Amgen Seminar Series in Chemical Engineering

in

Cherry Auditorium, Kirk Hall, 12:45 PM

Presents on October 31, 2019

Investigating the photophysics of solar energy conversion materials using ultrafast optical, X-ray, and Mössbauer spectroscopies

By

Dr. Dugan Hayes
Department of Chemistry
University of Rhode Island

Improving the function of solar energy conversion devices made from durable, earth-abundant materials is necessary to make solar technology an integral part of a clean, renewable energy strategy. Energy conversion in photovoltaic and photocatalytic materials begins with the formation of excitons and/or free carriers, and the fates of these transient species – whether or not they can be separated and extracted before they recombine – is what ultimately determines conversion efficiency. Thus, a thorough understanding of the dynamics of charge separation, migration, and recombination on timescales ranging from femtoseconds to microseconds is crucial for guiding the design of next-generation materials. To this end, our group employs a variety of cross-regime ultrafast transient absorption spectroscopies to characterize these dynamics. By combining ultrafast optical, terahertz, and X-ray pulses in different experimental configurations, we can probe a broad manifold of transient chemical and physical properties of materials as they evolve during photochemical or thermochemical processes. The insights gained from these techniques collectively give a picture of how solar energy conversion materials work and what properties could be targeted to improve performance. In this talk I will give an overview of optical and X-ray transient absorption spectroscopies and provide a few examples of transition metal complexes and oxides that we have studied using this technique. I will conclude with a discussion of time-resolved synchrotron radiation Mössbauer spectroscopy, an entirely novel transient absorption technique for studying solid state materials that we are currently developing in collaboration with Rhode Island College and Argonne National Laboratory.

Bio: Dugan Hayes has been an Assistant Professor in the Department of Chemistry at URI since 2017. He received his Ph.D. in physical chemistry from the University of Chicago in 2013, and he was the Joseph J. Katz Postdoctoral Fellow at Argonne National Laboratory from 2014 to 2017. During that time he was a frequent user of the Advanced Photon Source, an X-ray user facility operated by the Department of Energy that he and his group frequently visit for their research now. In addition to improving next-generation solar energy materials, he is interested in uncovering the mechanisms of synthetically useful photochemical reactions and developing hybrid molecular-nanophononic structures for controlling nanoscale thermal energy transfer.

This series at the University of Rhode Island is made possible through the generosity of Amgen, West Greenwich, R.I.

Refreshments provided by the Joseph Estrin Endowment.