**Dr. Delia J. Milliron**
University of Texas at Austin, McKetta Department of Chemical Engineering

**Plasmonic metal oxide nanocrystals and their gel assemblies**

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## Abstract

Metal oxide nanocrystals doped with a few percent of aliovalent dopants become electronically conducting and support strong light-matter interactions in the infrared due to localized surface plasmon resonance (LSPR). Focusing on the prototypical material, tin-doped indium oxide (ITO), we have found that the strength and spectrum of light absorption depend non-trivially on nanocrystal doping, size, and the radial distribution of dopants[1]. Localizing tin dopants in the outer shell of the nanocrystals makes them more sensitive to changes in the refractive index of their surroundings[2]. The associated compression of the near-surface depletion region also enhances conductivity in nanocrystal films[3]. Generally, controlling the arrangement of inorganic nanocrystals in assemblies allows realization of materials whose properties depend both on the distinctive characteristics of their nanoscale building blocks and on their organization. Nanocrystal gel assemblies are interesting because their porous, percolating structures can in principle lead to tunable (valence-dependent) material properties with dynamic reconfigurability. I will describe our use of dynamic covalent chemistry to create reversible gels of ITO nanocrystals under conditions guided by thermodynamic theory and rationalized with the help of simulations[4]. The infrared optical response of the gels is broadened by strong coupling between the LSPR of the nanocrystals.

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[2] SL Gibbs, C Dean, J Saad, B Tandon, CM Staller, A Agrawal, DJ Milliron, “Dual-Mode Infrared Absorption by Segregating Dopants within Plasmonic Semiconductor Nanocrystals,” *Nano Lett.* **20** (2020), 7498-7505.
[3] CM Staller, ZL Robinson, A Agrawal, SL Gibbs, BL Greenberg, SD Lounis, UR Kortshagen, DJ Milliron, “Tuning Nanocrystal Surface Depletion by Controlling Dopant Distribution as a Route Toward Enhanced Film Conductivity,” *Nano Lett.* **18** (2018), 2870-2878.
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