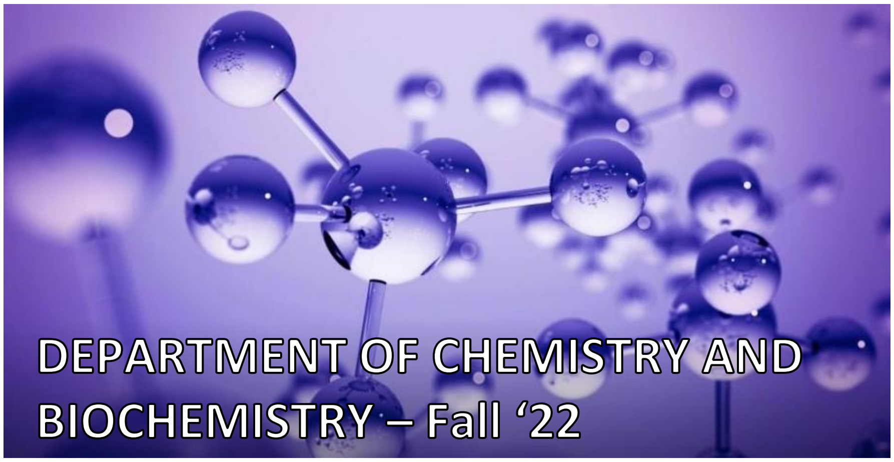

THE SALZBERG CHEMISTRY SEMINAR SERIES

The City College of New York

CREST IDEALS PHASE II

Monday, October 3, 2022 @ 12:00 noon – MR1027

A PARADIGM SHIFT INSPIRED BY NATURE: Supramolecular Assemblies for Solar-Energy Harvesting

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Abstract: The future of sustainable energy technologies requires not only highly efficient but also robust light-harvesting materials, especially as rising global temperatures threaten the efficiency of existing photovoltaic installations. Unlike current solar energy conversion technologies, natural photosynthetic organisms have clearly evolved beyond these challenges, capturing and transporting solar energy both robustly and efficiently even under extreme environmental stress. In photosynthetic organisms, the first step (that is, light harvesting) involves the interaction between light energy and the light-harvesting antenna, which are composed of delicate, weakly bound structures known as supramolecular assemblies. Delocalized Frenkel excitons—coherently shared excitations among molecular chromophores—are responsible for the remarkable efficiency of supramolecular light-harvesting assemblies within those photosynthetic organisms. However, the translation of nature's successful design principles to applications in optoelectronic devices has been limited by the fragility of the supramolecular structures used and the delicate nature of Frenkel excitons. In my talk, I will present a demonstration that the intrinsic barriers towards functionalization of supramolecular assemblies can finally be overcome. Through *in situ* cage-like scaffolding of individual supramolecular light-harvesting nanotubes, we designed highly stable supramolecular nanocomposites with discretely tunable (~4.7-5.0 nm), uniform (±0.3 nm), cage-like scaffolds. Indeed, high-resolution cryoTEM, spectroscopy and near-field scanning optical microscopy (NSOM) revealed supramolecular excitons within cage-like scaffolds are robust, even under extreme heat stress. Our complementary substrate studies on prototype dye-sensitized solar cells showed that our nanocomposites' precise scaffold tunability in solution was also maintained upon immobilization onto a solid substrate. Together, these results indicate that our novel supramolecular nanocomposite system is a successful, critical first step towards the development of practical, bio-inspired light-harvesting materials for solar-energy conversion technologies as well as a basis for future fundamental investigations that were previously not possible, e.g., dilution of supramolecular assemblies required for single-molecule imaging or precise tunability of scaffold dimensions for controlled functionalization of hybrid model systems such as plasmonic-excitonic (plexcitonic) systems.

Biography: Dr. Eisele was born and educated in Berlin, Germany. She received both her B.S. and M.S. in Physics from Technical University of Berlin. In 2009, she received a Ph.D. in Physics from Humboldt University of Berlin. From 2010-2014, she conducted her postdoctoral research at the Energy Frontier Research Center, EFRC, *Center for Excitonics* at MIT with Moungi Bawendi and the late Robert Silbey. In 2014, she joined CCNY as an Assistant Professor in Physical Chemistry. Her research is problem-oriented with a focus on nature-inspired nanomaterials, at the intersection of Chemistry, Physics, and Materials Science, and requires a highly collaborative approach. Inspired by nature, her research aims to contribute to our fundamental understanding on how light interacts with matter both in space and time. This is a challenging topic that underlies frontiers research areas such as renewable energy (solar energy harvesting and conversion), nanomedicine (sensing and drug delivery) or information technology (molecular electronics and spintronics). In nanoscience, research progress is often limited by the lack of *nanoscale* model systems that allow for experimental testing of current theoretical models. Addressing this issue, her research approach allows for a concerted investigation of novel nanomaterials—well-defined model materials systems—by uniting materials nanosynthesis with time-resolved optical spectroscopy and super-high resolution nanoscopy methods. Her research program has resulted in competitive national research awards (2018 NSF CAREER; 2017 and 2020 DOE; 2015 NSF MRI), major CUNY awards for junior faculty (2017 Felix Gross Award; 2016 CUNY Junior Faculty Research Award in Science and Engineering), and invited talks at international frontiers research conferences (including 2021 GRC on Photochemistry, 2019 GRC on Photosynthesis, 2020 Telluride Summer Lecture Series).

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