Abstract: Recent developments in high-density energy storage devices have heightened the search for materials that are mechanically robust and highly tunable. Polyelectrolyte blends and copolymers, consisting of at least one charged species, are ideal candidate materials for fuel cell and battery membranes, as they combine the mechanical stability of the polymer chain with the ion-selective conductivity of the charged backbone. Specifically, using charged constituents in a copolymer has is a powerful way to control the self-assembled nanostructures in the copolymer by introducing local ionic correlations between the charged backbone and the counterions. We show here that charged components enhance phase separation of copolymers even in the absence of polymer interactions, leading to nanostructures that are highly desirable for transport but inaccessible in neutral block copolymers. With statistical thermodynamic methods, we investigate the phase diagram of polyelectrolyte blends and charged-neutral block copolymers.

Biography

Research in the Olvera de la Cruz group is centered around the development of models to describe the self-assembly of heterogeneous molecules including amphiphiles, copolymers and synthetic and biological polyelectrolytes, as well as the segregation and interface adsorption in multicomponent complex fluids. Work by the group has resulted in a revised model of ionic-driven assembly: demonstrating the electrostatic spontaneous symmetry breaking of ionic fibers and membranes, and identifying its relevance to biological functions and to the design of functional materials. The group's investigations into soft and condensed matter physics have advanced scientific knowledge and opened new research fields of technological importance, including: gel electrophoreses dynamics, self-organization of molecular electrolytes into bio-mimetic materials, self-assembly of heterogeneous molecules into complex nano-structures, interface adsorption and phase segregation dynamics and structure of multicomponent fluids.