Silica-supported holmium–ytterbium nanocomposites: electrophoretic and morphological studies

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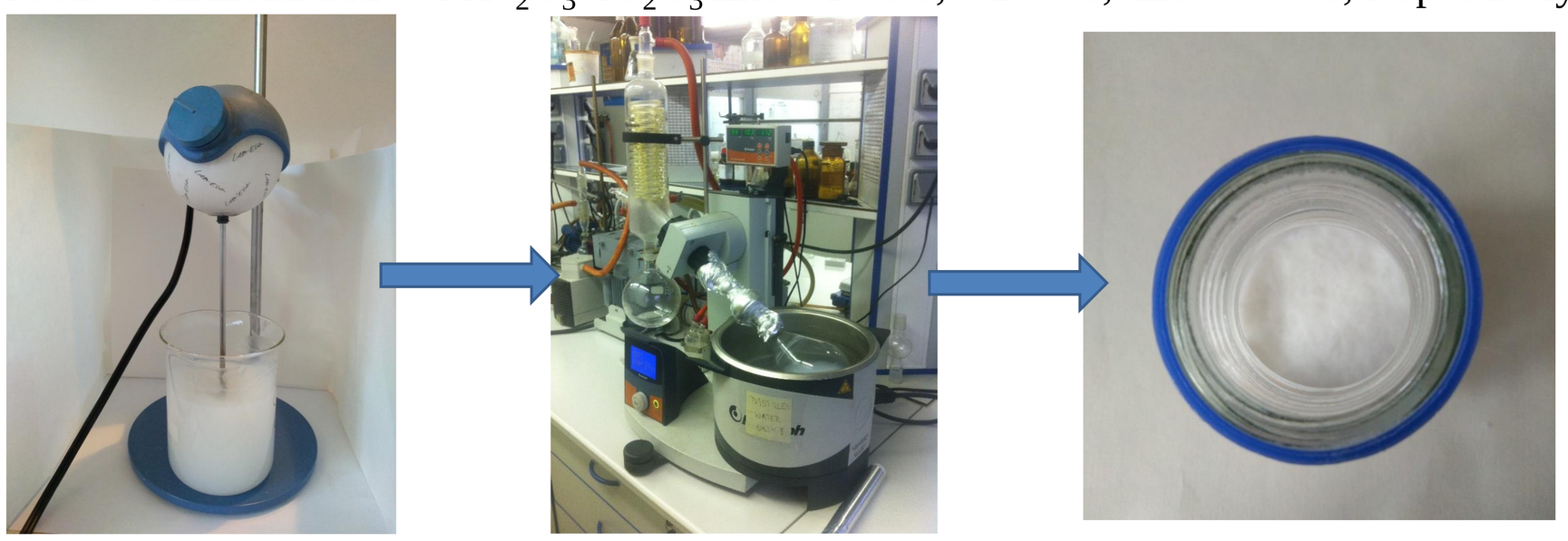
INTRODUCTION AND OBJECTIVE

In recent years, the production of nanostructured materials doped with trivalent lanthanide ions has drawn tremendous attention owing to their wide range of significant and unique properties as well as potential applications in solid state lasers, color displays, wavelength-calibration tools, catalysts and biolabels [1, 2].
In this work, we focused on studies of electrophoretic and morphological properties of Ho_2O_3–Yb_2O_3/SiO_2 nanocomposites.

EXPERIMENTAL

The ternary nanooxides were prepared by a liquid-phase method at room temperature using the water salt solutions of $Ho(NO_3)_3$ and $Yb(NO_3)_3$ (99.9 %, Aldrich) and fumed silica (S_{BET} = 265 m^2/g, 15 g) powder (Fig. 1). The mixtures were stirred in the beaker using propeller stirrer for 0.5 hour. Water was removed from the mixtures in rotary evaporator. Then the solid product was dried and calcined at 550 °C for 1 hour in a muffle furnace. The samples were marked as HoYbSi1, HoYbSi2 and HoYbSi3 with molar ratio of Ho_2O_3:Yb_2O_3 like 0.1 : 0.8; 0.2 : 0.8, and 0.4 : 0.8, respectively.



Stirring, 30 min | Rotary evaporation | Ho_2O_3–Yb_2O_3/SiO_2 nanocomposite after calcination

Fig. 1. *The preparation of silica-supported holmium–ytterbium nanocomposites*

RESULTS AND CONCLUSIONS

The stability and aggregation kinetic studies of the initial silica and mixed oxides suspensions without and with the polymer were performed using turbidimeter Turbiscan Lab[Expert] (Formulaction). Additionally, the particle size distribution (Fig. 2) and zeta potential of examined systems were determined applying a Zetasizer 3000 (Malvern Instruments) apparatus based on photon correlation spectroscopy. The obtained results enabled explanation of stability mechanism of solid particles (bare or covered with polymeric layers) dispersed in liquid medium. The SEM (Fig. 3) and TEM results reveal the preparation of the agglomerated sphere-like Ho_2O_3–Yb_2O_3/SiO_2 nanostructures with fine size.

