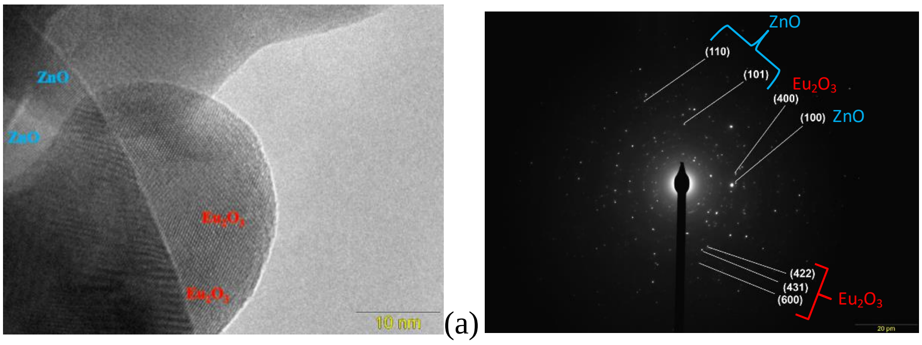
High Resolution TEM as a tool to investigate the formation of luminescent $ZnO@Eu_2O_3$ Core/Shell type system from modified Pechini Route

Alessandro Bruno Silva Garcia[1*], Glenda Gonçalves de Souza[1], Ana M. Pires[1]

[1]*Faculdade de Ciências e Tecnologia, Presidente Prudente, Brazil*

*e-mail: alessandroaicrag@gmail.com

Core/shell type systems include materials that when encapsulated with metals, inorganic solids or biomolecules, tend to form compounds with specific properties. The coated nanomaterials have become an important area of research due to their potential use in various fields such as catalysis, industry and biomedicine. Zinc oxide, a type II-IV semiconductor with direct band gap of 3.37 eV, at the nanoscale has shown great interest due to its low cost and its wide range of applications such as solar cells, sensors, laser diodes[1]. This work reports on the use of Pechini modified route to prepare nanostructured ZnO covered by Eu_2O_3 in order to provide core@shell type systems combining the zinc oxide semiconductor features and europium oxide optoelectronic ones. The coating process was performed with the dissolution of Eu_2O_3 (2% em mol com relação a Zn) in nitric acid with pH control and mechanical stirring and then the addition of citric acid and sorbitol; to this mixture the ZnO nanoparticles prepared by modified Pechini method [2,3] were added and kept under stirring for 5 h. After that, particles were isolated, washed and calcined at 750 °C for 2 h. X-ray diffraction pattern of the prepared sample ensures that both zinc and europium oxides phases are present, and photoluminescent spectrum showed the expected Eu(III) set of transitions in the red. High resolution transmission electron microscopy images of the prepared sample, for instance, allowed viewing in detail particles boundaries and atomic plans distribution, Fig. 1, from which it was possible to estimate interplanar distances and propose oxide phase assignment. SAED measurements, Fig. 1b, confirmed such estimative. Therefore, it was possible to prove the presence of Eu_2O_3 in the particles boundaries ensuring that the applied methodology was successful to provide luminescent $ZnO@Eu_2O_3$ core/shell type systems.



(a) (b)

Fig. 1 – (a) High resolution TEM image and (b) SAED (selected-area electron-diffraction) and hkl planes indexed for $ZnO@Eu_3O_3$ prepared sample.

[1]A. M. Peir´ o, P. Ravirajan, K. Govender et al., "Hybrid polymer/metal oxide solar cells based on ZnO columnar structures," Journal of Materials Chemistry, vol. 16, no. 21, pp. 2088–2096, 2006.
[2]Garcia, A. B. S., et al., In: 38a RASBQ, Águas de Lindóia. Livro de Resumos - Divisão de QM. São Paulo, SP: SBQ,2015.p.T0668-1. http://www.sbq.org.br/38ra/cdrom/resumos/T0668-1.pdf
[3]SOUZA, G.G.. 2013. Dissertação (Mestrado em Química). Unesp, São José do Rio Preto, 2013.

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