

# **The Effect of Ozone on Surface Morphology and Tubule Occlusion of Hypersensitive Dentin**

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BY

Rasha Raafat Hassan Abdel Aziz  
B.D.S. (Cairo University -2002)

Faculty of Oral and Dental Medicine  
Cairo University  
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# **Supervisors**

***Dr. Mai Mahmoud Yousry***

Associate Professor of Operative Dentistry  
Faculty of Oral and Dental Medicine  
Cairo University

***Dr. Rania Sayed Mosallam***

Lecturer of Operative Dentistry  
Faculty of Oral and Dental Medicine  
Cairo University

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	<b>Page</b>
<b>List of Tables.....</b>	<b>i</b>
<b>List of Figures.....</b>	<b>ii</b>
<b>Introduction.....</b>	<b>1</b>
<b>Review of Literature.....</b>	<b>3</b>
<b>Aim of the Study.....</b>	<b>28</b>
<b>Materials and Methods.....</b>	<b>29</b>
<b>Results.....</b>	<b>43</b>
<b>Discussion.....</b>	<b>65</b>
<b>Summary and Conclusions .....</b>	<b>78</b>
<b>References.....</b>	<b>80</b>
<b>Appendix.....</b>	<b>I</b>
<b>Arabic summary.....</b>	<b>-----</b>

	<b>Page</b>
<b>Figure 1</b> OzonyTronX; A: regulator, B: connector, C: probe activation applicator, D: plasma probe.....	31
<b>Figure 2</b> Kit of plasma probes; A: GI-probe.....	31
<b>Figure 3</b> Fluoride desensitizer; ALLSolutions.....	32
<b>Figure 4</b> Oxalate desensitizer; D/sense-Crystal.....	32
<b>Figure 5</b> Bronwill cutting machine.....	39
<b>Figure 6</b> Mesiodistal sectioning of the tooth.....	39
<b>Figure 7</b> Checking the width of dentin slab (4 mm) using precise caliber.....	40
<b>Figure 8</b> Checking the thickness of dentin slab (1 mm) using precise caliber.....	40
<b>Figure 9</b> GI-probe applied onto dentin slab.....	41
<b>Figure 10</b> Application of fluoride desensitizing agent.....	41
<b>Figure 11</b> Application of oxalate desensitizing agent.....	42
<b>Figure 12</b> Environmental scanning electron microscope.....	42
<b>Figure 13</b> ESEM photomicrograph representing control dentin specimen after treatment with citric acid (3000x).....	46
<b>Figure 14</b> ESEM photomicrograph representing control dentin specimen after immersion in distilled water (3000x).....	46
<b>Figure 15</b> ESEM photomicrograph representing dentin specimen before application of ozone (3000x)...	47
<b>Figure 16</b> ESEM photomicrograph representing dentin specimen after ozone application (3000x).....	47

<b>Figure 17</b>	ESEM photomicrograph representing dentin specimen before fluoride application (3000x).....	48
<b>Figure 18</b>	ESEM photomicrograph representing dentin specimen after fluoride application (3000x).....	48
<b>Figure 19</b>	ESEM photomicrograph representing dentin specimen before potassium oxalate application (3000x).....	49
<b>Figure 20</b>	ESEM photomicrograph representing dentin specimen after potassium oxalate application (3000x).....	49
<b>Figure 21</b>	ESEM photomicrograph representing ozone treated dentin specimen before fluoride application (3000x).....	50
<b>Figure 22</b>	ESEM photomicrograph representing ozone treated dentin specimen after fluoride application (3000x).....	50
<b>Figure 23</b>	ESEM photomicrograph representing ozone treated dentin specimen before potassium oxalate application (3000x).....	51
<b>Figure 24</b>	ESEM photomicrograph representing ozone treated dentin specimen after potassium oxalate application (3000x).....	51
<b>Figure 25</b>	SEM photomicrograph representing surface topography of a fluoride treated dentin specimen (2500x).....	52
<b>Figure 26</b>	SEM photomicrograph representing a longitudinal fractured fluoride treated dentin specimen (2500x).....	52
<b>Figure 27</b>	SEM photomicrograph representing surface topography of oxalate treated dentin specimen (2500x).....	53

