Synthesis of Co and Mg doped $BaTi_{0.7}Zr_{0.2}(Mg_{0.1-x}Co_x)O_3$ thin films by sol-gel method

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Ferroelectric perovskite thin films are of utmost importance since these materials exhibit enhanced electrical properties and used for various technological interests. Being an important ferroelectric material, the dielectric properties of $BaTiO_3$ are altered by various dopants such as La, Mn, Nb, Si, Sr, Zr, Fe, Nd, Co, and Mg either on A-site (Ba-site) or B-site (Ti-site). Among these barium zirconate titanate ($BaZr_xTi_{1-x}O_3$ or BZT) proved to be a promising material for tunable microwave device applications. Here we investigated the effect of Co^{3+}/Mg^{2+} co-doping on the electrical properties of BZT thin film deposited on ($Pt/Ti/SiO_2/Si_{(100)}$) substrate. Thin film of $BaTi_{0.7}Zr_{0.2}(Mg_{0.1-x}Co_x)O_3$ (x = 0.04, 0.05, , 0.06, 0.07, 0.08) were synthesized using sol-gel method. TGA/DTA analyses was carried out on dried gel in order to seek the annealing temperature. XRD studies were conducted to study the development of phase. An AFM study was carried out to investigate the surface topography of thin films. The effect of Co^{3+}/Mg^{2+} ratio on microstructure and dielectric properties of the $BaTi_{0.7}Zr_{0.2}(Mg_{0.1-x}Co_x)O_3$ thin films was investigated. The films deposited at the substrate temperature from 550ºC–750ºC show a pure cubic perovskite structure. The films deposited at 700ºC exhibit ⟨111⟩ preferential orientation. The film morphologies vary with changes in Co^{3+}/Mg^{2+} ratio. Top Pt electrodes were deposited on the surface of thin films using magnetron sputter coating technique. Dielectric properties vs. temperature were carried out to investigate phase transitions and dielectric properties (dielectric constant and dielectric loss). Dielectric properties vs. electric field were studied to find tunability for capacitor applications.

Keywords: Thin films, ferroelectrics, sol-gel, dielectric tenability, BZT