Superparamagnetic colloids in external magnetic fields

C. N. Likos, V. A. Froltsov, and H. Löwen

Instutut für Theoretische Physik II, Heinrich-Heine-Universität Düsseldorf, Germany

Email: likos@thphy.uni-duesseldorf.de

We examine the structural and phase behavior of superparamagnetic colloidal particles under the influence of external magnetic fields. The colloids are confined at the water-air interface and their motions are two-dimensional. Due to their high magnetic susceptibility, the particles develop, under the influence of magnetic fields, a dipole moment that completely aligns itself with the former, and whose magnitude and direction has practically no thermal fluctuations. By varying the tilt angle of the field with respect to the confining plane, we trace out the zero-temperature phase diagram of the system, discovering a variety of crystal structures, accompanied by chain formation at high tilt angles. Moreover, we confine the system in various types of inhomogeneous magnetic traps. By employing computer simulations and density-functional theory, we analyze the resulting inhomogeneous density profiles of the system.