Electronic and Ionic Conduction Processes in $(Bi_{0.5}Na_{0.5})TiO_3$-based Thin Films

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Abstract

Solid solutions based on the perovskite ferroelectrics $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) and $Bi_{0.5}K_{0.5}TiO_3$ (BKT) might someday replace current Pb-based ferroelectric and piezoelectric devices, pursuant to the Restrictions on Hazardous Substances (RoHS) guidelines seeking to limit Pb in consumer devices. The primary goal of this research was to advance the understanding of long term reliability in polycrystalline BNT-BKT thin films fabricated by chemical solution deposition (CSD). The constituent cations are highly volatile at the crystallization temperatures, and oxygen vacancies are common to all oxide perovskites. The resulting defects are associated with higher leakage currents, which can reduce long term stability by increasing the frequency of early failures due to localized breakdown events. This talk will focus on several topics related to conduction in BNT-BKT thin films. Mn-doping is a well known technique utilized to decrease electronic current in many perovskite ferroelectrics. A study of the steady state leakage current in Mn-doped 80BNT-20BKT films will be discussed. Ionic conduction processes also play a role in fatigue and resistance degradation. High temperature transient currents are believed to be directly related to ionic migration. Analysis of these peaks reveal activation energies and mobilities consistent with migration of oxygen vacancies.

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