SEMINAR

A detailed phase analysis and crystal structure investigation of a Bi1-xCaxFeO3-x/2 perovskite-related solid solution phase and selected property measurements thereof.

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Abstract

A well-ordered, perovskite-related, Bi1-xCaxFeIIIO3-x/2 solid solution phase is synthesized via a rapid liquid phase sintering technique and shown to exist over the composition range ~ 0.20 < x < ~ 0.49. Two phase regions are shown to separate this phase from compositionally narrow end-member Bi1-xCaxFeIIIO3-x/2 solid solutions based on rhombohedral BiFeO3 and brownmillerite, Ca2Fe2O5, respectively. The wide range non-stoichiometric phase is characterized by a well ordered, (in general) incommensurately modulated structure that varies systematically with composition. Mössbauer spectroscopy is used to verify the oxidation state of iron as (III), as well as showing the existence of three separate iron environments across the solid solution field. HRTEM imaging is used to develop a structural model for the phase at one particular composition. The magnetic, dielectric and impedance properties of this solid solution phase are reported. Magnetic measurements show antiferromagnetic behavior. There is no change in either susceptibility or antiferromagnetic behavior with composition. Attempts at obtaining saturated ferroelectric loops failed due to high intrinsic conductivity. The phase is found to exhibit a low frequency impedance relaxation that is like