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# Structural, Magnetic, and Microwave Properties of $SrFe_{12-x}(Ni_{0.5}Co_{0.5}Sn)_{x/2}O_{19}$ Particles Synthesized by Sol–Gel Combustion Method

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This study is intended to evaluate the structural, magnetic, and microwave properties of Ni-Co-Sn-doped strontium hexaferrite $SrFe_{12-x}(Ni_{0.5}Co_{0.5}Sn)_{x/2}O_{19}$ particles with $x$ = 0 to 2.5 synthesized by a sol–gel combustion method. These particles were evaluated to characterize the structural, magnetic, and reflection loss properties of prepared samples by use of x-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), Fourier-transform infrared (FTIR) spectroscopy, vibrating-sample magnetometer (VSM), and vector network analyzer. The XRD results confirmed the presence of strontium ferrite phase with magnetoplumbite structure in all synthesized samples. The results of FTIR analysis indicated the formation of functional groups such as metal-oxygen (Sr-O and Fe-O) and carboxylic groups during the sol–gel process. In addition, FE-SEM micrographs indicated that submicron particles with different morphologies such as spherical, pyramidal, irregular, and hexagonal platelet shapes appeared in the structure. According to hysteresis loops, magnetization and coercivity decreased due to occupation of Ni-Co-Sn cations at low levels of substitutions. The microwave absorption characteristics of this ferrite were investigated in the 8 GHz to 12 GHz frequency range. The sample with 80 wt.% ferrite content showed a maximum reflection loss of −29 dB at 9.6 GHz with 4 GHz bandwidth through the entire frequency range of 8 GHz to 12 GHz for absorber thickness of 1.5 mm. Based on microwave measurements of reflectivity, this material with the expressed chemical composition could be proposed as a good choice for electromagnetic compatibility and other practical applications such as microwave absorption at high frequencies.

**Key words:** Strontium ferrites, magnetic properties, microwave properties

## INTRODUCTION

The increase in radiation and interference problems due to the rapid development of gigahertz (GHz) electronic systems and telecommunications has led to development of electromagnetic absorber technology. Besides, developments in microwave absorber technology have resulted in materials which can effectively reduce reflection of electromagnetic signals with good physical performance.[1–4] Electromagnetic interference (EMI) can have many damaging adverse effects on electronic and telecommunication systems. These damaging effects encompass improper performance of electronic devices, increasing unfavorable radar returns, and radar performance reduction due to system-to-system couplings. To address such problems caused by EMI, electromagnetic wave absorbent materials with the capability of absorbing unwanted electromagnetic signals are used, and research on their electromagnetic and absorption properties is still being carried out. There

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