"Synthesis, characterisation and optical spectroscopy of rare earth doped nanocrystalline TiO$_2$ and Nb$_2$O$_5$"

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**Abstract.** It is well known that nanocrystalline TiO$_2$ containing various dopants is an important material for photocatalytic applications. On the other hand, nanocrystalline niobia is a valuable material finding applications as catalyst and sensor. Despite the intense research activity on these materials, scarce information is available in the literature on nanocrystalline TiO$_2$, and Nb$_2$O$_5$ doped with lanthanide ions, although they could be potentially useful also as luminescent materials. For these reasons, we found it interesting to investigate the synthesis, the structure and the luminescence of Ln$^{3+}$ doped nanocrystalline TiO$_2$ and Nb$_2$O$_5$. Titania powders were obtained using a sol-gel and a solvothermal synthesis, whilst niobia samples were prepared using a Pechini synthesis. The samples were doped with 1-5 mol% of Ln$^{3+}$ ions. X-ray diffraction showed that the powders are single phase materials with the tetragonal anatase and monoclinic Nb$_2$O$_5$ structure, respectively, and a particle size of about 20 nm. Their size is confirmed by TEM images, where monodisperse nanoparticles are observed. The luminescence spectra are characterised by relatively broad bands typical of lanthanide impurities in disordered environments. This result clearly shows that Ln$^{3+}$ can be accommodated in the oxide lattices, presumably in strongly disordered substitutional cationic sites. The nature of the sites occupied by the Ln$^{3+}$ impurities in TiO$_2$ is confirmed by EXAFS data obtained at the ESRF synchrotron in Grenoble.

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