Control of lattice spacing in a triangular lattice of feeble magnetic particles formed by induced magnetic dipole interactions

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Abstract. We studied methods of controlling the spacing between particles in the triangular lattice formed by feeble magnetic particles through induced magnetic dipole interaction. Formation of a triangular lattice is described by the balance between the magnetic force and the interaction of induced magnetic dipoles. The intensity of the magnetic force is proportional to the volume of particles V and the difference in the magnetic susceptibilities between the particles and the surrounding medium $\Delta\chi$. On the other hand, the intensity of the induced magnetic dipole interaction depends on the square of V and $\Delta\chi$. Therefore, altering the magnetic susceptibility difference by changing the susceptibility of the surrounding medium, volume of the particles, and intensity and spatial distribution of the applied magnetic field effectively controls the distance between the particles. In this study, these three methods were evaluated through experiment and molecular dynamics simulations. The distance between the particles, i.e. the lattice constant of the triangular lattice, was varied from 1.7 to 4.0 in units of the particle diameter. Formation of self-organized triangular lattice through the induced magnetic dipole interaction is based on magnetism, a physical property that all materials have. Therefore, this phenomenon is applicable to any materials of any size. Consequently, structure formation through induced magnetic dipole interaction is a potential way of fabricating materials with ordered structures.

Keywords: feeble magnetic particles, triangular lattice, magnetic dipole interaction

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