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Nanofibrous Polymeric Ionic Liquid Formed by the Electrospun Process as Quasi-Solid Electrolyte for a WO_3/Prussian Blue Electrochromic Device

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The polymeric ionic liquid (PIL) is considered as a versatile material, mainly due to its nonflammability, nonvolatility as well as excellent electrochemical and thermal stabilities. PIL plays an indispensable role as an ionic conductor in various electrochemical devices. In this study, a quasi-solid-state electrochromic device (ECD), consisting of tungsten trioxide (WO_3) as the cathodically coloring material and Prussian blue (PB) as the anodically coloring material, was fabricated. PIL, which is composed of nanofibers (NF) of poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) and poly(oxyethylene)-imide imidazolium perchlorate (POEI-$IClO_4$), was used to absorb lithium perchlorate and propylene carbonate to form the quasi-solid electrolyte. The nanofibers were characterized by scanning electron microscope (SEM) images. The electrolyte uptake and porosity of the nanofibers were determined. The ionic conductivity and diffusivity of the electrolyte was studied by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). CV and *In-Situ* potential-UV-Vis absorption spectra were utilized to find the safe operating voltage of the ECD. The electrochromic performance, including the dynamic transmittance responses and stability of the ECD, was also studied by the potential-UV-Vis absorption spectra. The SEM images show the average diameter of nanofiber is 551 nm. According to the CV data, the redox peaks were observed -0.7 and 0.8 V. The ECD offered a transmittance change of 42.36% at 650 nm, with response times of 15 s for bleaching at -0.8 V and 1 s for coloring at 1.5 V. As for the durability test, the retention percentage of the transmittance change remained 99.1% of its original value at 650 nm after 500 cycles, thus the proposed ECD is expected to offer sufficient stability. It is concluded that the structure and function of PIL NFs not only improve the response time but also the long-term stability of the ECD.

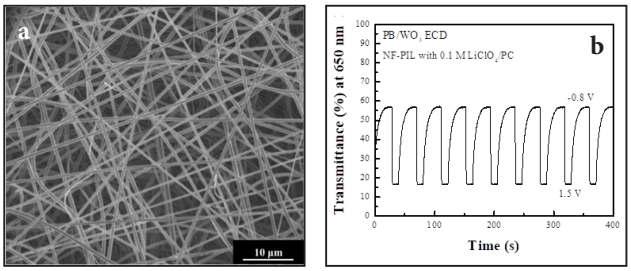

Figure (a) SEM image of nanofibers, (b) dynamic transmittance at 650 nm for the PB/WO_3 ECD using NF-PIL with 0.1 M $LiClO_4$/PC as a quasi-solid electrolyte.

Biography

Hsin-Fu Yu received his BS and MS degrees in Department of Chemical Engineering from the National United University, Taiwan in 2012 and 2014, respectively. He is currently a Ph. D candidate under the supervision of Prof. Kuo-Chuan Ho in Chemical Engineering Department at the National Taiwan University. His research focuses on the application of electrochromic materials and devices, with particular attention to organic synthesis and electrospinning process.