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Pulsed Laser Deposition of Mo-V-O Thin Films for Chromogenic Applications

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1. Abstract

Mo-V-O thin films were prepared by pulsed laser deposition (PLD) technique at an oxygen pressure of 13.3 Pa and room temperature on glass and Indium tin oxide (ITO)/glass substrates from $(MoO_3)_{1-x}(V_2O_5)_x$ (x=0, 0.09, 0.17, 0.23, 0.29) targets. We studied the effect of V_2O_5 counterpart on the growth characteristics of Mo-V-O thin films and coloring switching properties including thermochromic, gasochromic, photochromic and electrochromic. Surface morphology, surface chemical states, optical and electrochemical properties were examined using atomic force microscope (AFM), field emission scanning electron microscope (FE-SEM), X-ray photoelectron spectroscopy (XPS), UV-Vis spectroscopy and electrochemical impedance spectroscopy (EIS). Morphological characterizations illustrated porous cauliflower-like surface for the thin films and a columnar growth was observed in which surface roughness varied by x. XPS spectra showed that Mo surface composition for all the samples are Mo^{6+} and V composition at x=0.09 is a combination of V^{4+} and V^{5+} states. At the other stoichiometries the main state was V^{5+}. Moreover, XPS and EDS revealed that V:Mo molar ratio in a deposited film is smaller than in the target used for. It was found that there is a relation between the vanadium valance states and the optical band gap as well as chromogenic properties.

Keywords: $(MoO_3)_{1-x}(V_2O_5)_x$, thin film, pulsed laser deposition, XPS, chromogenic.

2. Introduction

Recently, chromogenic materials have become more important because they allow the transmittance of visible light and solar energy to be varied under the action of an external stimulus [1]. They are also known by other names such as “smart”, “intelligent” and ”switchable” materials [1]. They work based on the electrochromic, thermochromic, photochromic and gasochromic effects. Electrochromic materials exhibit a

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