Templated chromophore nanostructures: Experimental validation of new solar thermal fuels for the closed-cycle storage of solar energy

Timothy J. Kucharski, Ph.D. and Jeffrey C. Grossman, Ph.D.
Massachusetts Institute of Technology
77 Massachusetts Ave, Bldg 13-Rm 4078
Cambridge, MA 02139

Solar thermal fuels are a potential all-in-one solution for capturing, converting, transporting and delivering solar energy sustainably and cleanly by using sunlight to photochemically generate metastable isomers for later release of the stored energy as heat. Previous solar thermal fuel systems were impractical due either to low energy densities or poor photochemical properties, but we have recently found that the energy density and storage lifetime of photochromic molecules with favorable photochemical properties can be engineered by templating the molecules at the nanoscale, for example, by chemically appending functionalized azobenzenes to single-walled carbon nanotubes. Such an approach allows us to access energy densities in the range of 200 $W_{th}h/kg$ with storage lifetimes of years at ambient temperatures. This talk discusses the strategies for synthesizing solar thermal fuels using our templating approach and the experimental validation of the predicted increases in key energy differences as well as demonstrations of their stability towards repeated cycling.