Electrochromic Properties of Tungsten Oxide Combined with Metal Nanophases

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Electrochromic coatings are of increasing interest for applications in a wide range of fields for energy saving. The possibility of controlling the optical properties of tungsten oxide (WO_3) that has good electrochromic properties by applying small specific voltages in a reversible way has been widely investigated.[1] However, researches for electrochromic tungsten oxide have been mainly focused on the realization of smart windows, optical modulators, variable reflection mirrors, and visual sensors rather than display devices due to its slow response time, which is a structural characteristic of electrochromic devices. Tungsten oxide as a cathodic coloration material generally shows coloration of deep blue by the electrochemical reduction under negative voltage and become transparent by the oxidation under positive voltage.[2]

In this study, we have investigated how the electrochemical and electrochromic properties of tungsten oxide films combined with metals (Pt, Ni, etc.) are dependent on their microstructural changes. The metal-combined tungsten oxide films were deposited on glass substrates coated with indium tin oxide (ITO) by a co-sputtering technique,[3] while for comparison, tungsten oxide films were also prepared by rf magnetron sputtering.

Figure 1 shows cyclic voltametry curve of tungsten oxide and Pt-incorporated tungsten oxide films. Microstructural properties of these samples were investigated by means of X-ray diffraction, atomic force microscopy, scanning electron microscopy, transmission electron microscopy, and x-ray photoelectron spectroscopy. The electrochemical behaviors of the samples were characterized by cyclic voltametry and chronoamperometry in a sulfuric acid solution. The optical transmittance was also simultaneously measured *in situ* during all the experiments using He-Ne laser (633 nm). The effects of the addition of metals to tungsten oxide on their electrochemical, electrochromic, and microstructural properties are described and discussed in detail.

Reference

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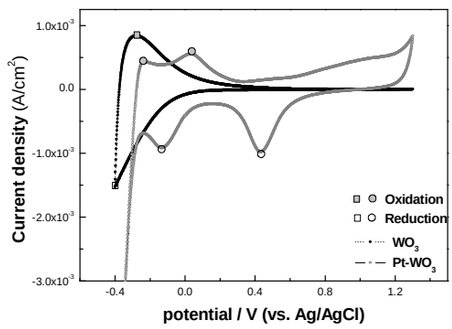

Figure 1. Cyclic voltametry curve of tungsten oxide and platinum-composite tungsten oxide.