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Crystal Size Effect on Dielectric Property of PVDF at High Electric Field and Its Effect on Energy Storage and Discharging Behaviors[1]
FANGXIAO GUAN, STEVEN BOGGS, LEI ZHU, Institute of Material Science and Department of Chemical, Materials and Bimolecular Engineering, University of Connecticut, Storrs, CT 06269-3136 — Improvement of the high energy density capacitor can be achieved by choosing a material with relatively high dielectric constant and/or high electric breakdown strength. In general, their relationship can be described as $U=0.5e(r)e(0)Eb^2$. For certain dielectric polymers, such as poly (vinylidene fluoride) (PVDF), dielectric constant shows strong electric field dependence. Therefore, the energy density cannot be described simply by this equation. In this work, electric field dependent dielectric response of PVDF is studied, and its relation to the energy density stored is discussed. Although the dielectric constants of PVDF with different crystal sizes can be different at high electric field, they all have similar stored energy density. Intriguingly, their energy discharging behaviors are different. The smaller the crystal size, the faster the energy discharging process, and the lower the dielectric loss. From this study, we conclude that a high energy density with fast discharge and low dielectric loss could be obtained by tuning the crystal sizes.

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