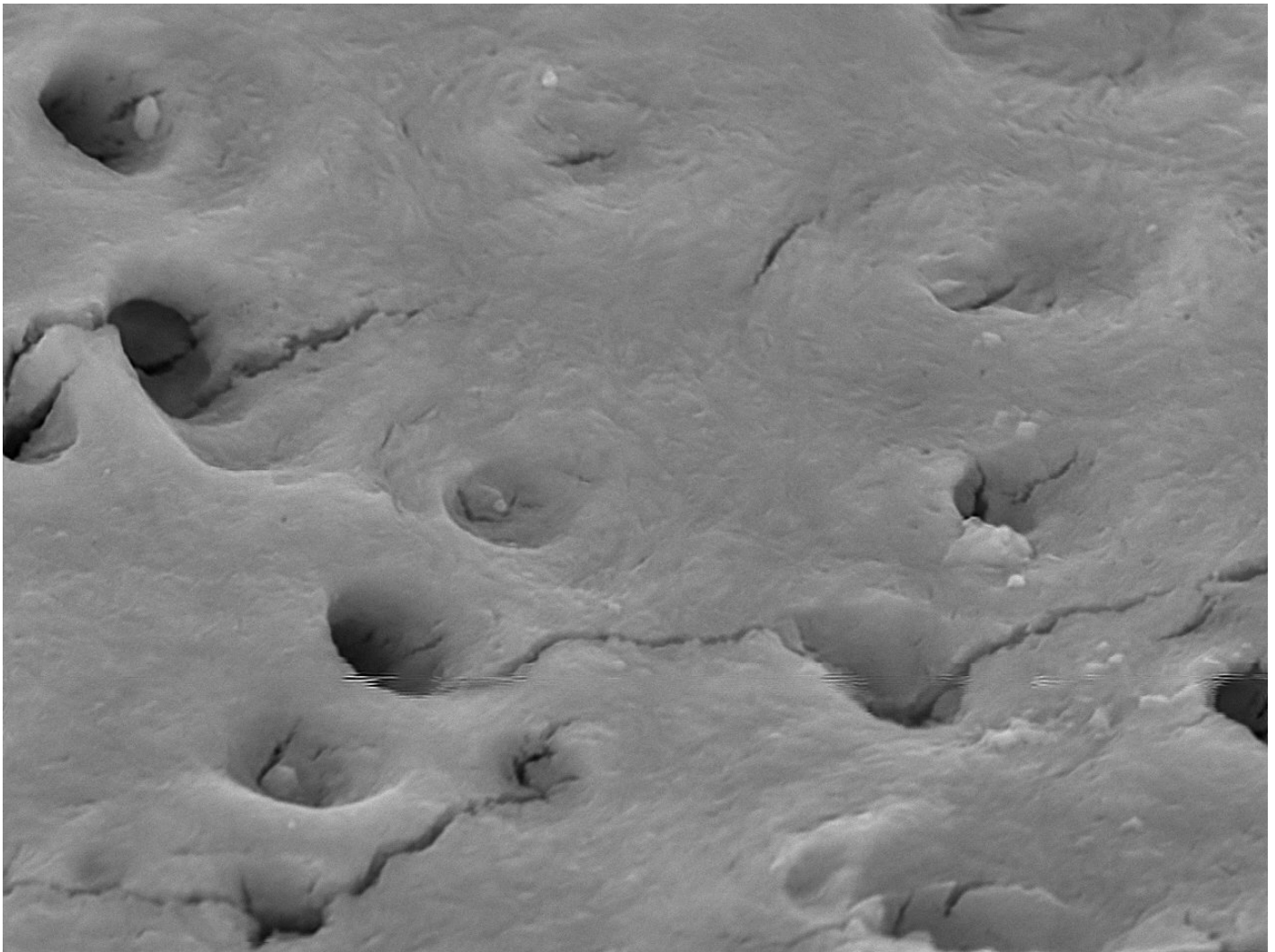
20 μ m

104) image338

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image339

image339



29179-3

2017/03/03 14:30 N

x5.0k

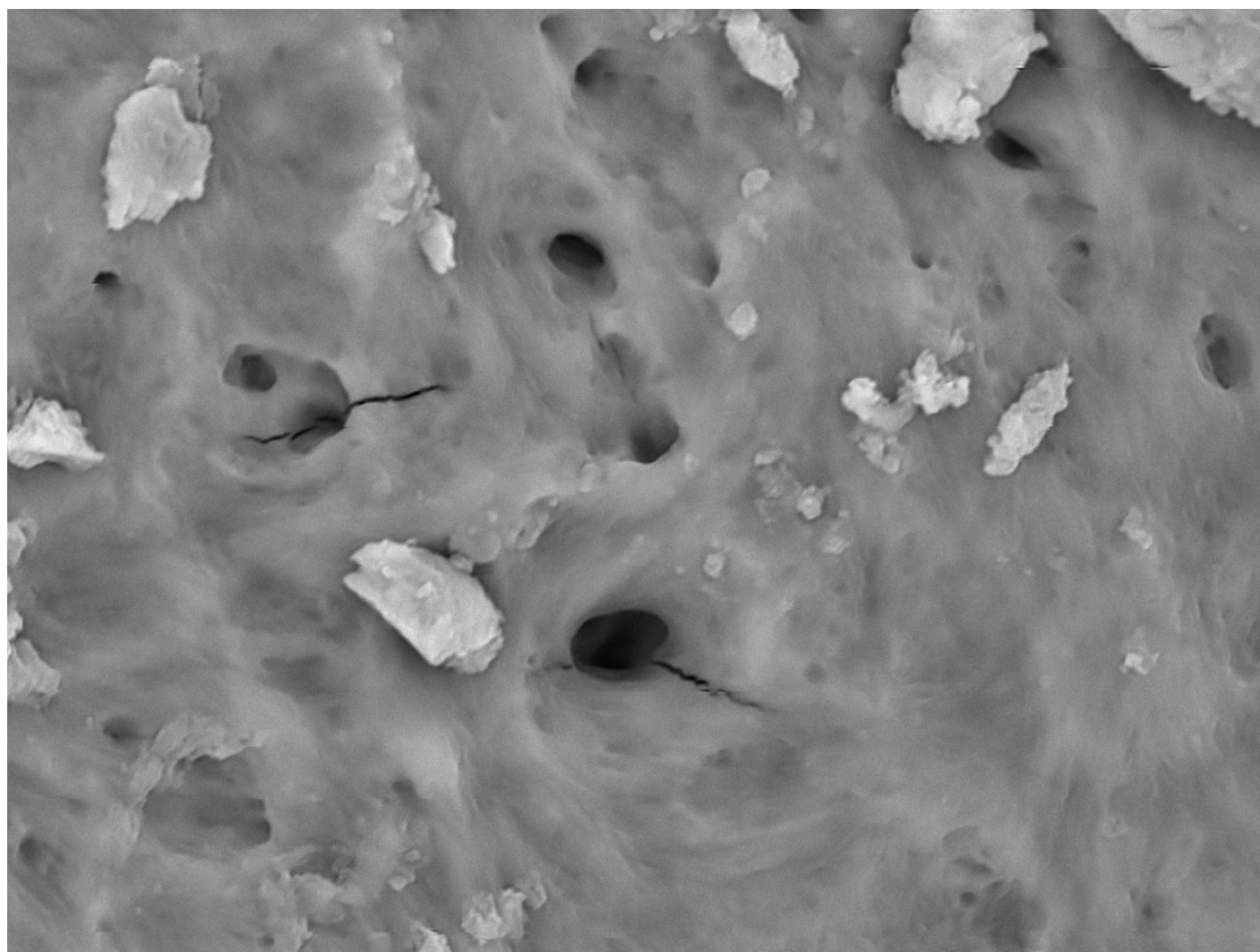
20 μ m

105) image339

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image340

