Structure of nanocrystalline $BaTiO_3$

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Recently it has been reported that ferromagnetic properties were observed in nanocrystalline oxides even at room temperature. The ferromagnetism has been proposed to originate from the existence of oxygen vacancies at the surface of the nanocrystalline, which leads to the appearance of transition metal ions with nonzero net spin, such as Ti2+ or Ti3+. It has also been argued that the magnitude of the magnetization is closely dependent on the particle size and crystalline structure of the nanocrystalline oxide. In this work we report the dependence of the structural properties of nanocrystalline $BaTiO_3$ (n-BTO) on the preparation conditions. n-BTO was prepared from a polymer precursor followed with heat treatment at various temperatures and gas ambients. Through XRD, SEM, and TEM characterization, we observed clear increase in grain size when the heating temperature varied from 600 to 1050^{o}C, together with a structural transformation from cubic to tetragonal lattice. Furthermore, even at same temperature, shorter heating time (2 h) resulted in cubic structured-BTO whereas a 8 h-heat treatment resulted in tetragonal structured-BTO. In addition to air, the heat treatment was also performed in N_2 and H2+Ar. Althoughn-BTO was formed, the grain size is smaller than in air, and the crystallinity is degraded.