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Fabrication of 3-D nanostructured and solution processed CIGS thin film solar cells

Van Ben Chu
Korea University of Science and Technology, Republic of Korea

In this presentation, we demonstrate the fabrication of CuInGaS2 (CIGS) thin film solar cells with a three dimensional (3-D) nanostructure based on indium tin oxide (ITO) nanorod films and precursor solutions (Cu, In, and Ga nitrates in alcohol). To achieve 3-D nanostructured and solution processed CIGS thin film solar cells ITO nanorod substrate was used as a back contact electrode. The precursor solution of Cu, In, and Ga without binder material was then drop-casted followed by ultrasonic vibration to completely fill the gaps between ITO nanorods. After all ITO nanorods were embedded the second precursor solution with polymer binder was spin-coated to increase the thickness of the CIGS films. Subsequent annealing processes in air as well as sulfur environment resulted in polycrystalline CIGS film. The structures, morphology, optical property and quantum efficiency were investigated by XRD, SEM, UV-Vis absorption and spectral IPCE measurements. Solar cell device with Al,Ni/AZO/i-ZnO/CdS/CIGS/ITO nanorods/glass structure was fabricated showing the power conversion efficiency of 6.3% at standard irradiation conditions, which is 22.5% higher compared to the identical solar cells with planar ITO substrate. The details of fabrication method and characteristics of the solar cells will be discussed in the presentation.

Biography

Van Ben Chu is a PhD in Clean energy and Chemical engineering Department at Korea University of Science and Technology. He received his BSc in Materials Science and Technology from Hanoi University of Technology in Vietnam and MSc in Intelligent light and display from Dongguk University in Korea. He has published 4 papers in reputed journals.

chuvanben@gmail.com

Thermo-mechanical properties of mechanochemical processed mullite nanocomposite with TiO_2 and Fe_2O_3 additives

Vijay Kumar, Vinay Kumar Singh, Abhinav Srivastava and **P Hemanth Kumar**
Indian Institute of Technology, India

Mullite has achieved outstanding importance as a material for both traditional and advanced ceramics because of its good thermal and physico-mechanical properties. In our study mullite was developed by high energy ball milling action and sintering of an alumina-silica mixture (in the stoichiometry ratio of mullite). TiO_2 and Fe_2O_3 (0-2 wt. %) were used as additives. The raw materials and additives were mixed, attrition milled and sintered in compacted form at 1300-1500°C with 3 h soaking period. The effect of TiO_2 and Fe_2O_3 on the densification behavior, thermo-mechanical properties, phase identification and microstructure was studied. It was found that addition of TiO_2 and Fe_2O_3 had slightly increased the densification process as well as enhanced the mechanical properties. All the samples achieved their highest bulk density at 1500°C. Thermo-mechanical properties of the sintered samples were effectively altered by the presence of additives. Scanning electron micrograph shows that TiO_2 and Fe_2O_3 occupy both an intergranular and intragranular position in the mullite matrix. The physical and thermo-mechanical properties such as bulk density, apparent porosity, cold crushing strength, modulus of rupture and thermal expansion test was studied in relation to temperature. The mullite nanocomposite samples show good modulus of rupture and excellent cold crushing strength at 1500°C. Attempts were made to correlate these properties with corresponding microstructure and X-ray diffraction phases.

vijaykumaritbhu@gmail.com