Templated Self-Assembly of sub-10nm Quantum Dots

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Patterned templates can guide the self-assembly of nanoparticles into ordered arrays [1]. Our motivation in pursuing templated self-assembly is to develop a robust method for the creation of ordered structures at length scales below ten nanometers. The basic process entails creating surface relief templates via electron-beam lithography, and spin-coating a suspension of colloidal nanoparticles onto the template. As the solvent evaporates, the quantum dots self-assemble primarily through the capillary forces created by the dewetting of the template [2].

We demonstrate this technique at sub-10nm length scales by spin-coating a solution of organically-capped CdZnS semiconducting quantum dots onto nanopatterned grating structures on silicon substrates. We observe the geometric confinement of the quantum dots via physical templating and capillary forces into well-ordered aggregates with defined lattice orientations. While recent research has demonstrated the ability to self-assemble sub-10nm metallic nanoparticles via capillary forces into physical templates of similar size [2], this work is unique in the demonstration of lattice orientation control via physical templating at sub-10nm length scales.

References:

[1] Y. Yin, Y. Lu, B. Gates, Y. Xia, "Template-Assisted Self-Assembly: A Practical Route to Complex Aggregates of Mondispersed Colloids with Well-Defined Sizes, Shaps, and Structures," *J. Am. Chem. Soc.*, vol. 123, pp. 8718-8729, 2001.

[2] J.A. Liddle, Y. Cui, P. Alivisatos, "Lithographically directed self-assembly of nanostructures," *J. Vac. Sci. Technol. B.*, vol. 22, no. 6, pp. 3409-3414, Nov/Dec 2004.

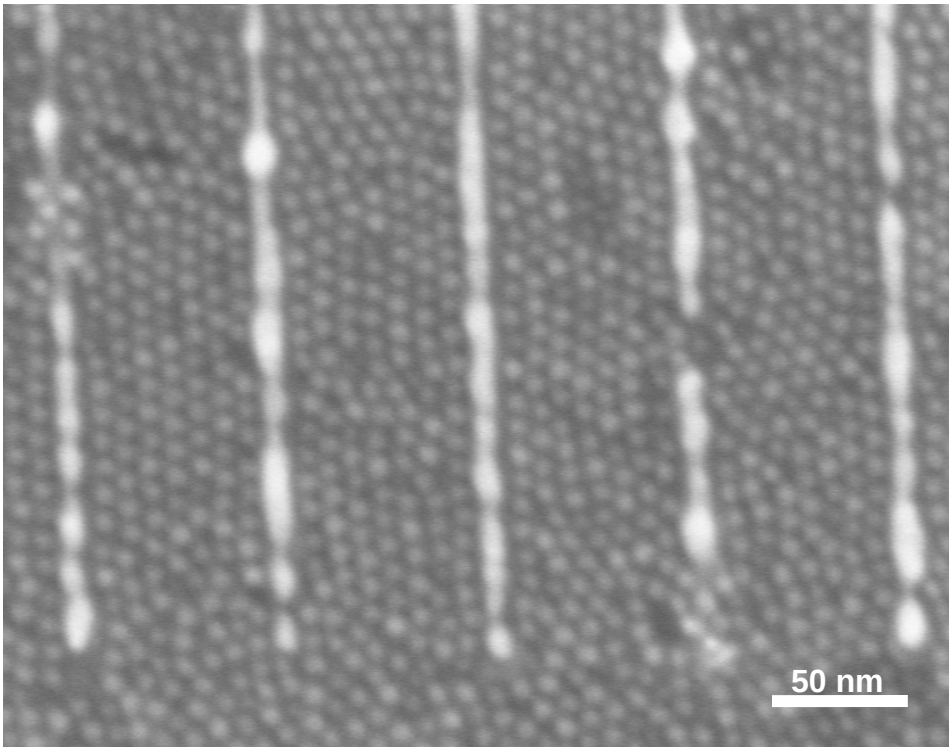

Figure 1. Scanning electron micrograph of a self-assembled quantum dots on a templated silicon substrate. The vertical lines visible are part of a template grating, with 10-nm-wide, 80-nm-tall Au lines at a pitch of 80 nm. The spheres are organically capped 8 nm CdZnS semiconducting quantum dots.