ICAM 2009
11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25

A study of single phase formation, scintillation and optical properties of scheelite calcium tungstate powders and high optical quality single crystal minirods

R. S. Silva (1)*, M. S. Silva (1), F. R. Cavalcante (1), L. B. Barbosa (2)*, D. Reyes Ardila (2), J. P. Andreeta (3)

(1) Departamento de Física, Campus Prof. José Aloísio de Campos, Universidade Federal de Sergipe, 49.100-000, São Cristóvão - SE
(2) Núcleo de Física, Campus Prof. Alberto Carvalho, Universidade Federal de Sergipe, Av. Ver. Olimpio Grande, Centro, 49.500-00, Itabaiana – SE
(3) Instituto de Física de São Carlos, Universidade de São Paulo, Av. Trabalhador SãoCarlense 400, 13560-970, São Carlos - SP
* rsilvafisica@gmail.com

Abstract – Powders and high optical quality single crystal minirods of stoichiometric scheelite $CaWO_4$ have been prepared by solid state reaction and floating zone methods, respectively, and their single phase formation, optical and scintillating properties have been evaluated by X-ray diffraction, optical absorption and radioluminescence measurements. All obtained results indicate that every sample is stoichiometric, while scintillation measurements reveal radioluminescence peaks at about 420 nm, 440 nm and 490 nm depending on the source of irradiation used. The single crystal samples exhibit higher radioluminescence light yield.

For their approved use in scintillating applications, solid-state optoelectronic devices, lasers and optical fibers-like components, scheelite-type photonic crystals have attracted much interest and materials like scheelite $CaWO_4$ have been synthesized in the last years by a diversity of methods including Pechini, polymeric precursor, co-precipitation, solvothermal, Czochralski, and microemulsion-mediated hydrothermal [1]. However, scheelites obtained by these routes show serious problems like off-stoichiometry in any case and undesirable optical quality and scintillating properties in single crystals.

In this work, powders and single crystal minirods of scheelite $CaWO_4$ were obtained by the methods of solid state reaction and laser heated pedestal growth, respectively, and an investigation has been made of their composition, scintillating and optical properties as revealed by X-ray diffraction (XRD), radioluminescence (RL) and optical absorption (OA) measurements.

We have found single phase $CaWO_4$ in both as-obtained powders and single crystals, and well-behaved optical and scintillating properties. Enhanced scintillating properties in single crystal samples were evidenced, with single or double RL peaks between 400 nm and 500 nm, with sources of β-ray or X-ray, respectively. Also, a decrease of the RL light yield with the temperature increase was observed in all the samples. A shift of the RL peak was also observed with the temperature increase.

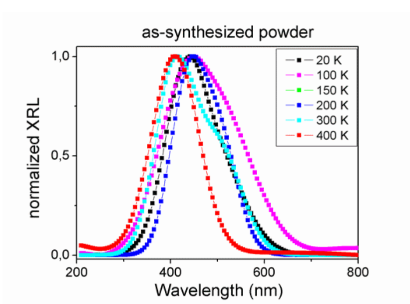

Figure 1: Radioluminescence light yield, as function of temperature and wavelength, during irradiation with β-rays from a $^{90}Sr/^{90}Y$ source in as-synthesized powder of $CaWO_4$.

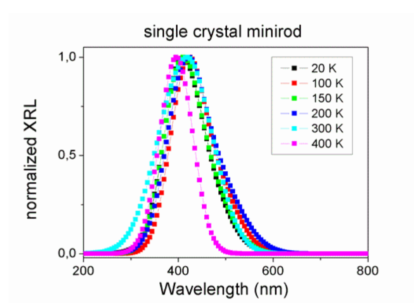

Figure 2: Radioluminescence light yield, as function of temperature and wavelength, during irradiation with β-rays from a $^{90}Sr/^{90}Y$ source in as-obtained single crystal minirod of $CaWO_4$.

References

[1] P. Parhi, T.N. Karthik and V. Manivannan, J. Alloys and Compounds 465 (2008) 380.