

Discovering new colors of luminescence in rare-earths doped CaTiO₃ through co-doping

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The luminescence of CaTiO₃:Pr³⁺ has been known since mid-90s [1] and its persistent luminescence has been explained *via* InterValence Charge Transfer transitions [2]. However, the trivalent dysprosium doped materials besides presenting white luminescence does not present any persistent luminescence. On the other hand, the expected red emission on materials doped with Eu³⁺ only occur when exciting in the forbidden 4f⁶-4f⁶ transitions. The objectives of this work are to show the synthesis and luminescence properties of CaTiO₃:Dy³⁺ and CaTiO₃:Dy³⁺,R³⁺ prepared with the sol-gel method [3, 4]. The excitation spectra of single Eu³⁺ or Dy³⁺ doped materials (Fig. left) show for Eu³⁺, only the 4f⁶-4f⁶ transitions while for Dy³⁺ both the 4f⁹-4f⁹ transitions as well as the O²⁻→Ti^{IV} charge transfer and the host absorption. The excitation spectrum for the Dy³⁺,Eu³⁺ co-doped material monitoring the Eu³⁺ emission at 610 nm exhibit both the Eu³⁺ intraconfigurational transitions as well as the O²⁻→Ti^{IV} charge transfer and the host absorption. This result indicates that there is no direct energy transfer from Dy³⁺ to Eu³⁺, but Dy³⁺ acts as a sensitizer for Eu³⁺ to be excited by host transitions. Based on experimental data the energy level diagram was constructed (Fig. right) showing that Eu³⁺ is deep inside the valence band.

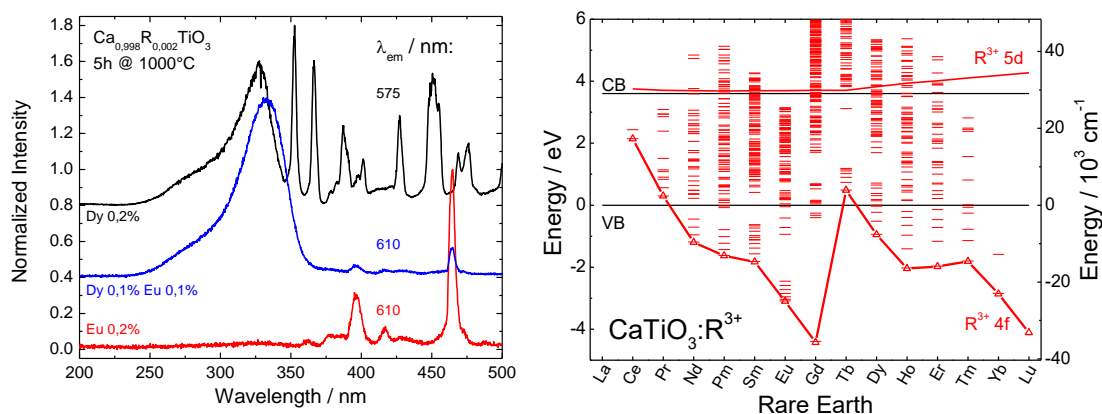


Figure. CaTiO₃:R³⁺ excitation spectra (left) and energy levels diagram (right).

[1] Vecht, A., Smith, D.W., Chadha, S.S., Gibbons, C.S.; Koh,J.; Morton, D.; *J. Vac. Sci. Technol B* 12 (1994) 781.

[2] Boutinaud, P.; Sarakha, L.; Cavalli, E.; Bettinelli, M.; Dorenbos, P.;Mahiou, R.;*J. Phys. D: Appl. Phys.* 42 (2009) 045106.

[3] Pfaff, G.; *Chem. Mater.* 6 (1994) 58.

[4] Hench.,L.L.; West,J.K.; *Chem. Rev.* 90 (1990) 33.

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