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Surface chemistry vs surface topography. What is important for metallic and polymer implants?

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One of the most important characteristics of the metallic and polymer implants for bone substitution is a possibility to establish a close contact with bone tissue. This contact is formed owing to physicochemical processes including formation of chemical bonds at the implant/bone interface and micromechanical integration of bone tissue with the implant surface. It is well known that chemical composition, surface topography, and roughness play an important role in implant osseointegration, but little is known which factor and the extent to which influence biological responses. Four groups of titanium samples with different values of roughness mean square (R_a) in the range of 0.3-100 mm were obtained by sand blast treatment, cold spraying, electro spark alloying, and selective laser synthesis. To change surface chemistry, the part of samples was covered by thin multifunctional bioactive nanostructured TiCaPCON films. The samples were characterized in terms of their structure, surface topography, open porosity, wettability, and biological properties. The data obtained suggest that the elemental composition of the substrates plays an important role at different stages of interaction between osteoblasts and the substrate surface. It was also shown that that the modification of the PTFE surface by the deposition of TiCaPCON films with and without stem cells is an effective way to improve the chemical and mechanical characteristics of polymer implants and provide them with a high osseointegration potential. Particular attention was paid to study the influence of ion etching and ion implantation, which are widely used for surface treatment to improve film adhesion, on the cytotoxicity of PTFE. It was shown that, unlike the ion implantation, the ion etching results in the destruction of the polymer and in the appearance of the cytotoxicity.

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