Cell Culture of Olfactory Neurons on Electrochemically Modified Surfaces

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In recent years, there has been a growing interest in electrochemistry as a tool for biological and biomedical applications. Indeed, many polymeric films, which can grow on an electrode surface by oxidation of a monomer, are interesting due to their biocompatibility.

For example, we show in this study that olfactory cells can grow on electropolymerized polyalkylenimine films previously coated on Fluorin doped Tin oxide (FTO) surfaces.

The first aim of this work was to determine which polymers could be useful for cell culture. Indeed, to be useful a polymer has to be biocompatible and to allow cells to adhere and then proliferate. Thus, we have synthesized four different biocompatible polymers (polyethyleneimine, polypropyleneimine, poly(p-phenylenediamine) and polypyrrole) on FTO surfaces using Cyclic Voltametry technique.

We used neuronal cells of rat to test the adhesion and the proliferation of these cells. So we put olfactory cells in contact with FTO surfaces, coated with the different polymers, in a culture medium. Then we let the olfactory cells adhere and during their growth we observed the evolution of their morphology using a confocal microscope (Figure 1) since FTO is a transparent semi-conductor surface which allowed us to follow the development of these cells. This qualitative observation allowed us to conclude that the development of the cells is normal.

Consequently our polymers are well biocompatible, and they allow cells to adhere and proliferate. More the adhesion rate (which is the number of cells sticked on the surface 8 hours after their immersion in the culture medium divided by the number of cells introduced in the culture medium) and the proliferation rates (which are the number of cells on the surface 24 and 72 hours after their immersion in the culture medium divided by the number of cells introduced) were calculated for each polymer in order to quantify and compare the ability of the olfactory cells to adhere and proliferate on the different polymers. These rates indicated that polyethyleneimine (PEI) and polypropyleneimine (PPI) are the best polymers to cultivate olfactory cells since those rates are far much higher than those obtained for polypyrrole (PPy), poly(p-phenylenediamine) (PPPD) or naked FTO and glass (Figure 2). So we proved that a FTO surface coated with PEI or PPI is a good substrate for the culture of olfactory cells.

Since we have already developed sensors [1,2] and microsystems [3] using polymer films coated on different surfaces and since we showed that the culture of olfactory cells is possible on surfaces coated with PEI and PPI, we want now to elaborate a microsystem using these polymers as cell culture supports. Thus, as each olfactory cell is able to recognize a specific odour, this microsystem will be used as a sensor of odour which can be very useful for water pollution control or drug's detection for example.

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[3] Lakard B., Herlem G., Fahys B., de Labachelerie M., Daniau W. and Martin G., *Proceedings of the Fifth International Conference on Microreaction Technology*, Springer-Verlag, Berlin, 561 (2002).

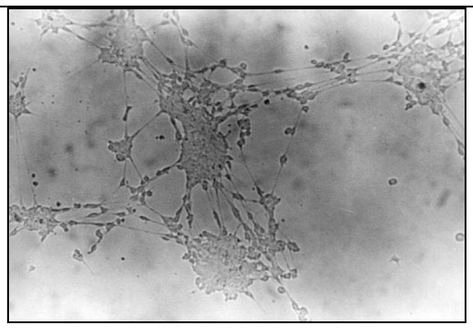

Figure 1: Image, obtained by Optical Microscopy, of Olfactory Cells cultivated on a FTO Surface coated with a Polyethylenimine Film

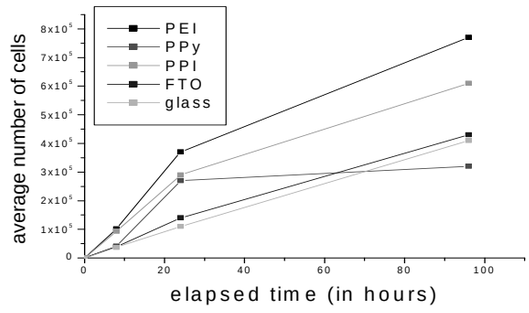

Figure 2 : Number of Cells as a function of the Elapsed Time since the Cells have been put in the Medium Culture

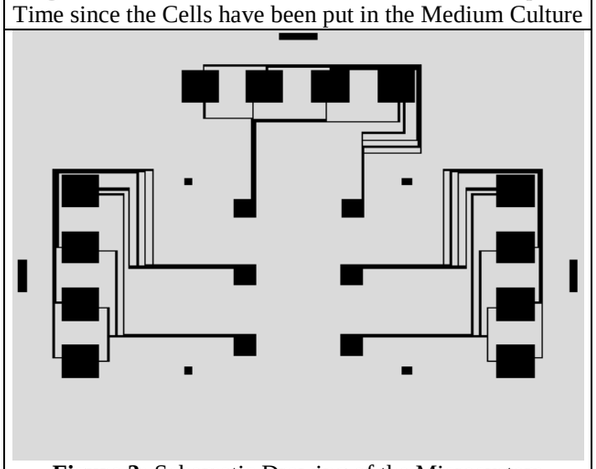

Figure 3: Schematic Drawing of the Microsystem