Expeirmental Study of the Behaviour of Materials Used in Creating Polymer Dentures Mobilized by Irradiation Microwave

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The study samples were taken Meliodent self-curing acrylic partial denture acrylics and flexible acrylate Bre.flex, used in manufacturing. The aim of the study was to observe if the irradiation of deployable dentures, there are changes in the structure of the material. Samples were subjected to irradiation at three different values of power (500, 650, and 750 W) and three different time intervals (2, 3, or 5 min), and was later examined by electron microscopy in comparison with control samples of the same material. After the microwave irradiation of materials it is made partial dentures and analysis using scanning electron microscope found no changes notable in the studied areas.

Keywords: self-curing acrylic, microwave, SEM

Polymethyl methacrylate (PMMA) is a plastic material consisting of methyl methacrylate, ester of methacrylic acid [1]. It is a termopolymeriyed resin composition in which the powder contains the polymer, pigments, plasticisers and the initiator and the liquid consists essentially of a monomer and a polymerization inhibitor [2,3]. Forming paste incurred by mixing liquid with the powder (in the doses indicated by the manufacturer) formed a sand table which in time turns into a homogeneous mass. When the dust saturated monomer mixture is introduced into the compression mold (tamping) or injection. The polymerization slurry is produced by polymerization of the monomer which is induced by temperature increase [4,5].

Regarding of physical properties we can mention: porosity (structure resin can be bubbles of varying sizes detectables macroscopic caused by mistakes dosing, handling, processing which affects mechanical properties and biological) [6]; water absorption: train variations volumetric decreases strength and cause discoloration; solubility is reduced. Variations in volume: in the process of polymerization occurring sequentially following physical phenomena: the first thermal expansion followed by contraction polymerization and global agreement reached 0.2 - 0.5%. Mechanical properties: hardness is much lower than that of dentin so do not suffer compared to the enamel, is good compressive strength, abrasion resistance is very low and represent major drawback of these resins [5,7]. In terms of chemical PMMA shows a high chemical inertia, being very stable in the mouth. However, it is possible an unfavorable time: initially translucent resin is opacify and yellows. Also, due to microcracks that occur over time is reduced and mechanical strength[1,5,8]. These aging phenomenon is due to several physical causes: water absorption, porous structure. Biological properties: the oral manifestations of intolerance (stomatopatia prosthetics) against these resins are quite rare. Allergic manifestations occur as a chronic inflammation of the mucosa that support acrylic prosthesis.The excess monomer,denture plaque, mechanical irritation triggers defensive reactions of mouth. It's an immune reaction triggered by bacterial antigens. Patient education is important in view of hygiene of the denture and the oral mucosa (lining support massage toothbrush). The monomer has a 100% cytotoxicity but usually does not appear in the residual monomer prosthesis made of resin termopolymerized.

Scanning electron microscopy, also known as SEM is a special equipment which allows the observation and characterization of micro and nano scale inorganic or organic solid material [9,10]. The computer provides the interface for working with the microscope and allows acquiring, storing and processing images obtained [11].

Inside signal range that will be analyzed are irradiated with an electron beam finely focused and scanned in a raster desired surface. The interaction of the electron beam with the irradiated material produces a variety of signals: secondary electrons, scattered electrons, X-ray light, all of which are signals that, after analysis can give a great deal of information about the topography and chemical composition of the sample [11,12].

In SEM there are issued the characteristic signals X-rays,also, which can give qualitative and quantitative information about the chemical composition of the sample examined. The SEM can produce images which can be quickly interpreted as lights and shadows, approximately as much as the human eye perceives contrasts everyday life. Level differences are suggested by differences in contrast so that low-lying areas appear dark, while heights are shown with a light side and a shade [11].

Experimental part

The work equipment is a FEI Nova Nano SEM 630, an FEG-SEM high resolution SEM located in the Laboratory Nanostructuring and Characterization of the IMT Bucharest. Has been used a mode in a high vacuum secondary electron detector, the accelerator voltage variable depending on the conditions of the visualization: surface conductivity, the contrast of the image, the degree of electrostatic charging of the sample, etc. Since the samples consists of non-conductive material (polymer in the present case), it was necessary prior to the metallization of the samples with a thin layer of gold to provide the contact surface.

