M.Sc. Thesis

Title: The effect of metal oxides on gasochromic properties of WO_3 thin films formed by pulsed laser deposition

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Abstract

Physical and chemical properties of tungsten oxide thin films change reversibly while exposure to hydrogen gas. This property is called gasochromic. To enhance optical properties of such films, nanostructured, amorphous and porous thin films of $(WO_3)_{1-x}(MeO)_x$ (MeO= TiO_2, MoO_3, NiO; x=0.09, 0.17, 0.23, 0.29, 0.33) were fabricated by pulsed laser deposition. Molar percentage of Me/W (Me= Ti, Mo and Ni) was changed in the films with respect to the targets; for Ti and Ni always a reduction, but for Mo an enhancement for low percentages was observed. The reason is the existence of thermal ablation mechanism during deposition, in the other word is different vapor pressure effect. An increment in x for films mixed by TiO_2 increased the band gap from 3 eV to 3.6 eV. However, for MoO_3 by x=0.09 the band gap was increased to 3.6eV; while for more increment in x, it was reduced to 3.1eV. Moreover, as it is expected, the enhancement of x results in higher band gap for NiO. Investigation of gasochromic response of thin films came to the result that adding metal oxides to tungsten oxide, decreases coloration velocity and contrast. Reversibility was preserved by adding TiO_2, while by adding MoO_3 and NiO the coloration was irreversible. The WO_3 thin films mixed by MoO_3 provided darker visual color and they were completely opaque in exposure to hydrogen gas. It was also found that by changing the deposition parameters, one can fabricate films with better coloration contrast, velocity and quality.

Key words: Gasochromic, pulsed laser deposition, mixed oxide, tungsten oxide, molybdenum oxide, titanium oxide, nickel oxide.