The Effect of Incorporating Method and Concentration of Niobium on the Properties of Barium Titanate Ceramics

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Doping of barium titanate ceramics by aliovalent dopants leads to many changes in the material properties, such as the conductivity especially at high temperatures, the morphology, the dielectric behavior, etc. Since impurities and the lattice imperfections play a crucial role in these phenomena and peculiarities of other properties such as the PTCR effect, their investigation has attracted much attention. The mutual influence of impurities and lattice defects follows from the necessity of excess charge compensation. Barium titanate doped with donors is usually an n-type semiconductor, the conductivity of which, however, is considerably influenced by intrinsic defects. Therefore, not only the equilibrium behavior of these defects but also the defect formation and diffusion play an important role with respect to the semiconducting properties. It is known that the addition of a small amount of Nb has significant effects on the electrical properties of $BaTiO_3$. However, how Nb is distributed locally, and what structural variations it causes have not been studied in depth. With this in mind, the effect of dopants (Nb) ions on the microstructure and electrical properties of $BaTiO_3$ crystals was investigated. A series of doped barium titanate powders were prepared by two different methods and were examined by: XRD, HR-SEM, TEM, Particle size analysis techniques, Zeta potential measurements, Specific surface area, DSC measurements, Impedance Spectroscopy and, to investigate the dopant distribution, SIMS analysis and electron microscopy were performed. The influence of the preparation method on the properties of the powder is discussed.