A COMPLEMENTARY ELECTROCHROMIC DEVICE CONTAINNING 3,4-ETHYLENEDIOXYTHIOPHENE AND PRUSSIAN BLUE

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A new organic-inorganic complementary electrochromic device (ECD), assembling with poly(3,4-ethylenedioxythiophene) (PEDOT) and Prussian blue (PB), is presented. PEDOT is a well known electrically conducting polymer with a good chemical and electrochemical properties [1]. It has applications in many fields such as antistatic films [2], capacitors [2], and electrochromic devices [3]. On the other hand, PB is also proven to have good cycle life in organic solvent [4]. In this work, an organic-inorganic ECD (ITO/PEDOT/GPE/PB/ITO) is proposed by assembling PMMA-based gel polymer electrolyte (GPE:1M $LiClO_4$ +PC+10wt% PMMA).

The typical cyclic voltammograms of PEDOT and PB films in 1M $LiClO_4$+PC electrolyte are shown in Fig. 1. The Ag/Ag^+ reference electrode contained a solution of 0.01 M $AgNO_3$ and 0.1 M TBAP in acetonitrile is used. The color state of PEDOT film is deep blue at *ca.* -1.2V and the bleach state is light blue at *ca.* 0.0V. On the contrary, PB film is blue at its oxided state (*ca.* 0.4V) and colorless at its reduced state (*ca.* -0.9V). Thus, this system fulfills the complementary requirement. The absorbance spectra of the ECD at different applied voltages are shown in Fig. 2. It shows a saturated absorbance at *ca.* -2.1V (PEDOT *vs.* PB), and the lowest absorbance at *ca.* 0.6V. The ECD can be operated between -2.1 and 0.6V to obtain the largest transmittance window. The in-situ transmittances of the ECD measured at 600 nm with the application of potential steps of -2.1 and 0.6V are shown in Fig. 3. From this figure, the transmittance window ($\Delta T=T_{bleach}-T_{darken}$) of the ECD is *ca.* 50% and maintains constant for the first 200 cycles.

Additionally, the composite coloration efficiency [5] of the ECD at 600 nm is calculated to be *ca.* 471 cm^2/C. After 10^4 cycles testing, the transmittance window decays *ca.* 50%. The preliminary stability test also shows that the ECD remains relatively stable after 2 weeks at-rest. In summary, the ECD exhibits a high coloration efficiency with a ΔT of *ca.* 50%, good cycling and at-rest stabilities. It provides the possibility of exploring a hybrid organic-inorganic complementary ECD.

References:

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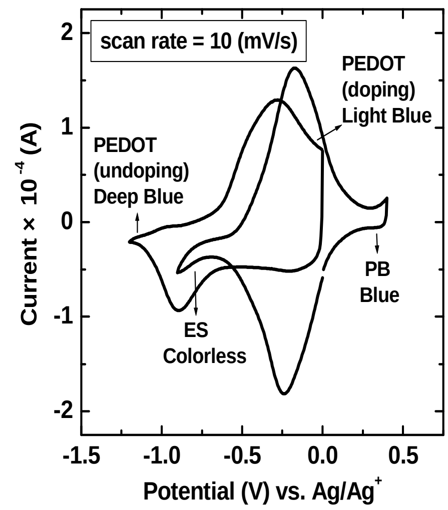

Fig. 1 Typical cyclic voltammograms of PEDOT and PB films in 1M $LiClO_4$+PC electrolyte at a scan rate of 10 mV/s.

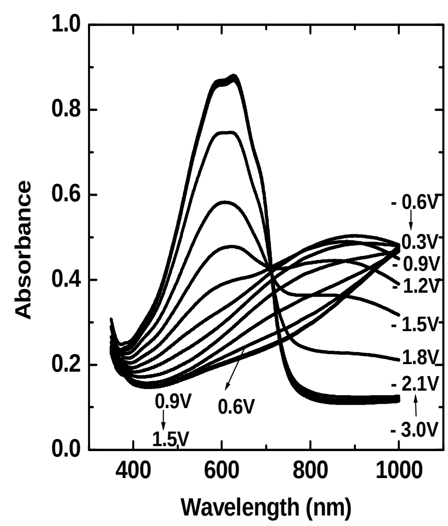

Fig. 2 Absorbance spectra of the ECD as a function of the applied voltage (PEDOT *vs.* PB).

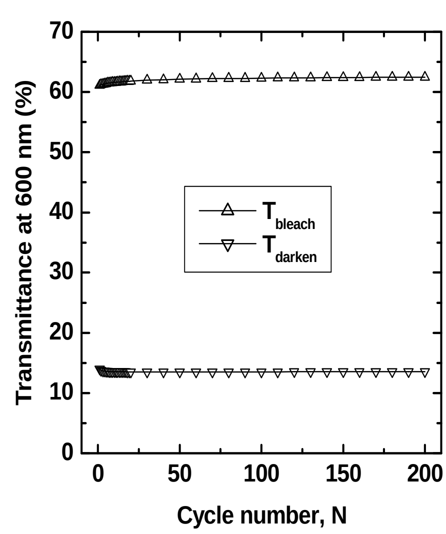

Fig. 3 Transmittances of the ECD at the bleached and darkened states as a function of cycling.