image340



29961-2

2017/03/01 14:36 N

x5.0k

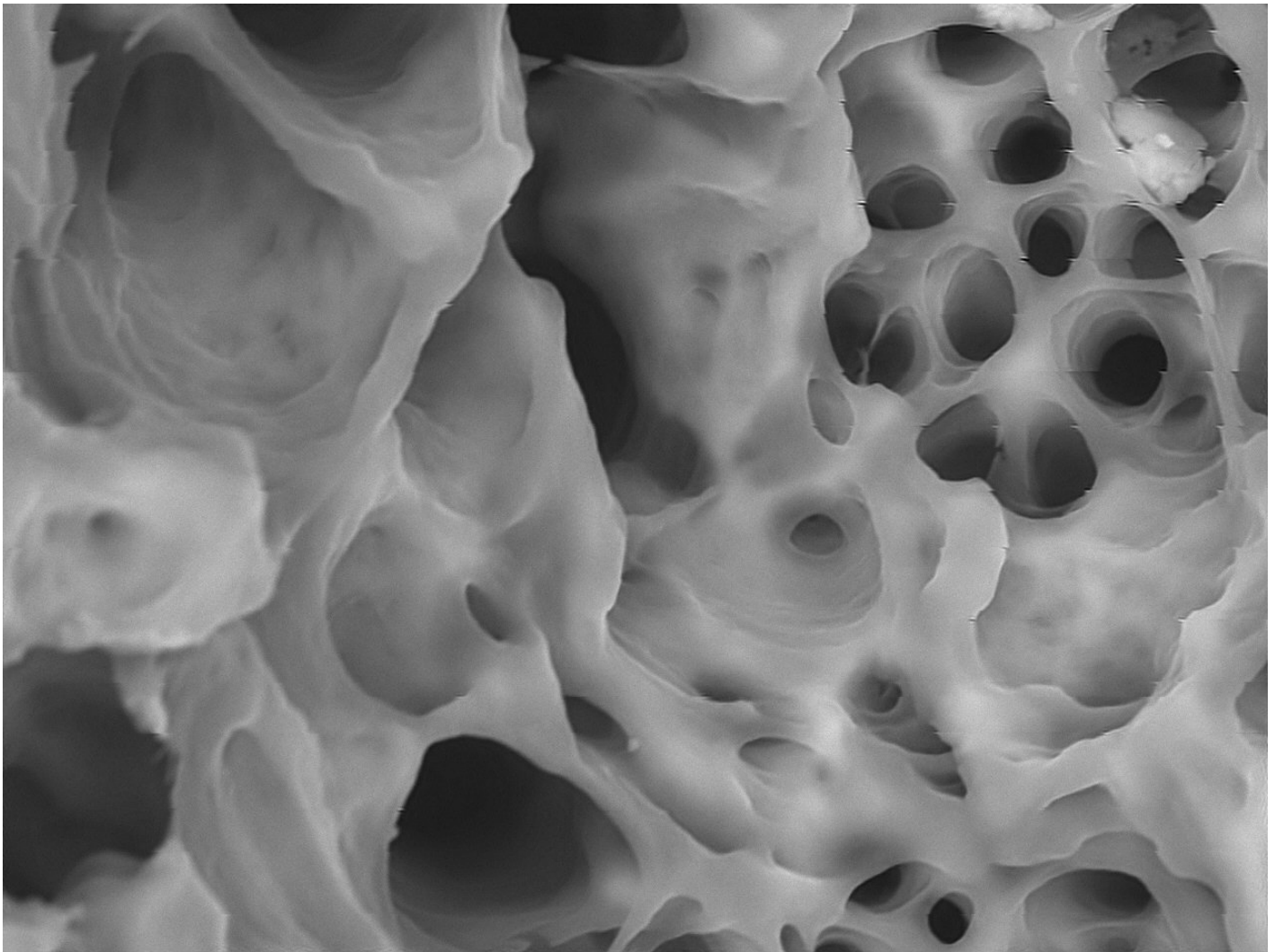
20 μ m

106) image340

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image341

image341



29960-14

2017/03/01 10:38 N

x5.0k

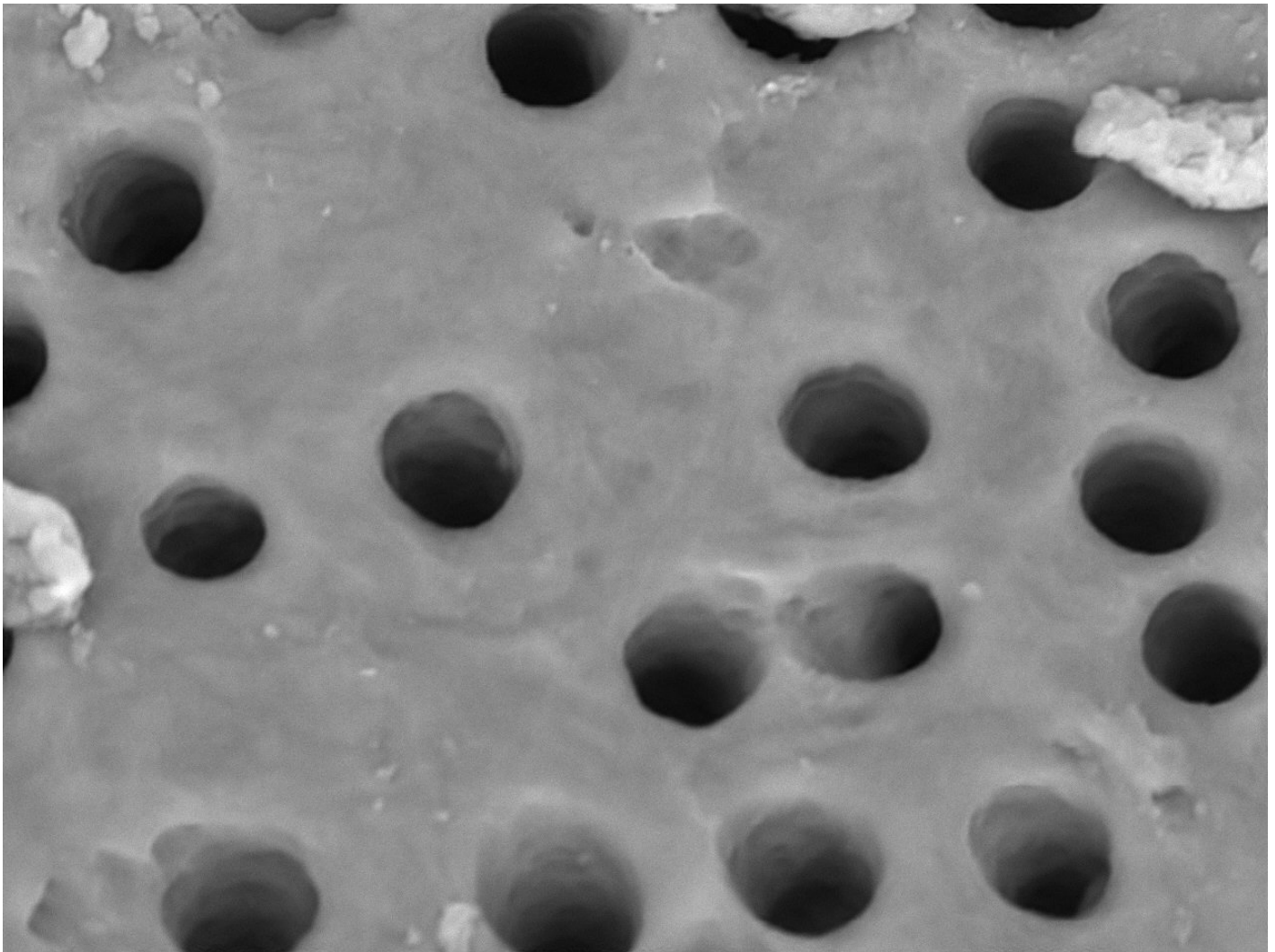
