

Understanding the Origin of Electrostriction Property in Electroactive Polymers

Lei Zhu, Professor of Macromolecular Science and Engineering, received funding from the National Science Foundation (NSF) and the Department of Energy (DOE) to study electrostrictive polymers with applications in sensing, actuation, and energy-harvesting. To understand the origin of the electrostriction property observed in electroactive polymers, we chose to study a variety of polymers, including poly(vinylidene-*co*-fluoride) [P(VDF-TrFE)] random copolymers, poly(vinylidene-*co*-TrFE-*co*-chlorotrifluoroethylene) [P(VDF-TrFE-CTFE)] random terpolymers, nylons (e.g., nylon-12 and nylon-6), poly(ether-amide) multiblock copolymers, and thermoplastic polyurethanes (TPUs). It is observed that uniaxially stretched polymers exhibit positive longitudinal strain upon electroactuation, while uniaxially stretched polyamide-based polymers exhibit negative longitudinal strain. From these observations, the large electrostriction in electroactive polymers is attributed to the nanoactuation of the crystalline phases. In P(VDF-TrFE)-based polymers, nanoactuation is realized by the twisted-to-all trans conformation transformation. In polyamide-based polymers, nanoactuation is realized by the trans-to-twisted conformation transformation. This understanding will help us design new electroactive polymers for various practical applications.

Biographic Sketch

Professor Lei Zhu received his B.S. degree in Materials Science and Engineering and M.S. degree in Polymer Chemistry and Physics from Case Western Reserve University. He received his Ph.D. degree in Materials Science and Engineering from the University of Akron in 2000. After two-year postdoctoral fellowships at the Maurice Morton Institute, University of Akron, he joined the Department of Chemical, Materials, and Mechanical Engineering at University of Connecticut, as an assistant professor. In 2007, he was promoted to associate professor with tenure.

He joined the Department of Macromolecular Science and Engineering at Case Western Reserve University as an Associate Professor. In 2013, he was promoted to full Professor. His research interests include high performance polymer and organic-inorganic hybrid nanomaterials for energy storage capacitor applications, development of artificial antibody and DNA-based materials, and supramolecular self-assembly of discotic liquid crystals. He is recipient of the 3M Non-tenured Faculty Award, DuPont Young Professor Award, and Case Western Reserve Excellence Award. He is author and co-author of 182 refereed journal articles and 10 book chapters. He delivered over 160 invited talks and 45 contributed presentations. His citation is ~9000 times with an *h*-index of 53 (Google Scholar).

