Basic Concepts in Cell-Materials Crosstalk at Nanoscale

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Abstract

In the last 15 years nanotechnologies have been largely applied to develop novel functional biomaterials. The key-challenge is to succeed in building functional biomaterials-cell interfaces able to control cell activities and direct their fate, i.e., in short, able to globally manage the cell–material crosstalk. In this framework, the basic objective consists in identifying which nanoscale surface factors are intrinsically relevant to the cellular processes, providing the elements of the cell–material communication code. This Lecture is therefore aimed to set the basic landscape, by focusing the attention on the material surface properties at nanoscale which have been reported to affect the strength and the nature of the cell–material interactions (participating in the same material–cytoskeleton crosstalk pathway via adhesion plaque), including topography, confined biological cues, mechanical and electrical properties. Among the many possible forms of surfaces nanostructuring, the Lecture will further suggest a few examples of self-structuring, patterning and nano-confinement as well as strategies to obtain the biomolecule "orientation", as propaedeutic steps to construct multifunctional bioactive platforms, integrating different possible biological actions. Finally, the concepts of "cell instructive" and "programmable" surfaces will be shortly discussed. Keywords: cell–material interaction; biomaterials; biomolecular signals; topography; cell adhesion; patterned substrates

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