Graded bandgap nanostructured SnS-based photocells

Elena A. Outkina, Alla I. Vorobyova, Aliaksandr A. Khodin

Tin sulfide SnS, SnS2 thin films have been fabricated and investigated for solar cell application as prospective inexpensive and environmentally safe material. Today, SnSx-based single bandgap and tandem solar cell designs demonstrate promising results as environment-friendly and cheap alternative to common Si, CdTe, CIGS cells. To enhance further the solar spectrum utilization, the graded bandgap structures are preffered. The chemical deposition of tin sulfide films presents a low-cost and scalable processing for thin-film solar cells mass production. In the paper, the successive ionic layer adsorption and reaction (SILAR) technique was used to produce SnSx layers, including successive cyclic dipping into Na2S and SnCl2 + NaCl + triethanolamine solutions. The XRD measurements reveal the SnS, SnS2 layers formation with nanograins micromorphology. The optical transmission measurements show the variable bandgap values depending, presumably, on the nanograins size. In this study, we propose and analyse, using SCAPS code simulation, a simple graded bandgap heterostructure solar cell structure based on nanostructured bandgap-engineered SnS/SnS2 active layers showing conversion efficiency up to ~ 14% for non-graded and ~ 16% for graded bandgap heterostructure.