INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

There is a growing demand for new functional materials to enhance the performance of microwave devices due to rapid development in wireless communication technology. The composite approach is one of the versatile methods to obtain desired physical parameters in a single compound as natural compounds usually do not exhibit all requisite characteristics. The 0.9 $MgTiO_3$- $0.1Ba_5Nb_4O_{15}$ composite ceramics exhibited a maximum relative density of 98% as well as suitable dielectric properties: dielectric constant (ε_r) ~20, loss tangent ($tan\delta$) ~ $10^{-4,}$ and quality factor ($Q \times f_o$) = 60,230 GHz at 8.25 GHz with τ_f ~ -5 ppm/ºC for microwave resonator. The thickness-dependent structural, microstructural, and dielectric properties of 0.9*MTO*-0.1*BNO* thin films revealed improvement with an increase in film thickness. Further, the $0.96MgTiO_3$-*0.04*$SrTiO_3$ composite ceramics exhibited the best microwave dielectric properties with moderate quality factor ($Q \times f_0$) ~ 26,154 GHz at 8.08 GHz and better thermal stability ~τ_f ~ 1.76 ppm/K are suitable for microwave communication applications as microwave filters, resonators, etc. The bilayer thin film of MTO and STO (*STMT3*) film exhibited excellent dielectric properties: loss tangent (1.89×10^{-3}) and considerable dielectric constant ~65 at 10 GHz. Furthermore, the $0.7MgTiO_3 - 0.3Ba_{0.5}Sr_{0.5}TiO_3$ composite ceramics exhibited high dielectric permittivity ε_r ~ 57, and quality factor, $Q \times f_0$ = 19,30 GHz at 4.16 GHz and τ_ε ~54% and found to be promising for type -II capacitors in integrated circuits of de-couplers and filters. The bi-layer thin films of *MTO* and *BST*: *MTO/BST* and *BST/MTO* with alternate stacking order showed the role of stacking order. As per theoretical estimation, *BST/MTO* bilayer exhibited intermediate dielectric constant and loss (27.3 and~10^{-2}) to *BST*, *MTO* monolayer whereas *MTO/BST* showed anomaly attributed to the generation of dipoles in the interface of individual layers at 100 kHz. Both *MTO/BST* and *BST/MTO* films exhibited tunable dielectric responses. These findings of this report provide perspective insight into the design of multilayer structured smart materials.