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All authors have equal contribution to the study and the publication

Samples were achieved as follows: 10 samples of Self-curing acrylic (Meliodent R-company Hereus Kultzer, Germany), 10 tests Self-curing acrylic with a molar inserted Self-curing acrylic with a crochet wiplã attached, 10 saples Self-curing acrylic transparent. The samples were produced so as to have the size of 20 cm in circumference and 1.8 mm thickness.

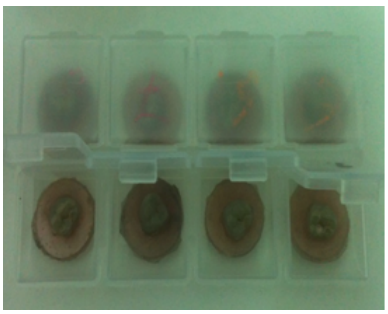

Fig. 1. The samples with the acrylate termopolymerized and tooth inserted

Fig. 2. The samples with the pink acrylate termopolymerized

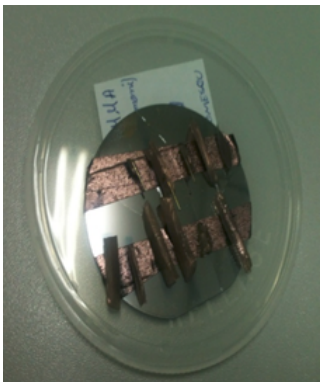

Fig. 3 The samples with the acrylate termopolymerized and crochet

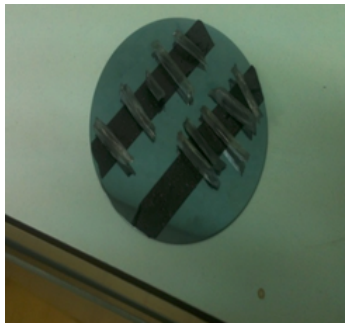

Fig.4 Samples Self-curing acrylic transparent

The coding of the samples is shown in table 1.

After irradiation in a household microwave samples were fractured or by immersion in nitrogen, either using two clamps to be observed by SEM's possible modifications arisen. Thereafter, the fragments of samples were metallized with gold by spraying (sputtering), using BOC EDWARDS AUTO 500. The gold layer was sprayed up to 10 nm. All samples were performed in comparison with control samples which have not been submitted the irradiation process.

Results and discussion

In figure 5 electron microscopy image to zoom X10,000, evidence examined.

Samples 1A and 1B present a rough surface (porous), uneven, relatively clean (no dirt or particles adhering more). Sample 1C shows large cracks in the substrate and large clumps of crystals of needle shaped about 2 microns length of the substrate (not adhering outdoors).

Sample 1D is agglomerated crystallites together with large impurities (agglomerations between crystals).

1E sample surface is smooth, with simple uneven, debris-free surface (granules or crystals). 1F sample shows large smooth regions separated by deep rifts with groups detached from the substrate material.

1G sample has uniform crystal clusters and clumps material embedded in small spherical formations deployed. 1H sample surface shows large, smooth, with small unevenness resulting from the deformation of the material, of relatively small particles (3-500 nm) on the surface,

	Control Sample	Irradiated samples			
		Time (min)	Power (W)		
			500	650	750
The samples with the acrylate termopolymerized and tooth inserted	Probe 1A	2	Probe 1B	Probe 1E	Probe 1H
		3	Probe 1C	Probe 1F	Probe 1I
		5	Probe 1D	Probe 1G	Probe 1J
Samples self-curing acrylic transparent	Probe 2A	2	Probe 2B	Probe 2E	Probe 2H
		3	Probe 2C	Probe 2F	Probe 2I
		5	Probe 2D	Probe 2G	Probe 2J
The samples with the pink acrylate termopolymerized	Probe 3A	2	Probe 3B	Probe 3E	Probe 3H
		3	Probe 3C	Probe 3F	Probe 3I
		5	Probe 3D	Probe 3G	Probe 3J
The samples with the acrylate termopolymerized and crochet	Probe 4A	2	Probe 4B	Probe 4E	Probe 4H
		3	Probe 4C	Probe 4F	Probe 4I
		5	Probe 4D	Probe 4G	Probe 4J

