World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:11, No:01, 2017

Submicron Laser-Induced Dot, Ripple and Wrinkle Structures and Their Applications

Authors : P. Slepicka, N. Slepickova Kasalkova, I. Michaljanicova, O. Nedela, Z. Kolska, V. Svorcik

Abstract : Polymers exposed to laser or plasma treatment or modified with different wet methods which enable the introduction of nanoparticles or biologically active species, such as amino-acids, may find many applications both as biocompatible or anti-bacterial materials or on the contrary, can be applied for a decrease in the number of cells on the treated surface which opens application in single cell units. For the experiments, two types of materials were chosen, a representative of non-biodegradable polymers, polyethersulphone (PES) and polyhydroxybutyrate (PHB) as biodegradable material. Exposure of solid substrate to laser well below the ablation threshold can lead to formation of various surface structures. The ripples have a period roughly comparable to the wavelength of the incident laser radiation, and their dimensions depend on many factors, such as chemical composition of the polymer substrate, laser wavelength and the angle of incidence. On the contrary, biopolymers may significantly change their surface roughness and thus influence cell compatibility. The focus was on the surface treatment of PES and PHB by pulse excimer KrF laser with wavelength of 248 nm. The changes of physicochemical properties, surface morphology, surface chemistry and ablation of exposed polymers were studied both for PES and PHB. Several analytical methods involving atomic force microscopy, gravimetry, scanning electron microscopy and others were used for the analysis of the treated surface. It was found that the combination of certain input parameters leads not only to the formation of optimal narrow pattern, but to the combination of a ripple and a wrinkle-like structure, which could be an optimal candidate for cell attachment. The interaction of different types of cells and their interactions with the laser exposed surface were studied. It was found that laser treatment contributes as a major factor for wettability/contact angle change. The combination of optimal laser energy and pulse number was used for the construction of a surface with an anti-cellular response. Due to the simple laser treatment, we were able to prepare a biopolymer surface with higher roughness and thus significantly influence the area of growth of different types of cells (U-2 OS cells).

Keywords : cell response, excimer laser, polymer treatment, periodic pattern, surface morphology
Conference Title : ICAMN 2017 : International Conference on Advanced Materials and Nanomaterials
Conference Location : Sydney, Australia
Conference Dates : January 26-27, 2017