Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

Restricted dislocation mobility in crystals of peanut-shaped colloidal particles

ITAI COHEN, Cornell University

Recent advances in colloidal particle synthesis techniques have enabled the production of a variety of anisotropic yet monodisperse particles, including colloidal "peanuts," which consist of two connected spherical lobes. Since their shape crudely approximates a dimer, colloidal peanut particles constitute a simple but fundamental extension of the classic system of colloidal spheres. Experimental investigations as well as simulations of colloidal peanut monolayers have shown that at high area fractions the particles form a degenerate crystal (DC). In this structure, the peanut particle lobes order into a triangular lattice, much like close-packed spheres, while the connections between lobe pairs are randomly oriented, uniformly populating the three crystalline directions of the underlying lattice. Comparative studies of crystal formation in rapidly compressed monolayers of peanut-shaped versus spherical particles show that DCs harbor many more defects than equivalent crystals of spheres. This suggests that defect annealing may be frustrated by the constraining rigid connections between particle lobes. To elucidate the interactions between these geometric constraints and defect mobility, we directly examine the mechanisms for dislocation nucleation and propagation in DCs. In particular, we show that obstacles formed by certain particle orientations severely limit the range over which dislocations can glide. Furthermore, we observe that transport over longer distances can proceed through dislocation reactions, which switch the direction of propagation and allow dislocations to bypass such obstacles. In this talk I will discuss the impact that these restricted mechanisms have on the macroscopic properties of DCs.