World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:11, 2016

Qusai-Solid-State Electrochromic Device Based on PolyMethyl Methacrylate (PMMA)/Succinonitrile Gel Polymer Electrolyte

Authors : Jen-Yuan Wang, Min-Chuan Wang, Der-Jun Jan

Abstract : Polymer electrolytes can be classified into four major categories, solid polymer electrolytes (SPEs), gel polymer electrolytes (GPEs), polyelectrolytes and composite polymer electrolytes. SPEs suffer from low ionic conductivity at room temperature. The main problems for GPEs are the poor thermal stability and mechanical properties. In this study, a GPE containing PMMA and succinonitrile is prepared to solve the problems mentioned above, and applied to the assembly of a quasi-solid-state electrochromic device (ECD). In the polymer electrolyte, poly(methyl methacrylate) (PMMA) is the polymer matrix and propylene carbonate (PC) is used as the plasticizer. To enhance the mechanical properties of this GPE, succinonitrile (SN) is introduced as the additive. For the electrochromic materials, tungsten oxide (WO3) is used as the cathodic coloring film, which is fabricated by pulsed dc magnetron reactive sputtering. For the anodic coloring material, Prussian blue nanoparticles (PBNPs) are synthesized and coated on the transparent Sn-doped indium oxide (ITO) glass. The thickness of ITO, WO3 and PB film is 110, 170 and 200 nm, respectively. The size of the ECD is 5×5 cm2. The effect of the introduction of SN into the GPEs is discussed by observing the electrochromic behaviors of the WO3-PB ECD. Besides, the composition ratio of PC to SN is also investigated by measuring the ionic conductivity. The optimized ratio of PC to SN is 4:1, and the ionic conductivity under this condition is 6.34x10-5 S•cm-1, which is higher than that of PMMA/PC (1.35x10-6 S•cm-1) and PMMA/EC/PC (4.52x10-6 S•cm-1). This quasi-solid-state ECD fabricated with the PMMA/SN based GPE shows an optical contrast of ca. 53% at 690 nm. The optical transmittance of the ECD can be reversibly modulated from 72% (bleached) to 19% (darkened), by applying potentials of 1.5 and -2.2 V, respectively. During the durability test, the optical contrast of this ECD remains 44.5% after 2400 cycles, which is 83% of the original one.

Keywords : electrochromism, tungsten oxide, prussian blue, poly(methyl methacrylate), succinonitrile
Conference Title : ICEECE 2016 : International Conference on Energy, Environmental and Chemical Engineering
Conference Location : Kyoto, Japan
Conference Dates : November 10-11, 2016