Enhanced electrochromic performance of organo-tungsten oxide films using organo-titanium oxides addition by low temperature-atmospheric pressure-plasma polymerization for flexible electrochromic device

Y.-S. Lin[1], P.-C. Chen[1]

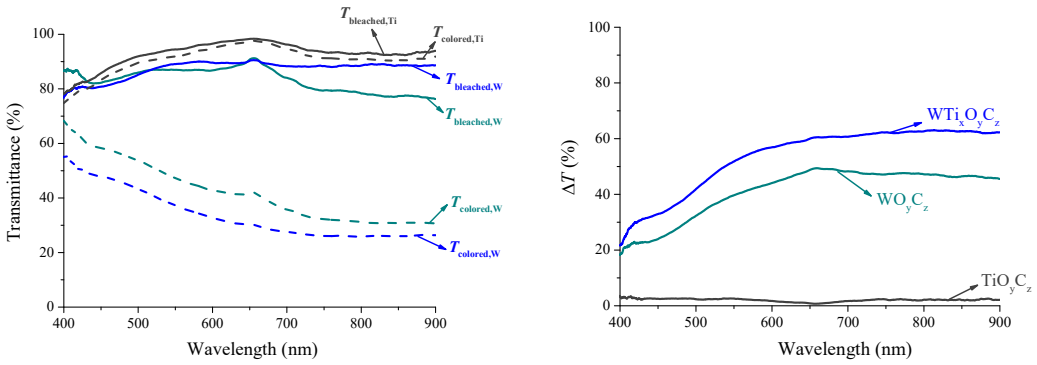
[1] *Department of Chemical Engineering, Feng Chia University, Taiwan, R.O.C*

Abstract

Tungsten oxide (WO_x) is the most extensively investigated transition metal oxide, utilized in electrochromic (EC) smart windows and in other diverse applications, such as gas sensors, EC displays, EC sunroofs and EC mirrors. This study has proven to enhance the light modulation (ΔT% at a wavelength of 550 nm) from 39% during Li^+ ions intercalation ($T_{colored,W}$) and deintercalation ($T_{bleached,W}$) for organo-tungsten oxide (WO_yC_z) to 51% for organo-tungsten-titanium oxide ($WTi_xO_yC_z$) films by co-synthesis with organo-titanium oxide (TiO_yC_z) onto flexible polyethylene terephthalate (PET)/indium tin oxide (ITO) substrates using an atmospheric pressure plasma jet (APPJ). $WTi_xO_yC_z$ films have EC properties for colorless $WTi_xO_yC_z$ (bleached state) forms a colored "bronze" (colored state) $Li_\alpha WTi_xO_yC_z$ by intercalation of ions and electrons according to the reversible intercalation/de-intercalation reaction (1):

$$WTi_xO_yC_z + \alpha_i Li^+ + \alpha_i e^- \underset{\text{bleaching}}{\overset{\text{coloration}}{\rightleftharpoons}} Li_{\alpha_i}[Ti^{5+}_{1-\alpha_{i1}} Ti^{4+}_{\alpha_{i1}}]_x [W^{6+}_{1-\alpha_{i2}} W^{5+}_{\alpha_{i2}}] O_yC_z \quad (1)$$

Keywords—*Plasma polymerization, Atmospheric pressure plasma, Electrochromic films, Tungsten oxides*



(a) (b)

Fig. 1 (a) The bleached and colored transmittance spectra and (b) light modulation (ΔT%) of 550 nm) of PET/ITO/$WTi_xO_yC_z$ films.

Acknowledgments

This study is supported by the Ministry of Science and Technology of the Republic of China (MOST 106-2221-E-035-080-MY3).

Professional Biography

Prof. Yung-Sen Lin received the B.S degree in chemical engineering from Chung Yuan Christian University, Zhongli, Taiwan, ROC, in 1987, and the M.S and PhD degrees in chemical engineering from the University of Missouri–Columbia, Columbia, MO, USA, in 1993 and 1996, respectively. He was a Researcher with the Industrial Technology Research Institute, Hsinchu, Taiwan, in 1997, where he was involved in semiconductor package R&D, and a Section Manager with Siliconware Precision Industries Company, Ltd., Taichung, Taiwan, in 1997, where he was involved in development of semiconductor package technology and materials, and an Assistant Professor with the Department of Materials Science and Engineering, I-Shou University, Kaohsiung, Taiwan, in 2000. In 2003, he joined the Department of Chemical Engineering at Feng Chia University, Taichung, where he is currently a Professor. His current research interests include thin films, nanomaterials, low temperature atmospheric pressure plasma polymerization and modification, low temperature plasma polymerization and treatment, electrochromic thin films, semiconductor packaging technology and materials, and functional thin films.



Email Id: yslin@fcu.edu.tw