Development of PVP Based Electrolytes and Their Applications in Electrochromic Devices

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Electrochromism is a rapidly developing branch in applied material sciences due to their potential applications such as smart glass and display devices with low power consumption. Development and characterization of a Polyvinylpyrrolidone (PVP) based electrolytes and their applications in electrochromism were main aims of the present study. Several experimental methodologies such as AC impedance spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, UV-Vis spectroscopyand cyclic voltammetry were used to optimize and characterize the electrolyte and the titanium dioxide (TiO_2) based electrochromic device.Set of liquid electrolyte samples were prepared by dissolving LiCl salt in Ethylene Glycol (EG). The molar ratio of total oxygen of ethylene glycol to lithium ions of LiCl ($O:Li^+$) was varied from 5:1 to 60:1. The best ionic conductivity of 1.276×10^{-2} S cm^{-1} was obtained at room temperature for the liquid electrolyte sample with molar ratio of $O:Li^+$= 15:1. Gel polymer electrolyte (GPE) prepared by adding 130 wt.% of PVP into the optimized liquid electrolyte showed ionic conductivity of 5.58 x 10^{-4} S cm^{-1} at room temperature.Remarkable electrochromic properties of TiO_2/FTO film with a persistent color change from blue colour to bleach state and bleach state to blue colour have been observed.Optical modulation of 59.9% at 700 nm and switching speed of $t_{bleaching}$=14.0 s and $t_{coloring}$=26.0 s were observed for electrochromic devices with the configuration of FTO/TiO_2/GPE/FTO.Long term stability of the polymer gel electrolyte dropped due to the hydrophilic property of PVP and stable nitrogen and oxygen bonds with lithium ions.

Keywords: *Electrolyte, Electrochromic Device, Optical Modulation, Ionic Conductivity*