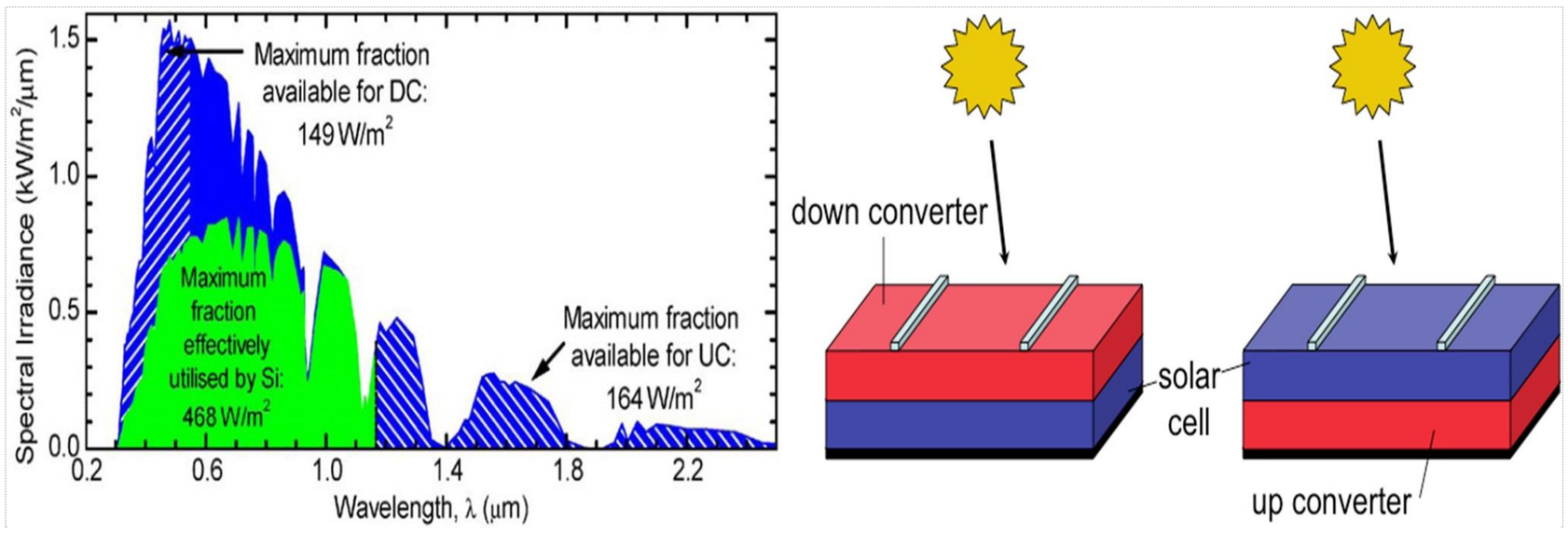
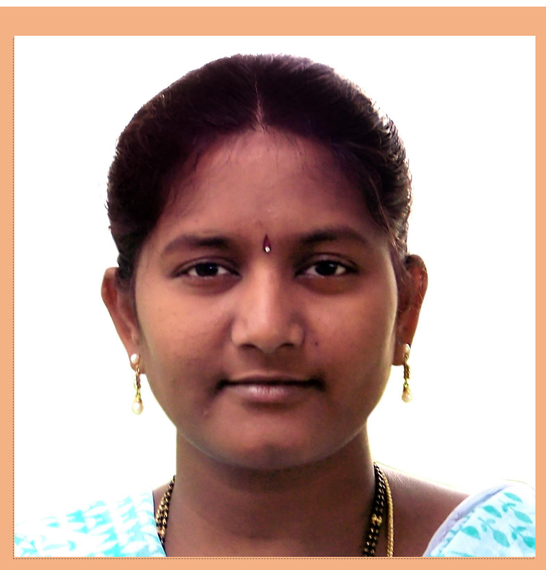
FSCOSD – Physics of Semiconductors, Optoelectronics and Disordered Systems, University of Aveiro

Spectral converters to enhance the efficiency of solar cells





Pavani Krishnapuram, Post-Doc

Supervisor: Prof. Armando Neves
Co-supervisor: Dr. M.P.F. Graça

Objectives

To synthesize the materials aimed to increase the efficiency of the solar cell by converting the high and low energy photons which are wasted in the solar spectrum into the photons within the band gap of the solar cell by using down- and upconversion mechanisms.

