

Preparation of Fe₃Si/Ferrite Micro-and Nano-Powder Composite

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Abstract : Composite material based on Fe₃Si micro-particles and Mn-Zn nano-ferrite was prepared using powder metallurgy technology. The sol-gel followed by autocombustion process was used for synthesis of Mn_{0.8}Zn_{0.2}Fe₂O₄ ferrite. 3 wt.% of mechanically milled ferrite was mixed with Fe₃Si powder alloy. Mixed micro-nano powder system was homogenized by the Resonant Acoustic Mixing using ResodynLabRAM Mixer. This non-invasive homogenization technique was used to preserve spherical morphology of Fe₃Si powder particles. Uniaxial cold pressing in the closed die at pressure 600 MPa was applied to obtain a compact sample. Microwave sintering of green compact was realized at 800°C, 20 minutes, in air. Density of the powders and composite was measured by He-pycnometry. Impulse excitation method was used to measure elastic properties of sintered composite. Mechanical properties were evaluated by measurement of transverse rupture strength (TRS) and Vickers hardness (HV). Resistivity was measured by 4 point probe method. Ferrite phase distribution in volume of the composite was documented by metallographic analysis. It has been found that nano-ferrite particle distributed among micro-particles of Fe₃Si powder alloy led to high relative density (~93%) and suitable mechanical properties (TRS >100 MPa, HV ~1GPa, E-modulus ~140 GPa) of the composite. High electric resistivity (R~6.7 ohm.cm) of prepared composite indicate their potential application as soft magnetic material at medium and high frequencies.

Keywords : micro- and nano-composite, soft magnetic materials, microwave sintering, mechanical and electric properties

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