Abstract

Potential theory is utilised to calculate the stray field and the stray field interaction of polarised (magnetised) particles. One aim is the optimisation of the geometry of periodic arrays to maximise the
stray field and accordingly the stray field modulation. Patterned media with optimised stray field or stray field modulation are of general interest in basic research, e.g. to create molecule-traps or a periodic potential used in quantum optics or semiconductor physics, respectively. For different particle geometries and magnetisation directions one and two-dimensional lattices are investigated. Special attention is paid to geometries and length scales that are or will be experimentally relevant. As the interparticle interaction in dense packed systems cannot be neglected a formalism is developed that enables the analytical calculation of multipole moments and, therefore, the series expansion of the stray field interaction for a large class of particle shapes. The interaction of various multipole moments on two dimensional periodic and quasi periodic lattices is studied systematically by means of Monte Carlo methods. Apart from the Monopole moment the interaction of multipole moments shows a strong dependency on the orientation in space. As different moments prefer different relative orientations, this interaction may influence self-assembly of interacting particles. The multipole induced order phenomena and anisotropies are studied systematically. Self-organised particles play an important role in the fabrication of large periodic structures and, therefore, periodic potentials, which are discussed in the first part of this thesis. The calculated order phenomena are in agreement with experimental findings concerning molecule adsorbents on surfaces as well as superferromagnetic states in systems of stray field coupled ferromagnetic particles. To prove the so far unconfirmed stray field induced anisotropy calculations, experiments utilising the magneto-optic Kerr effect are suggested.