

Discovering new colors of luminescence in CaTiO_3 with rare-earths doped through co-doping

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The luminescence of $\text{CaTiO}_3\text{:Pr}$ has been known since mid-90s [1, 2] and its persistent luminescence has been explained *via* InterValence Charge Transfer transitions. 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 Eu^{3+} only occur when exciting in the forbidden $4f^6-4f^6$ transitions. The objectives of this work are to show the synthesis and luminescence proprieties of $\text{CaTiO}_3\text{:Dy}^{3+}$ and $\text{CaTiO}_3\text{:Dy}^{3+}, \text{R}^{3+}$ prepared with the sol-gel method [3, 4]. The excitation spectra of single Eu^{3+} or Dy^{3+} doped materials (Fig. left) show for Eu^{3+} , only the $4f^6-4f^6$ transitions while for Dy^{3+} both the $4f^9-4f^9$ transitions as well as the $\text{O}^{2-} \rightarrow \text{Ti}^{\text{IV}}$ charge transfer and the host absorption. The excitation spectrum for the Dy-Eu co-doped material monitoring the Eu^{3+} emission at 610 nm exhibit both the Eu^{3+} intraconfigurational transitions as well as the $\text{O}^{2-} \rightarrow \text{Ti}^{\text{IV}}$ charge transfer and the host absorption. This result indicates that there is no direct energy transfer from Dy^{3+} to Eu^{3+} , but Dy^{3+} acts as a sensitizer for Eu^{3+} to be excited by host transitions. Based on experimental data the energy level diagram was constructed (Fig. right) showing that Eu^{3+} is deep inside the valence band.

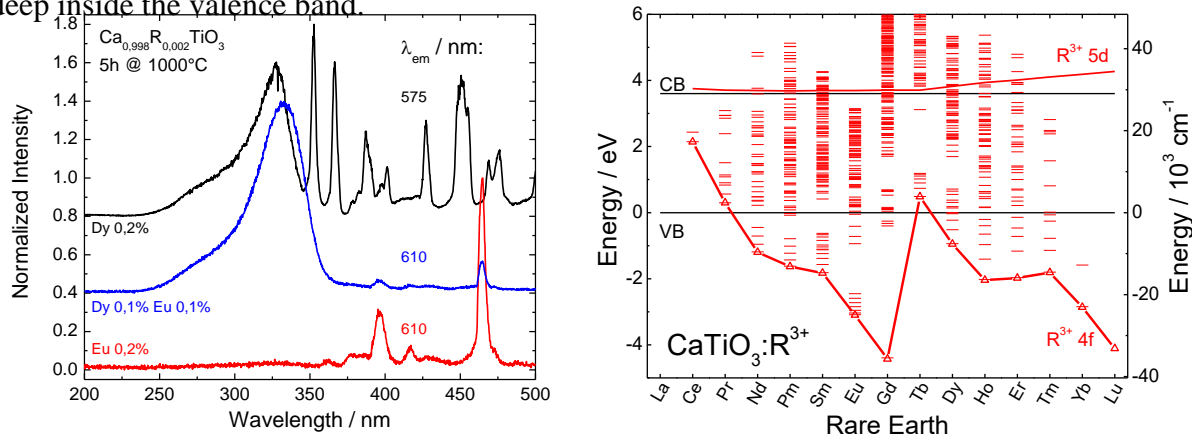


Figure. $\text{CaTiO}_3\text{:R}^{3+}$ excitation spectra (left) and energy levels diagram (right).

- [1] Vecht, A.; Smith, D. W.; Chadha, S. S.; Gibbons, C. S.; Koh, J.; Morton, D.; *J. Vac. Sci. Technol B* **1994**, 12, 781.
- [2] Boutinaud, P.; Sarakha, L.; Cavalli, E.; Bettinelli, M.; Dorenbos, P.; Mahiou, R.; *J. Phys. D: Appl. Phys.* **2009**, 42, 045106
- [3] Pfaff, G.; *Chem. Mater.* **1994**, 6, 58.
- [4] Hench, L. L.; West, J. K.; *Chem. Rev.* **1990**, 90, 33.

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