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Self-oscillating nanoparticle assemblies: a novel class of active materials

Proposal Abstract:

Despite the promise of active matter in sustainable energy, biomaterials, and environmental remediation, most active systems are limited by their finite energy sources. Here, we propose to conduct proof-of-concept experiments on a novel class of active matter comprised of polymer-grafted nanoparticles that oscillate between aggregation states, thereby leading to long-lived activity. We will synthesize these materials by grafting thermally responsive polymers to the surface of optically active gold nanoparticles (AuNPs), suspending them in a non-aqueous solvent, and exposing them to infrared light. By coupling the thermal response of the polymer and the photothermal response of the AuNPs, we will generate a feedback loop that generates structural oscillations. These structural oscillations will be characterized using dynamic light scattering, optical microscopy, and UV-vis spectroscopy, demonstrating their use as novel sensors for environmental or biological contaminants with significantly improved sensitivity. Using the data generated in this proposal, we will prepare proposals for external funding, which we expect to submit to the National Science Foundation.

Awarded: $19,854