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Use of TiO_2 as electrochromic material with Chitosan gel polymer electrolyte in low cost electrochromic smart windows

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Since most of the efficient electrochromic devices (ECDs) consist of expensive rare earth materials such as Tungsten (VI) oxide, (WO_3) and Cerium (IV) oxide, (CeO_2) and liquid electrolytes comprising with volatile solvents such as acetonitrile, there exist some significant technological problems associated with the fabrication cost and the encapsulation of these devices. Therefore, there is a considerable interest in both the development of a solid or quasi solid electrolyte and replacement of these expensive materials with possible low cost alternatives. By considering these facts, we have explored the possibility of use of natural polymer, Chitosan (Poly D-glucosamine) containing Li^+ ions as the quasi solid polymer electrolyte and at the same time replacement of expensive WO_3 and CeO_2 with low cost Titanium dioxide (TiO_2) and Tin oxide (SnO_2) respectively as alternatives. The EC devices with dimensions, 2.1x1.4 cm^2 with configuration FTO glass/TiO_2/Chitosan polymer electrolyte /SnO_2/FTO were fabricated. Temperature dependence of DC conductivity of the polymer electrolyte, containing either $LiClO_4$ or $LiCF_3SO_3$ salts, was measured with varying the salt concentration. The best room temperature ionic conductivities found are in the order of $5.17x10^{-2}$ S cm^{-1} and 4.09 x 10^{-2} S cm^{-1} with corresponding lithium concentration 0.5M and 1M for $LiClO_4$ and $LiCF_3SO_3$ respectively. Electrochemical and optical properties of the electrolyte and ECDs were measured by cyclic voltammetry and UV-visible spectroscopy. The average transmittance in the visible region of the spectrum is about 58% at the bleached state and below 15% at the colored state for all the samples studied.

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