Effect of process and material disturbances on the response of biomaterial surfaces functionalized via laser surface texturing

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Surface functionalization has become an important consideration in designing innovative products with high commercial impact. It allows new properties to be embedded into the underlying substrate material, for instance turning hydrophilic surfaces into super hydrophobic [1], or the enhancement of existing properties such as improving the biological response of Titanium alloys [2]. Laser Surface Texturing (LST) offers a number of advantages over available surface functionalization processes, namely it can be applied selectively on freeform surfaces of most engineering materials. In addition, relatively high processing speeds with high accuracy, repeatability and reproducibility could be achieved at relatively low cost without the use of harmful chemicals. In a previous study crossed Laser Induced Periodic Surface Structures (LIPSS) have been applied to improve the Saos-2 osteoblast-like cell growth on polished CoCrMo surfaces without compromising the initial cell adhesion that is a common characteristic of rougher surfaces. Having established that LST, LIPSS in particular, is a suitable technology for modifying implants' surfaces it is essential to investigate and determine the process limitations. This is especially necessary when modifying freeform surfaces, which are common in most implant designs. When working with such complex 3D surfaces, processing and material disturbances that are not present in processing planner surfaces become important factors affecting the LST overall performance and may lead to deterioration and ultimately losses of targeted functionalities. This research reports an investigation into the effects of process and material disturbances, i.e. incident angle variations, focal offsets and initial surface quality, on the response of LST CoCrMo surfaces. In particular, the static water contact angle and Saos-2 osteoblast-like cells proliferation was studied on such surfaces. The incident angle variations and the focal offsets proved to be significant factors affecting the surface functionality. No strong correlation was found between CoCrMo disks' water contact angle and Saos-2 cells proliferation.

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[2] Ma, Q.L., et al., *Improved implant osseointegration of a nanostructured titanium surface via mediation of macrophage polarization.* Biomaterials, 2014. **35**(37): p. 9853-9867.