SFB 767

Seminar

Universität Konstanz

Wed 06.12.2017
10:00
P 1138

Dr. Gabi Steinbach
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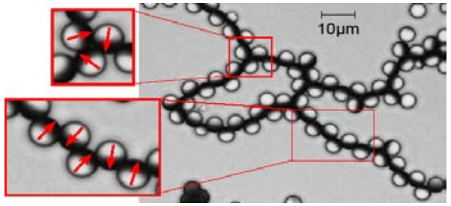
& TU Chemitz



Microscopy image of a self-assembled branched cluster. Insets show two distinct structure elements that occur: staggered chains and threefold branching points.

Colloidal particles with magnetization anisotropy: Flexible self-assembly and field-controlled dynamics

Interacting colloidal particles are ideal systems for studies of pattern formation and collective non-equilibrium dynamics on the mesoscopic scale. I will demonstrate that these ordering phenomena can be greatly varied in a controlled way using particles with anisotropic interactions. As an example, I present the self-assembly and field-induced dynamics of particles that exhibit an off-center magnetic dipole moment. Experimentally, artificially designed magnetic spheres (silica microspheres with hemispherical ferromagnetic coating of [Co/Pd] multilayers) dispersed in water have been studied via video microscopy. In two dimensions, the particles spontaneously self-assemble into branched structures as a result of a bistable assembly behavior where neighboring particles exhibit a noncollinear magnetic orientation. These features, which are atypical for homogeneous systems of magnetic particles, can be reproduced by analytical and numerical calculations of interacting spheres with radially shifted point dipoles (sd-particles). By applying homogeneous magnetic fields, a rich variety of stable, interconvertible structures with diverse spatial and magnetic ordering has been found. The collective alignment of the specially designed particles in external fields opens new possibilities for the remote control over reversible pattern formation on the mesoscopic scale. Moreover, the collective dynamics of the anisotropic particles has revealed a novel approach for field-driven actuation. Using the same experimental particle system, we realize various modes of motion - ranging from stirrers to steerable movers with helical or directed path - depending on the magnetic configuration of a cluster.

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