SILICA-SUPPORTED ERBIUM–YTTERBIUM NANOCOMPOSITES: THE STRUCTURAL AND MORPHOLOGICAL PROPERTIES

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In recent decades, the rare earth doped nanostructured materials have received great attention due to their potential applications in the fabrication area of sensors, laser materials, solar cells, and optical communication. From these reasons, microstructure and morphology of Er_2O_3–Yb_2O_3 mixed oxides supported on amorphous SiO_2 was studied by FTIR, XRD and SEM techniques. Er_2O_3–Yb_2O_3/SiO_2 nanocomposites were prepared using a liquid-phase method. For the synthesis the water salt solutions of $Er(NO_3)_3$ and $Yb(NO_3)_3$ were added to 15 g fumed silica powder at room temperature (Evonik A-300; S_{BET} = 300 ± 30 m^2/g). The mixtures were stirred in the beaker using propeller stirrer for 0.5 hour. Water was removed from the mixtures in rotary evaporator. The solid produced was then dried and calcined at 550 °C for 1 hour. The content of Er_2O_3 added varied from 0.5 to 10 wt. % while the content of Yb_2O_3 was held constant at 4 wt. %. The XRD patterns indicated that all samples remained amorphous after their heating at 550 °C. The FTIR spectra for SiO_2 and Er_2O_3–Yb_2O_3/SiO_2 shows the absorption bands that correspond to vibrations of physically adsorbed water as well as the bands including 1096 cm^{-1} of Si–O–Si asymmetric stretching vibration, 809 cm^{-1} of Si–O–Si stretching vibration. Only in the case of the initial SiO_2, the narrow band at 3745 cm^{-1} representing the O–H stretching vibration of silanol groups present can be observed.

The surface morphology of the initial silica and nanocomposites can be seen at SEM images shown in the Fig.. The SEM images shows presence of rounded aggregates and/or spherical-like SiO_2 particles (Fig. *a*) varying in size between 40 and 180 nm (Fig. *c*). The aggregates size slightly decreases and more narrow size distribution after silica modification with Er_2O_3–Yb_2O_3 mixed oxides (Fig. *b*) can be observed. According to the histograms observed (Fig. *c*, *d*) the average sizes of nanoparticles present are in the range of 90 nm and 75 nm for SiO_2, and Er(10)Yb(4)Si(86) samples, respectively.

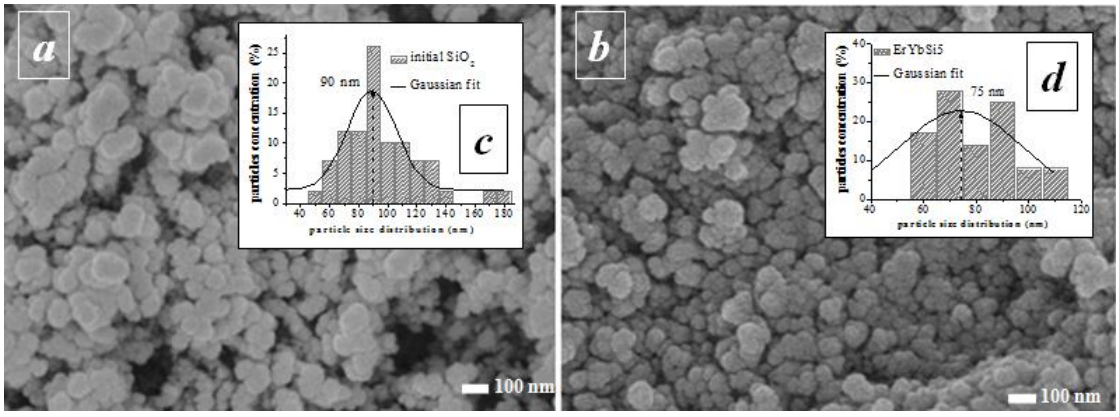

Fig. SEM images (*a*, *b*) and calculated particle size distribution using the software MEMO v.1.0.2. (*c*, *d*) for initial silica (*a*) and Er(10)Yb(4)Si(86) samples

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