Electric and Magnetic Field-Driven Assembly of Patchy and DNA-Linked Anisotropic Colloids

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Anisotropy in particle shape and surface properties provides a powerful tool for directing the assembly of colloidal systems into complex structures. When combined with external fields and selective interactions, it enables programmable and reconfigurable organisation. In this work, we study programmable assembly of anisotropic colloids using two complementary systems.
In the first system, TPM-encapsulated magnetic hematite cubes behave as patchy particles with an off-centred magnetic patch. By varying electric field parameters, we obtain tunable open lattices, stacked structures, and clusters. The displaced magnetic patch further enables the formation of chains, flocks, and reversible oligomers under combined electric and magnetic fields. These assemblies arise from the interplay between electric dipolar repulsion and magnetic dipolar attraction, allowing controlled transitions between configurations. In the second approach, DNA linkers are used to assemble size-asymmetric magnetic particles into dimers and short chains, which can then be reconfigured under external fields.
Overall, this work highlights how coupling particle anisotropy, selective binding, and external fields enables access to a wide range of adaptive and reconfigurable colloidal architectures, relevant for smart materials and microscale devices.

Keywords:
Programmable self-assembly, DNA colloids, Field-induced assembly

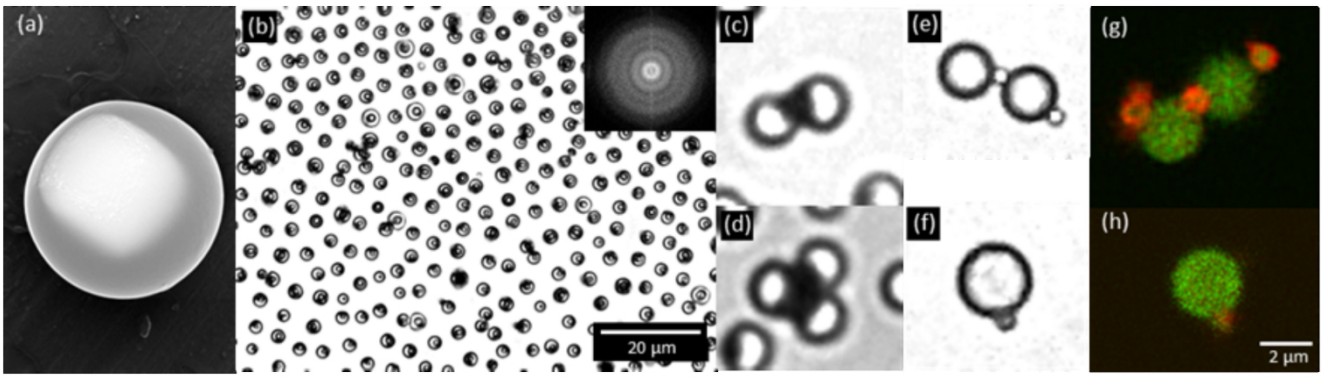

Figure 1: (a) SEM image of cube-TPM conjugate. (b-d) Structures formed by these conjugates in electric and magnetic fields. (e-h) Alternating chains and dimers formed by DNA mediated assembly (bright field and confocal microscopy images)

References:

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