Harnessing Peptides for Ferroelectric Innovation: Fabrication and Characterization of Peptide-Polymer Composite Thin Films

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Poly(vinylidene fluoride-co-trifluoroethylene), P(VDF-TrFE), is a well-known piezoelectric and ferroelectric fluoropolymer, commonly used in actuators, sensors, capacitors, and memory devices. The properties of PVDF-TrFE depend on the crystalline β-phase, which can be influenced by annealing temperature, electrical poling, adding fillers or other chemical methods. In this work, we took a bioinspired approach by exploring the effect of adding dipeptides as molecular-based fillers to PVDF-TrFE and observing changes in polymer film morphology and electrical characteristics, specifically modifications to non-linear electrical behavior. We prepared thin films of dipeptide-PVDF-TrFE composites and fabricated parallel plate capacitors. The composites were prepared using 100% Methyl Ethyl Ketone (MEK), known to be adequate for preparing suspensions of PVDF-TrFE. X-ray diffraction confirmed that addition of certain dipeptides did not inhibit the growth of β-phase PVDF-TrFE. Non-linear electrical behavior, measured with a Radiant Precision LC II Ferroelectric tester, confirmed the films exhibited polarization reversal at low electric fields. Each dipeptide produced unique and differing results, likely due to the interaction of their functional groups with the polymer interface. Dipeptides composed of different amino acids can provide insights into the domain-switching mechanism within the PVDF-TrFE polymer, which could be applied to the fabrication of devices capable of operating across a wide range of electric fields.