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Nanostructured Ti surfaces by low-energy ion-beam irradiation

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Titanium is of high interest for biological and medical applications, since it has superior physical properties as low-weight, resistance against corrosion and a considerable strength, which can be easily combined with the outstanding nature of high bio-compatibility of titanium oxide via simple surface oxidation of a titanium device. Nano-patterning is a powerful method for customization of the surface properties to gain a substantially increased effective surface size, a specific local shape, or a defined surface periodicity. Hence, the combination of a controllable inorganic surface based on titanium together with functionalized molecules or specific bio-species bears a great potential for innovative future applications [1]. A flexible processing tool to fabricate different kinds of nanostructured surfaces in form of ordered fields of nano-dot or nano-ripple structures is ion-beam erosion by low-energetic ions (<1.5keV) [2]. Deterministic processing by scanning a narrow ion-beam with a typical size of 5 mm over a sample area allows a homogeneous nanostructuring onto a broad device surface. Moreover, applying a 4-axis motion system for device positioning also complex formed surfaces can be precisely machined. We applied this technique to create differently shaped nano-ripple structures on polished titanium surfaces. The morphology was analyzed by optical microscopy, atomic force microscopy, and secondary electron microscopy. Ordered nano-ripples with saw-tooth cross-section were fabricated with a structure period of 20 – 200 nm and a height of 10 – 70 nm. Furthermore, the local crystal structure was determined by electron back-scatter reflection experiments. The ripple morphology was found to be strongly correlated to the crystallographic orientation of the titanium grain structure.

[1] J. P. L. Gonçalves et al.: Beilstein J. Org. Chem. 10, 2765–2773 (2014)

[2] F. Frost, B. Ziberi, A. Schindler, and B. Rauschenbach: Appl. Phys. A 91, 551–559 (2008)

Keywords

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