The concept is simple: to build functional nanomaterials in the protein size regime (i.e. 2-5 nanometers in diameter), one must be able to manipulate matter on a similar length scale. Canonical synthetic organic chemistry operates on a length scale an order of magnitude too small (a few angstroms rather than and few nanometers). Traditional polymer nanoparticle fabrication techniques (e.g. solution assembly of block copolymers or emulsion polymerization techniques) operate on a length scale that is an order of magnitude too large (a few tens of nanometers). In between the two is a vast chemical space that remains largely unexplored, and yet sits firmly in the realm of synthetic polymer chemistry. Nature's strategies and abilities in this regard are, regrettably, far superior to anything we can do in the laboratory. Still, using modern techniques in polymer and supramolecular chemistry it is possible to imitate Nature's methods and in the process, fill a significant gap in technological understanding. Our group's efforts over the past several years have focused precisely on this topic via an emergent class of materials termed “single-chain nanoparticles” (SCNP). SCNP are formed through the intramolecular cross-linking and collapse of single polymer chains in dilute solution to yield an architecturally defined network with dimensions similar to the parent linear chain. This talk will review what we’ve learned by highlighting a few important discoveries, and also offer a few predictions for the path forward.

Figure 1: Schematic Representation of single-chain nanoparticle synthesis