Multifunctional Molecular Ferroelectic Thin Films

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Molecular ferroelectrics (MOFEs) have been attracting significant interest as a viable alternative to conventional ceramic ferroelectrics, barium titanate and lead zirconium titanate, because of their solution processability, lightweight, flexibility and non-toxicity in the emerging field of molecular electronics. However, MOFEs are not abundant, are rigid crystalline solids and difficult to handle. Many ferroelectric applications demand the fabrication of thin films of defined thickness and high homogeneity as well as tunable chemical functionality. It would thus be desirable to be able to produce MOFEs that are both crystalline and flexible, when prepared as thin films, suitable for ferroelectric-based applications. Here we demonstrate large-area high temperature molecular ferroelectric thin films fabricated by in-plane liquid phase epitaxy. Devices based on these ferroelectric thin films would be able to utilize polarization controlled piezoelectric, pyroelectric, and electro-optic effects to mediate energy transduction as well as electroresistance, as we demonstrate through their high sensitivity piezoresponse force and conducting microscopy. The combination of controllable crystal orientation and electric switching polarization renders this type of molecular ferroelectric thin film an attractive multifunctional energy transduction material, leading to new generation molecular electronics for sensing, actuation, energy and data storage.