20 μm

107) image341

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image342

image342



29265-2

2017/02/27 11:25 N

x5.0k

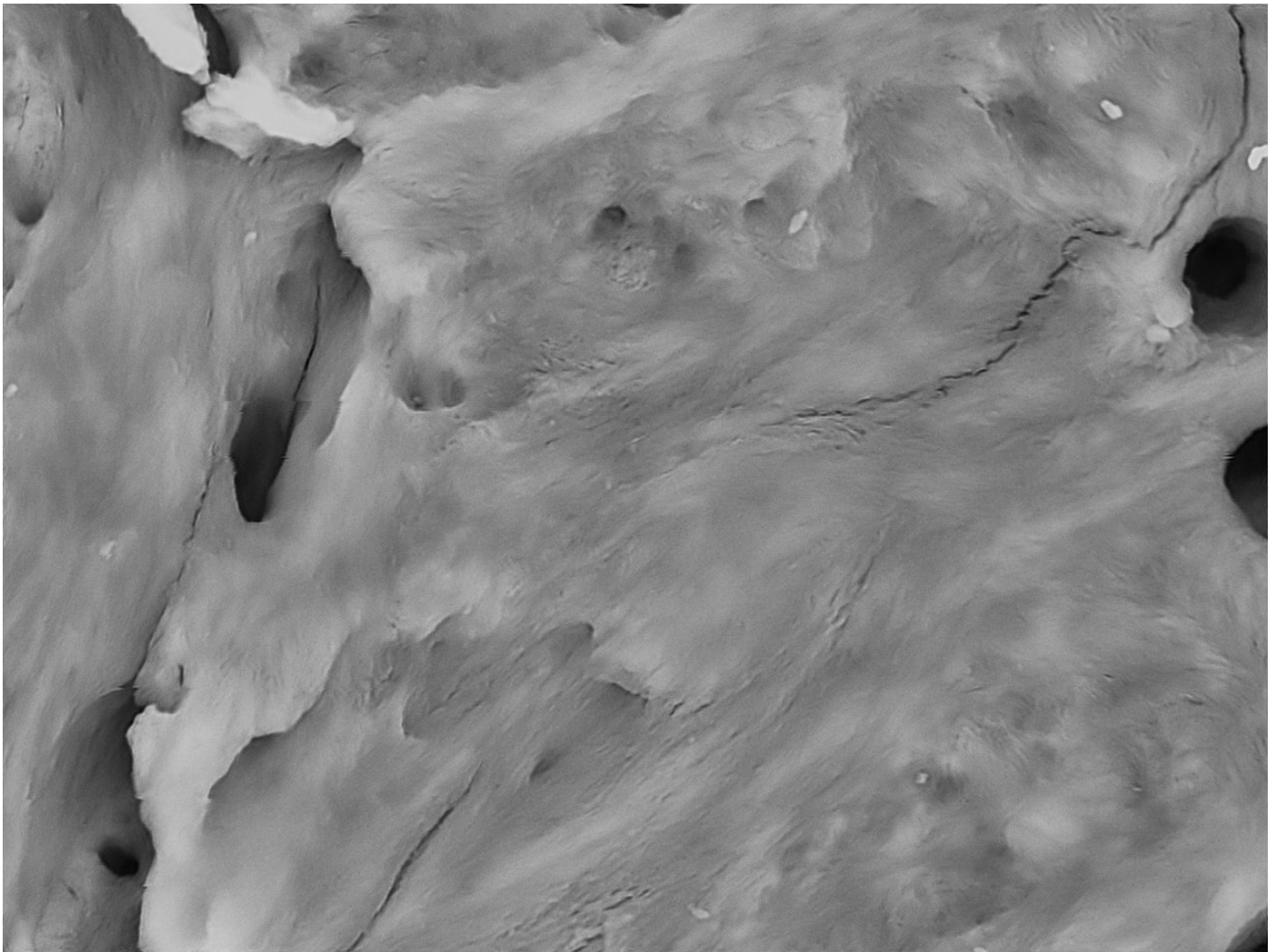
20 μ m

108) image342

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image343

