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The Effect of Small Molecule Additives on the Self-Assembly and Functionality of Protein-Polymer Diblock Copolymers CARLA THOMAS, LIZA XU, BRADLEY OLSEN, Massachusetts Institute of Technology — Self-assembly of globular protein-polymer block copolymers into well-defined nanostructures provides a route towards the manufacture of protein-based materials which maintains protein fold and function. The model material mCherry-b-poly(N-isopropyl acrylamide) forms self-assembled nanostructures from aqueous solutions via solvent evaporation. To improve retention of protein functionality when dehydrated, small molecules such as trehalose and glycerol are added in solution prior to solvent removal. With as little as 10 wt% additive, improvements in retained functionality of 20-60% are observed in the solid-state as compared to samples in which no additive is present. Higher additive levels (up to 50%) continue to show improvement until approximately 100% of the protein function is retained. These large gains are hypothesized to originate from the ability of the additives to replace hydrogen bonds normally fulfilled by water. The addition of trehalose in the bulk material also improves the thermal stability of the protein by 15-20 °C, while glycerol decreases the thermal stability. Materials containing up to 50% additives remain microphase separated, and, upon incorporation of additives, nanostructure domain spacing tends to increase, accompanied by order-order transitions.

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