<b>Figure 28</b>	SEM photomicrograph representing a longitudinal fractured oxalate treated dentin specimen (2500x).....	53
<b>Figure 29</b>	Representative ESEM photomicrograph for qualitative image analysis evaluation of dentinal tubule.....	54
<b>Figure 30</b>	Bar chart for the mean percentage change in dentinal tubule count with and without ozone application for the desensitizing agents.....	56
<b>Figure 31</b>	Bar chart for mean percentage of tubule occlusion with and without ozone application for the desensitizing agents.....	57
<b>Figure 32</b>	Bar chart for the mean percentage change in tubule count for the desensitizing agents with and without ozone application.....	60
<b>Figure 33</b>	Bar chart for mean percentage of tubule occlusion for desensitizing agents with and without ozone application.....	61
<b>Figure 34</b>	Bar chart for the mean percentage change in tubule count of the different subgroups.....	63
<b>Figure 35</b>	Bar chart for mean percentage of tubule occlusion of the different subgroups.....	64

	<b>Page</b>
<b>Table (1)</b> Specifications of desensitizing agents.....	30
<b>Table (2)</b> Variables of the study.....	35
<b>Table (3)</b> Interaction of the variables of the study.....	35
<b>Table (4)</b> Mean percentage change in dentinal tubule count, standard deviation (SD) values and statistical analysis for the effect of ozone application with desensitizing agents.....	56
<b>Table (5)</b> Mean percentages of tubule occlusion, standard deviation (SD) values and statistical analysis for the effect of ozone application with desensitizing agents.....	57
<b>Table (6)</b> Mean percentage change in dentinal tubule count, standard deviation (SD) values and statistical analysis for desensitizing agents with and without ozone application.....	60
<b>Table (7)</b> Mean percentages of tubule occlusion, standard deviation (SD) values and statistical analysis for the desensitizing agents with and without ozone application.....	61
<b>Table (8)</b> Mean percentage change in dentinal tubule count, standard deviation (SD) values and statistical analysis for comparison between different interactions of subgroups.....	63
<b>Table (9)</b> Mean percentages of tubule occlusion, standard deviation (SD) values and statistical analysis for interactions between subgroups.....	64



This study was conducted to evaluate the effect of ozone and its combination with fluoride or oxalate desensitizing agents on tubular occlusion of hypersensitive dentin. Results for qualitative Environmental Scanning Electron Microscope (ESEM) examination are presented in figures 13 to 24 and 25 to 28 for Scanning Electron Microscope (SEM) examination while that for quantitative image analysis are presented in tables 4 to 9 and figures 29 to 35.

## **I. Qualitative assessment of dentinal tubules**

### **I. A Environmental scanning electron microscope:**

Qualitative assessment, using ESEM, for a representative specimen for each subgroup before and after treatment is presented. In the control group, a typical ESEM photomicrograph after citric acid treatment is shown in (figure 13). The specimen reveals a smooth appearance with opened tubules' orifices, simulating hypersensitive dentin. Dentin specimens were immersed in distilled water as control and representative ESEM photomicrographs is shown in (figure 14). The control specimens maintained their condition and no significant changes were observed between that before and after immersion in distilled water. On the other hand, ESEM examination of specimens treated with ozone (figure 16) showed slight widening in the lumen of dentinal tubules as compared to the ESEM photomicrograph taken before ozone application (figures 15).

Figures (17 and 18) show representative ESEM photomicrographs for a dentin specimen before and after treatment with fluoride. Some crystals are seen loosely attached to the tubules. However, no precipitates seem to occlude the dentinal tubules which

appear opened and exposed but slightly narrower than before treatment. In contrast, the application of potassium oxalate on dentin surface (figure 20) reveals obliteration of dentinal tubules compared to the widely patent dentinal tubules before treatment (figure 19). With oxalate application, a homogenous layer is shown on the surface of dentin occluding the majority of dentinal tubules orifices. Spherical and crystal-like inclusions are also observed on the surface (figure 20).

