Electrostatic Control of Block Copolymer Morphology

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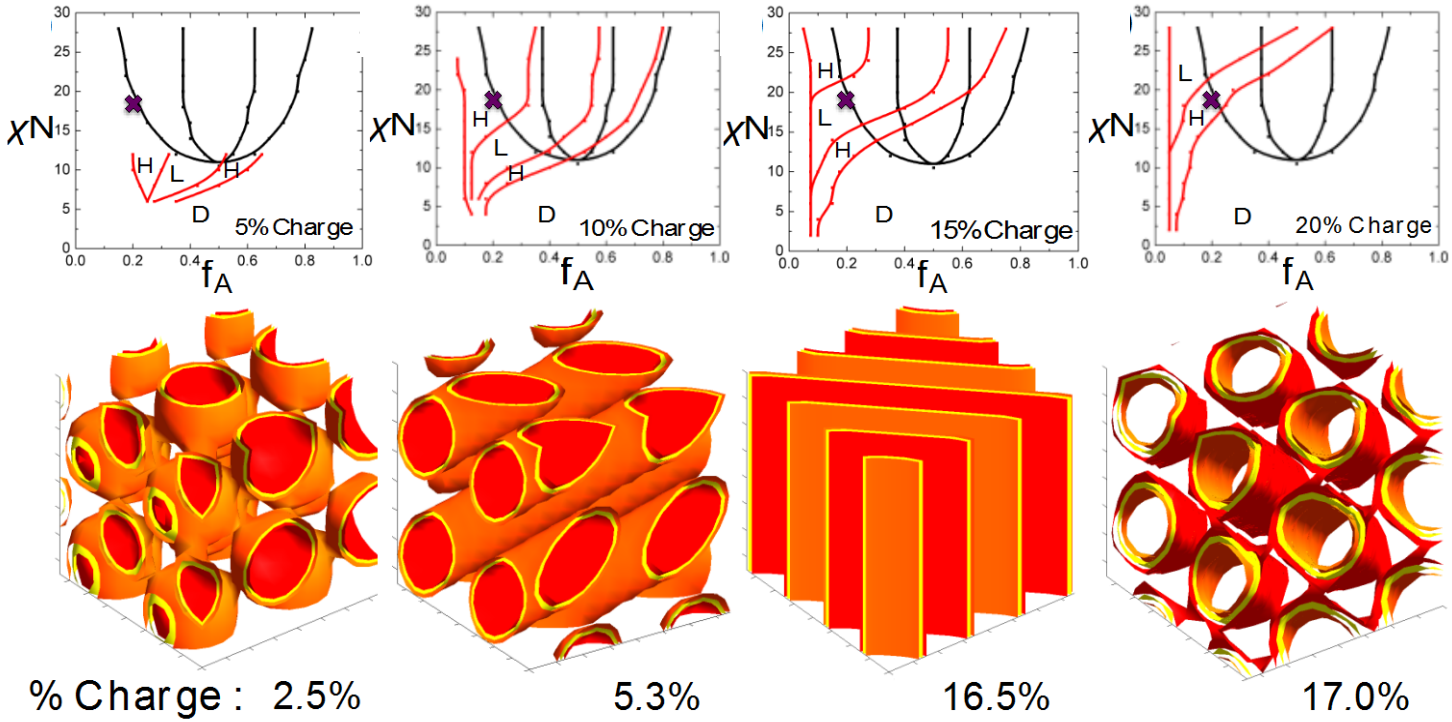
Solid electrolytes for Li-ion batteries are currently limited by difficulties in designing block copolymers that simultaneously provide mechanical stability while still facilitating ion transport; this is due to the widespread lack of conceptual understanding of how charges manipulate block copolymer materials. We demonstrate that new methods to articulate charge ordering in self-consistent field theory calculations enable the articulation of these systems such that their physics is elucidated. Parameters such as the fraction of charged monomers and the strength of the Coulombic interaction provide new routes to tune nanostructures via electrostatics; this provides the versatility needed to design and optimize battery membrane materials. We demonstrate new phase features unattainable in simple diblock copolymers, such as percolating minority phases and charge-driven microphase separation.



(Left) Increasing the charge on a block copolymer with a single charged A-block *tilts* the phase diagram (red) away from the uncharged case (black) and can even drive phase separation when the blocks are otherwise fully miscible. This allows a wide variety of morphologies to be accessed even without changing fraction of A or the chi-parameter.

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