Structural and magnetic properties of La^{3+} substituted barium-natural nanoferrites as microwave absorber in X-band

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Abstract	Selection of proper microwave absorbers in the X-band is vital to prevent the interference issues that often damage devices and cause signal degradation. In this spirit, we prepared three La3+ substituted barium-natural nanoferrites (BNFs) samples with chemical composition of BaO:(x) La2O3:(6-x) Fe2O3 (x=0, 0.1, 0.2 in mol) via solid-state reaction route. Synthesized samples were characterized via SEM, XRD, VSM, and VNA measurements to determine the La3+ ions concentration dependent variation in the structural, magnetic and microwave absorption properties. Transmission/reflection line (TRL) method was used to evaluate the samples reflection loss. La3+ free samples sintered at 1100 degrees C revealed hexagonal BaFe12O19 and rhombohedral Fe2O3 phases. SEM images displayed the growth of new particle with the average size of 0.2 - 0.8 mu m as filler in BNFs. Furthermore, an incorporation of La3+ into the BNF system manifested the emergence of new BaLa2Fe2O7 tetragonal crystal phase. The average crystallite size of BNF was found to decrease with increasing La3+ ion concentrations. Conversely, substitution of La3+ in the BNF caused insignificant changes in the magnetic properties, the real part of the relative permittivity and the natural resonance frequency. Meanwhile, a reasonable shift in the microwave frequency absorption and enhancement in the reflection loss was evidenced due to the inclusion of La3+. BNF sample containing 0.2 mol La2O3 exhibited a saturation magnetization and magnetic field anisotropy of 19.02 and 0.36 T, respectively, where the maximum reflection loss is discerned to be -26.61 dB at 10.87 GHz with 1.25 GHz bandwidth. This new class of ferrites may be prospective for microwave absorber in the X-band.
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