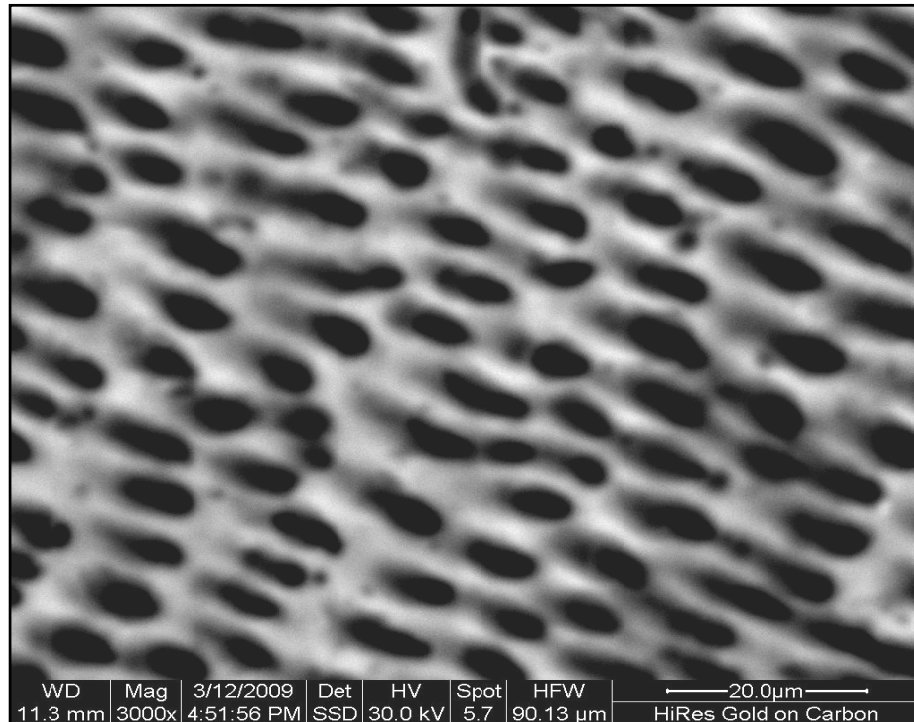
Figures (21 and 22) show representative photomicrographs of dentin surface before and after treatment with ozone followed by fluoride application. Figure (22) reveals partial occlusion of dentinal tubules with narrowing in the apertures of the dentinal tubules, but not complete obliteration. On the other hand, the dentin surfaces treated with ozone followed by application of potassium oxalate is presented in (figure 24) compared to before treatment (figure 23). It could be observed that precipitates of oxalate crystals covered the treated dentin surface and occluded the orifices. However, some dentinal tubules opening remained visible with slight narrowing of tubules apertures than before treatment.

### **I. B Scanning electron microscopic examination:**

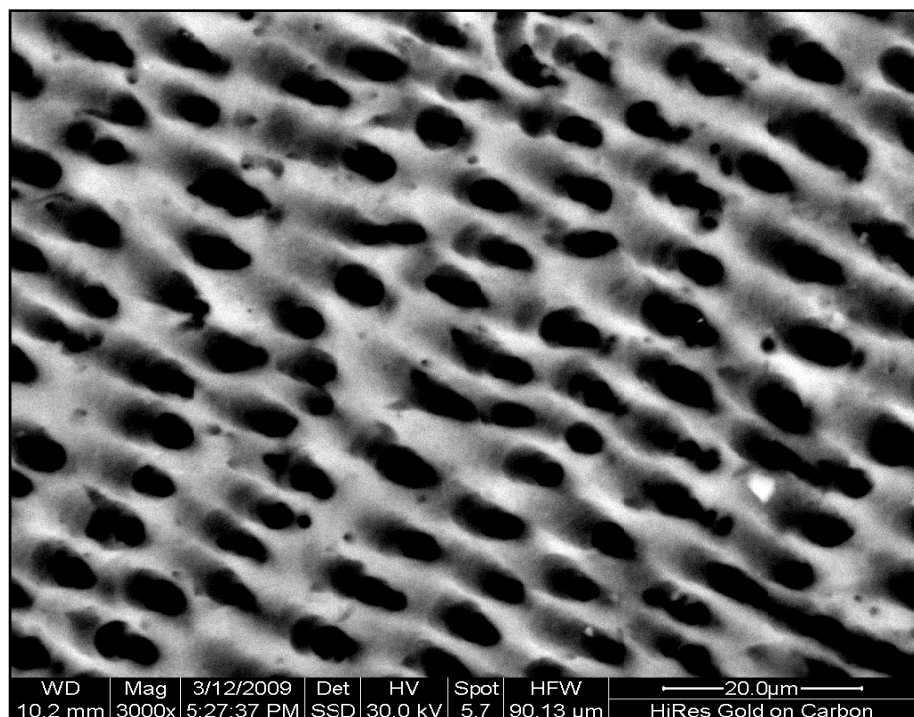
SEM assessment of representative specimens treated with fluoride or oxalate is presented in figures (25 to 28). In fluoride treated specimen; examination of the surface topography revealed a relatively smooth thin surface coating over some areas of the treated surface (figure 25). Most of the dentinal tubules showed narrowing in the tubule aperture due to fine precipitates on the tubular walls. However, full tubular occlusion was very rare.

