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Directing Colloidal Particle Organization Using Soft Lithography and Polyelectrolyte Assembly[1]

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The use of electrostatic interactions to guide colloidal assembly can be used to achieve an elegant level of control on the ordering of particles at surfaces. We have utilized a combination of self-assembled monolayers and electrostatic layer-by-layer assembled thin films as templates for the directed deposition of colloidal particles. In this work, it is also of interest to manipulate two or more colloid components on a surface using attractive and/or repulsive interactions. This work has since led to an investigation into other interactions that can be used to guide colloid assembly. By extending our understanding of interactions between polyelectrolytes and different forms of functional surfaces, we have been able to guide polyelectrolyte coated colloids to different surface regions based on hydrophobic or hydrogen bonding interactions as well as charge attraction. Recent success has been obtained in our group on the use of DNA acid/base pairs to direct the deposition of polyion functionalized colloids to specific regions of surfaces. In this work, the strong and highly specific hydrogen bonding interactions that take place between poly(phosphonic acids) is being pursued. New developments have included the formation of hydrogen bonded Janus particles – colloids that have been functionalized with a different polybase on either side of the particle. Finally, we have also begun to use a range of soft lithographic methods, combined with polyelectrolyte multilayer assembly on nanometer scale patterns to direct nanoparticles into patterned arrays. The interactions involved in this work, guiding principles, as well as the interplay between hard boundaries and surface chemistry in template surfaces, will be discussed, and potential applications and new collaborations will be addressed in display, microfluidic and biological applications.

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