

Time resolved confocal luminescence of Nd³⁺ doped BK7 glass microspheres.

A. Benayas¹, G.S. Murugan², Y. Panitchob², D. Jaque¹ and J.S. Wilkinson².

¹ GIEL, Departamento de Física de Materiales, Universidad Autónoma de Madrid, 28049 Madrid, Spain

² Optoelectronics Research Centre, University of Southampton, Highfield, Southampton, SO17 1BJ, United Kingdom

* Corresponding author: Daniel.jaque@uam.es

Interest in dielectric microspheres is rapidly increasing because of their potential application in integrated photonics for filtering, dispersion management and all-optical switching. When doped with luminescent ions capable of laser oscillation, such as the rare-earths, these applications are extended to incorporate the potential for low threshold laser oscillation exploiting Whispering Gallery Modes (WGMs) to form cavities. This possibility has already been demonstrated in glass microspheres doped with different rare earth ions including Neodymium, of special relevance due to its high emission cross section at laser wavelengths and also because of the long lifetime of the metastable state (both facts ensuring low laser thresholds), that are presented in bulk materials. These two properties, and their possible modification during the fabrication procedure of microspheres, will dominate the final laser performance of the microspheres.

In this work we have investigated, by means of time resolved confocal micro luminescence, the spectroscopic properties of BK7 glass microspheres doped with 1.5 wt% Nd₂O₃. Under continuous wave excitation, we have obtained the emission spectrum from a single microsphere (see Figure 1 below), from which information concerning the Q factor has been extracted. We also report on fluorescence lifetime measurements in single microspheres, paying special attention to the effect that the presence of WGM could have in the measured value of the metastable fluorescence lifetime. As it is shown in Figure 2 the measured fluorescence lifetime reduces as the microsphere size is reduces. The possible mechanisms at the origin of this behavior will be discussed.

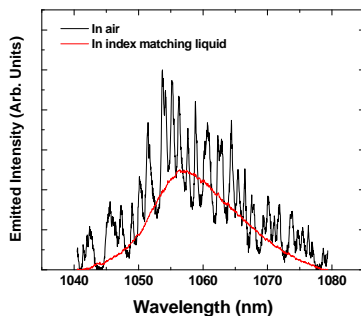


Fig 1 Luminescence spectra of Nd³⁺-doped microspheres

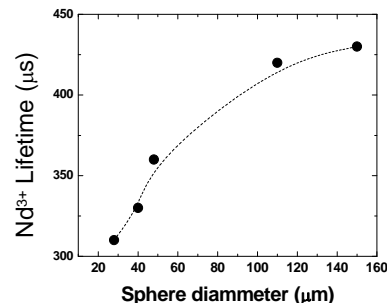


Fig 2 Fluorescence lifetime as a function of the size of the microsphere.