Viscosity and interfacial properties in a marine-invertebrate inspired adhesive coacervate

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The chemistry of mussel adhesion has commanded the focus of much recent research activity on wet adhesion. By comparison, the equally critical adhesive processing by marine organisms has been little examined. Using a mussel-inspired coacervate formed by mixing a recombinant mussel adhesive protein (fp-151-RGD) with hyaluronic acid (HA), we have examined the nanostructure, viscosity, friction, and interfacial energy of fluid-fluid phase-separated coacervates using the surface forces apparatus and microscopic techniques. At mixing ratios of fp-151-RGD:HA resulting in marginal coacervation, the coacervates showed shear-thickening viscosity and no structure by cryo-transmission electron microscopy (cryo-TEM). However, at the mixing ratio producing maximum coacervation, the coacervate showed shear-thinning viscosity and a transition to a bicontinuous phase by cryo-TEM. The shear-thinning viscosity, high friction coefficient (>1.2), and low interfacial energy (<1mJ/m2) observed at the optimal mixing ratio for coacervation are promising delivery, spreading and adhesion properties for future wet adhesive and coating technologies.