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Polyaniline-Coated Electrospun Fibers for Electrochromic Applications

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Extended Abstract

The electrospinning technique has an important role in the field of nanomaterials and nanodevices due to the possibility of obtaining submicron fibers with good mechanical, optical and chemical properties which make them suitable for various uses, starting from medical to electronic applications (Bhardwaj N., Kundu S.C., 2010).

Moreover, electrochromism is a characteristic of materials which allows changing the optical properties due to the redox reactions that occur when a voltage is applied (Wan M., 2008).The corresponding devices can be used in many potential applications, like displays, windows and sunglasses. Until now, the most used electrochromic material was tungsten trioxide. Recently, inorganic oxides were replaced with organic polymers, such as polypyrrole, polyaniline, polythiophene and their derivatives, due to the large number of switching cycles, high contrast during the switching process, electrochromic memory and long stability (DeLongchamp D., Hammond P. T., 2001). In this context, polyaniline (PANI) is a conducting polymer with very good switching properties due the quick protonation/ deprotonation of polymer backbone in the presence of an electrolyte which can be solid (solid polymer electrolytes), liquid (sulfuric acid or lithium perchlorate solution) or gel (poly(methylmetacrylate) based gels) (Sequeira C., Santos D. (2010)). This polymer has associated three oxidation states on which conductivity and colour of material depends. PANI films can be filed on diverse substrates, starting from the monomer, by chemical method or by electrochemical polymerization in the presence of an oxidant agent where aniline exists as a cation (Lee J.H. et al., 2009).

By combining the electrospinning technique with electrochromic properties of PANI, we synthesized fiber meshes with good characteristics in terms of optical transmittance, sheet resistance and response time. Therefore, in this work we focused on developing a new electrochromic device which combines the advantages of both methods: high surface-to-volume ratio, controlled morphology, composition and shapes, colour variety and flexibility. Thus, poly(methylmetacrylate) fibers with nanometric diameters were obtained by electrospinning a precursor solution and solid nonwoven meshes being collected on copper frames. Further, a gold layer was sputtered on the resulting webs in order to make them conductive and improve the mechanical properties. The metalized fiber networks were then covered with a PANI layer by *in situ* electropolymerization starting from the monomer. During the deposition step, the gold-covered fibers act as working electrode, while platinum plate was used as auxiliary electrode and saturated calomel as reference. For the assessment of the device optical properties, an electrochromic cell with three electrodes was fabricated, where PANI-coated fiber webs were employed as working electrode, platinum wire as counter electrode and Ag/AgCl wire as reference.

Hence, we propose a combined method for fabrication of nanometric fiber-based electrochromic devices with reproducible characteristics by using inexpensive starting materials and low power consumption. Such systems can be easy integrated in other applications like tissue engineering or sensors.

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