Magnetic and Microwave-Absorbing Properties of Scandium-Doped Co0.5Ni0.5Fe2-xO4 Nano-Spinel for High-Frequency Applications

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Spinel ferrites are commonly used in various industrial and technological devices, such as microwave instruments, power antennas, spintronics, signal processing, and energy storage. However, such devices require both high magnetization properties and microwave absorption simultaneously at high frequencies. This project aimed to study the magnetization and microwave absorption of Co0.5Ni0.5ScxFe1.8-xO4 (x = 0.1), CoNiSc (x=0.1) nano-spinel ferrite fabricated by sol-gel approach with different Sc contents. The structural and phase formation were characterized using XRD, SEM, and TEM. The magnetic features were explored via Vibrating Sample Magnetometer (VSM). The analyses of M-H loops indicated that the present samples display ferrimagnetic behaviour at both 300 and 10 kelvin temperatures. The addition of Sc greatly influenced the magnetization of this ferrite due to the changes in cations distribution. The values of Ms, Mr, and magneton Bohr number (nB) increased for 0.02 wt.% Sc and then reduced with further addition of Sc content (=0.04 wt.%). The correlation between the Sc concentration and microwave properties was observed. Also, Sc addition leads to the increase of the resonant frequency (f) from 44 GHz (for 0.02 wt.% Sc) to 47.5 GHz (for 0.08 wt.% Sc) and an increase of the resonant amplitude from -18.2 dB (0.02 wt.% Sc) until -23.1 dB (0.1 wt.% Sc). In this study, high magnetization properties and high microwave absorption of CoNiSc (x = 0.1) was achieved simultaneously at high frequencies.

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