BIO-SURFACE ENGINEERING FOR CELL ADHESION STUDIES

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Cell adhesion to biomaterials is an important prerequisite of tissue cells in successful incorporation of implants or scaffolds for tissue engineering. The understanding of complex biological adhesion phenomena requires the development of biological materials and novel technologies. The ideal biological material should be amenable to design, versatile and easy to fabricate and analyze. In this regard, chemically microstructured surfaces have gained increasing attention in the cell biological biomaterial community in the past few years. There is a broad field of applications of microstructured substrates, ranging from tissue engineering through miniaturized biosensors, artificially designed neuronal networks, hybrid molecular electronics to microseparation. Several microfabrication methods for biological surface modification have been developed. For example, photolithography has often been used, and although it is a common method for microfabrication, its use for cell biologists is limited by the equipment and procedures required [1].

Our group is especially interested in the development of multifunctional bio-surfaces, mimicking cell membranes, for cell adhesion studies. The main goal of our research is the preparation of hybrid surfaces incorporating different concentration profiles or micropatterns of several biomolecules involved in cell migration, adhesion and proliferation. In our case the selected biomolecules are:

- RGD peptide: The Arg–Gly–Asp (RGD) peptide sequence is known as a cell recognition site for numerous adhesive proteins present in the extracellular matrix (ECM) and in blood. It has been demonstrated that surface immobilized RGD groups enhance cell attachment as this peptide is recognized by integrins, heterodimeric cell surface proteins [2].
- Carbohydrates: The surface of most types of cells is covered with a dense coating of glycoconjugates (glycoproteins and glycolipids), the so-called glycocalyx. Repulsive forces to prevent nonspecific adhesion of cells have been attributed to the glycocalyx. In some cell configurations, however, this repulsive barrier is counterbalanced by the formation of cell-cell contacts through attractive forces. Cell-surface oligosaccharides contribute to these specific contacts, mainly by interactions with proteins (lectins). In addition, there is now also evidence that cells use attractive forces between surface oligosaccharides as a mechanism for cell adhesion and recognition [3].
- Cadherins: These proteins are a class of type-1 transmembrane proteins, and they constitute one of the most important groups of cell adhesion receptors. These glycoproteins mediate cell adhesion and play a fundamental role in normal development. They participate in the maintenance of proper cell-cell contacts. Cadherins depend on calcium for their function [4].

Our group is developing different strategies for the incorporation of these biomolecules to the surfaces using a well known reaction called "click chemistry" [5]. This kind of reactions provides advantages like good yields, simple protocols, compatible with physiological conditions and, the most important for us, short reaction times. Very effective conjugation results have been obtained using an innovative catalyst. Our goal is, using this simple chemical strategy, to develop surfaces to study the synergetic effect of carbohydrates, cadherins and peptides on cell behaviour. Two different techniques are under exploration for the creation of micropatterns: Microcontact printing [6] and microfluidics devices [7] (figure 1).

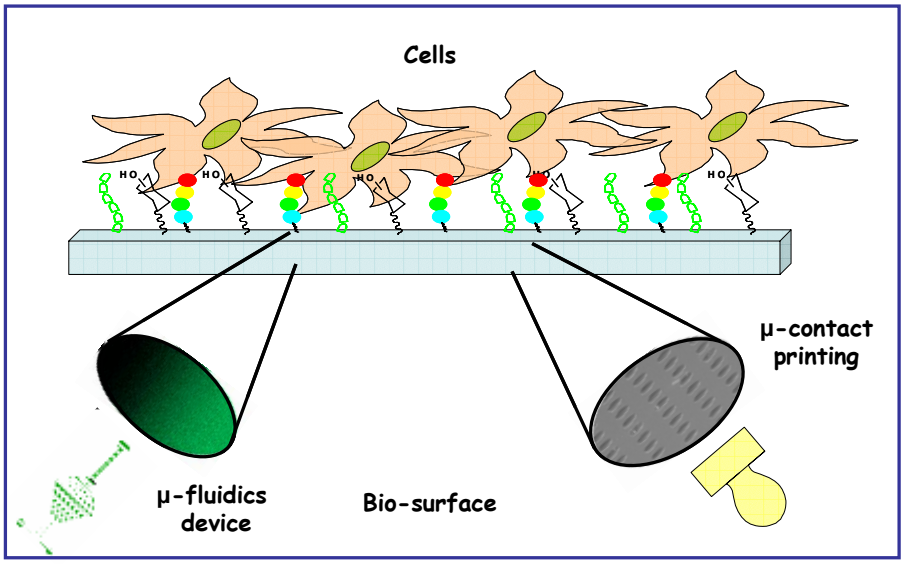

Figure 1. Cartoon representing the hybrid samples prensented in this work.

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