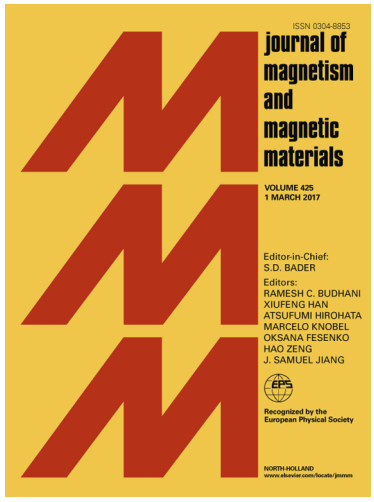

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Mahmoud S. Alkathy, K.C. James Raju

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Onset of Multiferroicity in Nickel and Lithium Co-substituted Barium Titanate Ceramics

Mahmoud S. Alkathy[1] & K. C. James Raju[*1]

[1]*School of Physics, University of Hyderabad, Hyderabad-500046, India*

[*]Corresponding Author: kcjrsp@uohyd.ac.in

Abstract

The structural, magnetic and ferroelectric properties of Nickel and Lithium co-substituted barium titanate were investigated in this work. $Ba_{(1-x)}Li_xNi_{x/2}TiO_3$ (x= 0, 0.02, 0.04 and 0.08) ceramics were synthesized via solid-state reaction with the assist of microwave heating of the starting materials. The tetragonal structure has been observed in all samples, and it is confirmed by Rietveld refinement study. The morphological study has been carried out by FE-SEM. Electron spin resonance (ESR) has been used to study the electron interaction and to verify the magnetism behavior of present samples. No resonance signal was observed in pure $BaTiO_3$ samples. However, the resonance signal has appeared in the co-substituted samples. The result shows that the electron interactions are strongly affected by Ni^{2+} and Li^{+} concentrations. M-H loop was traced using VSM at room temperature. The results confirm that the sample with x=0 shows an anti-ferromagnetic response. However, a ferromagnetic hysteresis loop arises with co-substitution. The emergence of M-H loops confirms the appearance of magnetic properties in Ni^{2+} and Li^{+} co-substituted $BaTiO_3$ ceramics. The origin of magnetic behavior could be due to the carrier-mediated exchange interactions. Room temperature P-E hysteresis loop has been investigated at an applied electric field of 35 kV/cm and 33 Hz frequency. Measurements of room temperature ferroelectric and magnetic hysteresis loops indicate that the Ni^{2+} and Li^{+} co-substituted $BaTiO_3$ ceramics show ferroelectricity and ferromagnetism simultaneously.

Keywords: *Multiferroic, ESR, Co-substitution, Microwave calcination, Ferromagnetic, Ferroelectric.*