

Effect of grain size on microstructural and magnetic properties of holmium substituted yttrium iron garnets (Y_{1.5}Ho_{1.5}Fe₅O₁₂)

ABSTRACT

Grain size changes on microstructural and magnetic properties of holmium substituted yttrium iron garnet with $x = 1.5$, (Y_{3-x}Ho_xFe₅O₁₂) has been discovered in this research work. The influence of grain size via sintering temperature on a sample's properties in Holmium substituted in YIG (Ho-YIG) samples has been scrutinized experimentally. In this study, Ho-YIG was mechanically alloyed for 2 h with a mixture of yttrium oxide (Y₂O₃), holmium oxide (Ho₂O₃) and iron oxide (Fe₂O₃). Then, the samples were sintered at distinct temperatures at 1000 to 1400 °C with 100 °C increment. The morphology, physical and magnetic properties has been studied in order to comprehend the resulting materials. Single phase cubic garnet structure has been observed without any other crystallographic phase confirmed through XRD spectra. Single phase of Ho-YIG was formed at 1100 °C. FESEM micrographs showed smaller grain size compared to pure YIG reported in literature as the consequences of holmium substitution. The effects of Holmium substitution in permeability values and B–H hysteresis loops were clearly seen since the dominant magnetization process (spin rotation and movement of ease domain walls) has been interrupted by the presence of rare earth element has decreased the permeability and saturation magnetization values. Substitution of Holmium makes YIG as better soft magnetic material which may be used in electronic devices for the microwave region.

Keyword: Mechanical alloying (MA); Magnetic properties; Rare earth; Microwave ferrites