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Crystal structure and magnetic properties of cerium-doped YIG: Effect of doping concentration and annealing temperature

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Abstract

We present a study of the effect of the substitution of Y^{3+} by Ce^{3+} on the crystal structure and magnetic properties of cerium-doped yttrium iron garnet (YIG), $Ce_xY_{3-x}Fe_5O_{12}$ ($0 \leq x \leq 0.5$), which was synthesized using high-energy ball milling. In particular, we aimed to study the effect of the cerium concentration and the annealing temperature on the crystal structure and magnetic properties of the Ce-doped YIG. Fe_2O_3 , Y_2O_3 , and $Ce_2(CO_3)_3$ were mixed in a stoichiometric ratio, milled for 5 h, and annealed at different temperatures, from 1000 to 1400 °C. The X-ray diffraction pattern confirmed the presence of CeO_2 as a secondary phase, together with the formation of the YIG structure, at all studied temperatures and compositions. A complete solid solution of Ce^{3+} in the garnet structure was obtained for the samples annealed at 1400 °C. Increasing the Ce^{3+} content resulted in a consistent decrease in the saturation magnetization and a slight decrease in the coercivity, resulting from the insertion of Ce^{3+} into the YIG structure and the presence of CeO_2 as a secondary phase.

Keywords: Ce doped YIG; CeO_2 -YIG; YIG magnetic properties; YIG crystal structure; iron garnet; mechanochemical processing.

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