STRUCTURAL AND LUMINESCENT PROPERTIES OF EUROPIUM DOPED GADOLIUM NANORODS IN HYDROXIDE OR OXIDE PHASE

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Eu^{3+}-doped Gd^{3+}-oxide and hydroxide nanorods have been prepared by hydrothermal synthesis, with an Eu content in the range 1 - 20 % [1-2].

The samples consist of nanostructured cylinders, 20 to 50 nm in diameter and *ca.* 300-500 nm in length, figure 1. Structural analysis was performed using powder X-ray (XRD) and the morphology of the nanorods was studied by SEM, TEM and AFM. The Eu^{3+} photoluminescence (PL), excited-state ($^5D_0$) lifetime, emission quenching effects and quantum yield values have been measure and studied as a function of the Eu^{3+} amount. The hydroxide phase presents a hexagonal structure, space group P63/m (Z=2), cell parameters a=b=0.63 nm and c=0.36 nm. In this phase the Gd (or Eu) atoms occupy sites with x=0.33, y=0.66 and z=0.25 nm in the unitary cell (C_{3h} point symmetry).

The emission spectrum of the oxide phase is completely different from the spectrum of the hydroxide phase, being dominated by the electric-dipole induced $^5D_0 \rightarrow {}^7F_2$ line. The presence of two $^5D_0 \rightarrow {}^7F_0$ lines and the room-temperature $^5D_0$ decay curve indicate the presence of, at least, two distinct local environments for Eu^{3+} in the $Gd_2O_3:Eu^{3+}$ nanorods. While for the hydroxide phase there is no significant quenching of the PL intensity up to 20% Eu^{3+} content, for the oxide phase quenching is clearly observed for 5 %. Eu^{3+} content. The emission quantum yields have been measured using the methods of Wrighton *et al.* [3] and Brill *et al.* [4]. For the hydroxide nanorods with 3% Eu^{3+} content the value obtained is *ca.* 10.6±2.1%, under 394 nm excitation. The quantum yield value decreases as the europium content increases. Larger quantum yields, up to 32.1±6.4 % for 5% Eu^{3+} content (excitation of 254 nm), have been measured for the oxide nanorods. The nanorods have been functionalised at the surface OH groups with amine species. Silver nanoparticles have also been formed at the nanorods surface.

Some applications of these materials have been tested, such as fibers growth, AFM probes and light emission devices.

References:

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Figures:

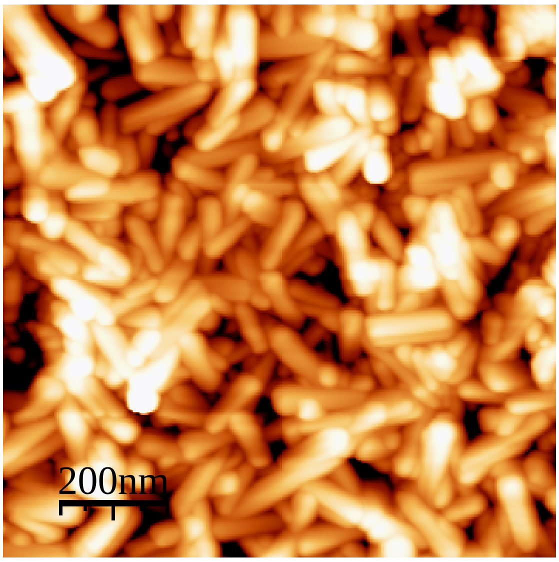

Figure 1- AFM image of Europium doped Gadolinium oxide Nanorods