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Investigation on structural, electrical and magnetic properties of Gd3+ doped magnesium ferrite (MgFe2O4) ceramics

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Properties of Gd3+ rare earth ion incorporated MgFe2-xGdxO4 (0 =< x =< 0.16) ceramics prepared from powders using combustion technique with DL- alanine fuel are investigated. Re-arrangement of cations in the unit cell due to Gd3+ substitution for Fe3+ in MgFe2O4, and the consequent effects on the electrical and magnetic properties are discussed. Improvements in electrical resistivity with increasing Gd3+ content are shown to be significant, and dielectric response is analyzed using impedance and electric modulus. The X-ray density increases while the lattice parameter decreases slightly with increase of Gd3+ ion content in up to x = 0.08 in the phase pure MgFe2-xGdxO4 (0 =< x =< 0.08) powders. However, the measured bulk density in sintered ceramics decreases from 4.26 to 3.78 g cm-3, and porosity increases from 5.12 % to 18.58 %. In comparison to pure MgFe2O4 improvement is seen for an optimum Gd3+ concentration (x = 0.02) i.e., Mg2Fe1.98Gd0.02O4 ceramics. The MgFe2O4 ceramics having porosity 5.12%, while Mg2Fe1.98Gd0.02O4 ceramics having porosity 5.38 %, while electrical resistivity improves by ~100 times, the dielectric constant (ε'=14.3), loss factor is low (tan δ ~ 0.003) at 1MHz.

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