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FUNCTIONALIZED NANOSTRUCTURED CONDUCTING POLYMERS AS BIO-ELECTRONIC INTERFACES

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Nanotechnology is an emerging field having potential technological applications in various areas such as mimic biological systems, biosensors, drug delivery systems, conducting polymers and so on. Nanostructured materials can be performed using the template synthesis[1] technique which allows the formation of a compound inside the pores of a nanoporous membrane. The nanostructured substrates show high electronic conductivity due to their ordered structure.

We report herein the results on the electrochemical synthesis of redox polymers, based on polypyrrole (Ppy) and biologically active compounds (such as Heparin and Hyaluronan derivatives HA) inside the pores of an alumina inert membrane (Fig.1). These materials[2-3], which combine biological activity with electrical properties, represent an excellent substrate for the development of biocompatible 3D scaffolds for specific cell functions. By controlling the nature of the doping anions and the polymerization time, we can control the thickness of the Ppy along the pore walls of the template membrane. The kinetics and mechanism of charge transport in the nanostructured polymers can be studied using the usual electrochemical techniques.

Studies on the interactions between polymers and redox proteins such as Cytochrome-c indicate that the absorption on the electrode surface may be inactive and irreversible[4]. Only if the protein retains its native redox potential, we could suppose that it also maintain its structural and functional characteristics. The Ppy-Hep nanotubes here described represent an excellent substrate for protein surface interaction. Moreover, the absorption of metalloproteins on the electrode has been probed to be a useful technique to minimize the electron transfer reactions into the cellular membrane. In fact, these proteins need a highly organized molecular structure to perform the vectorial electron transfer toward other membrane components. In this respect, nanotubes of conductive polymers give the protein a high spatial orientation toward the electrode and eventually other species in the film or in solution.

Due to the favorable characteristics shown by the Ppy-Hep and Ppy-HA substrates, we may hypothesize that these nanostuctured conductive polymers may emerge in different areas[5]. The possibility to modulate the shape and the structures (pore size distribution and thickness) candidates the nanoporous materials as successfully tools in molecular medicine.

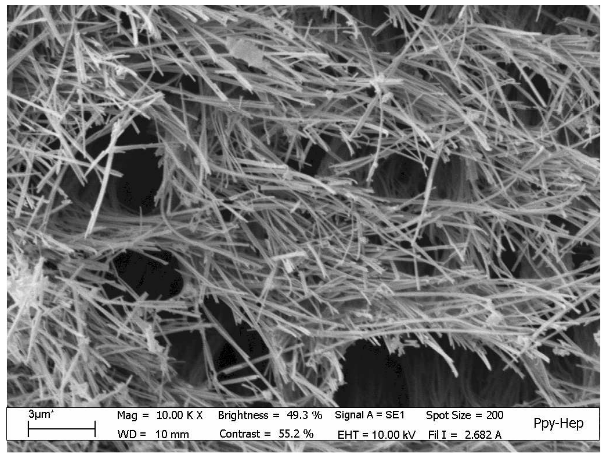

Fig.1 Scanning electron micrograph of Ppy Heparin nanotubes.

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