“Cooperative” Secondary Relaxation Induced High Room-Temperature Dielectric Constant in Supramolecular Diblock Copolymer Assembly

WEI CHEN, JIA-YU WANG, THOMAS RUSSELL, University of Massachusetts, Amherst — The development of high-dielectric-constant polymers as active materials in high-performance devices is one of challenges in polymer-based electric system like flexible high-energy-density capacitors and organic thin-film transistors. Here, we incorporated homochiral (1S)-(+)10-camphorsulfonic acid (CSA) and non-linear optical Disperse Yellow 7 (DY7) into poly(2-vinylpyridine)-block-poly(methyl methacrylate) (P2VP-b-PMMA) copolymers via both ionic interactions and hydrogen bonding, forming a supramolecular assembly with cylindrical nanostructures. In contrast to the P2VP homopolymer assembly with a dielectric constant less than 10 at room temperature, supramolecular diblock copolymer assembly exhibits a temperature- and frequency-independent dielectric constant close to 50 at frequencies lower than 100 Hz. This is comparable with that of ferroelectric poly(vinylidene fluoride-trifluoroethylene-chlorofluoroethylene) (PVDF-TrFE-CFE) terpolymer (40~60) and larger than those of PVDF (~10) and PVDF-TrFE (<20). Such a high room-temperature dielectric constant arises from the cooperative secondary relaxation between two blocks which increases the relaxation amplitude of CSA and DY7, both of which have large dipole moments.

Wei Chen
University of Massachusetts, Amherst