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Understanding of DNA directed nanoparticle superlattices in bulk and thin film

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Over the years, there have been significant advances in assembling nanoparticles with DNA into superlattices. Since the first reports on DNA directed FCC and BCC superlattices consisting of single type of spherical nanoparticles,[1,2] building blocks for the DNA-nanoparticle superlattices have been extended from a spherical gold nanoparticle to various types of other particles including quantum dots, magnetic, hollow, or polyhedral particles.[3,4] Not only single component, but superlattices of binary[5] and ternary components[6] have also been synthesized. Although still many details are unclear, now there is a general consensus about thermodynamics of this type of assembly, which led us to fabricate thin films of DNA directed nanoparticle superlattices on substrate for applications such as optical materials.[7] Since the structures are formed in aqueous condition, small angle x-ray scattering (SAXS) that does not disturb the system has been a critical tool to determine structural and thermodynamic characteristics of the assemblies. Thus, we have also been improving SAXS instrumentations and computational methods to calculate scattering profiles for the nanoparticle superlattices.[8] In this talk, we will summarize our works with a focus on some structural details of these superlattices and DNA and understanding about the role of DNA in the crystallization processes in bulk and thin film. 1. Park, S. Y. et al, C. A. Nature 2008, 451, 553. 2. Nykypanchuk, D. et al, Nature 2008, 451, 549. 3. Jones, M. R. et al, Nat Mater 2010, 9, 913. 4. O'Brien, M. N. et al, Nat Mater 2015, 14, 833. 5. Macfarlane, R. J. et al, Science 2011, 334, 204. 6. Macfarlane, R. J. et al, Science 2013, 341, 1222. 7. Senesi, A. J.et al, Angew. Chem. Intern. Ed. 2013, 52, 6624. 8. Senesi, A. J. and Lee, B. J. of Appl. Crystallog. 2015, 48, 1172.