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$Gd_{0.745}Y_{1.255}O_3$ and $Yb_{1.4}Y_{0.6}O_3$ Mixed Rare-earth-yttrium Oxides Nano-powders: Synthesis, Characterization, Particle-size Distribution and Optical Properties

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ABSTRACT

$Gd_{0.745}Y_{1.255}O_3$ and $Yb_{1.4}Y_{0.6}O_3$ nano-powders of mixed rare-earth-yttrium sesquioxides (diluted magnetics) were successfully synthesized via a simple co-precipitation method using rare-earth-nitrate salts as cation precursors and followed by a 4 hour heat-treatment at various temperatures (600 °C, 800 °C and 1000°C) for material crystallization. Experiments demonstrated the role of pH on the "co-precipitation" synthesis of $Gd_{0.745}Y_{1.255}O_3$ and $Yb_{1.4}Y_{0.6}O_3$ nano-powders. The pH-values were adjusted by adding NaOH which, as a precipitating agent, has a key role in this process. The obtained nano-powders were characterized by X-ray powder diffraction; their morphologies were analyzed by scanning electron microscope SEM, their average sizes were calculated using Scherrer formula, and their optical properties were studied using UV-Vis spectrophotometer with Tauc plot estimation to determine the band-gap energy. The influence of heat treatment, on the morphology and crystallite sizes of $Gd_{0.745}Y_{1.255}O_3$ and $Yb_{1.4}Y_{0.6}O_3$ nano-powders, was studied. The results indicated that the agglomeration of particles was favored by hydroxide precipitation, one of many other factors, including temperature and calcination time, that influence the quality of $Gd_{0.745}Y_{1.255}O_3$ and $Yb_{1.4}Y_{0.6}O_3$ nano-powders according to the SEM images, while the XRD analysis showed that crystallinity increased with an increase in calcination temperature. The study of particle-size distribution at different calcination temperatures indicated that the Grain-size increased from ~42 nm to ~100 nm for $Gd_{0.745}Y_{1.255}O_3$ and from ~13 nm to ~50 nm for $Yb_{1.4}Y_{0.6}O_3$ as the calcination temperatures increased, this influence also the optical band-gap which found to be decreasing from 4.22 to 3.95 eV when the particle sizes increasing for $Yb_{1.4}Y_{0.6}O_3$.

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INTRODUCTION

Recently, many researches have been conducted on improving the quality and use of materials for meeting the new requirement. Oxide Ceramics are extraordinary materials (especially non-Centrosymmetric ones) that are exploited in

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