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Factors Influencing the 2D Elastic Moduli of Self-Assembled Nanoparticle Monolayers[1] SIHEN YOU, ROSSEN RASHKOV, PONGSAKORN KANJANABOOS, IGNAVIO CALDERON, MATI MERON, HEINRICH JAEGER, BINHUA LIN, University of Chicago — Nanoparticles with hydrophobic capping ligands are found to self-assemble into monolayer films when deposited on the air/water interface. Different nanoparticle monolayers exhibit a rich morphology of wrinkling, folding and buckling behavior that indicates interesting elastic properties. We obtain the 2D bulk and shear moduli of several different nanoparticle films by measuring the anisotropic stress response of the film under uniaxial compression using a Langmuir trough, a method previously applied to lipid and protein membranes. We find that the elastic properties of the nanoparticle film are affected by size distribution of the nanoparticles and the properties of their capping ligands. Higher polydispersity results in a greater number of packing defects that weaken the assembled film. The ligands mediate the particle-particle interaction, acting like elastic springs that join together hard spheres. The strength of such "springs" is determined by the degree of interdigitation of ligands between neighboring nanoparticles as well as the shapes of the capping ligands. These results suggest that the elastic moduli of nanoparticle films can be tuned through careful alteration of size distribution and capping ligand's shape and density.

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