# Abstract

In this work, molybdenum oxide ($MoO_3$) films were deposited on silicon substrate using RF magnetron sputtering system at room temperature. After deposition, the films were annealed in air at different temperatures ranging from 100 to 550°C in a muffle furnace. The structural study was performed through X-ray diffraction that indicated amorphous nature of the as-prepared films. Post-deposition annealing of $MoO_3$ film enhanced its crystal quality, showing β-$MoO_3$ phase at 100°C and a mixture of α-$MoO_3$ and β-$MoO_3$ phases at 300°C. The crystallinity of α-$MoO_3$ was improved with increasing the annealing temperature to 500°C, however, the β-$MoO_3$ phase became amorphous. The average crystallite size of $MoO_3$ was increased from 3.4 to 34.2 nm with increase of the annealing temperature from 100 to 500°C. The $MoO_3$ film was dissolved at 550°C as no diffraction peak of $MoO_3$ was detected at this temperature. The optical band gap of $MoO_3$ was investigated through ultraviolet-visible reflectance spectroscopy. The results showed a decrease in band gap of $MoO_3$ from 3.70 to 3.39 eV with increase of the annealing temperature up to 500°C. The film with optimum crystalline quality was used for the fabrication of an ultraviolet (UV) metal-semiconductor-metal (MSM) photodetector. Nickel contacts were deposited on the film using a metal mask having two electrodes and the photo-detection response of the film was studied. The parameters of photodetector such as current gain (G), sensitivity (S), responsivity (R), rise time and fall time were calculated. The Ni/$MoO_3$/Ni photodetector displayed high current gain (16.73) and sensitivity ($15.73\times10^2$ %) at 7 V in the presence of 365 nm UV light which shows the formation of a good quality UV photodetector. The responsivity of the device under UV light was found to be 0.41 A/W at 7 V bias. The rise and decay time of the photodetector were 0.32 and 0.23 sec respectively, indicating a fast response from the device. These findings suggested that the $MoO_3$ film of good crystalline quality having dominant orthorhombic α-phase can potentially be used for a UV photodetector application.