NANOLAYERS FOR OPTOELECTRONIC DEVICES BASED ON PEDOT FORMULATIONS IN ORGANIC MEDIUM

[1]Salsamendi, M.;[1] Pozo-Gonzalo, C.[*]; [1]Pomposo, J.; [1]Marcilla, R.; [1]Mecerreyes, D.; [1] Rodriguez, J.; [2]Bolink, H.

[1]*CIDETEC, Paseo Miramón, 196, San Sebastián, Spain*
[2] *Instituto de Ciencia Molecular (ICMoI), Universidad de Valencia, P.O. Box 22085, 46071 Valencia ,Spain.*

cpozo@cidetec.es

Polymer electronics has attracted a lot of attention in the past decade due to potential applications in novel optoelectronic devices such as organic light emitting diodes (OLEDs), photovoltaic (FV) and electrochromic (EC) devices.[1] The main reason for using conducting polymers in polymer electronics is related to light weight, high flexibility and the possibility of manufacturing all-plastic devices.[2] Intrinsically conducting polymers (ICPs) have received a great deal of investigation due to the important properties such as high conductivity, low cost and weight, and mechanical durability.[3] From all conducting polymers, polythiophenes are one prominent class of ICPs present in the market due to the high stability to moisture in both doped and undoped state. Specially, a derivative from polythiophene, poly(3,4-ethylenedioxythiophene) (PEDOT), has emerged as a promising material for optoelectronic devices due to many advantageous properties such as high transparency in the visible range, excellent thermal stability, electric conductivity and optoelectronic performances.[4,5,6] Current issues under investigation are the improvement in processability, for instance attaining conducting polymers soluble in organic solvents (formulations), enhancement of the electrical conductivity of the films, as well as the tuning of the hydrophobic/hydrophilic properties.
In this communication, we report some of our work related to the synthesis of novel PEDOT formulations for different optoelectronic applications[7] such as transparent electrodes, organic light emitting diodes and electrochromic devices (Figure 1).

a) b) c)

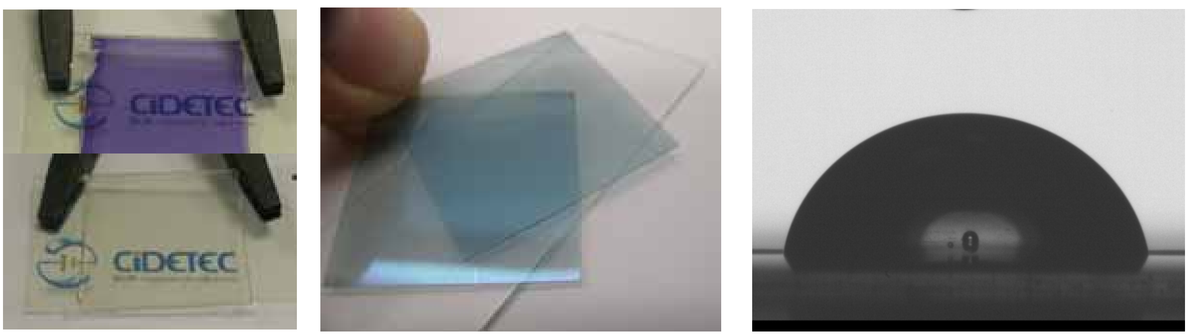

Figure 1 Nanolayers for optoelectronic devices prepared at CIDETEC. a) Electrochromic device prepared on plastic substrate, b) transparent and conductive layer based on PEDOT on plastic substrate, c) hydrophobic character of PEDOT formulations on plastic substrate.

Hence, commercial PEDOT:PSS formulations in water have been modified using water soluble ionic liquids as secondary dopants to enhance the conductivity in order to replace traditional ITO as transparent electrode.[8] Nanolayers of pure PEDOT:PSS (Baytron P HC V4) prepared by spin coating showed an average conductivity of 14.5 S/cm, which upon addition of a minor percentage of ionic liquid based on imidazolium cation was significatively enhanced to give a final value of 136 S/cm. Furthermore, PEDOT formulations in organic solvents such as acetonitrile and dimethylformamide have been prepared using stabilizers based on poly (1-vinyl imidazolium) (typical particle size < 50 nm). Several formulations have been developed depending on the final properties desired. These organic formulations have been electrochemically characterised and successfully tested in both OLEDs[9] and electrochromic devices[10] with promising results. The most relevant ones include optical contrast as high as 44% in the visible region with switching time in the order of seconds for electrochromic devices, conductivity in the range of $10\text{-}10^{-3}$ S/cm and increased hydrophobic character of the optoelectronic nanolayers.

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