MAR15-2014-008883

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

DNA templates silver clusters with magic sizes and colors for multi-cluster fluorescent assemblies[1]

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The natural inclusion of information in DNA, a vital part of life's rich complexity, can also be exploited to create diverse structures with multiple scales of complexity. Now emerging in novel photonic applications, DNA-stabilized silver clusters (Ag_N-DNA) are compelling examples of multi-scale DNA-directed assembly: individual fluorescent clusters, each templated by specific DNA base motifs, can then be arranged together in DNA-mediated multi-cluster assemblies with nanoscale precision. We discuss how DNA imbues Ag_N-DNA with unique features. Our optical data on pure Ag_N-DNA show that DNA base-cationic silver ligands impose rod-like shapes for neutral silver clusters, whose length primarily determines fluorescence color [1]. This shape anisotropy leads to the aspherical Ag_N-DNA magic number cluster sizes and "magic color" groupings [2]. We exploit DNA's sequence properties to extract multi-base motifs that select certain magic cluster sizes, using machine learning algorithms applied to large data sets [3]. With these base motifs, we design DNA scaffolds to arrange multiple atomically precise Ag_N together in nanoscale proximity. We demonstrate that clusters are stable when held at separations below 10 nm, both in bicolor, dual cluster DNA clamp assemblies [4] and in one-dimensional assemblies of atomically precise clusters arrayed on DNA nanotubes.

[1] D. Schultz *et al.*, Adv. Mater. **25**, 2797 (2013).
[2] S. M. Copp *et al.*, J. Phys. Chem. Letters. **5**, 959 (2014).
[3] S. M. Copp *et al.*, Adv. Mater. **26**, 5839 (2014).
[4] D. Schultz, S. M. Copp *et al.*, ACS Nano **7**, 9798 (2013).

[1]Supported by NSF-CHE-1213895 and NSF-DMR-1309410. SMC acknowledges NSF-DGE-1144085, a NSF GRFP.