ABSTRACT

This work is divided into three parts. The first part; the effect of laser energies on spectral plasma characterizations of solid materials (CdTe, CdS, and CdTe: CdS mixing) were investigated. The second part; involved the preparation of CdTe thin films and CdS thin films on glass substrates by a pulsed laser deposition method using Nd: YAG laser with a wavelength of 1064 nm with different laser energies (400, 500, 600, and 700 mJ) and (100 pulses), as well as preparation of CdTe: CdS mixing thin film on a glass substrate with laser energy of 700 mJ, and a number of pulses 100 and an annealing time of 1.30 hours, 200 pulses and a 3-hour annealing time. The effect of laser energy on the structural and optical properties of all the prepared films was studied. The third part; was prepared a CdS/CdTe solar cell on a glass substrate coated with fluorine-doped tin oxide (FTO-glass).

Optical emission measurements showed that laser energy has a strong and important influence on the intensity of the line emission where the intensity of the spectral lines increases with the increase in laser energy. Laser-induced plasma parameters such as electron temperature (T_e) and electron density (n_e), Debye length (λ_D), and plasma frequency (f_p) were calculated. The results indicating that T_e, f_p, and ne values increased with increasing of laser energy and the values of λ_D was decreased with increased laser energy.

The XRD results showed that all of the prepared thin films had a polycrystalline structure, and the intensity of the peaks increased with increasing of laser energy.

The optical measurements showed that the films have a direct energy gap and an increase in the absorption of the films with increasing laser energies, led to a decrease in the energy gap values, from 1.87 to 1.58 eV in CdTe and from 2.5 to 2.4 eV in CdS. As well as for CdTe: CdS, the increase in the number of laser pulses from 100 pulses with an annealing period of 1.30 hours to 200 pulses with an annealing period of 3 hours led to an increase in absorption and a decrease in the energy gap from 2 to 1.5 eV. The optical constants were measured, such as the refractive index (n), the extinction coefficient (k), and the dielectric constant of the real part and imaginary part (ε_i, ε_r).

The current density-voltage curves for a CdS/CdTe solar cell at different lighting intensities were studied. It was found that increasing the lighting intensity falling on the solar cell resulted in an increase in solar cell efficiency, where cell efficiency were 3.82, 4.67, 6.66, and 7.8 % at lighting intensities of (40, 60, 80, and 100) mW/cm^2, respectively.