Fractured fluoride-treated specimen (figure 26), showed that this surface coating had fine deposits adhered to the surface (solid white arrow). It is also shown that this fine coating did infiltrate the dentinal tubules at various depths and appear to be in intimate contact with the dentinal tubules. Some tubules were infiltrated by the precipitate for approximately 10  $\mu\text{m}$  (solid black arrow) but not to the full length of the dentinal tubule (dotted white arrow). Other tubules appear to be narrowed to its full visible length by the infiltrate which appear to line the lumen of the tubule (dotted black arrow).

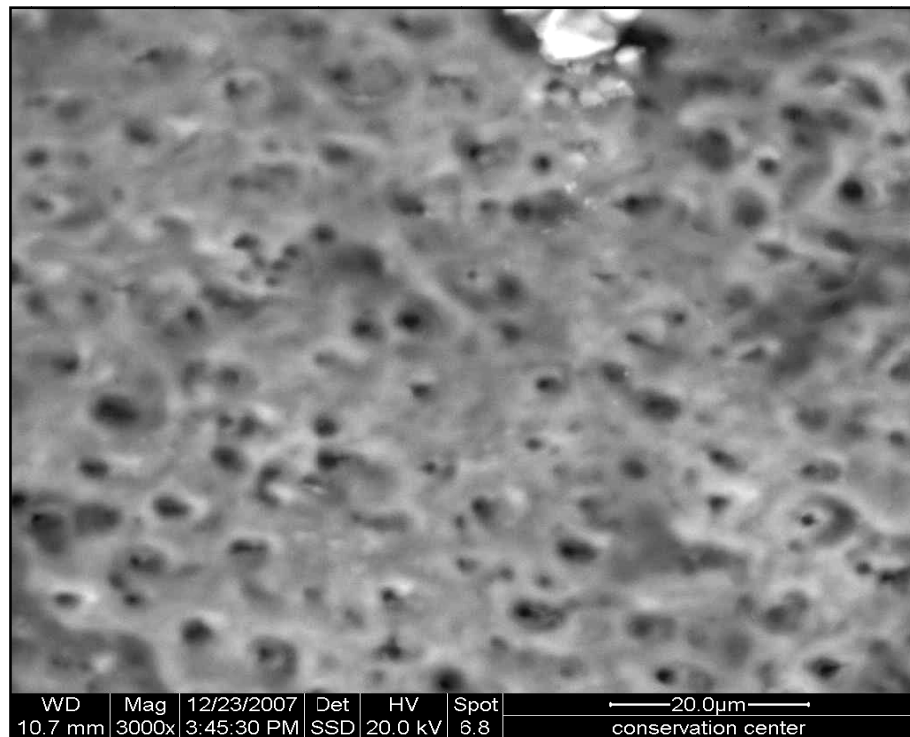
On the other hand, SEM examination of the surface topography of the oxalate-treated specimen (figure 27) reveals crystalline rectangular, rod-shaped aggregates with different dimensions. Angular and cluster-like crystals are deposited on the dentin surface hiding most orifices of the dentinal tubules. Some tubules are barely visible. Fractured longitudinal section (figure 28) reveals that these deposits formed a dense mass on the surface of dentin (solid white arrow), occluding the tubule entrance and firmly attached to the dentinal tubules and intertubular dentin to an approximate depth of 7  $\mu\text{m}$  (solid black arrow). Below this depth, some oxalate crystals or aggregates (dotted black arrow) was found plugging the tubules but did not penetrate, however, more than approximately 14  $\mu\text{m}$  inside the tubules. The crystals appear to be larger than the diameter of the deeper portion of the tubule which was probably not affected by the superficial demineralization by citric acid.



