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Soft Magnetic Properties of MnZn Ferrites Prepared by Powder Injection Moulding

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Abstract:

In this study, properties of soft-magnetic manganese zinc ferrite manufactured by powder injection moulding – PIM technology were presented. A powder consisting of $Mn_{1-x}Zn_xFe_2O_4$ *and a small amount of hematite* α-Fe_2O_3 *was mixed with an organic binder (wax and thermoplastic) to form ferrite feedstock. Then, injection moulded toroidal samples were solvent, thermally debinded prior to sintering in air atmosphere. Magnetic properties were investigated by thermomagnetic measurements (Faraday balance* μ–T *curve) and a hysteresis graph (B-H curve at different frequencies up to 1 kHz).*

The Curie temperature was $T_C \approx 390$ *K for the green sample but after heating up to 740 K,* T_C *increased up to about 570 K. The high increase in normalized magnetic permeability of about 700 % was observed due to the melting and burning of the binder. The hysteresis loop of sintered MnZn ferrite toroidal cores had an R-shape with saturation of 0.44 T and the remanence ratio of 0.49. The low value of coercivity (only 0.047 kA/m) was related to the presence of* α-Fe_2O_3 *crystalline phase as well as optimum density attained (*$\rho \approx 4800$ *kg/m³) i.e. the low porosity observed. The relative magnetic permeability attained* $\mu_r \approx 2 \cdot 10^3$ *and core power losses* $P_s \approx 21$ *W/kg for the sintered sample (at 1000 Hz; 0.39 T) are in agreement with the MnZn ferrite commercial samples prepared by standard ceramic route.*

Keywords: *MnZn ferrite, PIM technology, Sintering, Magnetic hysteresis properties.*

1 Introduction

Soft magnetic ferrites are used as cores in modern electronic components such as recording heads, filters, switching power supply transformers, amplifiers, etc. MnZn ferrites attracted attention due to a wide range of relative magnetic permeability values (from 10^3 to 10^4 and therefore low magnetic losses) as well as due to increased thermal stability (high saturation magnetic flux density at high temperatures (B_s > 0.4 T at 370 K) and a relatively high Curie temperature) [1, 2]. Operating frequencies are usually in the 1 kHz to 1 MHz range but the frequencies in GHz range were used in some applications. Furthermore, excellent corrosion resistance and chemical stability enable their application in extreme exploitation conditions.

Recently, a variety of preparation routes have been examined for MnZn ferrite

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