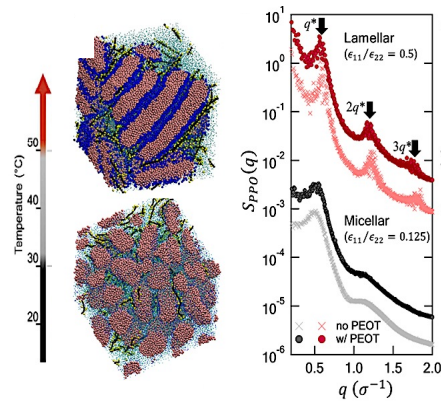
An Electrolyte-free Polymeric "smart material"

Achievement: An electrolyte-free polymeric "smart material" based on a thermo-controllable nanostructure.

Significance and Impact: A flexible polymer processing strategy utilizing water-soluble conjugated polymers in aqueous pluronic triblock copolymer solutions for self-assembly based fabrication of stimuli-responsive nanostructures and sensory materials.

Research Details:

- Small-angle neutron and X-ray scattering to understand the sub-domain structures
- Coarse-grained molecular dynamics simulations provide dynamical/structural information for the thermoreversible behavior
- Impedance spectroscopy showing conductivity is coupled to the thermoreversible structural change with no signs of quenching at high temperature



Thermotropic morphology changes. PEO (blue) and PPO (pink); D_2O are the cyan. Lamellar peaks at q^*, $2q^*$, and $3q^*$ ($q^* \approx 0.6\ \sigma^{-1}$) with increasing temperature are clearly observed.

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PI and affiliation: ??

Team: Jian Gao, Young Duck Kim, Liangbo Liang, Juan Carlos Idrobo, Phil Chow, Jiawei Tan, Baichang Li, Lu Li, Bobby G. Sumpter, Toh-Ming Lu, Vincent Meunier, James Hone, Nikhil Koratkar

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Overview:

This study shows promise for enabling more flexibility in processing by utilizing water-soluble conjugated polymers in aqueous solutions for self-assembly based fabrication of stimuli-responsive nanostructures and sensory materials. The structural and electrical properties of the conjugated polymer-embedded self-assembled architectures were investigated by combining small-angle neutron and X-ray scattering, coarse-grained molecular dynamics simulations, and impedance spectroscopy. Results show how a pluronic L62 solution template organizes the water soluble conjugated polymers by stably incorporating them into the

hydrophilic domains which effectively inhibits the typical aggregation. The thermo-tunable morphology of L62 from the micellar-to-lamellar phase defines the embedded conjugated polymer network. As a result, the conductivity is strongly coupled to the structural change of the templating L62 phase and exhibits a thermally reversible behavior with no signs of quenching of the conductivity at high temperature.