image343



29576-18

2017/03/01 12:05 N

x5.0k

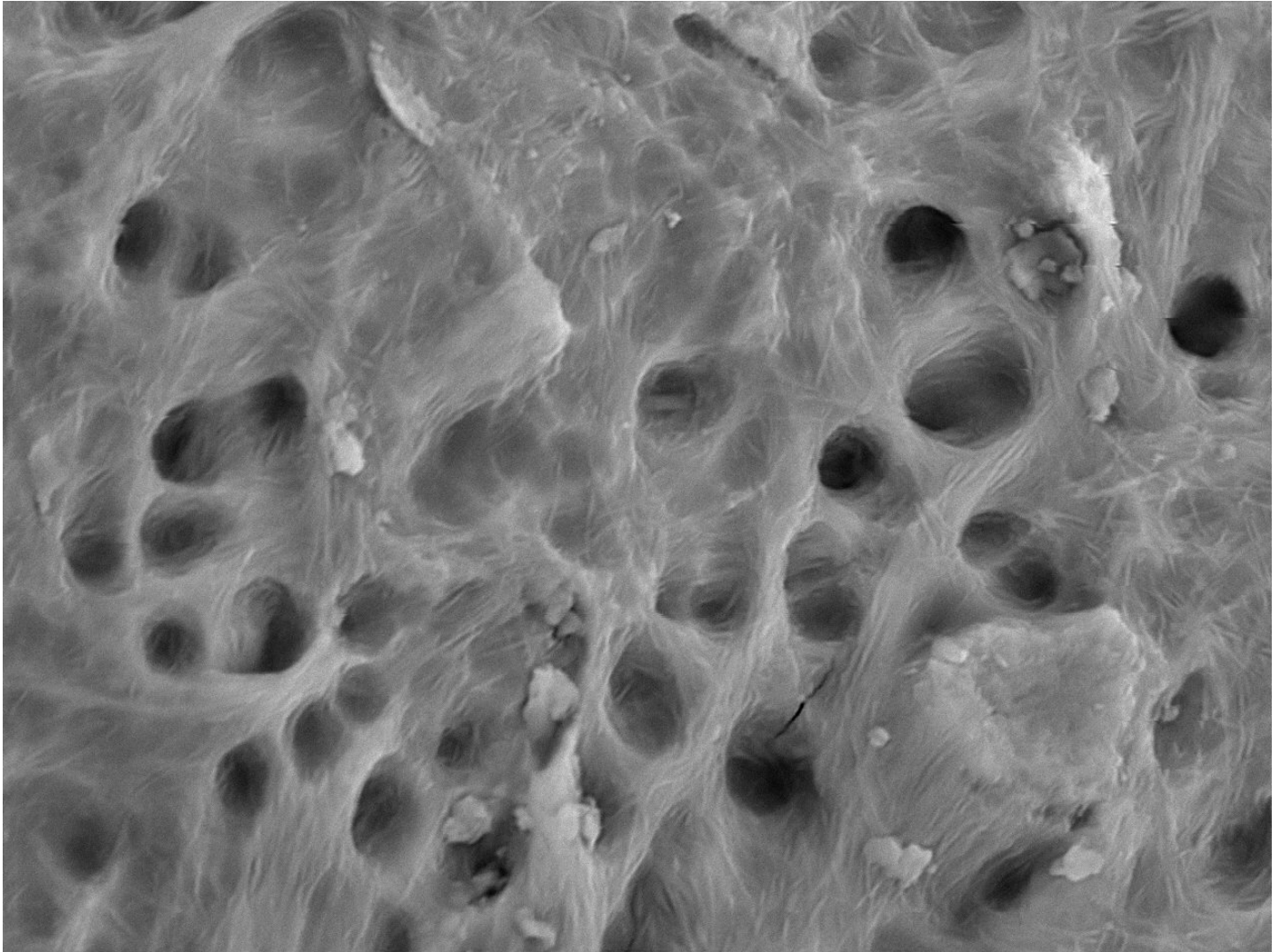
20 μ m

109) image343

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image344

image344



29052-14

2017/02/28 18:18 N

x5.0k

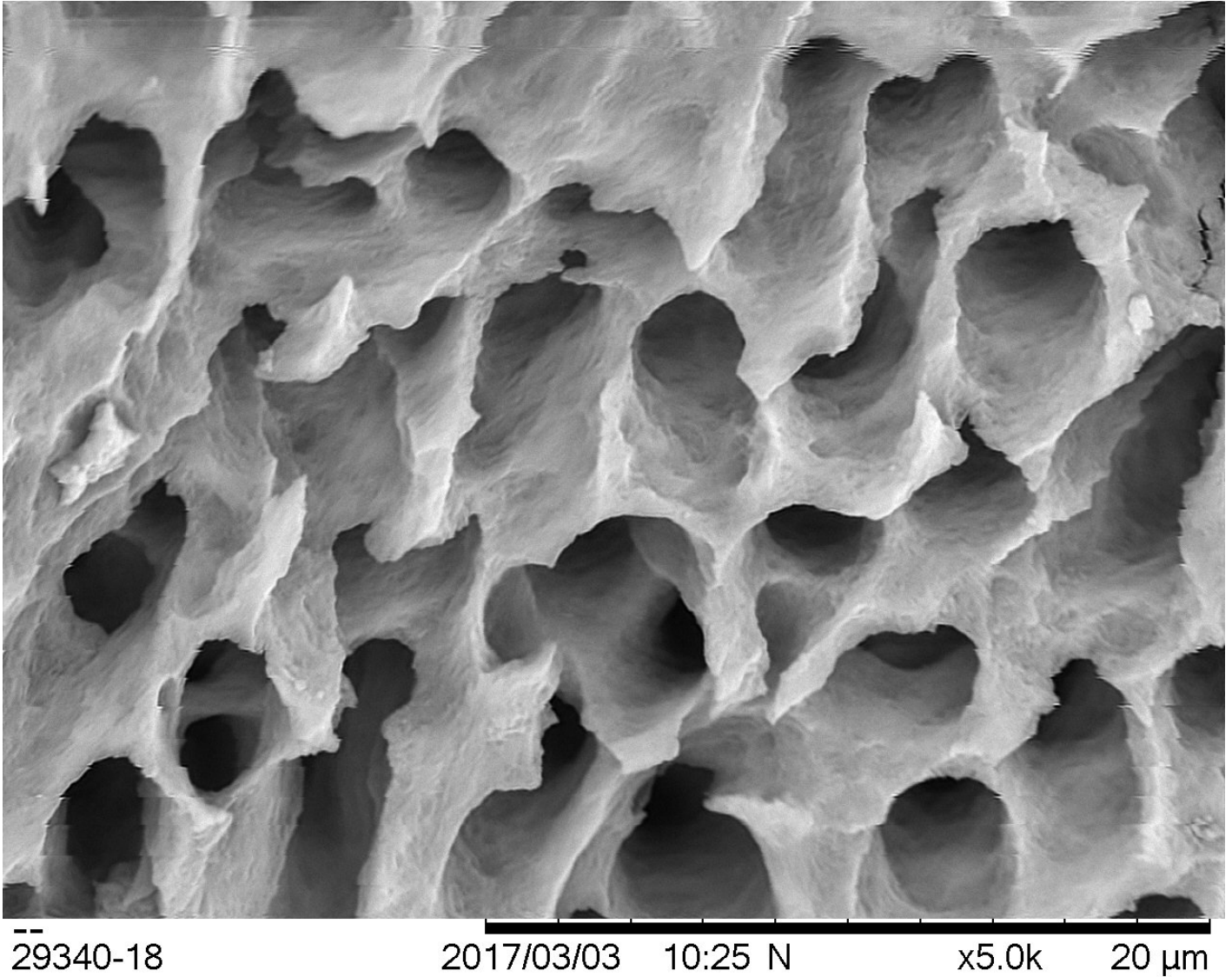
20 µm

