Micelles of Thermo-Sensitive Elastin-Like Polypeptides: Protein Analogues that Follow the Scaling Laws of Polymers!

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With a perfectly defined primary structure, both in terms of monomer sequence and chain length [1], recombinant polypeptides obtained by protein engineering techniques allow investigating the structure-property relationships at a level of detail difficult to achieve with traditional synthetic polymers thank to the precision at which their sequence can be tailored. In the present work, we have studied the behavior and temperature-triggered self-assembly of a series of recombinant elastin-like diblock polypeptides (ELPs) with the aim of elucidating the mechanism of self-assembly. Solutions of diblock ELPs were studied below and above the critical micellar temperature (CMT) by multi-angle dynamic light scattering and small-angle neutron scattering, a useful technique to study conjugated polymer-peptide micelles [2]. Below the CMT, the radius of gyration follows a power law as a function of molecular weight with an exponent value close to 0.5, characteristic of Gaussian coil conformations. When the temperature is raised and reaches the CMT, attractive interactions between the more hydrophobic block of the diblock ELP chains leads to the self-assembly of monodisperse spherical nanoparticles at thermodynamic equilibrium. Above the CMT, micelles were found to expel water molecules from their core whose densification results in the increase in the light and neutron scattering intensities. The behavior of these diblock ELPs in solution and as self-assembled nanoparticles follows universal experimental scaling laws that make them analogous to synthetic amphiphilic diblock copolymers (star-like *vs.* crew-cut micelle model), unrevealing the utmost important role of water in the thermal behavior of these polypeptides.

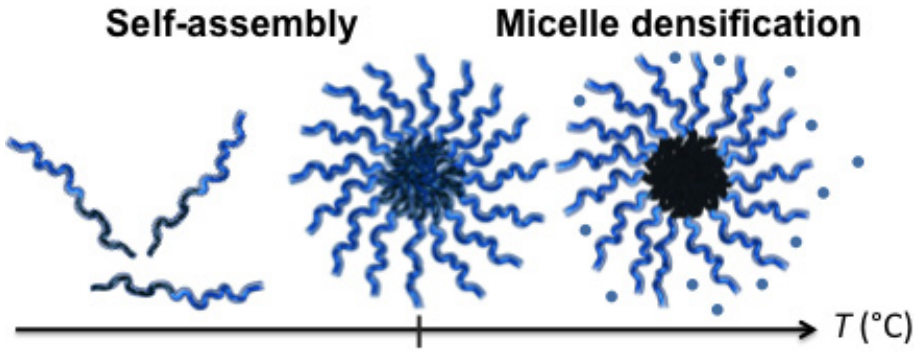

Figure: Diblock elastin-like polypeptides (ELPs) are random-coils at low temperature and spherical aggregates above the critical micelle temperature (CMT), followed by a progressive dehydration of the micelle core.

[1] E. Garanger, S. Lecommandoux
Towards Bioactive Nanovehicles Based on Protein Polymers, Angew. Chem.-Int. Ed. **51**, 3060 (2012)

[2] C. Drappier, H. Oliveira, O. Sandre, E. Ibarboure, S. Combet, O. Garanger, S. Lecommandoux,
Self-assembled core-shell micelles from peptide-b-polymer molecular chimeras: towards structure-activity relationships, Faraday Discus. **166**, 83 (2013)