ABSTRACT

Zinc sulfide film was deposited on p-Si (100) substrate by radiofrequency magnetron sputtering system. The as-deposited film was annealed at different temperatures (125, 250, 375 and 500 ^{o}C) for 2 hours in air using a high temperature furnace. The structural characterization of the un-annealed and annealed ZnS films was made by X-ray diffraction (XRD). The XRD analysis showed a hexagonal wurtzite nature of the ZnS film. The crystallite size of the ZnS was increased whereas the atomic spacing decreased with the increase of annealing temperature to 500 ^{o}C. The surface roughness of the ZnS film was studied using atomic force microscope (AFM). The roughness was slightly decreased with the increase of annealing temperature. The UV-vis spectroscopy in the reflectance mode was used to investigate the band gap of the ZnS. The band gap of ZnS was increased by increasing the annealing temperature to 250 ^{o}C and then decreased with further increase of the annealing temperature. These variations in the band gap of ZnS film were associated to the film's crystallinity as well as the oxygen diffusion in the film due to air annealing. The un-annealed and the ZnS film annealed at 500 ^{o}C were used for the fabrication of a p-N heterojunction photodiode. The silver metal contacts were deposited on the ZnS and Si by using thermal evaporator system. The current-voltage (IV) characteristics of the n-ZnS/p-Si heterojunction device (based on both un-annealed and annealed ZnS films) were investigated under dark and in the UV light of power density 1.2 mW/cm2. The fabricated devices displayed I-V characteristics similar to the typical I-V characteristics of a p-n photodiode. The current in both the devices was increased under the exposure of UV light, however, increase in the photocurrent was more significant in the case of device based on the annealed ZnS film. This increased photocurrent in the annealed film was attributed to reduction in the structural disorder of the ZnS lattice through the annealing process. The current gain of the un-annealed and annealed film-based devices was calculated to 43 and 115 respectively which indicated a remarkable performance of the fabricated device based on the annealed ZnS film.