

Investigation of Surface of Photopolymer Composite Materials for Dental Application Using Atomic Force Microscopy

Zenon Hotra, Valentyn Makeev, Nataliya Mykyevych, Lesya Voznyak

Abstract – Surface microstructures of photopolymer composite materials Filtek Z250, Charisma, Dipol for dental application were investigated by using atomic force microscopy. It was shown that dental inlay Charisma characterized by the smoothest surface and small spread of the height distribution.

Keywords – photopolymer composite material, atomic force microscopy, surface microstructure, dental application.

I. INTRODUCTION

Physical and handling properties of photopolymer composite dental materials which are used for direct and indirect restoration of all group of teeth, determine their lifespan. Surface microstructure of dental composite is one of the important parameters that affect their durability [1, 2].

Photopolymer composite material should have smooth, without any micro-hills surface microstructure [3].

In this work surface morphology of photopolymer composite dental materials Filtek Z250, Charisma, Dipol which have microparticles (1-2 mk) of inorganic filler was investigated.

II. EXPERIMENT

Samples were prepared by means of layerwise ultraviolet polymerization of dental composites during 20 sec and additional thermal handling at temperature 140°C during 10 minute. Samples were prepared in the form of plates with thickness of 4 mm.

The morphology of dental composites was studied by means of Solver P47-PRO atomic force microscope (AFM) at contact mode with a scanning frequency of 1 Hz using NSG10-A probe sensor (cantilever) [4].

III. RESULT AND DISCUSSION

The results were processed by program that is adapted to analyze images of samples. It was obtained the three-dimensional images of investigated materials and was build the surface height-distribution histogram.

Fig.1 shows three-dimensional images and surface height-distribution histogram of dental inlay Charisma, Filtek Z 250 and Dipol materials.

According to the height distribution histogram, surface of the dental inlay Charisma is smooth with maximum of micro-hills height of 140 nm and height-distribution histogram covers the range 50-200 nm. Height of majority micro-hills on dental inlay Filtek Z250 surface is 230 nm and height-distribution histogram covers the range 100-350 nm.

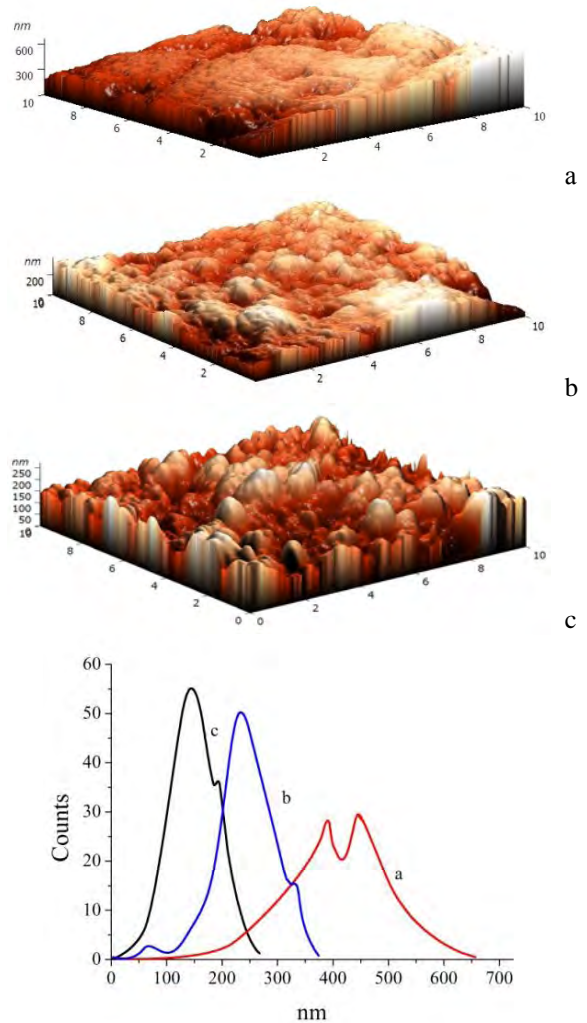


Fig. 1 Tree-dimensional images and surface height distribution histogram of dental inlay materials: Dipol (a), Filtek Z250 (b) and Charisma (c).

Heights of majority micro-hills on dental inlay Dipol surface are 390 nm and 440 nm, height-distribution histogram covers the range 100-600 nm.

Fig.2 shows three-dimensional images and height distribution histograms of dental filling Charisma, Filtek and Dipol materials.

Height of majority micro-hills on dental filling Charisma surface is 230 nm and height-distribution histogram covers the range 100-250 nm. Height of majority micro-hills on dental filling Filtek surface is 380 nm and height-distribution histogram covers the range 200-500 nm. Heights of majority micro-hills on dental filling Dipol surface are 445 nm and 490

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nm and height-distribution histogram covers the range 100-750 nm.