Table 1

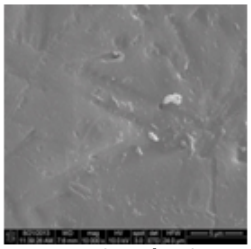

Fig. 5.Sample 1A

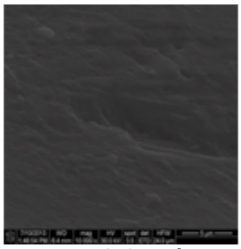

Fig. 6. Sample 1B

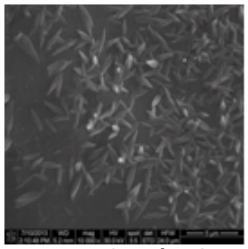

Fig. 7.Sample 1C

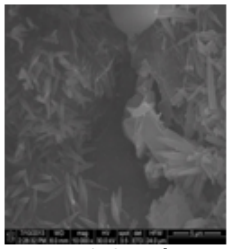

Fig. 8. Sample 1D

Fig. 9. Sample 1E

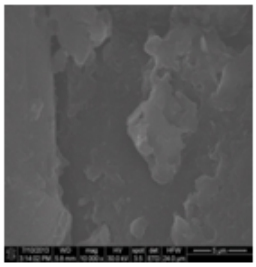

Fig. 10. Sample 1F

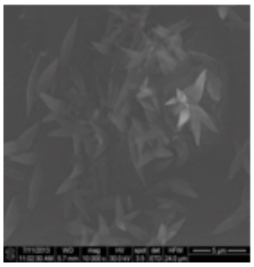

Fig. 11. Sample 1G

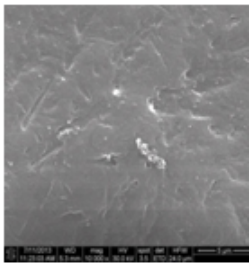

Fig. 12. Sample 1H

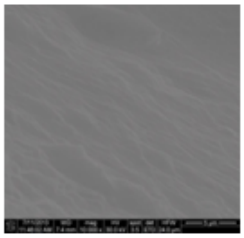

Fig. 13. Sample 1I

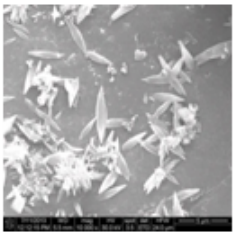

Fig. 14. Sample 1J

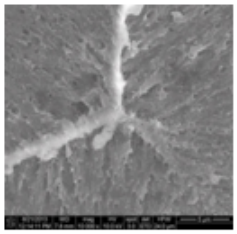

Fig. 15. Sample 2A

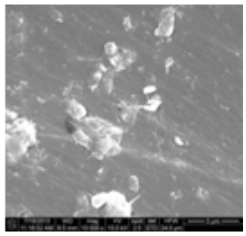

Fig. 16. Sample 2B

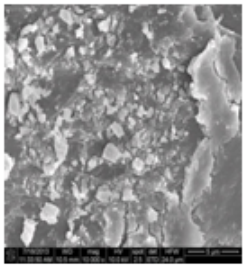

Fig. 17. Sample 2C

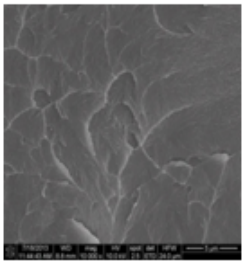

Fig. 18. Sample 2D

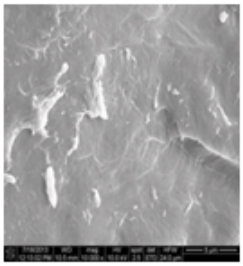

Fig. 19 . Sample E

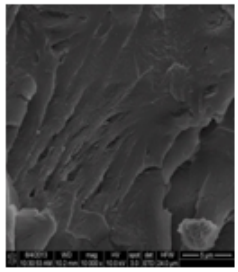

Fig. 20. Sample 2F

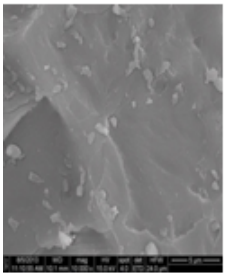

Fig. 21. Sample 2G

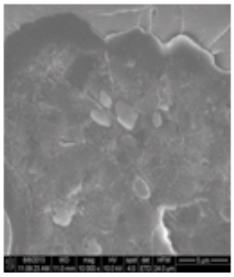

Fig. 22. Sample 2H

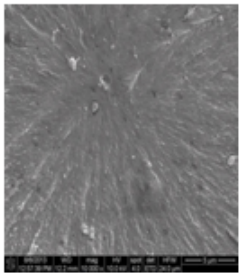

Fig. 23. Sample 2I

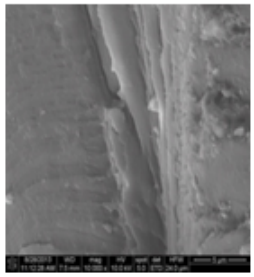

Fig. 24. Sample 2J

discrete or merged. It can also see areas where gold was deposited (lighter areas).

