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Nanoparticle Self-Assembly

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Real-Time Monitoring and Control of Colloidal Crystal Growth Using AuNPs and DNA

The self-assembly of colloidal crystals from gold nanoparticles (AuNPs) is a growing research area in chemical reactions and nanotechnology with biomedical applications. Our research, which builds on the existing knowledge of nanoparticle crystallization, focuses on investigating the crystallization of AuNPs functionalized with DNA and developing a real-time monitoring system to observe and control this process dynamically.

Currently, temperature is the primary factor used to regulate nanoparticle crystallization. However, we propose a different approach that allows syringe pumps to introduce dynamic control over key crystallization parameters, such as salt concentration, nanoparticle concentration, nanoparticle identity, etc. By controlling these variables, we aim to determine whether we can change the crystallization pathway and influence the crystal structures.

To achieve this, we will use digital photography to monitor crystal growth and identify structural changes in real-time. We have used established synthesis and functionalization methods for AuNPs, including the St ö ber process and freeze-thaw, respectively, while characterizing the results using UV-Vis spectroscopy, NanoDrop analysis, and scanning electron microscopy (SEM). These methods will allow us to assess the impact of our dynamic control strategy on crystallization efficiency, structural order, and reproducibility.

Our findings will provide insight into the understanding of nanoparticle crystallization and demonstrate whether real-time changes in key parameters can yield improved or better crystal structures. This research can lead to more precise and scalable methods for colloidal crystals, offering exciting possibilities for the future as this is a new chemistry field being developed.