Effects of Pre-synthesized $BaTiO_3$ Addition on the Microstructure and Dielectric/ Piezoelectric Properties of $(Bi_{0.5}Na_{0.5})_{0.94}Ba_{0.06}TiO_3$ Piezoelectric Ceramics

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Abstract : Due to the environmental issue vast research is going on to replace the widely used lead contented piezoelectric materials. Bismuth sodium titanate (abbreviated as BNT) based bismuth sodium titanate-barium titanate (abbreviated as BNBT) ceramic was prepared by using modified method rather than conventional mixed oxide method. This modification was made to improve the properties of BNT based ceramic. In this procedure $BaTiO_3$ (abbreviated as BT) was prepared using conventional mixed oxide method. Analytical grade raw materials of $BaCO_3$ and TiO_2 were weighted and ball milled using ethanol medium. The mixed slurry was dried and sieved under 80 mesh. Then the powder was calcined at 1100°C for 2 hours. This calcined BT powder was used in the preparation of BNBT. Stoichiometric amount of Bi_2O_3, Na_2CO_3, TiO_2 and BT were weighted and mixed by using ball mill. The used calcination temperature was 850°C for 2 hours. Calcined powder was taken for another milling step. BNBT disks were pressed to 15 mm of diameter and then cold isostatical press (CIP) was used. Pressed samples were sintered at 1150°C for 2 hours. The SEM microstructure analysis revealed that the grain shape of the sintered ceramic was polyhedral and grain boundary was well matched where as the sample prepared by conventional method showed irregular arrangement and grain boundary not well matched. And sintered density was better (5.78 g/cc) for the modified method. It was strongly observed that the properties of BNBT ceramic near MPB composition was found to be improved by the modified method compare to the conventional mixed oxide method. The piezoelectric constant d_{33} of 177.33 pC/N, electromechanical coupling factor k_p of 33.4%, dielectric constant K_{33}^T of 688.237 and mechanical quality factor Q_m of 109.37 was found.

Key Words : BNBT, Pre-synthesized $BaTiO_3$, Piezoelectiric, Dielectric