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Signatures of Soft Phonons in Impedance Spectroscopy of Barium Titanate Colloidal Solutions SCOTT TAN, GRAHAM KRAHN, Pomona College, RICHARD HASKELL, Harvey Mudd College, TODD MONSON, Sandia National Laboratories — Barium titanate (BTO) is a widely used dielectric material in capacitor technologies due to a high bulk dielectric constant between 1500-2000 [1] at room temperature. Although bulk BTO has been extensively studied, it is still not entirely clear how varying BTO nanoparticle size affects the dielectric constant, particularly for non-sintered discrete nanoparticles. The most widely accepted and agreed upon behavior is that smaller BTO particles have lower dielectric constants due to lower tetragonality. However, Wada et al. reported that the BTO dielectric constant reached a high value of ˜5000 near a small particle size of ˜140 nm. This anomaly was attributed to the soft phonon, which reached a minimum frequency at the particle size of ˜140 nm when observed in FIR reflection measurements [2]. The soft phonon explanation for the anomaly observed by Wada et al. implies that the measured value of the dielectric constant will depend on the frequency of the applied electric field when performing impedance measurements. Herein, we present an equivalent circuit model to fit BTO colloidal solution impedance spectra, which accounts for a distribution of capacitance values as a function of applied electric field frequency. This model fits reasonably well to experimental measurements obtained via impedance spectroscopy, which suggests that the soft phonon contribution to the dielectric constant is observed in the impedance spectra for BTO colloidal solutions.

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