**THESIS INFORMATION**

Thesis title: Fabrication of Cu2ZnSnS4 thin film and MoS2, ZnO nanorods material layers for CZTS solar cell application.

Speciality: Optics.

Code:62440109.

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Academic year: 2015.

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1. ABSTRACT:

The thesis includes the main contents: First, we prepared CZTS thin films by sol-gel method and investigated the factors that affect on optoelectronic properties of CZTS thin films under annealing in N2 atmosphere. From that, it is found that optimal conditions for synthesis process, at the annealing temperature of 4500C, film thickness of thin films is found to be 670 nm and the ratio of Cu:Zn:Sn:S in the precursor is 1,8:1:1:8, respectively. The results indicated that CZTS thin film showed good crystallinity, preferred orientation along the (112) planes in kesterite structure (with FHWM (Full width at half maximum) = 0,4310), bandgap of 1,47 eV, optical absorption coefﬁcient over 104 cm-1, carrier concentration of 1,351.10+18 (cm-3) and mobility Hall of 5,286 (cm2V-1S-1). Second, we prepared MoS2 thin films as n-type buffer layer for CZTS solar cell structure. We have successfully prepared n-MoS2/p-CZTS heterojunction and surveyed the effect of annealing temperature, annealing atmosphere on heterojunction, with the annealing temperature of 5000C in 0,04g S powder-containing atmosphere, the MoS2 thin film growth time of 20 minutes, n-MoS2/p-CZTS heterojunction showed a rectification behavior with open-voltage of 0,44 eV. Third, to synthesis AZO/ZnO nanorods/MoS2/CZTS multi-layered structure for solar cell application, we prepared and investigated the charge transport processes of ZnO nanorods/MoS2 thin film heterostructure. The results showed that it is exhibited the best charge transport processes, reduced recombination of ZnO nanorods/MoS2 thin film heterostructures at 51 nm film thickness of MoS2 and 1,1 μm length of ZnO nanorods. The investigation of structural and optoelectronic properties of AZO/ZnO nanorods/MoS2/CZTS multi-layered structure indicated good crystallinity for each material layers and AZO/ZnO nanorods/MoS2/CZTS/In showed a rectification behavior with open-voltage of 0,67 V, ideal factor (n) of 2,5, Rshunt= 7894,7 kΩ and Rs=869,5 kΩ.

2. NEW RESULTS:

- The p-CZTS thin films with good crystallinity were prepared by dip coating method and only annealed in N2 atmosphere. It showed optical absorption coefﬁcient over 104 cm-1, carrier concentration of 1,351.10+18 (cm-3) and mobility Hall of 5,286 (cm2V-1S-1).

- The combination of n-MoS2 thin films and p-CZTS thin films formed n-MoS2/p-CZTS heterostructure that MoS2 thin film is n-type buffer layer.

- It indicated optimum condition for synthesis and investigation of charge transport process of ZnO nanorods/MoS2 thin film heterostructures: the film thickness of MoS2 is about 51 nm and the length of ZnO nanorods are 1,1 μm.

- The AZO/ZnO nanorods/MoS2/CZTS multi-layered structure prepared and the AZO/ZnO nanorods/MoS2/CZTS/In junction showed a rectification behavior with open-voltage of 0,67 V, ideal factor (n) of 2,5, Rshunt= 7894,7 kΩ and Rs=869,5 kΩ.

3. FUTURE APPLICATIONS/DEVELOPMENTS

- Choosing appropriate electrode for solar cell structure.

- Investigating performance of AZO/ZnO nanorods/MoS2/CZTS solar cell with selected electrode.

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