

Energy level of Ce³⁺ at energy higher than 2000 cm⁻¹ in silica

Manuel Vermillac¹, Maria Rita Cicconi², Mourad Benabdesselam¹, Franck Mady¹, Dominique de Ligny², Cristina Armellini³, Thi Ngoc Lam Tran Lam^{3,4,5}, Anna Lukowiak⁶, Maurizio Ferrari^{3,7}, Wilfried Blanc¹

1 - Université Côte d'Azur, CNRS, Institut de Physique de Nice, UMR 7010, Parc Valrose, Nice, Cedex 2, France

2 - Department Werkstoffwissenschaften, Lehrstuhl für Glas und Keramik, Universität Erlangen-Nürnberg. Martensstrasse 5, D-91058 Erlangen, Germany

3 - IFN-CNR CSMFO Lab. and FBK Photonics Unit, Via alla Cascata 56/C, 38123 Povo-Trento, Italy

4 - DICAM Department of Civil, Environmental and Mechanical Engineering, University of Trento, Via Mesiano, 77, 38123 Trento, Italy

5 Ho Chi Minh City University of Technical Education, 1 Vo Van Ngan Street, Linh Chieu Ward, Thu Duc District, Ho Chi Minh City, Vietnam

6 - Institute of Low Temperature and Structure Research, PAS, 2 Okolna St., 50-950 Wroclaw, Poland

7 - Enrico Fermi Center, Piazza del Viminale 1, 00184 Roma, Italy

Among rare-earth ions, cerium is widely used in laser technology, fast scintillators and white emitting LEDs thanks to its ability to emit in the UV-visible. This emission band is due to the transition of an electron from the 5d energy levels to the 4f ones. As a consequence, the position of its emission wavelength depends strongly on the environment. It spans from UV in fluoride to red in nitride. Electrons on the two 4f levels (²F_{5/2} and ²F_{7/2}) are shielded from the external field by the 5s² and 5p⁶ electrons. Then, the two 4f levels are usually known to be separated by ~2000 cm⁻¹ whatever the change of the environment. However, it has been reported recently that a higher 4f energy level does exist in crystals, located at 3639 cm⁻¹ in Gd₃Ga₅O₁₂ [1] and ~4000 cm⁻¹ in Lu₃Al₅O₁₂ [2].

In cerium-doped silica glasses prepared by sol-gel, we have measured absorption spectra in the 4f energy levels domain. An absorption band at ~5300 cm⁻¹ has been observed. During this presentation, we shall discuss on the origin of this absorption band, based on results obtained both in silica and silicates (silica containing aluminum or sodium) glasses prepared by sol-gel, melt-quenching and phase vapor (MCVD process).

[1] H. Przybylinska *et al.*, Phys. Rev. B 87 (2013) 045114

[2] L. Seijo and Z. Barandiaran, Phys. Chem. Chem. Phys. 16 (2014) 3830