Paper ID: 18343
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialised Technologies, Including Nanotechnology (8)

Author: Mr. Jan Hrabovský
University of Pardubice, Czech Republic, honza.hrabovsky@gmail.com

Prof. Tomáš Wágner
University of Pardubice, Czech Republic, tomas.wagner@upce.cz
Mr. Lukáš Strižik
University of Pardubice, Czech Republic, lukas.strizik@centrum.cz

RARE-EARTH-DOPED AMORPHOUS CHALCOGENIDES IN PHOTONICS

Abstract

Nowadays, we observe increasing interest in power supply technologies for space programs. Silicon solar cells are most often used to cover this consumption, but there is Shockley Queisser limit which restrict efficiency of energy conversion. This limitation can be overcome by using up-converter or down-converter materials that are studied for theirs luminescent properties. The work deals with the preparation of efficient phosphors based on amorphous chalcogenides doped with rare earth ions operating from near infrared to mid infrared spectral region and with the photon energy conversion from infrared to visible spectral region. All materials were synthesized by the melt quenching technique from high purity elements sealed at residual pressure of 10-3 Pa in silica glassy tubes which were subsequently exposed to 970 C for 24 hours. The melt was quenched into water and annealed near of glass transition temperature to release mechanical strains. Photon up conversion and photoluminescence (PL) were studied in Ga Ge Sb S amorphous chalcogenides doped with rare earth (RE3+) ions such as Pr3+, Nd3+, Dy3+, Ho3+, Er3+, Tm3+ and Yb3+. Both up conversion and photoluminescence spectra were measured under excitation by Ti:sapphire tunable laser or by diode laser. Photon up conversion was observed e.g. for Er3+ doped Ga Ge Sb S amorphous chalcogenides in the visible (2H11/2 -> 4I15/2, 4S3/2 -> 4I15/2, 4F9/2 -> 4I15/2) and near infrared (4I9/2 -> 4I15/2, 4I11/2 -> 4I15/2,) spectral regions under 802 nm or 1.55 m pumping, respectively. Photoluminescence emission was observed in near infrared and mid infrared (2.7 μm emission from Er3+: 4I11/2->4I13/2 transitions) spectral regions. These phosphors are potentially applicable in lasers, telecommunication, sensors, LIDAR technology or to improve the silicon solar efficiency. The efficiency of silicon solar cells is limited but other enhancement can be improved by using of up converters. The up converter layer should be deposited on the rear side of a bifacial silicon solar cell.