Abstract

P-type Cupper aluminum oxide ($CuAlO_2$) thin films are very important materials in the field of optoelectronics device technology for the realization of 'Transparent Electronics'.

In this work, a Nd:YAG laser beam, λ=1.06μm, repetition rate 1Hz with the pulse duration 9ns,has been used to deposit $CuAlO_2$ thin films on glass and n/p-type silicon substrate to the synthesis of $CuAlO_2$/Si hetrojunction photodetectors.

Basic material characterizations have been studied for these films to specify the optimum conditions namely; number of laser pulses of (30-100) with step of 10 at a fixed substrate temperature 448 ^{o}k.

X-Ray Diffraction (XRD) results show that the structure of the deposited films is crystalline and it was found is that increasing of laser pulses leads to an increase in the crystalline of the films.

UV-VIS transmittance measurements illustrate that the films are highly transparent in the visible region with average optical transmission of (45%-85%).The UV-VIS transmittance measurements showed that the increasing of laser pulses leads to decreasing of the optical transmittance. The optical band gap of the prepared films determined at different number of laser pulses was found to be in the range of (3.5-3.9) eV depending on the number of laser pulses.

SEM and AFM results show that the surface morphology of the deposited materials and the grain size of the films are dependent on the number of laser pulses. It is found that the optical band gap increases with decreasing both the grain size and the Root Mean Square (RMS) roughness and the smallest grain size was (79.67) nm obtained at 30 laser pulses.

It is found that increasing of number of laser pulses resulted in increasing of optical band gap.

Electrical properties of $CuAlO_2$/Si hetrojunction were investigated. The I-V characteristics in the dark related that the fabricated $CuAlO_2$/Si hetrojunction exhibited good rectification and the best hetrojunction fabricated with (90) laser pulses give ideality factor around 1.79.Hall Effect was studied to estimate the type of conductivity. From the results it is deduced that $CuAlO_2$ thin films are p-type. Hetrojunction photodetectors parameters results indicate that the fabricated detectors have a responsivity in range of (0.12A/W - 0.59A/W) at peak wavelength of (830nm), while maximum detectivity of ($1.7*10^{11}$ W^{-1}. cm. $Hz^{1/2}$-$1.9*10^{11}$ W^{-1}. cm. $Hz^{1/2}$).