Optical temperature sensor based on upconversion in fluorophosphates glasses doped with Er^{3+}.

Allysonn Jorge dos Santos, Tássia de Souza Gonçalves, Marcos de Oliveira Júnior, Hellmut Eckert, Andrea S. S. de Camargo[1]

São Carlos Institute of Physics, University of São Paulo, São Carlos, Brazil

e-mail: tassia.sg@hotmail.com

The infrared-to-visible upconversion process is widely studied in materials doped with Er^{3+} ions due to the various possibilities of technological applications. The process is based on the emission of photons with higher energy (in the visible) than the excitation photons (in the infrared) via the mechanisms of two-photon absorption and/or energy transfer between RE^{3+}, exhibiting intense emissions in the green and red, which can be efficiently excited by diode lasers in the near infrared region (980 nm). One application of this process is an optical temperature sensor based on the dependence of the ratio of the emission intensities of levels $^2H_{11/2}$ and $^4S_{3/2}$ on the temperature of the sample. Such sensor would be advantageous for operation in hostile environments, such as high voltage transformers, industrial process, etc. Because the efficiency of upconversion also depends on the host matrix composition, fluorophosphates glasses are interesting candidates due to their high chemical stability, good mechanical properties and relatively "low phonon energy". When mentioning low phonon energy we want to convey that this vibrational energy doesn't have much importance in the rare earth radiative properties because it is found in a fluoride dominating environment. The local environments of the rare-earth species have been studied by pulsed EPR spectroscopy of the Yb^{3+} spin probe (S = 1/2), revealing composition- dependent echo-detected lineshapes and strong hyperfine coupling with ^{19}F nuclei in hyperfine sublevel correlation (HYSCORE) spectra consistent with the formation of Yb^{3+}–F bonds. Glasses with composition $25BaF_2 25SrF_2 (30\text{-}x)Al(PO_3)_3 xAlF_3 (20\text{-}z)YF_3 : zErF_3$ with x=20 and z varying from 1.0 to 5.0 mol% were characterized and selected to develop the prototype employing the fluorescence of fluorophosphates glass doped with Er^{3+} for measuring temperatures with the following characteristics: low cost, high accuracy and fast response.