

Non-ferroelectric relaxor properties of BMN, $\text{Bi}_{3.55}\text{Mg}_{1.78}\text{Nb}_{2.67}\text{O}_{13.78}$ pyrochlore

ABSTRACT

Phase-pure $\text{Bi}_{3.55}\text{Mg}_{1.78}\text{Nb}_{2.67}\text{O}_{13.78}$, BMN pyrochlore was prepared by conventional solid-state reaction at 1025 °C for 2–3 days. Electrical properties measured by impedance spectroscopy over the range 10–1073 K showed relaxor behaviour with a maximum dielectric constant, ϵ'_{max} of 209 at its temperature maximum, T_{max} of 204 K. Impedance data were analysed by fixed-frequency sweeps of dielectric constant and $\tan \delta$ and variable frequency scans at fixed temperature. Low temperature data were modelled using the classic dielectric relaxation circuit that consists of a resistance in combination with series and parallel capacitances, but modified to include a constant phase element that introduced variable resistances and capacitances into the equivalent circuit. There was no evidence of ferroelectric behaviour, either from extrapolation of high temperature Curie-Weiss plots or the temperature-dependence of low temperature capacitance data. At intermediate temperatures, ~240–623 K, BMN is an insulator with resistivity $>10 \text{ M}\Omega \text{ cm}$. Above ~623 K, it is a modest electrical conductor, activation energy 1.07 eV; the charge carriers are probably oxide ions.

Keyword: Pyrochlore; Dielectric; Relaxor; Equivalent circuit modelling