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doi:10.1017/S1431927618009467
Microsc. Microanal. 24 (Suppl 1), 2018

Precipitative Synthesis of Gd_2O_3: Eu^{3+} Using Sucrose Precursor: Surface Modification and its Water Dispersibility

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Currently nanoparticles have taken a very important role especially in the area of biology and medicine because of their unique physical and chemical properties. Furthermore, by making a superficial modification to the nanoparticles, makes them chemically active, water dispersible and biocompatible. There has been various types of nanoparticles being used as a drug delivery agent, among all of them the nanomaterials with photo luminescent behavior are highly in demands. Considering the properties of Gadolinium oxide, it has been used in magnetic resonances, tomography, computerized X-ray (CT), on screens and in photodynamic therapy [1,2]. Specifically Gd_2O_3 is considered an appropriate host for the development of a luminescent material by doping with Eu3 since they have thermal stability, low phononic energy and chemical durability [2].

In this work, we present the synthesis of Gd_2O_3:Eu^{3+} with doping of 1 %, using sucrose as a precursor via precipitation method. The advantage of using sucrose precursor is the reaction mechanism is quite fast compared with other conventional methods as well its less time taking. We also present the morphology of the prepared material together with their water dispersibility measured by using uv-Visible microscope. The morphology and elemental composition were measured by SEM-EDS (Scanning electron microscope Jeol-JSM-6390LV / LGS, with a dispersive energy system model LK-IE250 Oxford Inca Energy 250) and water dispersibility using Photospectrometer (Thermo Scientific GENESYS 10S UV-Vis).

To synthesize the nanoparticles of gadolinium oxide was 0.52 g of $Gd(NO3)_3$ of SIGMA -ALDRICH, 0.02 g of Eu $(NO3)_3$ of SIGMA -ALDRICH and 0.5466 g of $C_{12}H_{22}O_{11}$ of Karal, then dilute with 50ml of distilled water, placed in a thermostatic bath at 30°C for 15 min, precipitated with ammonium hydroxide and filter, then washed with distilled water and dried in drying oven at 103°C and finally Calcinated at 1000 ° C.

The surface modification was carried out using 1g of nanoparticles, in 10 ml of deionized water and in an ultrasonic bath for 1 hour. Subsequently added 1 ml of APTES dropwise with stirring with 4 ml of ethanol, 15 ml of acetic acid was added and left under mechanical stirring for 45 minutes. It was centrifuged for 20 min at 20,000 rpm and was washed with deionized water and ethanol twice. Finally, it was dried in an oven at a temperature of 70 ° C until constant weight was obtained.

Fig.1 Shows the morphology of Gd_2O_3 nanoparticle at 1% doping concentration of Eu prepared by using sucrose precursor. The elemental composition were analysed to ensure the % composition of Eu and Gd contribution in final product (Figure 2). Absorption spectrometry is a technique based on the interaction of electromagnetic radiation with matter, when a beam of light of a certain intensity passes through the

sample, the molecules or particles present are able to absorb part of the radiation, so that the intensity of light is reduced. Absorbance was measured at two different wavelengths with respect to time. The representation of absorbance versus time gave rise to the absorption spectrum observed in Figure 3. It can be seen as there is an increase in absorbance as the minutes increase. In view of these results, it was determined that it had a better behavior at 285 nm and with APTES coating.

Finally we conclude that the precipitation method we used was quick, homogenos formation of particles as well the solubility of these prepared nanoparticles were quite well even without any surface modification. Since its important the stability of these nanoparticle in water as well the formation of functional groups. Considering that our APTES coted nanoparticles shoing a good response over the surface of Gd-Eu oxides.

References:

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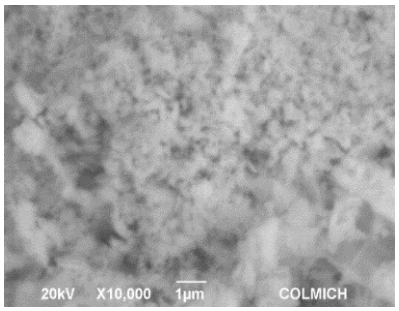

Figure 1. The SEM images corresponding are from the nanoparticle GdEu with sucrose.

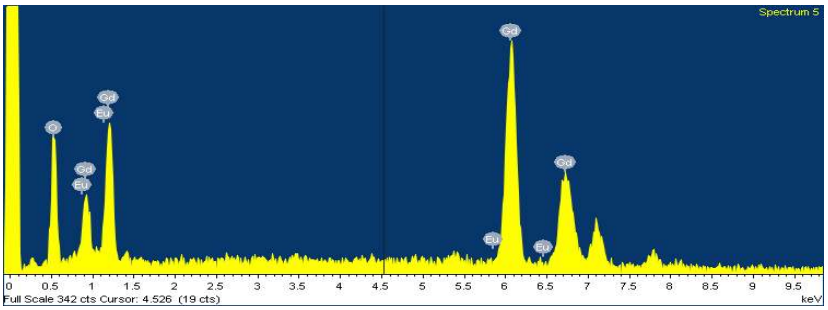

Figure 2. Spectrum obtained after the semiquantitative analysis by EDS of an area of the Gd2O3 sample: Eu.

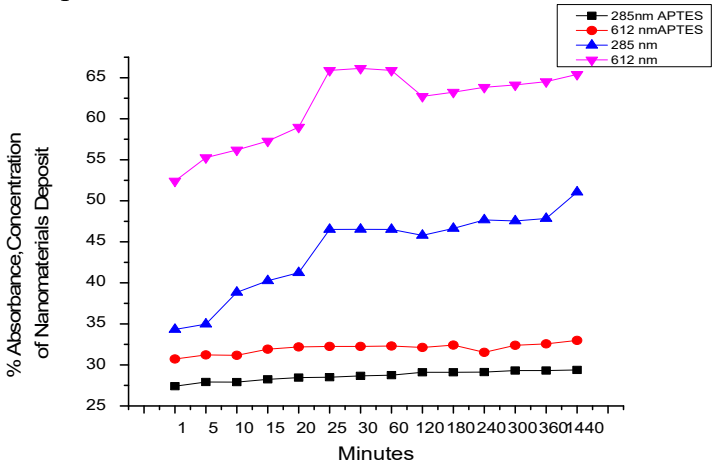

Figure 3. Representation of absorbance of the nanoparticles over time, with UV / VIS Spectrophotometer. In comparison to those of GdEu with and without APTES.

https://doi.org/10.1017/S1431927618009467 Published online by Cambridge University Press