110) image344

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image345

image345

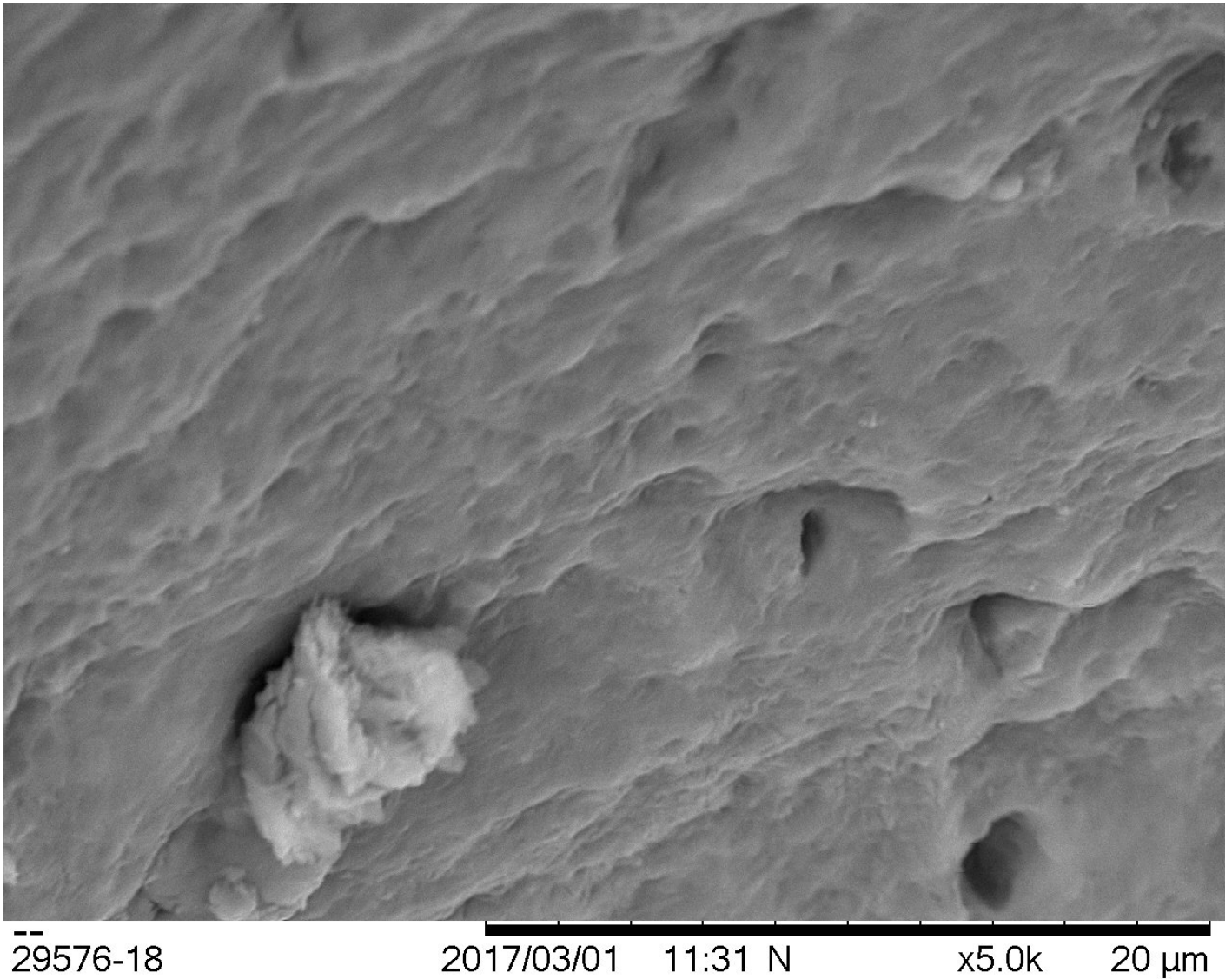


111) image345

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image346

image346

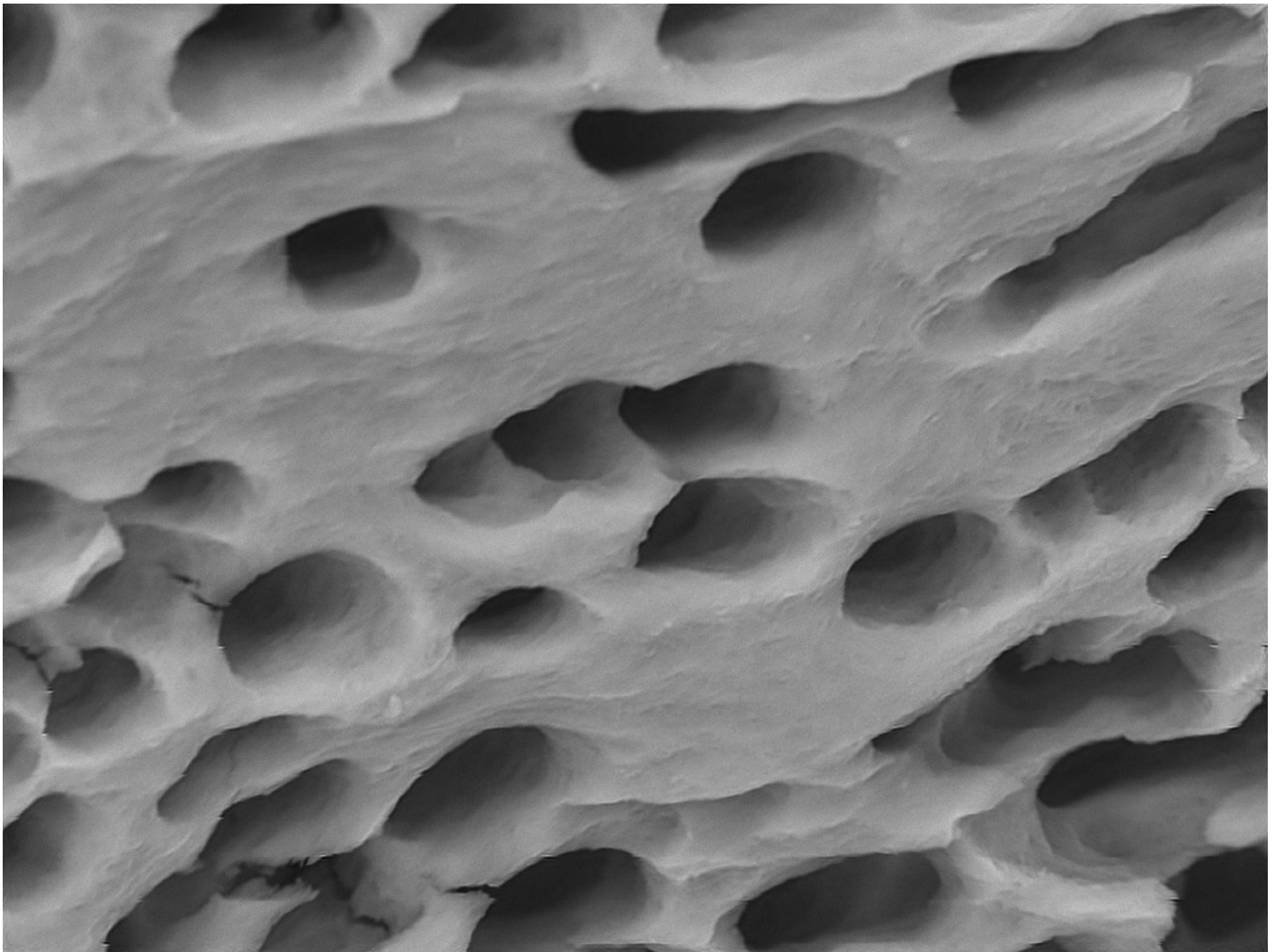


112) image346

