ELUCIDATING THE MECHANISM OF POLYMER/SURFACTANT COACERVATE DELIVERY/CONDITIONING SYSTEMS

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For almost half a century, stimuli-responsive complexes formed by dilution of anionic surfactant/cationic polymer compositions have dominated conditioning shampoos and dilution-deposition delivery systems. There are a plethora of cationic polymers available but only a few are present in successful commercial products. Moreover, conditioning and delivery attributes are strongly dependent on compositional details and use conditions. In order to explore the reasons for the dominance of few polymers and the variability of performance with composition, we studied the effects on complex coacervate formation of polymer charge density and distribution, polymer backbone rigidity and hydrophilicity, and concentration relative to polymer overlap and entanglement concentrations and surfactant CMC by surface tensiometry, shear rheometry, and fluorescence spectroscopy. Our results show that, above the critical entanglement concentration, complex coacervates separate as shear-thinning gel networks that desorb anionic surfactant from the interface. Such networks are favored by polymers having relatively rigid hydrophilic backbones. Alternatively, systems below the critical overlap concentration separate as unconnected phase droplets which enhance interfacial adsorption. The importance of critical polymer concentrations on these delivery systems helps to provide a mechanistic scientific basis for better tailoring of compositions to confer optimal delivery of attributes.