Conducting polymers and composite hydrophilic biopolymers: new approaches to produce biomimetic systems

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The need to produce new biomaterials for a wide range of applications, including artificial muscles, neural interfaces and biosensors, is driving the attention of the scientific community towards the class of conductive polymers (CP) and of hydrophilic biopolymers.
As regards the CPs, due to their intrinsic conductivity, the good charge-transfer properties and the low impedance, they can be used as coating of implantable electro-stimulation electrodes providing interfaces suitable to improve soft-tissue integration [1].
Moreover the volume changes induced by the charge-compensating ions flowing into or from their backbone during oxidation/reduction processes, make CP promising electrochemomechanical systems to be explored for production of artificial muscles [2,3].
We present here the realization of innovative bio-electrodes , based on Titanium sheets coated with conductive and boron free diamond films onto which thin layers of different CP (polyaniline, polypirrole, polythiophene) have been subsequently electrodeposited.
Structural and morphological features as a function of process time, applied potential or current flow through the sample have been investigated performing cyclic voltammetry experiments simultaneously to topographic imaging by means of electrochemical atomic force microscopy technique. The conformational movements produced by the re-organization of double bonds along the chains during CP redox reactions have been monitored and are proposed as possible new artificial motor systems [4].
In the scenario of new materials, also the development of nanocomposites based on hydrophilic biopolymers and nanostructured carbons is considered a compelling task. In our labs nanocomposite layers made by PVA and oxidized graphene (GO) platelets have been prepared by an innovative procedure in which the in situ cross-linking of vinyl alcohol with maleic anhydride is carried out in the presence of the carbon filler [5].
The composite eco-friendly and biodegradable material shows enhanced mechanical and electrical properties with respect to pure PVA . The high processability , the facility of casting and of film forming , coupled with the high flexibility and the totally reversible stretchability under dry conditions and in the swollen state , make the PVA/GO nanocomposites promising bio-mimetic model materials .

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