Materials Science and Engineering Department

Winter Seminar Series

Unifying the Structural and Electronic Dynamics of Low-Dimensional Materials

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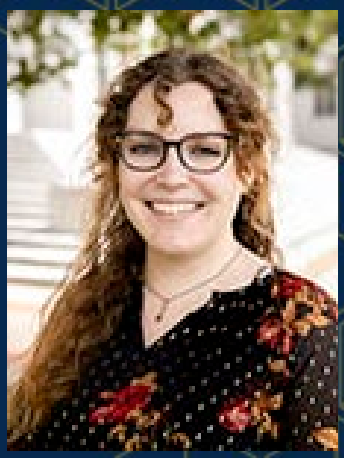

February 4, 2026
11AM-12PM | Hill Seminar Room (LeBow 240)

The design of novel materials for optoelectronic devices, such as solar cells, light-emitting diodes, and sensors, has traditionally relied on the use of optical spectroscopy and charge transport measurements to determine the dynamics of excitations. The behavior of optoelectronic materials is governed by their structures, just as how the properties of molecules are dictated by theirs; however, it is easy to overlook that structure is a dynamic feature of materials that changes as a material is synthesized, incorporated into a device, or exposed to the environment. To truly understand the fundamental photophysics of inorganic materials, it is necessary to conduct coupled, time-resolved structural and optical characterization in dynamic environments. Only by doing so will we understand how materials undergo structural transformations, how these transformations impact optoelectronic properties, and how to leverage these changes for optoelectronic applications.

The focus of the Brumberg Group is on controlling and understanding dynamic structural processes – such as phase transitions, self-assembly, and crystallization – in nanocrystalline and bulk inorganic materials. Our goal is to establish control over optoelectronic and other physicochemical properties from two directions: (1) the study of carrier dynamics as a function of materials structure, and (2) the development and characterization of stimuli-responsive materials. As a materials chemist trained in ultrafast optical spectroscopy and transient X-ray diffraction, my approach to these fundamental problems is primarily based on the use of advanced characterization tools that enable access to important electronic and structural information. In this talk, I will demonstrate how my lab will combine inorganic synthesis, *in situ* characterization, and ultrafast spectroscopy to determine how structure impacts optoelectronic properties and finally uncover the mechanisms driving dynamic structural processes that have eluded chemists for so long.

Alexandra Brumberg is an Assistant Professor of Chemistry at Drexel University with affiliate appointments in the Departments of Materials Science and Engineering and Chemical Engineering. She received her B.S. in ACS-certified Chemistry and Mathematics at Tufts University and a Ph.D. in Chemistry at Northwestern University, where she used ultrafast optical spectroscopy to uncover the photophysics of two-dimensional semiconductor nanoparticles. She completed postdoctoral training at the University of California, Berkeley, and Santa Barbara, where she worked to develop structure/optical property relationships in perovskite derivatives. During her graduate studies, Alexandra was awarded the National Science Foundation and 3M Graduate Research Fellowships and the International Institute for Nanotechnology's Ryan Fellowship. At Drexel, her group's research focuses on unifying structural changes in materials (like those that occur during crystallization, self-assembly, and phase transitions) with their electronic dynamics and optoelectronic properties through *in situ* methods and ultrafast characterization techniques.

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FOR MORE INFORMATION

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