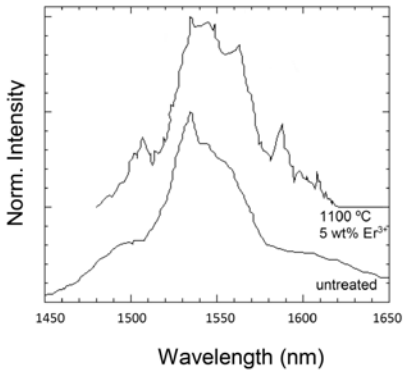
Spectroscopic signature of Pyrochlore Erbium Titanate nanocrystals precipitated in high phonon silicate matrix

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Abstract

Several rare-earth doped optical materials have been developed for photonic applications, mainly for applications such as semiconductor lasers (or diodes), fluorescent labels and optical amplifiers. In particular, erbium ions (Er^{3+}) doped SiO_2 sol-gel glasses have attracted increasing importance as amplifier devices. The incorporation of TiO_2 into the SiO_2 glass, as a structural modifier, is a suitable strategy to reduce the high phonon energy of asymmetrical Si-O-Si stretching vibrations (~1080-1100 cm^{-1}) in the SiO_2 glass, while that of the Si-O-Ti bonds is comparatively lower (~ 920-960 cm^{-1}). TiO_2 co-doping create –(Si-O-Ti)– bonds in the glass structure, as demonstrated by the FTIR spectrum. On the other hand, during the annealing process, ETO nanocrystallites can be single-precipitated in the main matrix for specific conditions (depending on Er^{3+} content, temperature and time of heat treatment) as reveled by XRD. Er^{3+} ions are thus divided between the host glass and the nanocrystallites. This ordered (crystalline) environment would avoid undesired Er^{3+} ions clustering. In a previous work, it was revealed that Er^{3+} ions within SiO_2-TiO_2 sol-gel glasses are inserted in nanocrystals of pyrochlore erbium titanate, $Er_2Ti_2O_7$ (ETO). Additionally, a pure $Er_2Ti_2O_7$ pyrochlore based-waveguide was obtained with remarkable spectroscopic properties and reduced non-radiative absorption mechanisms. However, no signature of such phase considering it spectroscopic characteristics in host glasses was reported yet. In this work, an optical spectroscopic analysis of ETO in transparent SiO_2-TiO_2 glass–ceramics is presented.

Image



Recent Publications

1. Helena Cristina Vasconcelos and Afonso Silva Pinto, Rare-Earth Activated Glasses in Integrated Optical Devices with Different Geometric Shapes: Fibers, Planar Waveguides and Microspheres in Photoluminescence: Advances in Research and Applications", Ellis Marsden (Editor), NOVA Publishers, USA, ISBN: 978-1-53613-537-4, 2018.
2. Helena Cristina Vasconcelos and Afonso Silva Pinto, Fluorescence Properties of Rare-Earth-Doped Sol-Gel Glasses in Nanotechnology and Nanomaterials- Recent Applications in Sol-Gel Synthesis", ISBN 978-953-51-3246-2, Print ISBN 978-953-51-3245-5, edited by Usha Chandra, INTECH Publishers, 2017.
3. H.C. Vasconcelos, M.G. Meirelles and F. Rivera-López, Erbium photoluminescence response related to nanoscale heterogeneities in sol-gel silicates, Journal of Rare-Earths, 31 (2013), Pages 18–26.
4. F. Lahoz, C. Perez-Rodrıguez, A. Halder, S. Das, M. C. Paul, M. Pal, S. K. Bhadra, and H. C. Vasconcelos, Complete energy transfer due to rare-earth phase segregation in optical fiber preform glasses, Journal of Applied Physics 110, 083121, 2011.
5. Vasconcelos, H.C., The effect of PO2,5 and AlO1,5 additions on structural changes and crystallization behaviour of SiO2-TiO2 sol-gel derived glasses and thin films, Journal of sol-gel science and technology 55, 126-136, 2010.

Photograph



Biography

Prof. H. Cristina Vasconcelos is graduated in Physical and Materials Engineer and got a Materials Engineer Doctor's degree (Ph.D.) from the Instituto Superior Técnico, Lisboa, Portugal. Presently, she is a professor at the Azores University, Ponta Delgada, were she lectures on a wide range of subjects at both under- and postgraduate level, including Physics, Biophysics, Physics Applied to Biologic Sciences and Biomaterials. She is a member of the Portuguese Physics Society and of the Portuguese committee of the program Hands On Particle Physics Masterclasses - CERN. She chaired several International Conferences and develops her research activity within the CEFITEC (Centre for Physics and Technological Research) at Universidade Nova de Lisboa, Portugal.

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Notes/Comments