Scalable nanoparticle arrays for thin-film solar cells
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Thin-film solar cell efficiency
Thin-film solar cells use less material than conventional solar cells, making them a viable option for cheaper solar electricity. Unfortunately, their thinness also hinders them from trapping and absorbing longer light wavelengths, making them less efficient. Monolayered, non-close packed nanoparticle arrays placed within the cell help to scatter longer wavelengths within the cell and allow them to be absorbed.

Future Work
Dimer self-assembly
Standing cylindrical nanoparticles have been theoretically shown to maximize the fraction of light scattered into a solar cell. We would like to explore monolayered dimer self-assembly in the hopes that we could create cylindrical particle arrays in the same way. We plan to charge one dimer lobe to control particle spacing, and coat the other lobe to make it hydrophobic.

Conclusions
Solvent type and concentration seemed to have the greatest effect on forming an even array with long-range particle order. In our experiments, a solution of 1% amidine latex particles suspended in pure methanol provided the most order, least aggregations and best control over particle spacing. Further, the physical method of creating the arrays did not greatly affect their formation, allowing for flexibility in future methods of creating larger-scale arrays.

Acknowledgements
I would like to thank Ning Wu and Fuduo Ma for mentoring this project, and Sijia Wang for coating the particles in our experiments. The National Science Foundation, as well as the REMRSEC program at the Colorado School of Mines, provided funding and sponsorship.

References
Atwater and Polman, Plasmonics for improved photovoltaic devices. NATURE MATERIALS, VOL 9, MARCH 2010
I. Sijia, Particle Lithography from Colloidal Self-Assembly at Liquid-Liquid Interfaces. ACS NANO, VOL. 4, NO. 10