Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Controlling Crystal Microstructure to Minimize Loss in Polymer Dielectrics[1] DANIEL MIRANDA, CIPRIAN IACOB, Pennsylvania State University, SHIHAI ZHANG, PolyK Technologies, JAMES RUNT, Pennsylvania State University — Polymer dielectric films are of great importance for high performance capacitors. For these films it is critical to reduce dielectric loss, as it diminishes efficiency and contributes to waste heat generation during device operation. Here, a model semi-crystalline polymer, poly(ethylene naphthalate) (PEN), was used to examine how morphological factors inhibit chain relaxations responsible for loss. This was achieved by manipulating the extent of crystallization and the crystalline microstructure through a combination of annealing and uniaxial drawing, and investigating their effects on dielectric performance. Varying crystallization conditions influenced the dynamic T_g and extent of rigid amorphous fraction formation, but had a limited effect on loss magnitude. Film orientation however greatly reduced loss, through strain-induced crystallization and development of oriented amorphous mesophasic regions. Post-drawing annealing conditions were capable of further refining the crystal microstructure and, in turn, the dielectric properties. These findings demonstrate that semi-crystalline polymer morphology has a very strong influence on amorphous chain relaxations, and understanding how processing conditions affect morphology is critical to the rational design of polymer dielectrics.

[1]Office of Naval Research

Daniel Miranda
Pennsylvania State University

Date submitted: 10 Nov 2016 Electronic form version 1.4