Nanostructured surfaces

Effect of particle shape anisotropy on a freezing phenomenon in 2D monolayer

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Alder and Wainwright [1] by means of computer simulations have shown that two-dimensional (2D) fluid of hard spherical particles can freeze upon increasing particle density. Since then a number of studies dedicated to the physics behind such a phenomenon were reported.

Recently, Huerta *et al* [2] have suggested rather transparent freezing mechanism for such a system. The mechanism states that taking into account only three (out of six in total) alternating nearest neighbors of any particle is enough to describe the disordered and crystalline phases, as well as transition between them. The disordered phase becomes unstable when the average centre-to-centre distance between pairs of alternating nearest neighbors becomes shorter than two particle diameters and resulting gap between alternating neighbors prohibits for the central particle to wander.

In the present report, the same mechanism is applied to understand the freezing behavior of the nanosurface array formed by elongated particles. When the shape anisotropy is either low or large, the freezing transition scenario is reduced to that discussed for an array of spherical particles [2]. However, there exists an intermediate range of the particle shape anisotropy, when freezing is frustrated, and monolayer proceeds continuously from a disordered phase to a crystalline one.

1. *Alder B.J., Wainwright T.E.* Phase transition in elastic disks // Phys. Rev.-1962.**-127.-**359.
2. *Huerta A., Henderson D., Trokhymchuk A.* Freezing of two-dimensional hard disks // Phys. Rev. E.-2006.**-74.-**061106.