Multiscaled Directed Self-Assembly of Composite Microgels in Complex Electric Fields

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We discuss the application of localized electric fields for reversible directed self-assembly of colloidal particles in 3 dimensions. Electric field-microgradients, arising from the use of micro-patterned electrodes, were utilized to direct the localization and self-assembly of polarizable (charged) particles resulting from a combination of dielectrophoretic and multipolar forces. Deionized dispersions of spherical and ellipsoidal core-shell microgels were employed for investigating their assembly under an external alternating electric field. The frequency of the field was found to allow for an exquisite control over the localization of the particles and their self-assembled structures near the electrodes. This approach was then extended to concentrated binary dispersions consisting of polarizable and less polarizable composite microgels. Hereby, the thermosensitivity of the microgels was utilized to adjust the effective volume fraction and the dynamics of the system, providing the possibility to dynamically ”solidify” the assembly of the field-responsive particles by a temperature quench from their initial fluid state into an arrested crystalline state. Reversible solidification enables re-write/reconstruct various 3 dimensional assemblies by varying the applied field frequency.

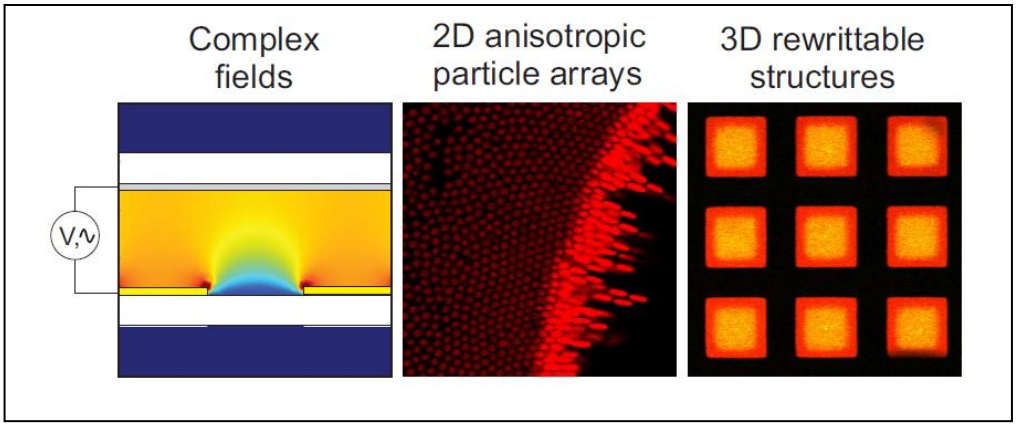

Figure 1 Alternating complex electric fields were employed to direct the self-assembly of spherical and ellipsoidal composite microgels to create, among other structures, 2D hexagonal arrays of vertically aligned ellipsoidal particles and 3D rewrittable structures.