$BiGdWO_6$(BGW) phosphors were prepared and are characterised by X-Ray diffraction (XRD), Raman spectroscopy, diffuse thermal analysis (DTA) and photoluminescence spectroscopy (PL).

Methods and techniques

- In this work, the phosphor materials prepared by solid state reaction and Pechini sol-gel techniques.
- In solid-state reaction method the stoichiometric amounts of Bi_2O_3, Gd_2O_3 and WO_3 were taken in an agate mortar and mixed thoroughly in acetone for homogenous grinding and kept for sintering at 1000^0 C for 15 h. The powders were removed from the furnace at a temperature 500^0 C for intermediate grinding. The grounded powders were again annealed for 45h at 1050^0 C.
- The powders prepared by Pechini sol-gel method using the corresponding nitrates as starting materials and citric acid, ethylene glycol were used as chelating and binding agents.

Results

(a)The XRD patterns revealed that the BGW can be indexed to a pure monoclinic phase with space group P2/a, which is the simplest member of the Aurivillius family of layered perovskites.

(b)The spectrum consists of broad band ranging from 400 to 510 nm with a maximum at 440 nm. This emission is ascribed to $^3P_1 \rightarrow {}^1S_0$ transition of Bi^{3+} ions in host BGW lattice

(c) The SEM image shows the polycrystalline nature of the material, but following the high temperature annealing causes growth of grains to an irregular and bigger size with an average grain size in few-micrometre range.

(d)The Raman spectra of BGW consists of well defined characteristics bands of the constituents. The Raman vibrational features of a molecular species depend on its molecular structure and also the nature and strength of its chemical bonding.

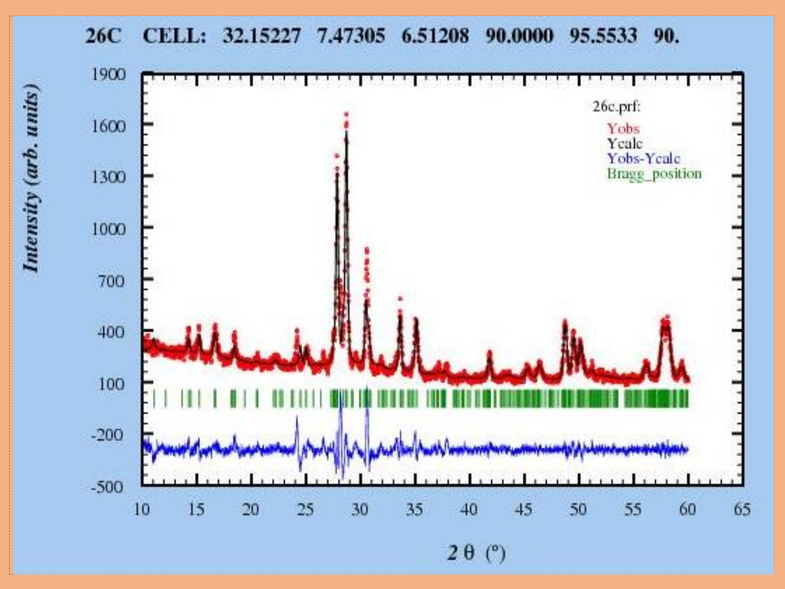
Publications

1) K. Pavani, J. Suresh Kumar, L. Rama Moorthy, Materials Research Express 1 (2014) 016201.

