Structural and magnetic properties of yttrium iron garnet (YIG) and yttrium aluminum iron garnet (YAlG) nanoferrite via sol-gel synthesis

ABSTRACT

The structural and magnetic properties of yttrium iron garnet (YIG) and yttrium aluminum iron garnet (Y3AlxFe5ī xO12, YAIG) (x = 0.2, 0.6, 1, 1.4, 1.8, and 2.2) nanoparticles were investigated. The samples were prepared via auto combustion sol-gel technique, using citric acid as chelating agent and fuel for the combustion process. The obtained powder was heated at 950 °C. X-ray diffraction peaks confirmed the garnet phase formation. Crystallite size increases with Al from 28.5894 to 28.6170 nm. Lattice constant of the samples was found to decrease from 12.4674 Å to 12.3233 Å as Al increase from 0.0 to 2.2. FTIR was used to confirm the garnet structure, the main vibrating modes were observed to shift to higher wave number with increasing Al concentration. Saturation magnetization, Ms shows a decreasing trend from 20.721 to 0.7586 emu/g with increasing Al from 0.0 to 2.2. Furthermore, the decreasing trends in the static magnetic properties of YAIG samples may be due to the introduction of Al ions in the YIG crystal lattice. High content of Al substitution on YIG leads to paramagnetic behavior of the ferrite. The grain size decreased from 0.64 ε m to 0.32 ε m, while the bulk density decreased from 5.058 gcmī 3 to 4.233 gcmī 3 as Al increase from 0.0 to 2.2.

Keyword: YIG; YAIG; Sol-gel; Phase composition; Magnetic properties