WO_3 Nanoparticle Single Doped With Ti and Co-Doped With Ti And Zn Thin Films: Enhancement of Electrochromic Properties

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Abstract

WO_3 nanoparticles doped with Ti ($W_{1-x}Ti_xO_3$) and co-doped with Ti and Zn ($W_{1-x}Ti_{x-y}Zn_yO_3$) have been prepared, on FTO/glass substrate, using wet chemical method (dipping in a sol-gel). The Ti molar concentration into $W_{1-x}Ti_xO_3$ ranges from 0-30 %. Best electrochromic properties were observed for composition that has Ti nominal concentration of 5 % ($W_{0.95}Ti_{0.05}O_3$). This was evidenced from measurements of cyclic voltammetry (CV), chronoamperometry (CA), and transparency during CA. The composition that gives best electrochromic properties ($W_{0.95}Ti_{0.05}O_3$) was chosen to prepare WO_3 nanocrystallite films co-doped with Zn for the first time ($W_{0.95}Ti_{0.05-y}Zn_yO_3$). The Zn molar concentration in these films varied from 1-5%. From CV and CA measurements, Co- doped WO_3 films showed better electrochromic performance than Ti single doped films. From co-doped films, the best electrochromic properties were observed for films that contains 4% of Zn ($W_{0.95}Ti_{0.01}Zn_{0.04}O_3$). The transparency spectrum of $W_{0.95}Ti_{0.01}Zn_{0.04}O_3$ electrode shows a high improvement in coloration efficiency compared to the coloration efficiency of $W_{0.95}Ti_{0.05}O_3$ electrode. The stability of the samples is also tested in 0.125 M H_2SO_4 electrolyte though cycling electrodes for at least 5000 cycles.