DNA- and Field-Mediated Assembly of Magnetic Nanoparticles into High-Aspect Ratio Crystals

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Colloidal crystal engineering with DNA is a powerful method to achieve highly ordered nanoparticle assemblies. Here, we demonstrate that an applied magnetic field can direct the anisotropic growth of magnetic PAE crystals. We describe experiments aimed at determining how magnetic fields can influence DNA-directed colloidal crystal growth. These experiments, when combined with molecular dynamics (MD) simulations, provide a framework for understanding and deliberately driving particle crystallization pathways, and they provide access to structures different than what is possible with DNA hybridization alone.

Significance and Impact

This structural control coupled with tunable nanoparticle compositions and lattice symmetries enabled by DNA colloidal crystal engineering will facilitate future magnetic, optical, and mechanical property studies in high-aspect ratio PAE crystals. In particular, recent microrobotic studies with magnetic particles show reconfigurable control of hierarchical motion, and this fundamental study could push such work to nanoscale manipulations.

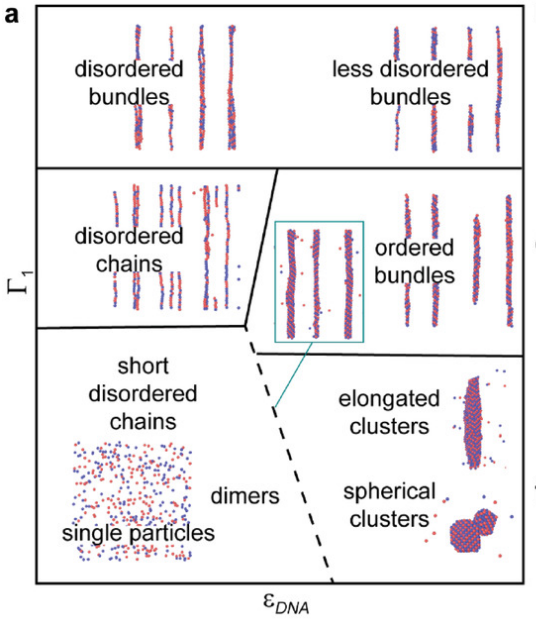

Figure: Schematic showing how magnetic coupling between individual PAEs, Γ_1, and the DNA hybridization interaction strength, ε_{DNA}, between complementary PAEs affect system morphology.

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