Abstract

Two and Three Dimensional Ordered Structures in Electro-magneto-rheological Fluid[1]

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We have observed both two dimensional [1] and three dimensional [2] ordered structures in electromagnetorheological (EMR) fluids by using uniform-sized microspheres coated with a inner layer of nickel and outer insulating materials. For the 2D structures, the magnetic microspheres floating on a liquid meniscus were seen to form planar crystal structures with lattice constant which is variable as a function of applied normal magnetic field. Other symmetries, such as oblique, centered rectangular, square, and even local formations of quasicrystals with five-fold symmetry, were also obtained under a tilted external magnetic field, where the structural transition from 2D to 1D can be also observed. Here the balance between the repulsive magnetic interaction and the "attractive" interaction, due to the weight of the particles projected along the surface tangent, is the basic underlying physical mechanism. Three dimensional ordered structures with body-centered tetragonal (BCT) or face centered cubic (FCC) symmetries were obtained by dispersing the coated microspheres in liquid and applying crossed electric and magnetic fields.

[1]Work done in collaboration with L. Zhang, P. Sheng, N. Wang, H. Ma, Z. Lin, W. Y. Tam, and C. T. Chan.