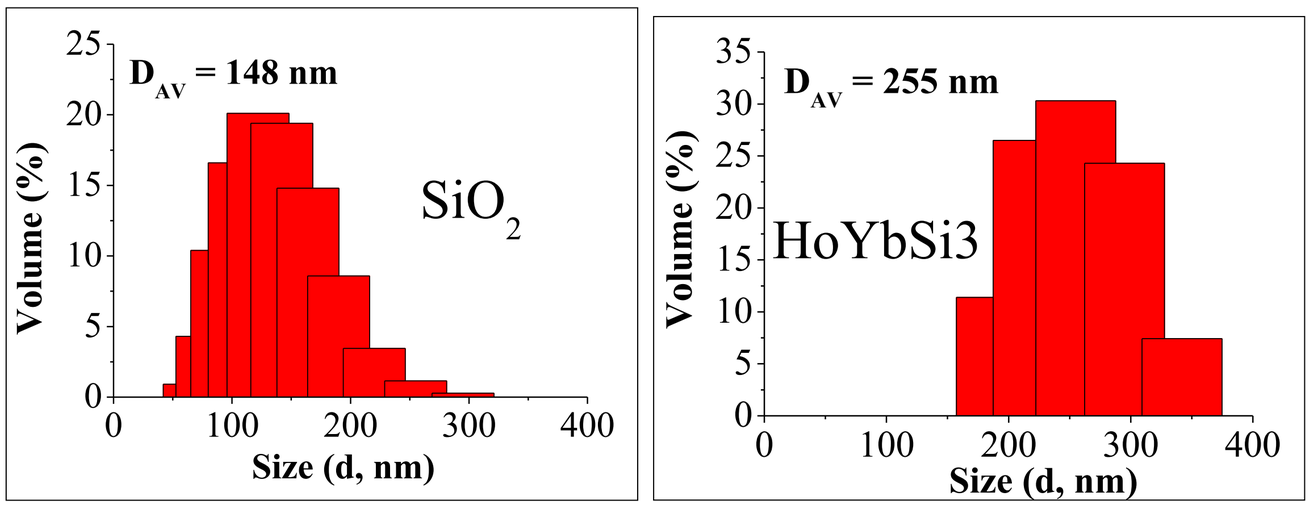


Fig. 2. *The particle size distribution for the "water/nanooxide" systems.*

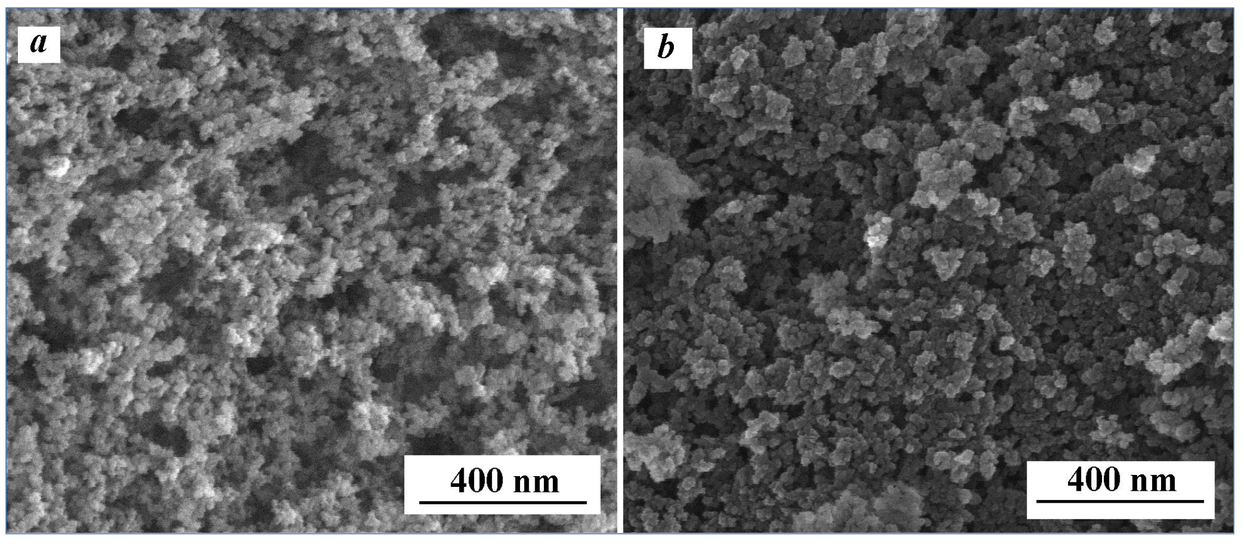


Fig. 3. *SEM images of fumed silica (a) and (b) HoYbSi3 sample calcined at 550 °C.*

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