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Nanostructured conducting polymer devices for tissue engineering.

E. Moyen[1], E. Ismailova[1], A. Hama[1], I. Ozerov[2], M. Hanbücken[2], G. G. Malliaras[1], R. M. Owens[1];

[1]Bioelectronics, Ecole des Mines de St. Etienne, Gardanne, France,

[2] UMR 7325, Université Aix-Marseille; CNRS, Marseille, France

The ability to control the microenvironment around a cell offers tremendous value in understanding life processes. Cell–cell and cell-microenvironment interactions regulate cell behavior, however, the underlying biological mechanisms remain poorly understood. Cells cooperate with their environment by interacting with neighbouring cells, with their surrounding extracellular matrix and by communicating through secreted soluble factors. Typically, these interactions are well-coordinated, but perturbation of the underlying cellular and molecular interplay may affect intracellular signalling pathways, immunological reactions and tissue homeostasis.

The triggering of the eventual fate of the cell is mediated through chemical cues from the adsorbed proteins and physical cues such as surface energy, stiffness and topography. For example, it has recently been shown that a gradient of surface energy, obtained by applying a bias to conducting polymer, can lead to a gradient in cell density [1]. It is also known that nano-topography [2] and stiffness variations [3] affect cell proliferation, death, differentiation or migration. Interestingly, stiffness modifications can be induced by nano-topography, the ability of nano-pillars to bend defining an effective stiffness [4]. We have achieved the fabrication of such nanotopography by fabricating pores or pillars in conducting polymers over large areas, using porous aluminum oxide membranes as a template. This enables the development of electrically active devices combining topography, stiffness and surface energy control to investigate cell-substrate interactions and cell migration. We report on the fabrication of such devices and show the results of their interactions with cells.

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