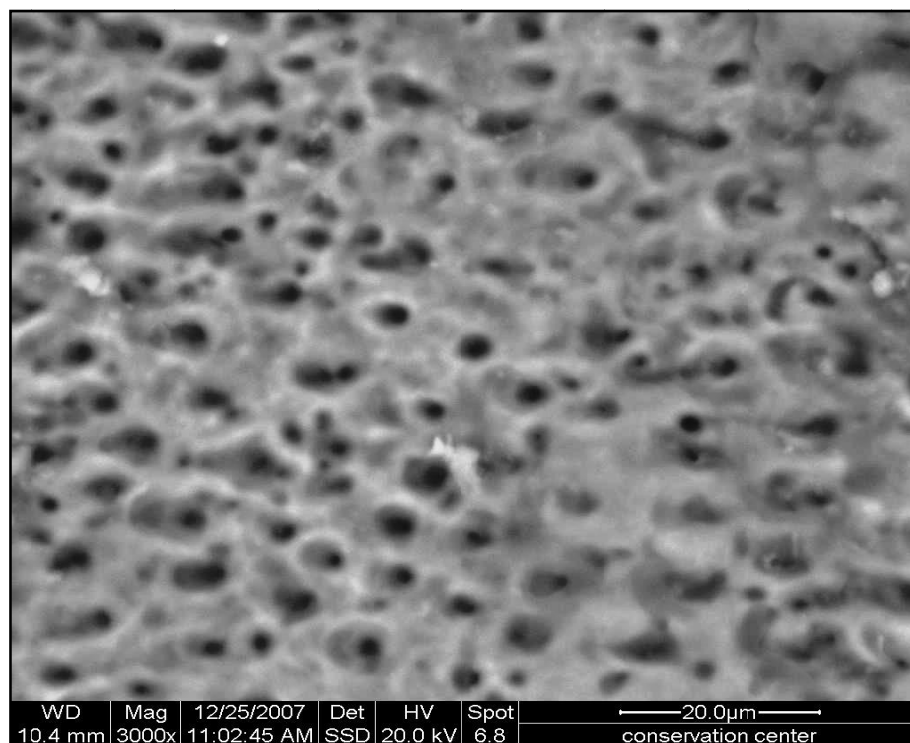
**Figure (13):** ESEM photomicrograph representing control dentin specimen after treatment with citric acid (3000x)



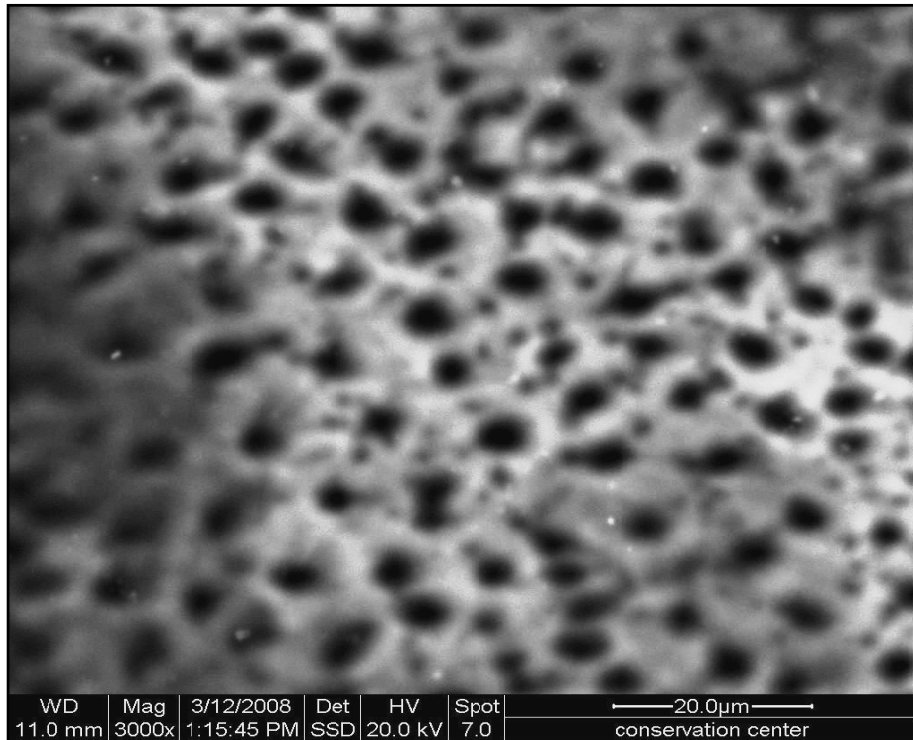
**Figure (14):** ESEM photomicrograph representing control dentin specimen after immersion in distilled water (3000x)



