NANO HIGHLIGHT
Fabricating "colloidal molecules" by "particle lithography"

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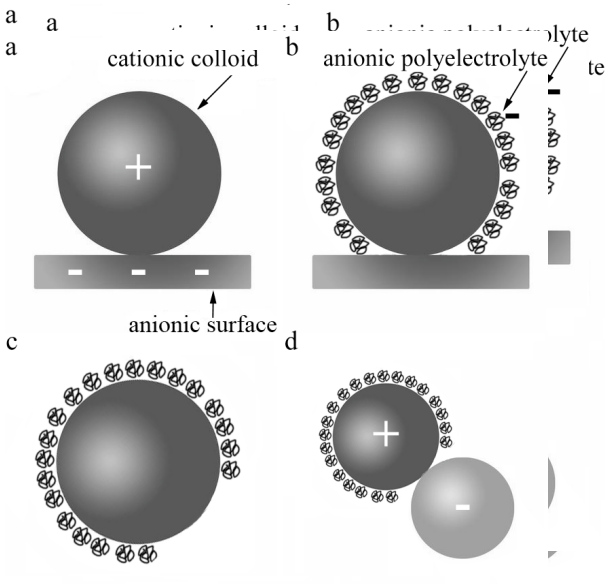
Imagine if we could build houses by "bottom-up assembly". We would throw into a large ditch smart doors, smart windows, and smart boards. We would come back a day later and !presto!, we would find a fully-constructed house. No hammers, no drills, no saws, no builders – no "top-down assembly".

In a similar way, our lab groups are working to build new types of logic circuits with bottom-up assembly, making specially designed nanowire and spherical particles that will self-assemble when put in suspension together. One method we have developed for bottom-up assembly is the fabrication of "colloidal molecules" using "particle lithography".



In water glass surfaces naturally become negative, and so we first adhere positively-charged amidine-functionalized particles to the surface. Second, we introduce a negatively-charged polyelectrolyte like polystyrene sulfonate into the system. It adsorbs everyone on the adhered sphere – except where the glass-particle contact prevents access of the polyelectrolyte. Third, by sweeping out the polyelectrolyte and sonicating the particles off the surface, we obtain "colloidal atoms" that are mostly negative, with a small nanoscale region of positive charge where the polyelectrolyte could not access. This region acts as a "bond" in the fourth step, when we introduce an excess of negatively-charged particles to obtain doublets.

We have begun to extend this technique using alternative binding chemistries (e.g., receptor-ligand, carbodiimide chemistry) and lithographing coatings (e.g., dendrimers, fullerenes). In addition, we have begun to create assemblies other than doublets (e.g., "water"-shaped assemblies and more complex). By introducing complementary DNA-binding, using metal and semiconductor nanowire pieces, and employing molecular dynamics simulations to guide stabilization during intermediate steps, we aim to produce novel, low-power logic circuits.

References (10 point font)

[1] For further information about this project contact Darrell Velegol (velegol@psu.edu, www.velegol.org)
[2] National Science Foundation NIRT Grant #CCR-0303976: "Bottom Up Assembly of Metal and Semiconductor Nanowires: Fundamental Forces to Nanoelectronic Circuits". PIs: Darrell Velegol, Kristen A. Fichthorn, Theresa Mayer, Christine D. Keating. (2003-2007)

[3] Snyder, Charles E.; Yake, Allison M.; Feick, Jason D.; Velegol, Darrell. "Nanoscale Functionalization and Site-Specific Assembly of Colloids by Particle Lithography." *Langmuir* , **21**, 4813-4815 (2005).