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Formation of ion clusters in the phase separated structures of neutral-charged polymer blends[1] HA-KYUNG KWON, MONICA OLVERA DE LA CRUZ, Department of Materials Science and Engineering, Northwestern University, Evanston, Illinois 60208, United States — Polyelectrolyte blends, consisting of at least one charged species, are promising candidate materials for fuel cell membranes, for their mechanical stability and high selectivity for proton conduction. The phase behavior of the blends is important to understand, as this can significantly affect the performance of the device. The phase behavior is controlled by χN, the Flory-Huggins parameter multiplied by the number of mers, as well as the electrostatic interactions between the charged backbone and the counterions. It has recently been shown that local ionic correlations, incorporated via liquid state (LS) theory, enhance phase separation of the blend, even in the absence of polymer interactions. In this study, we show phase diagrams of neutral-charged polymer blends including ionic correlations via LS theory. In addition to enhanced phase separation at low χN, the blends show liquid-liquid phase separation at high electrostatic interaction strengths. Above the critical strength, the charged polymer phase separates into ion-rich and ion-poor regions, resulting in the formation of ion clusters within the charged polymer phase. This can be shown by the appearance of multiple spinodal and critical points, indicating the coexistence of several charge separated phases.

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