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Direct submicron patterning of titanium for bone implants

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Abstract

Recent research evidences the strong modulatory role of controlled submicron and nanoscale topographies on stem cells fate. To harness these physical surface cues for clinical applications, fabrication of nano- and submicron patterns on clinically relevant biomaterials is greatly needed. In this study, an electron beam lithography method for direct patterning (i.e., no use of masters/imprinting steps) of titanium in the submicron range was developed. The process required the use of an etch mask consisting of a double layer of SiO_2 and Al, and the positive AR P-6200.04 electron beam resist. An optimum electron beam dose of 288 $\mu C/cm^2$ was established for writing the desired patterns. The transfer of the patterns into the titanium substrates was achieved by three different steps: inductively coupled plasma etching of the mask in BCl_3/Cl_2 followed by reactive ion etching of titanium in $SF_6/CHF_3/O_2$ and a final wet etch of mask residue. Highly ordered arrays of titanium pits with submicron diameters were produced with high reproducibility. This method provides great versatility in pattern design, direct transfer