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Effect on the Grain Size of Single-mode Microwave Sintered NiCuZn Ferrite and Zinc Titanate Dielectric Resonator Ceramics

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ABSTRACT

Microwave sintering of materials significantly depends on dielectric, magnetic and conductive losses. Samples with high dielectric and magnetic loss such as ferrites could be sintered easily. But low dielectric loss material such as dielectric resonators (paraelectrics) finds difficulty in generation of heat during microwave interaction. Microwave sintering of materials of these two classes helps in understanding the variation in dielectric and magnetic characteristics with respect to the change in grain size. High-energy ball milled $Ni_{0.6}Cu_{0.2}Zn_{0.2}Fe_{1.98}O_{4-\delta}$ and $ZnTiO_3$ are sintered in conventional and microwave methods and characterized for respective dielectric and magnetic characteristics. The grain size variation with higher copper content is also observed with conventional and microwave sintering. The grain size in microwave sintered $Ni_{0.6}Cu_{0.2}Zn_{0.2}Fe_{1.98}O_{4-\delta}$ is found to be much small and uniform in comparison with conventional sintered sample. However, the grain size of microwave sintered sample is almost equal to that of conventional sintered sample of $Ni_{0.3}Cu_{0.5}Zn_{0.2}Fe_{1.98}O_{4-\delta}$. In contrast to these high dielectric and magnetic loss ferrites, the paraelectric materials are observed to sinter in presence of microwaves. Although microwave sintered zinc titanate sample showed finer and uniform grains with respect to conventional samples, the dielectric characteristics of microwave sintered sample are found to be less than that of conventional sample. Low dielectric constant is attributed to the low density. Smaller grain size is found to be responsible for low quality factor and the presence of small percentage of TiO_2 is observed to achieve the temperature stable resonant frequency.

KEYWORDS: Microwave sintering, ferrites, dielectric resonators, grain size, dielectric properties, magnetic properties.

INTRODUCTION

The use of microwave radiation in the processing of various ceramic materials such as dielectric, magnetic, superconducting, polymer and other composite materials offers several