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image347

image347



29340-18

2017/03/03 10:48 N

x5.0k

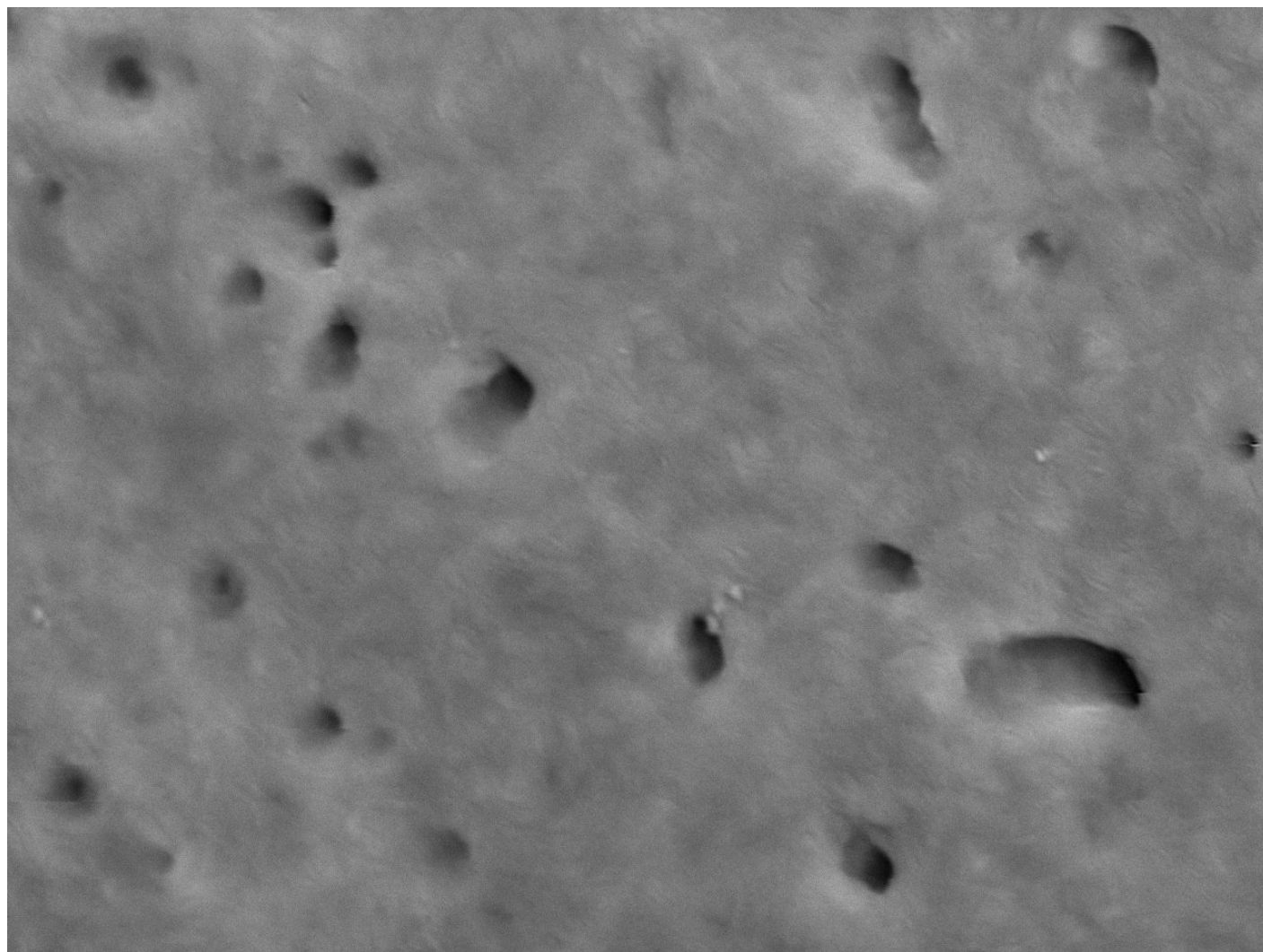
20 μ m

113) image347

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

image348

image348



29340-18

2017/03/03 09:53 N

x5.0k 20 μ m

114) image348

- 0: Less than 5% biofilm coverage of the root canal wall
- 1: Biofilm coverage between 5-33% of the root canal wall
- 2: Biofilm coverage between 34-66% of the root canal wall
- 3: Biofilm coverage between 67-100% of the root canal wall

