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DNA-Mediated Colloidal Crystallization, Interactions and Dynamics

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DNA has emerged as a powerful and versatile tool for nanoscale self-assembly. Several researchers have assembled nanoparticles and colloids into a variety of structures using the sequence specific binding properties of DNA. Until recently, however, all of the reported structures were disordered, even in systems where ordered colloidal crystals might be expected. We detail the experimental approach and surface preparation that we used to form the first DNA-mediated colloidal crystals, using polystyrene microspheres. We also report the first direct measurements of such DNA-induced interactions between such micron-sized particles. The interactions measured with our optical tweezer method can be modeled in detail by well-known statistical physics and chemistry, boding well for their further application to directed self-assembly. The microspheres reversible adhesion dynamics have an unexpected power-law scaling, which we hypothesize is due to the non-exponential kinetics of DNA hybridization process itself.