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Nanotopographic microdomains on Ti alloys by sequential ion beam irradiation and wet etching

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The multiscale topography of Ti alloys (and especially Ti6Al4V) has been studied extensively as a way of conditioning cell adhesion and biocompatibility. In the present work, we have induced the modification of Ti alloys at the micro and nanoscale by using selective ion beam irradiation with Si ions at 5 MeV and wet etching in HF solutions. The selectivity is induced by the irradiation through a microstripe micropattern, which modifies the susceptibility of the Ti to the acid solutions and gives rise to 1D microscale distributions of nanorough areas. The susceptibility can be predicted by using ellipsometry, since a thin passivation oxide layer progresses on the Ti alloy in agreement with the applied fluence within the submonolayer to monolayer range. The resulting micropatterns are also a function of the wet-etching solution and immersion time. Both field effect scanning electron microscopy and atomic force microscopy confirm that the contrast between the irradiated and non irradiated areas consists of an additional nanorough background. The consequences on the biological response of the surfaces have been studied by water contact angle measurements and incubation of serum proteins and interrogation by optical and infrared spectroscopy. At cellular level, the patterns are able to induce guidance, which sustains that the Ti alloys could be attractive substrates for the analysis of cells response to drugs under non voltaic polarization.

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