Effect of interaction heterogeneity on disordered microstructures at an oil-water interface

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The properties of colloid-assembled crystalline structures on macroscales can be predicted from interactions between individual particles on microscales. However, the prediction can be deviated due to heterogeneity of interparticle interactions. When colloidal particles reside at a fluid-fluid interface, the particles exhibit abnormally strong electrostatic repulsions, compared to the case when they are immersed in a single fluid medium (i.e., water). Note that the strong electrostatics are due to dipole-dipole interactions that decay as r-4, where r is the separation between the particles. The electrostatic repulsive interactions lead to a formation of highly organized colloidal crystalline structures, whereas the presence of interaction heterogeneity causes a disordered configurations. In this work, we employ the optical laser tweezers to quantitatively investigate interaction heterogeneities of microspheres with various surface functionalities and their effects on forming assembly structures when the particles are confined at an oil-water interface.