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Tuning of physical properties in MoO_3 thin films deposited by DC sputtering

M. Rabizadeh[1] · M. H. Ehsani[1] · M. M. Shahidi[1]

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Abstract
In this work, MoO_3 films have been prepared using DC magnetron sputtering deposition technique in different growth conditions. And also the structural and optical properties of the films prepared in different conditions, has been systematically investigated. The results showed the relation between morphology, composition, and growth conditions. By increasing the ratio of O/Mo in the MoO_x composition, not only the bandgap and the transmittance increase but also the size of the crystals decreases. In addition, it was found that by increasing the ratio of oxygen to argon and the DC power during deposition process, the phonon lifetime increases and consequently the crystallinity of the films will improve. This is consistent with the results of the structural study.

Keywords MoO_3 films · DC magnetron sputtering deposition · Optical and structural properties

1 Introduction

MoO_3 is among attractive inorganic transition metal oxides materials because it has a wide bandgap n-type. MoO_3 is found to have interesting applications in industry such as high-density memory and electrochromic devices (Yordanov et al. 2014) and are also extensively applied in the string of energy storage and conversion, catalysis, transistors, solar cell, etc. For example, the MoO_x thin films are being used in lubricants (Wang et al. 1999), solid-state micro-batteries (Juliena et al. 1994) and, gas sensor such as NO_2 (Ferronia et al. 1998; Yamazaki et al. 2005), NH_3 (Mutschall et al. 1996), CO (Ferroni, et al. 1997), H_2 (Hamagami, et al. 1993) and volatile organic compounds (Mirmohseni and Rostamizadeh 2006).

Due to the great matching of MoO_X with organic optoelectronic elements, it was initially employed as both a hole injecting and an anode buffer layer material in organic light-emitting diode (OLED) and photovoltaic (OPV) cells respectively, which introduce it as a standard alternative of the anode buffer layer in the analysis of the latest materials in OPV cells (Gong et al. 2020; Varnamkhasti et al. 2012).

✉ M. H. Ehsani
ehsani@semnan.ac.ir

[1] Faculty of Physics, Semnan University, Semnan 35195-363, Iran

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