Proposal of Er^{3+}/Yb^{3+}-doped recyclable material for application as future optical amplification in C-telecom region

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Nowadays the telecommunications areas have a great interesting in materials that present a broad band emission in C-telecom region, around 1550 nm for optical amplification[1]. In this sense many materials are reported in literature that show this properties, however many of them require expensive process of preparation. The blend between the low cost of preparation process and the use of recycled materials may be one of the ways out for aid word sustainable. The Er^{3+} doped Al_2O_3 is the promising material for appliance in this specific area. The aim of this work is the investigation of photoluminescence RE^{3+} in aluminum oxide (Al_2O_3). The Er^{3+}/Yb^{3+} co-doped Al_2O_3 materials were synthesized by co-precipitation using rings of aluminum cans as precursors and Er^{3+} and Yb^{3+} in ethanolic anhydrous solutions. Initially the rings of aluminum cans were dissolved in HCl 5.0 mol L^{-1}. After full solubilization of this one, the doping was performed with 0.1, 1 and 3 mol% of Er^{3+} and co-doping with 1.2 mol% of Yb^{3+} in relation to the total amount of moles of Al^{3+}.The materials were heat-treated at 400, 600, 900, 1000, 1100 °C for 4h thereby obtaining RE^{3+}-doped Al_2O_3. Subsequently the materials Er^{3+}/Yb^{3+}-codoped Al_2O_3 were also synthesized by the sol-gel process using aluminum tri-sec-butoxide as precursor. Wishing to obtain 20 ml of solution, this one was prepared with the mixture of anhydrous ethanol, ethoxyethanol, aluminum tri-sec-butoxide, HCl and solutions of RE^{3+}. The amounts of RE^{3+}, and heat-treatment in the synthesis were reported previously. XRD showed that the crystallinity of the material increases as a function of heat-treatment temperature, obtaining the mixture of γ-Al_2O_3 and α-Al_2O_3 phases. The micrographs of materials obtained by sol-gel showed the formation of smaller agglomerates and homogeneous morphology when compared to the materials obtained by the co-precipitation process. The up-conversion emission spectra showed emission in the visible region with inhomogeneous broadening bands, associated the different position of RE^{3+} in Al_2O_3 matrix. This can be associated to the different phases obtained or then to the many sites of symmetry that the RE^{3+} may be positioned in the host. The emission band in the red region is more intense than the emission in the green region, and both bands increase as a function of excitation power pump. Furthermore, the materials showed an intense emission in the infrared region around 1550 nm, with FWHM of around 89.8 nm. The properties presented by the materials obtained in this work invite us to study and proposed this material as a future candidate for application in optical amplification devices or even as infrared radiation detector, particularly the radiation with wavelength of 980 nm.

1. Ferrari, J. L.; Lima, K. O.; Pecoraro, E.; Ferreira, R. A. S.; Carlos, L. D.; Gonçalves, R.R.; J Mater Chem, **2012**, 22, 9901-9908.

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