1I sample is smooth, uneven simple, no impurities on the surface (granules or crystals). Can be observed certain areas impurities. Sample 1J is smooth and uniform substrate with clusters of very small particles (200-300 nm), together with large pieces of material, sometimes with as many as 10 microns conglomerates.

Samples 1B, 1E and 1H have the same characteristics as the control sample 1A, the remaining evidence showing differences more apparent as magnification increases the order of examination. The changes are the greater since the higher the exposure to radiation was higher.

Sample 2A shows a relatively smooth surface with little unevenness. 2B sample is smoother than the control sample roughnesses 2A, but uneven and sometimes with clusters of small, evenly spread over the surface.

2C sample surface is irregular, rough shaped conglomerates of dimensions of the order of a micron. The surface is relatively smooth 2D sample with small humps arranged in the same direction and the sample 2E has an over uneven pronounced and regular.

Sample 2 F is relatively smooth surface with uneven more pronounced. 2G probe has an over uneven pronounced regular. Sample 2H has pronounced unevenness arranged in steps aimed relative oriented in the same direction. It can be can be observed also small clusters of the order of a micron.

2I sample has pronounced irregularities arranged in steps, randomly oriented.

It is observed that with increasing power and decreasing the irradiation time samples 2D, 2F, 2H and 2I retains the same topography that I met and blank 2A. Random orientation increases exponentially with time.

Samples 2E and 2G are the same as topography, which means that there are changes with increasing time.

3A sample shows smooth and well-defined contour between crochet and acrylate. It is observed some rough irregular. 3B shows the sample surface uneven and irregular shape well defined between crochet and acrylate, no cracks.

The remaining samples were 3C-3J smooth surface, this makes no change with increasing power and (or) exposure time. The area of the interface acrylate hooks are similar to features present in the control sample 3A.

