Optical spectroscopic studies of metal oxides thin films for electrochromic applications

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Abstract

The studies of electrochromic materials and devices mainly include viologens, conducting polymers, transition metal oxides (WO_3, VO_2, V_2O_5, MoO_3, NiO, Cr_2O_5, Nb_2O_5,Ta_2O_5), hybrid materials, and metal coordination complexes. Regarding the transition metal oxides, the possible combination of diverse compositions/structures associated with superior electrochromic performance offers exciting prospects for further advancements in electrochromic technology. Recently, there have been significant advances in this field, including the development of new materials, new nanostructures and new composites. These improvements opened opportunities for use in emerging areas and for the development of multifunctional electrochromic devices.

In this study, metal oxides and mixed metal oxides thin films were deposited on different substrates (ITO-coated PET, glass ITO coated and silicon) by reactive magnetron sputtering. A structural threshold as a function of the O2/Ar flow rate ratio was found, regarding the crystalline to amorphous nature, and the nontransparent appearance with metallic-like conductivity to transparent and dielectric behaviour. All transparent nanometer-thick films present a compact/dense and featureless morphology. The films surface roughness is in the order of a few nanometers and the maximum optical transmission, in the visible range, is 89%. Optical transmittance was also recorded in situ and simultaneously with cyclic voltammetry. Electrochromic behavior of thin films was investigated upon Li+ intercalation.