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Tuning the Size of Elastin-like Polypeptide Nanoparticles

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Abstract

The ability to control the size of biologically-based, environmentally-sensitive colloidal nanoparticles can advance their application in areas such as drug delivery, tissue engineering, and biosensors. Controlling size is a primary task in engineering nanomaterials because many of their properties depend on size. With the aim of fine-tuning the size of particles, we characterize mixtures of two elastin-like polypeptide structures: a linear and a trimer configuration. Both constructs undergo aggregation above their inverse transition temperatures, but the linear ELP forms large aggregates which coalesce into a protein-rich phase, while the ELP trimer with polar head groups forms stable polymer micelles in low salt concentrations. The mixing of these two constructs makes possible a range of sizes of stable particles through the formation of a microemulsion. The linear ELP fills the cores of the micelle aggregates, resulting in larger stable particles. We determined the dependence of particle size on both the salt and linear ELP concentration across a range of temperatures using UV-vis spectroscopy and dynamic light scattering (DLS). We find that a given mixture of linear and trimer constructs has two temperature-based transitions and therefore displays three predominant size regimes. The results help elucidate the mechanisms of ELP aggregation.