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Macroscopic and tunable PEG-gold nanoparticle superlattices at aqueous interfaces[1] WENJIE WANG, HONGHU ZHANG, SURYA MALLAPRAGADA, ALEX TRAVESSET, DAVID VAKNIN, Ames Laboratory and Iowa State University — To address the challenge of assembling nanoparticles (NPs) into superlattices in controlled manner, we have developed a simple, robust protocol to assemble AuNPs functionalized with synthetic polymers (i.e., polyethylene glycol, PEG) into two-dimensional (2D), macroscopic superlattices with tunable lattice parameters. Here, we report on the formation of 2D superlattices of PEG-AuNPs at aqueous surfaces characterized with surface-sensitive, grazing-incidence small-angle x-ray scattering (GISAXS) and x-ray reflectivity (XR) methods. We show that the presence of salts (i.e., potassium carbonate) in the aqueous solutions drives PEG-AuNPs to the air-water interface and form a hexagonal superlattice beyond a threshold concentration. Varying the nanoparticle concentration and PEG length can further regulate the lattice parameters. We have built a model based on polymer-brush theory that can account for the experimental observations and provide more insight on the driving force for the interfacial self-assembly and crystallization of the PEG-AuNPs. The approach we developed paves the way for 2D macroscopic and tunable supercrystal formation and can be applied to other nanoscale building blocks with various functionalities and to the formation of 3D structures.

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