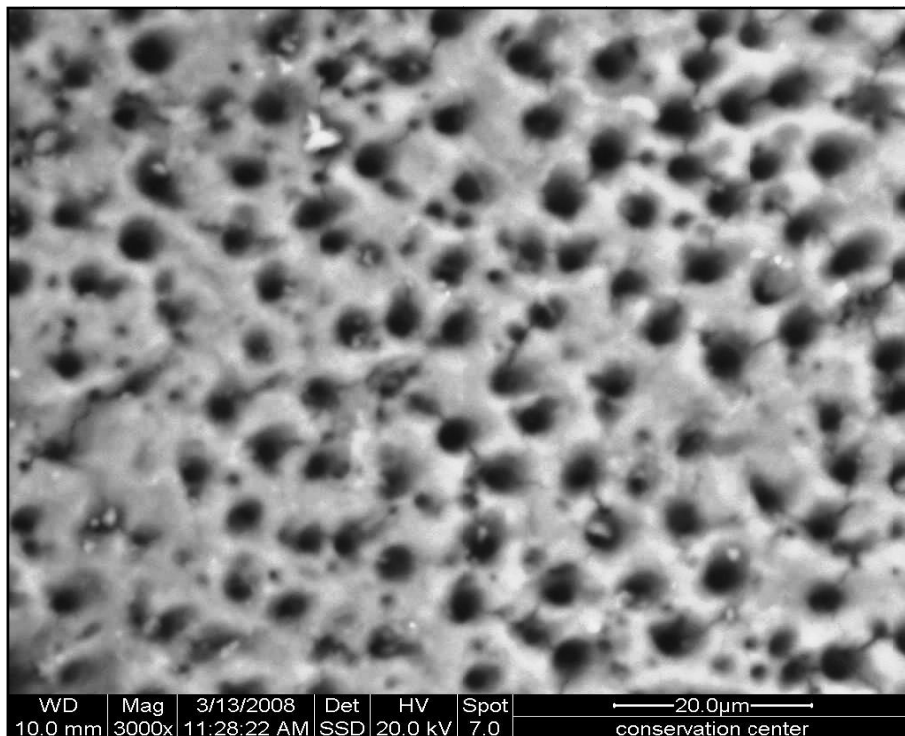
**Figure (15):** ESEM photomicrograph representing dentin specimen before application of ozone (3000x)



