INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In the current thesis work, dielectric resonators (DRs) of $Ba_5Nb_4O_{15}$ and $BaWO_4$ ceramics have been prepared using mechanical alloying method and semi - alkoxide precursor (sol - gel) method. The $Ba_5Nb_4O_{15}$ - $BaWO_4$ composite have been prepared in the bulk form using the conventional solid - state reaction method. The overall efforts in this study are to enhance the microwave dielectric properties of the bulk samples by improving the microstructure and relative density of this material prepared with the addition of their own nanoparticles prepared by sol - gel process. Successful efforts were made to reduce the sintering temperature without affecting the microwave dielectric properties of the $Ba_5Nb_4O_{15}$ and $Ba_5Nb_4O_{15}$ - $BaWO_4$ ceramics by supplementing with their own nanoparticles. Furthermore, it is proposed to compare the microwave properties of $Ba_5Nb_4O_{15}$ (BNO), $BaWO_4$ (BWO) and $Ba_5Nb_4O_{15}$ - $BaWO_4$ (BNO - BWO) in bulk and thin film forms. In addition, we have also investigated their optical and electrical properties, which could not only be useful in various applications but also helps in arriving at a comprehensive picture of the physics of these materials, and the results were compared with the existing literature. In the present study, DRs of BNO, BWO and BNO - BWO composite have been prepared by mechanical alloying and solid state reaction method. The BNO, BWO and BNO - BWO thin films were prepared with RF reactive magnetron sputtering respectively. In bulk form BNO, BWO and BNO - BWO has dielectric constant of 34, 16.3 and 39, and $Q \times f_o$ of 32.5 THz, 38.05 THz, and 59.8 THz observed for the sample sintered at 1250 ^oC, 800 ^oC, and 900 ^oC respectively, where as in BNO, BWO and BNO - BWO composite thin film form dielectric constant of 35.45, 16.53 and 38.63, and $tan\delta$ = 0.0070, 0.020 and 0.0027 were observed at 10 GHz, and 5 GHz, respectively. The dielectric constant of each film is close to the bulk value whereas the dielectric losses of the films are observed to be higher than the bulk value. From the present study, the obtained excellent microwave dielectric properties of the BNO, BWO and BNO - BWO based ceramics makes these materials suitable for type -I capacitor, dielectric resonators for various microwave communication applications. The fabricated fully densed BNO - BWO composite ceramic at low sintering temperature (900 ^oC), with best microwave dielectric properties are suitable for LTCC based applications. Furthermore, the optimized best optical and dielectric properties of pure BNO, BWO and BNO - BWO composite thin films are suitable for optoelectronic, antireflection, integrated electronic and CMOS applications. Further, the observed irreversible thermochromic behavior of BWO films was suitable for decorative and smart window applications.