Multifunctional Transparent Molecular Ferroelectrics

Shenqiang Ren
Department of Mechanical and Aerospace Engineering, Department of Chemistry, Research and Education in Energy Environment & Water Institute, University at Buffalo, The State University of New York, Buffalo, NY 14260, USA

Abstract

Transparent molecular ferroelectrics, which show ferroelectric properties approaching inorganic perovskites, have amassed much attention due to their lightweight, tunable electro-optic and electromechanical coupling effects. Spontaneous polarization and the ability to switch the electro-optic and electromechanical activity by an external electric or mechanical stimulus is of prime importance, establishing the basis for potential metamaterial technologies. We present a continuous rapid printing strategy for the volumetric deposition of water-soluble molecular ferroelectric metamaterials with precise spatial control in virtually any three-dimensional geometry by means of an electric-field–assisted additive manufacturing. We demonstrate a scaffold-supported ferroelectric crystalline lattice that enables self-healing and a reprogrammable stiffness for dynamic tuning of mechanical metamaterials with a long lifetime and sustainability. A molecular ferroelectric architecture exhibits adaptive mitigation of incident vibroacoustic dynamic loads via an electrically tunable subwavelength-frequency band gap, as well as electro-optic coupling effects. The findings shown here pave the way for the versatile additive manufacturing of molecular ferroelectric metamaterials.

BRIEF CV

http://rengroup.eng.buffalo.edu/

Dr. Shenqiang Ren is Professor of Mechanical and Aerospace Engineering, and Chemistry at SUNY-Buffalo, with research interests in emerging functional materials and devices. He earned his Ph.D. degree in Materials Science and Engineering at the University of Maryland College Park, and then served as a postdoc fellow at Massachusetts Institute of Technology (MIT). He received 2015 National Science Foundation - CAREER Award, 2014 Army Research Office - Young Investigator Award, 2013 NSF EPSCOR First Award, 2013 Air Force Summer Faculty Fellowship, 2009 Dean's Doctoral Research Award and Distinguished Doctoral Dissertation Award at University of Maryland, College Park.