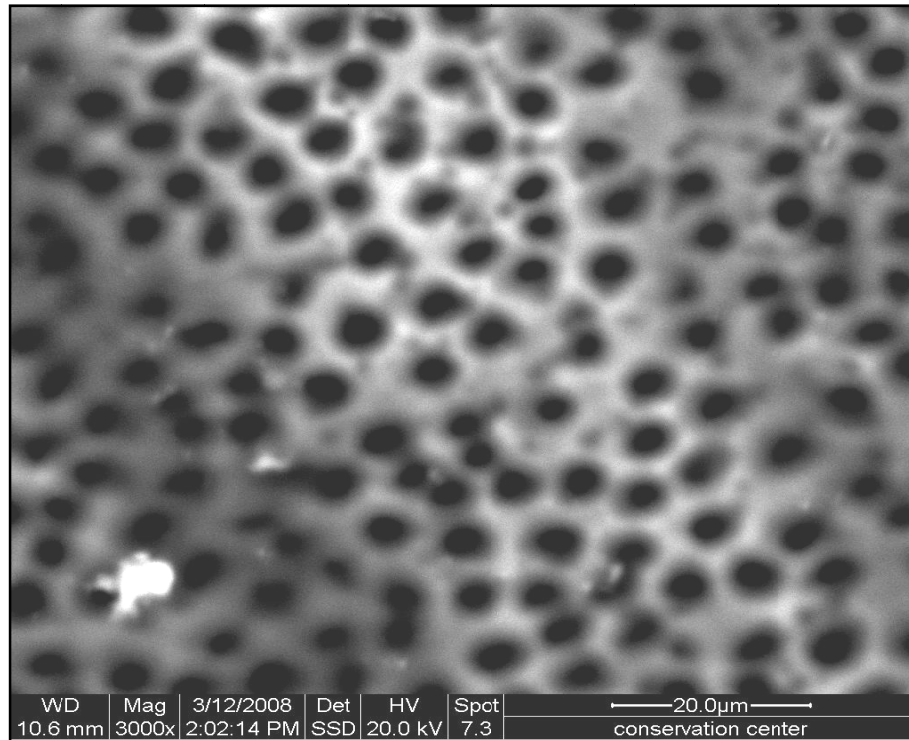
**Figure (16):** ESEM photomicrograph representing dentin specimen after ozone application (3000x)



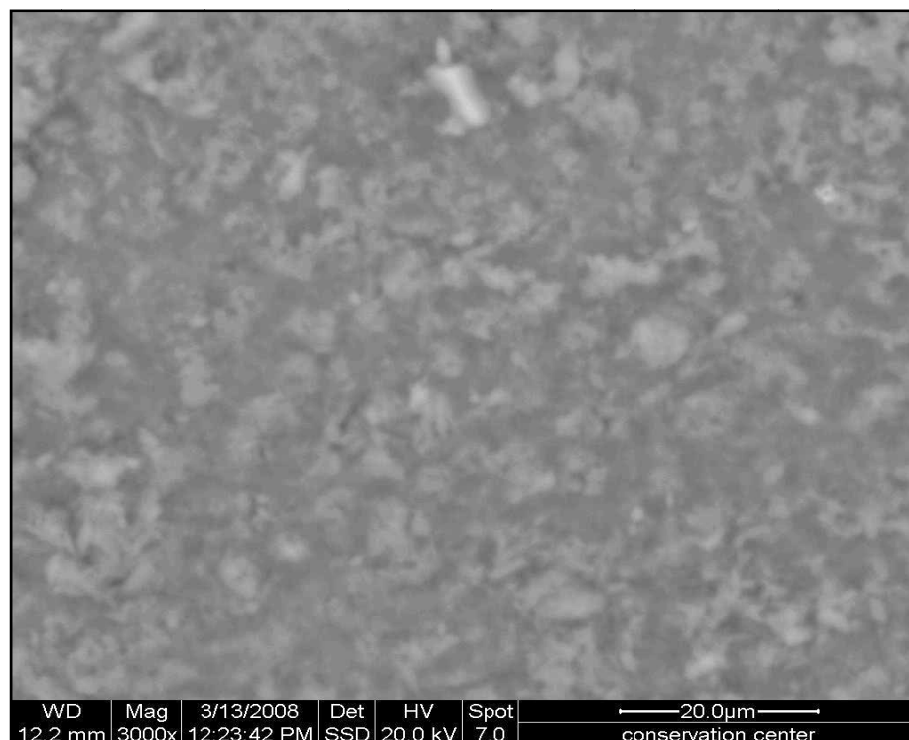
**Figure (17):** ESEM photomicrograph representing dentin specimen before fluoride application (3000x)



**Figure (18):** ESEM photomicrograph representing dentin specimen after fluoride application (3000x)



**Figure (19):** ESEM photomicrograph representing dentin specimen before potassium oxalate application (3000x)



**Figure (20):** ESEM photomicrograph representing dentin specimen after potassium oxalate application (3000x)