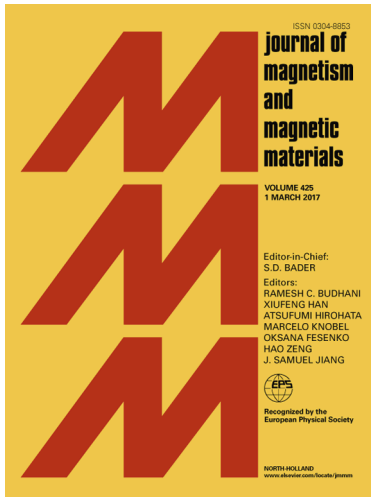

Research articles

Enhanced room temperature multiferroic characteristics in hexagonal $LuFe_{1-x}Ni_xO_3$ ($x = 0 – 0.3$) nanoparticles

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Enhanced room temperature multiferroic characteristics in hexagonal $LuFe_{1-x}Ni_xO_3$ (x = 0 – 0.3) nanoparticles

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Abstract

Single phase polycrystalline $LuFe_{1-x}Ni_xO_3$ (x = 0 – 0.3) (LFNO) nanoparticles are synthesized using the sol-gel method. X-ray diffraction measurements revealed that the crystal structure of Ni-doped samples is isomorphic to hexagonal $LuFeO_3$ (LFO). The phase pure hexagonal $P6_3cm$ symmetry exists for $0 \leq x \leq 0.3$, and the secondary phases appear for $x \geq 0.4$. Raman spectra show a shift in the mode frequency corresponding to the changes in Lu-O and Fe-O bond lengths with Ni doping. An enhancement in the magnetization is observed for LFNO throughout the temperature range (400 K – 5 K) compared to LFO. The antiferromagnetic state of LFO becomes ferrimagnetic at low temperatures, and a net magnetization is observed at room temperature with Ni doping. As Ni concentration increases, a systematic increment in the ferroelectric polarization is observed. This enhancement in polarization is believed to be due to the distortion in FeO_5 cage, while the improvement in magnetic properties is due to the induced magnetic interactions, caused by the Fe-Ni interactions on the triangular lattice with Ni doping in $LuFeO_3$.

Keywords: magnetic nanoparticles, hexagonal ferrites, Raman spectra, hexagonal ferroelectricity, multiferroics.