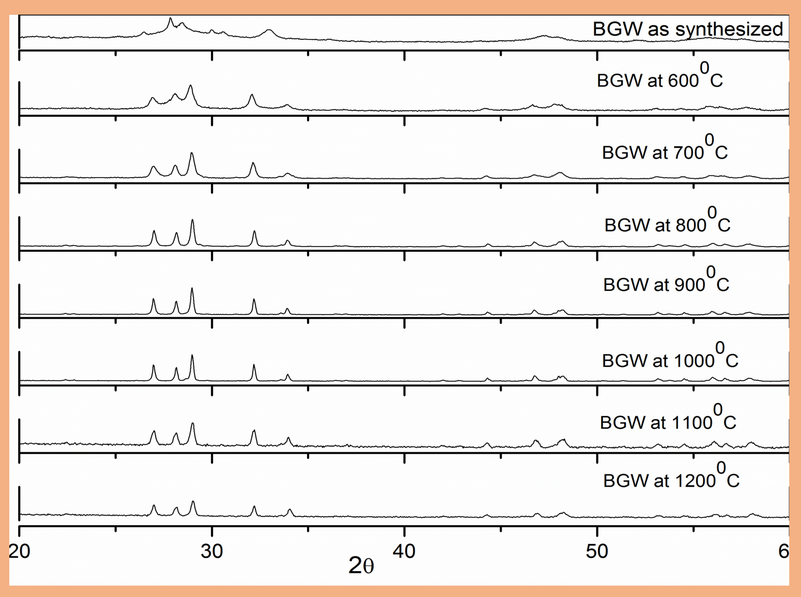
2) K. Pavani, J. Suresh Kumar, L. Rama Moorthy, Journal of the American Ceramic Society 97(5) (2014) 1481-1488.

3) K. Pavani, J. Suresh Kumar, L. Rama Moorthy, Journal of Alloys and Compounds 586 (2014) 722-729.

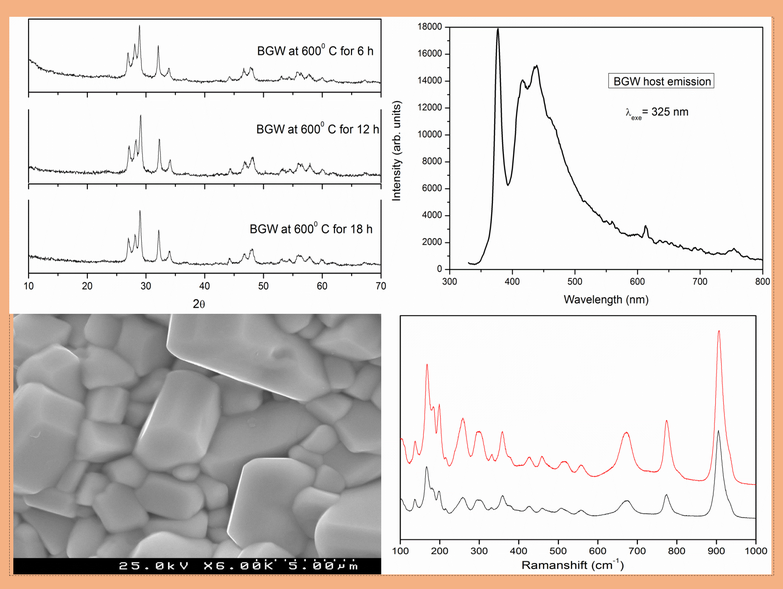
4) J. Suresh Kumar, K. Pavani, M.P.F. Graça, M.J. Soares, Journal of Alloys and Compounds 617 (2014) 108–114.



XRD patterns of BGW prepared by solid state reaction



XRD patterns of BGW prepared by sol-gel method with different calcination temperatures



(a) XRD patterns of BGW prepared by sol-gel method with different time intervals at 600^0C.

(b) Pl emission of BGW powders with 325 nm excitation.

(c) SEM image of BGW powder.

(d) Raman spectra BGW powders

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