How do Emerging Light Harvesting Materials Form, Transform, and Transport Energy at the Nanoscale?

We are interested in the optoelectronic properties and the spatiotemporal nature of photogenerated energy carrier transport of emerging semiconducting materials, broadly defined. These materials include not only semiconductors who basic building blocks are atoms but also those made of small particles or molecules, including the aggregates of molecular pigments involved in photosynthesis. Those of greatest interest to us are ones that spontaneously assemble into organized and/or densely packed solid structures starting from the solution phase or whose structures can be thermodynamically or kinetically transformed. What are the multiscale relationships between the dynamics and products of material formation and transformation and the emergent electronic properties of these materials? How does disorder, as an inherent byproduct of the assembly process, affect these properties both locally and macroscopically?

To answer these questions I will provide examples of our work to elucidate the mechanisms for ultrafast photoinduced energy transport and for the slower dynamics of material transformations in a wide range of emerging, heterogeneous electronic materials. This work has often required the development of spectroscopic nano-imaging modalities with new, more appropriate combinations of spatial sensitivity and temporal resolution. As examples, I will take you first on a journey with transient optical elastic scattering to reveal the nature of energy flow–structure correlations for various photogenerated species in virtually any semiconductor. In related materials, we will then explore the nature of structural phase transitions both at and away from equilibrium using cathodoluminescence microscopy – the mapping of light emitted from a sample in a scanning electron microscopy – and *in situ* X-ray scattering.

Naomi S. Ginsberg is an Associate Professor of Chemistry and Physics at University of California, Berkeley and a Faculty Scientist in the Materials Sciences and Molecular Biophysics and Integrated Imaging Divisions at Lawrence Berkeley National Laboratory, where she has been since 2010. She currently focuses on elucidating the electronic and molecular dynamics in a wide variety of soft electronic and biological materials by devising new electron and optical imaging modalities that enable characterization of fast and ultrafast processes at the nanoscale and as a function of their heterogeneities. Naomi received a B.A.Sc. degree in Engineering Science from the University of Toronto in 2000 and a Ph.D. in Physics from Harvard University in 2007, after which she held a Glenn T. Seaborg Postdoctoral Fellowship at Lawrence Berkeley National Lab. Her background in chemistry, physics, and engineering has previously led her to observe initiating events of photosynthesis that take place in a millionth billionth of a second and to slow, stop, and store light pulses in some of the coldest *atom clouds on Earth. She is the Berkeley lead of STROBE, a multi-university NSF Science and Technology Center devoted to imaging science, a member of the Kavli Energy Nanoscience Institute at Berkeley, and the recipient of a David and Lucile Packard Fellowship in Science and Engineering (2011), a DARPA Young Faculty Award (2012), an Alfred P. Sloan Foundation Fellowship (2015), and a Camille Dreyfus Teacher-Scholar Award (2016) in addition to a series of teaching awards in the physical sciences. In 2017-18 she was a Miller Professor for Basic Research in Science at UC Berkeley and was designated a Kavli Fellow.*

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