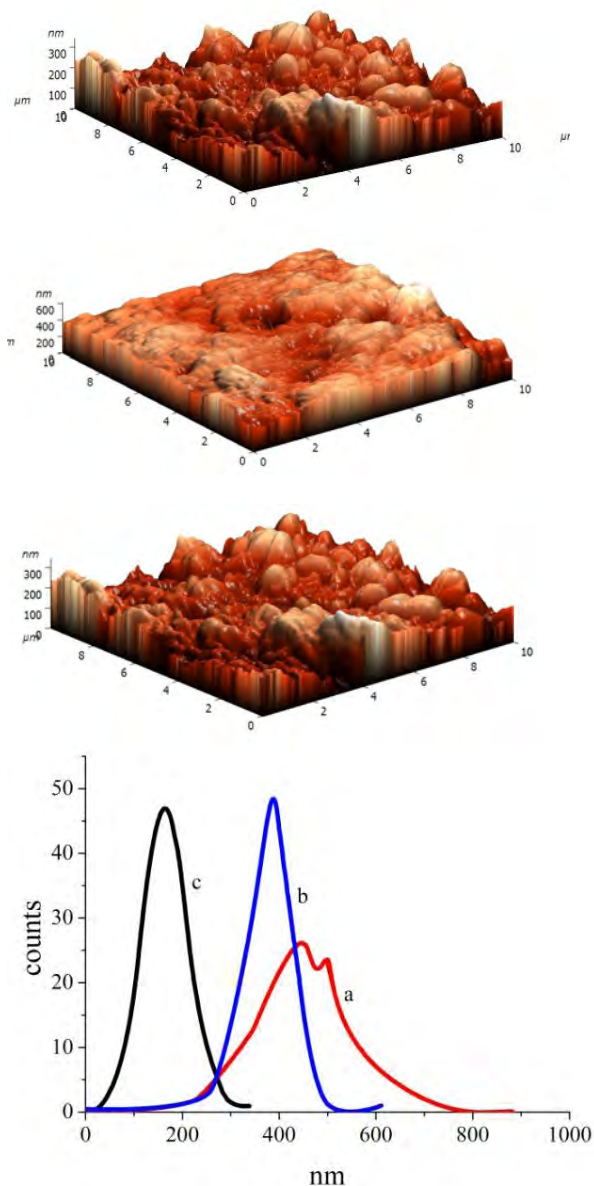


Fig. 2 Three dimensional images and height distribution histogram of dental filling materials: Dipol (a), Filtek Z250 (b) та Charisma (c).

From the analysis of three-dimensional surface images of dental materials it was found dental materials Dipol is more rough (Table) surface and has large spread of the height distribution (Fig.3). Charismas surface is much smoother than others (Table) and has less spread of the height distribution (Fig. 3).

Table. Surface roughness of photopolymer composite materials.

Materials	Charisma		Filtek Z250		Dipol	
	dental inlay	dental filling	dental inlay	dental filling	dental inlay	dental filling
Average roughness, nm	35,5	40,1	42,6	44,53	76,36	82,8

a

b

c

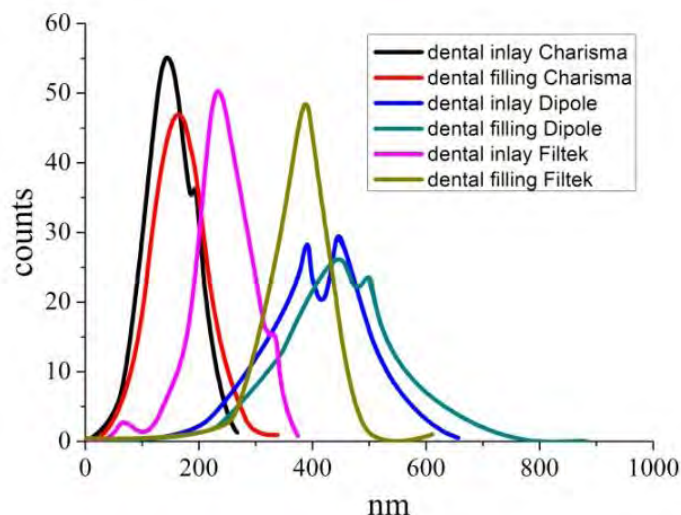


Fig. 3 Surface height distribution histogram of dental materials: Dipol, Filtek Z250 та Charisma.

Moreover, dental inlay Charisma characterized by better surface properties. Moreover, thermal handling slightly improves the smoothness of the surface. Thus, photopolymer composite material Charisma is better for practical dental application.

IV. CONCLUSION

Surface morphologies of photopolymer composite dental material Charisma, Filtek Z 250 and Dipol were investigated. It was shown that surface of Charisma is the smoothest and thermal handling improves the dental surface.

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