While members of Professor Roberts’ group work on an array of chemical problems, the theme that runs through each is that they develop new ways of utilizing time-resolved nonlinear spectroscopy to separate dynamics that occur in different areas of the materials they study. Projects currently underway in the group include developing techniques that can selectively examine dynamics at buried interfaces in thin film electronics. They also utilize time-resolved Raman spectroscopy to look at ligand-nanocrystal interactions.

Information:
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Manipulating Energy and Spin for Photon Up- and Down-conversion

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The negligible spin-orbit coupling in many organic molecules creates opportunities to alter the energy of excited electrons by manipulating their spin. In particular, molecules with a large exchange splitting have garnered interest due to their potential to undergo singlet fission (SF), a process where a molecule in a high-energy spin-singlet state shares its energy with a neighbor, placing both in a low-energy spin-triplet state. When incorporated into photovoltaic and photocatalytic systems, SF can offset losses from carrier thermalization, which account for ~50% of the energy dissipated by these technologies. Likewise, compounds that undergo SF’s inverse, triplet fusion (TF), can be paired with infrared absorbers to create structures that upconvert infrared into visible light. In this presentation, I will review our group’s efforts to create organic:inorganic structures that use SF and TF for improved light harvesting and photon upconversion.