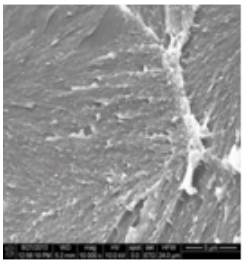
Fig. 25. Sample 3A

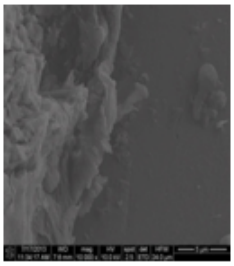
Fig. 26. Sample 3B

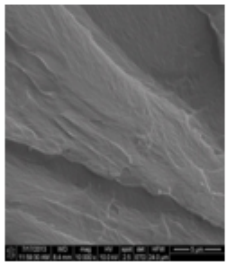
Fig. 27. Sample 3C

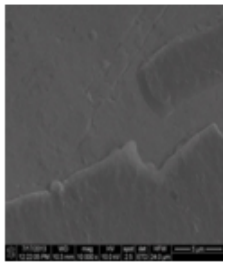
Fig. 28. Sample 3D

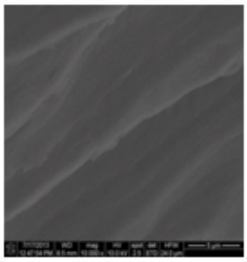
Fig. 29. Sample 3E

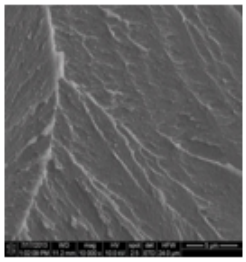
Fig. 30. Sample 3F

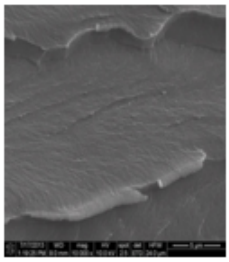
Fig. 31. Sample 3G

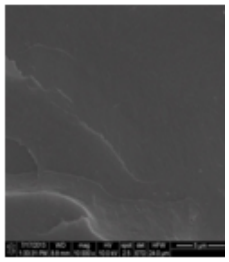
Fig. 32. Sample 3H

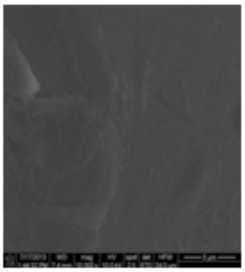
Fig. 33 . Sample 3I

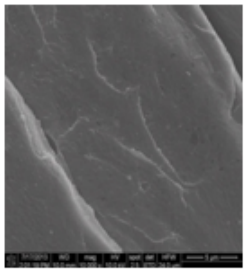
Fig. 34. Sample 3J

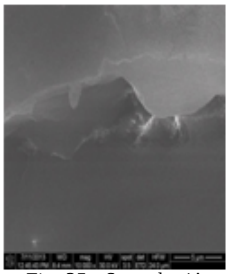
Fig. 35. Sample 4A

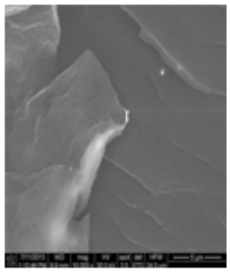
Fig. 36. Sample 4B

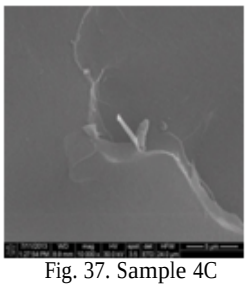
Fig. 37. Sample 4C

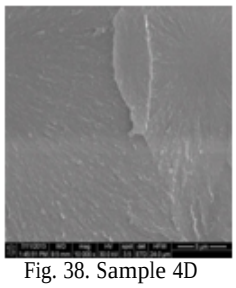
Fig. 38. Sample 4D

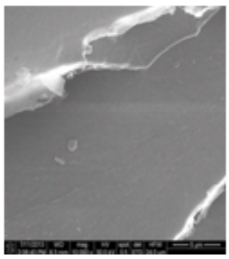
Fig. 39. Sample 4E

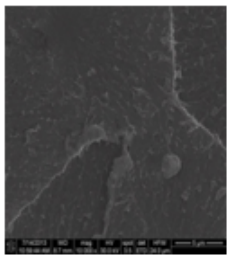
Fig. 40. Sample 4F

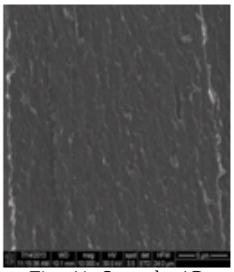
Fig. 41. Sample 4G


Fig. 42. Sample 4H


Fig. 43. Sample 4I


Fig. 44. Sample 4J

Sample 4A shows irregular appearance, without cracks and free of impurities. Samples 4B, C, D and E have pronounced the rough surface, irregular. 4F sample has rough surface and irregular clumps nanoscale. Sample 4G shows the smooth surface, but with regular unevenness. 4H sample has supreme smooth, with small irregularities and the sample 4I shows a porous surface. Sample micron pore 4J has no cracks.

For samples 4A-4H and 4I we noticed that as its increase the power and temperature are observed smoothing of surface roughness fewer in number and more rare in topographical terms of the settlement. You probably out of print, but can be analyzed in relation to other samples that were subjected to the same power, but made of different materials.

Conclusions

Regarding of the length constant power microwave treatment, it was found that with increasing exposure period studied range microwave (2-5 minutes) sectional area suffers minor changes by the control sample. These changes are manifested by the appearance of clusters *crystalline* holes and cracks of nanoscale dimensions and micron.

The same behavior was observed morphology of the samples analyzed if the parameter was the change of microwave power beam. So by increasing the microwave power between 500-750 W, sectional area suffers minor changes by the control sample, changes manifested by the appearance of defects in the form of irregularities, lumps *crystal*, voids and cracks size of micron and nanometer . It was also found to induce the same effect

on the surface section or by increasing and decreasing power microwave beam exposure time or by decreasing microwave power beam and increasing exposure time.

Basically, there is not morphologically major differences between controls and samples subjected to microwave treatment beam regardless of the power used and exposure time.

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