# Magnetic properties of LTCC Ni-Zn-Cu-ferrite thick films

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Ferrite has been extensively used in many electronic chip devices because of its high permeability in high frequency regions, high electrical resistivity and chemical stability.[1] Thus, an application of low temperature co-fired ceramics(LTCC) technology on ferrite has recently attracted much attention because LTCC, a technology of 3-D multilayer structures in one multi-chip-module (MCM) package, can offer a high density of electronic components and interconnections possibilities.[2,3] In cofired electronic components, Ag is generally used as an electrode material due to high electrical conductivity that enhances signal delivery between electronic components. Since the melting point of Ag is 961℃, the sintering temperature of ferrite should be below 950℃ to prevent the Ag diffusion and shrinkage.[1,4] In addition, the information of thick films for LTCC is very limited. In this study, we, therefore, focus on the synthesis of nano-sized ferrite powders and the fabrication of ferrite thick films by metal nitrates and a doctor blade method, respectively.

To achieve homogeneous ferrite powders, raw materials such as iron nitrate [$Fe(NO_3)_3$ $9H_2O$], nickel nitrate [$Ni(NO_3)_2$ $6H_2O$], zinc nitrate [$Zn(NO_3)_2$ $6H_2O$] and copper nitrate [$Cu(NO_3)_2$ $3H_2O$] were dissolved in ethyl alcohol(99.9%) and then ethyl alcohol was evaporated by an evaporator. The quantities was controlled according to the mole ratios(X=0, 0.1, 0.2, 0.3) of $Ni_{(0.5-X)}$-$Zn_{(0.5)}$-$Cu_{(X)}$-ferrite. The ferrite powders were calcined in air at 700℃ for 1hr. XRD and TEM analyses showed that calcined ferrite powders at 700℃ for 1hr had a spinel structure and a particle size of 20-30nm. For preparing thick films, the calcined powders were reground with wet ball milling for 10hr. After adding binder, plasticizer dispersant and solvent, ferrite paste was mixed again by ball mill for 24hr. Thick films with a thickness of 30 ㎛ were finally fabricated by doctor blade method. Ferrite green sheets were prepared by the lamination of 30 thick films with an applied pressure of 800MPa and then sintered in air at temperature ranges from 900 to 950℃ for 20hr. The magnetic properties of the sintered sheets were measured by VSM and permeability measuring system. It was revealed that the magnetic properties of the sheets were close to that of bulk materials (permeability > 50, coercivity < 5 Oe) with increasing the sintering temperature and Cu contents.

## References

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