Study for Electrochromism of Amorphous WO_3 Thin Films - Mechanism of Degradation of Electrochromism, Design of Films Having Prolonged Lifetime and Mechanism of Coloration -

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We have conducted a study to clarify the mechanism of the degradation of the electrochromism of amorphous WO_3 thin films and to obtain films having a long lifetime. Moreover, we have studied the mechanism of its electrochromism. The films were prepared by using vacuum evaporation and the coloration were performed in $LiClO_4$-propylene carbonate.

XPS and EELS analyses have revealed that injected electrons occupy the bottom of a conduction band after coloration and that the Fermi level increases in energy in proportion to the amounts of injected lithium. It has been concluded that the electrochromism of the film is due to an intraband transition between electrons injected in the conduction band and an empty state.

XRD and SIMS results have revealed that the lithium are accumulated in the WO_3 film and that the crystalline compounds are formed in degraded films. Moreover, lithium tungstate is formed in the film, when a large quantity of lithium is injected. It has been concluded that the degradation of the electrochromism is caused by the formation of the compounds.

The lifetime of the WO_3-TiO_2 films exceeds that of WO_3 films by a factor of five. XRD, SIMS and XPS analyses have shown that the lithium can not be accumulated in the WO_3-TiO_2 film and that the crystalline compound is not formed. We conclude that lithium can not be accumulated in the structure of the WO_3-TiO_2 film and that the structure gives a prolonged lifetime.