**Designing an Artificial Blood Clot with Synthetic Polymers**

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Living organisms possess an intriguing property: their polymers become stiffer when subjected to shear or tensile loads. A prime example is the fibrin biopolymers that make up blood clots, which stiffen under strain to protect a wound site and aid healing. Strain stiffening is a unique characteristic is absent in synthetic polymers and itremains highly challenging, yet desirable to create synthetic materials that mimic this behavior. In this project, you will build on recent advances in strain stiffening biopolymer synthesis to construct tuneable polymeric hydrogels that stiffen under strain and can controllably release chemical compounds to enable wound healing. To accomplish this, you will adopt a modular approach comprising:

1. **Synthesis**. Through reversible addition−fragmentation chain transfer (RAFT) polymerization, you will construct amphiphilic block copolymers with controllable size, morphology, and with reactive groups for functionalization.
2. **Fiber Assembly**: You will engineer the copolymers to self-assemble into rigid fibers using hydrophobic interactions and hydrogen bonds. You will optimize the polymer morphology and ensure the assembly of well-defined fibers. To maintain the self-assembled structure under applied strain, you will employ photochemical methods for covalent crosslinking.
3. **Hydrogel Construction**: Building upon the assembled fibers, you will progress to crosslink them into a robust hydrogel network using click chemistry to facilitate the precise control of crosslink density and polymer concentration.

You will employ advanced characterization techniques such as electron microscopy, light scattering, and nonlinear shear rheology to examine the structure and mechanical response of the hydrogels. To evaluate the controlled release properties, you will conjugate fluorescent dyes to the hydrogels and employ fluorescence recovery after photobleaching (FRAP) to probe their diffusion behavior.

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*Polymer amphiphiles synthesised using RAFT polymerisation will self-assemble via hydrogen bonding interactions to produce macromolecular building blocks which can be loaded with cargo, and cross-linked to form strain-stiffening hydrogel networks that enable controlled release.*

By controlling polymer composition and molecular weight, you will fine-tune the remarkable mechanical properties of the resultant hydrogel networks. The controlled release of cargo molecules will be achieved through the integration of slowly hydrolysable linkages for progressive release or triggered release mechanisms, that will for the first time demonstrate the utility of strain stiffening hydrogels for wound healing applications.