In vitro response of osteoblast to ion beam micro/nano fabricated polymeric substrate

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Cell-material interactions involve a couple of phases. The first phase includes cell attachment, adhesion and spreading. The quality of this first phase will further affect the cell's capacity of proliferation and differentiation. Surface characteristics of materials, such as topography, chemistry and surface energy, play an essential part in osteoblast function on biomaterials. While surface free energy influences cell adhesion, chemistry and surface topographic properties are of importance for cell spreading and growth. In this study we employed Masked Ion Beam Lithography (MIBL) as an alternative microfabrication method. The advantage of this technique is that the patterns can be engraved into the polymer in a controlled manner, and at the mean time, by selecting the right ion to implant, the surface chemistry of the material can be tailored. In our preliminary study, poly(methyl methacrylate) film was used as a model system and subjected to Ca^+ and P^+ ion implantation through masks. Implantation was performed at an energy of 85 keV, with a fluence of $1x10^{14}$ ions/cm^2 for Ca^+, $1x10^{15}$ and $1x10^{16}$ ions/cm^2 respectively in the case of P^+. Arrays of uniform holes were produced, and AFM showed that these holes have depth of nanoscale and width of microscale. Contact angle measurements inferred changes in surface hydrophobicity as a result of ion irradiation. To evaluate cell response to surface topography and surface chemistry, rat calvarial osteoblasts were cultured on the ion implanted PMMA films. The cells were seeded at a density of 10,000 cells/cm^2. Adhesions of osteoblasts to the films after 24 hr culture were assessed using phosphor-screen autoradiography technique. Results have shown preferred and increased nucleation sites on the Ca^+ and P^+ ions implanted PMMA films as compared to unmodified PMMA films.

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