Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Understanding Nonlinear Dielectric Properties in a Biaxially Oriented Poly(vinylidene fluoride) Film at Both Low and High Electric Fields[1] YUE LI, College of Polymer Science and Engineering,Sichuan University. , LEI ZHU, Department of Macromolecular Science and Engineering, Case Western Reserve University, CASE WESTERN RESERVE UNIVERSITY TEAM, SICHUAN UNIVERSITY TEAM — Understanding nonlinear dielectric behavior in polar polymers is crucial to their potential application as next genera tion high energy density and low loss dielectrics. In this work, we studied nonlinear dielectric properties of a biaxially oriented poly(vinylidene fluoride) (BOPVDF) film under both low and high electric fields. It was observed that the low-field dielectric nonlinearity for the BOPVDF disappeared above 10 Hz at room temperature, suggesting that the low-field dielectric nonlinearity originated from ionic migration of impurity ions rather than dipolar relaxation of the amorphous segments. Above the coercive field (EC ˜70 MV/m), bipolar electric displacement-electric field (D-E) loop tests were used to extract the nonlinear behavior for pure PVDF crystals, which had a clear origin of ferroelectric switching of polar crystalline dipoles and domains and nonpolar-to-polar ($\alpha \rightarrow \delta \rightarrow \beta$) phase transformations. Using HVBDS, it was observed that the ferroelectric switching of polar crystalline dipoles and domains in BOPVDF above the EC always took place between 20 and 500 Hz, regardless of a broad range of temperature from -30 to 100 C. This behavior was drastically different from the amorphous PVDF dipoles, which had a strong dependence on frequency over orders of magnitude.

[1]This work is supported by NSF(DMR-1402733)

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Date submitted: 05 Nov 2015 Electronic form version 1.4