Appendix D: Rater agreement

Table 8. Between rater agreement

rater A	rater B				Total
	0	1	2	3	
0	111	51	32	55	249
1	6	13	5	9	33
2	0	4	0	6	10
3	0	4	14	38	56
Total	117	72	51	108	348

Exact agreement = 46.6%. Kappa = 22.0%.

rater A	rater C				Total
	0	1	2	3	
0	245	1	1	2	249
1	29	2	1	1	33
2	3	2	4	1	10
3	5	1	19	31	56
Total	282	6	25	35	348

Exact agreement = 81.0%. Kappa = 52.6%.

rater A	rater D				Total
	0	1	2	3	
0	90	88	30	41	249
1	3	18	6	6	33
2	0	2	5	3	10
3	0	1	13	42	56
Total	93	109	54	92	348

Exact agreement = 44.5%. Kappa = 24.2%.

rater B	rater C				Total
	0	1	2	3	
0	117	0	0	0	117
1	65	2	2	3	72
2	37	2	10	2	51
3	63	2	13	30	108
Total	282	6	25	35	348

Exact agreement = 45.7%. Kappa = 20.4%.

rater B	rater D				Total
	0	1	2	3	
0	70	29	11	7	117
1	10	43	13	6	72
2	5	20	10	16	51
3	8	17	20	63	108
Total	93	109	54	92	348

Exact agreement = 53.4%. Kappa = 37.1%.

rater C	rater D				Total
	0	1	2	3	
0	93	105	38	46	282
1	0	2	1	3	6
2	0	1	11	13	25
3	0	1	4	30	35
Total	93	109	54	92	348

Exact agreement = 39.1%. Kappa = 17.7%.

Table 9. Within rater agreement on the duplicate images

Rater	Control	Filename	Rating			
			0	1	2	3
A	Negative	29960-14__MB__SIDE 1 Apical__5000X2.jpg	4	0	0	0
A	Negative	29960-14__MB__SIDE 2 Apical__5000X3.jpg	4	0	0	0
A	Negative	29961-2__MB__SIDE 1__5000X2.jpg	4	0	0	0
A	Negative	29961-2__MB__SIDE 1__5000X3.jpg	4	0	0	0
A	Positive	29679-03__side 2 DB__Apical__5000x1.jpg	0	0	3	1
A	Positive	29679-03__side 2 DB__Apical__5000x3.jpg	0	0	0	4
A	Positive	29965-2__MB__SIDE 1__5000X1.jpg	0	0	0	4
A	Positive	29965-2__MB__SIDE 1__5000X2.jpg	0	0	0	4
B	Negative	29960-14__MB__SIDE 1 Apical__5000X2.jpg	4	0	0	0
B	Negative	29960-14__MB__SIDE 2 Apical__5000X3.jpg	4	0	0	0
B	Negative	29961-2__MB__SIDE 1__5000X2.jpg	0	4	0	0
B	Negative	29961-2__MB__SIDE 1__5000X3.jpg	1	3	0	0
B	Positive	29679-03__side 2 DB__Apical__5000x1.jpg	0	0	0	4
B	Positive	29679-03__side 2 DB__Apical__5000x3.jpg	0	0	0	4
B	Positive	29965-2__MB__SIDE 1__5000X1.jpg	0	0	4	0
B	Positive	29965-2__MB__SIDE 1__5000X2.jpg	0	1	3	0
C	Negative	29960-14__MB__SIDE 1 Apical__5000X2.jpg	4	0	0	0
C	Negative	29960-14__MB__SIDE 2 Apical__5000X3.jpg	4	0	0	0
C	Negative	29961-2__MB__SIDE 1__5000X2.jpg	4	0	0	0
C	Negative	29961-2__MB__SIDE 1__5000X3.jpg	4	0	0	0
C	Positive	29679-03__side 2 DB__Apical__5000x1.jpg	0	0	4	0
C	Positive	29679-03__side 2 DB__Apical__5000x3.jpg	0	0	4	0
C	Positive	29965-2__MB__SIDE 1__5000X1.jpg	0	0	3	1
C	Positive	29965-2__MB__SIDE 1__5000X2.jpg	0	0	4	0
D	Negative	29960-14__MB__SIDE 1 Apical__5000X2.jpg	3	1	0	0
D	Negative	29960-14__MB__SIDE 2 Apical__5000X3.jpg	3	1	0	0
D	Negative	29961-2__MB__SIDE 1__5000X2.jpg	0	3	1	0
D	Negative	29961-2__MB__SIDE 1__5000X3.jpg	1	1	2	0
D	Positive	29679-03__side 2 DB__Apical__5000x1.jpg	0	0	2	2
D	Positive	29679-03__side 2 DB__Apical__5000x3.jpg	0	0	1	3
D	Positive	29965-2__MB__SIDE 1__5000X1.jpg	0	0	1	3
D	Positive	29965-2__MB__SIDE 1__5000X2.jpg	0	0	3	1

Vita

Dr. Cyrus Ardalan was born on June 19th, 1981 in Panorama City, CA. Dr. Ardalan received his Bachelor of Science in Biology from the University of North Carolina at Chapel Hill in 2003 and Doctor of Dental Medicine from Tufts University School of Dental Medicine in 2007. Dr. Ardalan then completed a General Practice Residency at Cedars Sinai Medical Center in 2008. He then worked as a general dentist in private practice as well as a Chief Dental Officer of a Federally Qualified Health Center in New Orleans, Louisiana for 6 years. In 2015, he enrolled in the Advanced Dental Program in Endodontics at Virginia Commonwealth University School of Dentistry. Dr. Ardalan is a member of the American Association of Endodontists, American Dental Association, and Louisiana Dental Association. He will graduate with a Master of Science in Dentistry and a Certificate in Endodontics.