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Microwave Behavior of Bi-substitute Yttrium Iron Garnet

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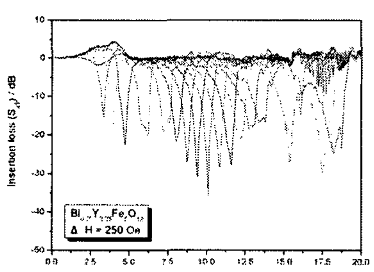
Yttrium iron garnet (YIG) materials possessing a high Q value over a broad band frequency range make it to be widely used for various microwave components including magnetic filters, tunable oscillators and phase shifters etc., for years. Recently, miniature mobile systems such as cell phone have become popular in the communication market. This is an obviously increasing demanding for miniature technologies in microwave devices. Including the widely used YIG devices, multilayer ceramic microwave devices have attracted extensive study because of the feasibility of integrating multi functional communication devices in a single chip. However, from the past experience, YIG garnet is hardly used in multilayer communication chip, due to the sintering temperature is up to 1400°C that is higher than the melting temperature of most conductive metals. Bi substitute YIG garnet has been known as the relevant ceramic materials that the sintering temperature is much lower than of pure YIG polycrystalline ceramics. In this study, the $BixY_{3-x}Fe_5O_{12}$ (x=0.25~1.25) was prepared by the sol gel method and sintered at 1200 ~850°C. The prepared samples were examined by the XRD and VSM to ensure the successful phase structures. The microwave properties were measured by the perturbation technique and flip chip method, respectively for their dielectric dispersion and ferromagnetic resonance (FMR). The experimental data show that even the sintering temperature is down to 900°C, the successful samples still kept stable dielectric dispersion and FMR responses.



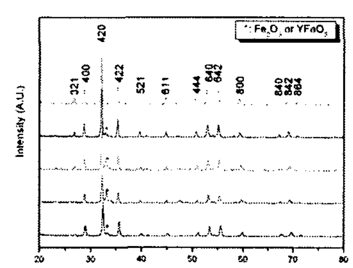


Figure FMR signal (left), XRD (right)

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Microwave dielectric propertiesof Cu doped $(Ba_{0.6}Sr_{0.4})TiO_3$ ceramic bulks

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INTRODUCTION

The miniaturization of microwave telecommunication productions can be achieved by utilizing IC design and modulation to miniaturize the microwave devices. The small volume and good qualities of devices can be effective improved by more stable and reliable dielectric materials. The $Ba_{1-x}Sr_xTiO_3$ (BST) systems with high dielectric constants are well known. To improve the performance of the BST microwave devices, doping Cu in a BST system have been tried. In this research, $(Ba_{0.6}Sr_{0.4})Ti_{1-x}Cu_xO_3$ ceramics were prepared by sol-gel method in order to investigate the influence of doping Cu on the dielectric properties.

EXPERIMENT

The $(Ba_{0.6}Sr_{0.4})Ti_{1-x}Cu_xO_3$ (x = 0 - 0.1) ceramics were prepared by using sol-gel method. BSTCu precursor solutions were synthesized by usingbarium acetate, strontium acetate, copper acetate, and titanium tetraisopropoxide as the source materials. Glacial acetic acid and 2-methoxyethanol were selected as the solvents. The solutes and solvents were mixed and stirred at a temperature of 60 °C to obtain a clear solution. The precursor solution was dried to obtain ceramic powders.The powders were pressed to yield disc-shaped samples, and then the samples were sintered at 1400 °C.

RESULTS AND DISCUSSION

In this research, the $(Ba_{0.6}Sr_{0.4})Ti_{1-x}Cu_xO_3$ ceramics have been fabricated by sol-gel method. The system doped with 5% Cu exhibits the highest dielectric constant of 1510 and the lowest dielectric loss of 0.026 at 100 KHz.

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