Nanostructured surfaces

Formation of the nanostructured surface layer of the Co-Cr-Mo alloy by the high-energy processing

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The formation of the structure and chemical composition regularities of the dental Co-Cr-Mo alloy surface layer after laser treatment and sandblasting was investigated. The Co–Cr–Mo alloy named as "Bondi–Loy" was manufactured by Krupp Medizintechnik GmbH, Germany. According to the chemical certificate the alloy composition is 64.5 at.% Co, 29.7 at.%Cr, 3 at.% Mo, 0.7 at.% C, 1.4 at.% Si and 0.7 at.% Mn.

Samples were irradiated in argon atmosphere with Nd:YAG laser (λ = 1.06 μm). The surface morphology and nanostructure were studied by Scanning Electron Microscope and Transmission Electron Microscope. It is established that the heterogeneity of the chemical composition in the plane of the melted surface is associated with different rates of the recrystallization and the surface segregation of the alloy elements during laser irradiation. Laser treatment of the Co-Cr-Mo alloys leads to the formation of the periodic surface relief ring wave period depends on the power density of the laser irradiation. It was first observed the formation of the nanocrystallites with the symmetry axis of the fifth order.

Sandblasting was carried out at the instrument Heraues Combilabor Kulzer CL-FSG94 which is widely used in dental practices. Samples were processed powder of pure corundum, particle size – 250 μm and 125μm. It has been founded that the sandblasted surface layer is enriched oxide, without implanting particles Al_2O_3. The thickness of nanostructured surface layer was 5 μm. Grain size increases monotonically from 30 nm to 90 nm in depth. Formation of nanostructures due to three important factors: 1) a high degree of deformation; 2) high-speed deformation (estimated at about $10^3 – 10^4$ s^{-1}); 3) multidirectional shock load that is repeated. As a result of the formation more perfect nanostructured surface layer was significant improvement of Co-Cr-Mo alloy corrosive properties, which suggests increase its biocompatibility.