INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In the present thesis work, we have prepared single phase Mg_2TiO_4 ceramics by mechanical and solid-state reaction methods. The effect of various additives, their concentrations and processing parameters on crystal structure, microstructure and on microwave dielectric properties of MTO ceramics are studied systematically. Successful efforts were made to reduce the sintering temperature from 1450 to 1250 ^oC without affecting the microwave dielectric properties of the MTO ceramics by reducing the initial particle size and supplementing different types of additives. A maximum relative density of 97.75 % was obtained for the MTO sample sintered at 1325 ^oC for 3 hr with best microwave dielectric properties of $\varepsilon_r \sim 13.68$, $Q \times f_o \sim 155{,}000$ GHz synthesized by the mechanical alloying method. The increase in $Q \times f_o$ values can be attributed to the increase in relative density and identical grain sizes. Further, with the addition of CeO_2 nanoparticles, the sintering temperature of MTO ceramics is effectively reduced from 1450 to 1300 ^oC along with the significant improvement in the density and uniform microstructure with highest density of 98.7% (1.5 wt.%) having maximum microwave dielectric properties of $Q \times f_o = 167000$ GHz and ε_r of 14.6. For the samples added with 0.5 wt.% of La_2O_3 or V_2O_5 possessed excellent microwave dielectric properties: $\varepsilon_r = 14.3$, $Q \times f_o = 157{,}550$ GHz and $\varepsilon_r = 14.4$, $Q \times f_o = 168{,}000$ GHz, sintered at 1300 ^oC and 1250 ^oC, respectively. In case of MTO ceramics added with 1.0 wt.% of Bi_2O_3, exhibited best microwave dielectric properties: $\varepsilon_r = 13.2$, $Q \times f_o = 160{,}500$ GHz, sintered at 1250 ^oC. The obtained excellent microwave dielectric properties of the MTO based ceramics make this material appropriate for type -1 capacitor and dielectric resonators for various microwave communication applications. Further, microwave dielectric properties of MTO ceramics added with different wt.% of CeO_2 and V_2O_5 was measured at cryogenic temperatures (6.5 K to 295 K) are found to be applicable for cryogenic device applications. In addition, MTO thin films are deposited on various substrates like, Si (100), quartz and platinized silicon ($Pt/TiO_2/SiO_2/Si$)) from the homemade sputtering target by RF magnetron sputtering. The impact of processing parameters (Ar / O_2 ratio) and the post-deposition annealing on structural, microstructural, optical and dielectric properties of MTO films were investigated and for the first time, the microwave dielectric properties of pure MTO thin films are studied. Furthermore, the microwave dielectric properties of thin films were measured at discrete microwave frequencies, and these properties are comparable to the bulk. Thin films of MTO are suitable for optoelectronic and microwave integrated circuits.