**Bridging energy conversion and storage in two-dimensional molecular frameworks**

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The energy challenge facing our global society is, in its very essence, a materials challenge. This is because primary sources of sustainable energy abound, while their conversion into usable forms of energy such as fuels or electricity is limited by the efficiency of absorbers, catalysts, or simply by the thermodynamics and kinetics of (electro)chemical conversions occurring between a given set of materials. Progress in energy science is therefore contingent on new materials solutions that are both sustainable and scalable; it also requires new concepts and processes that have the potential to lead to disruptive changes in the conversion, storage, or utilization of energy across the scales.

Due to their earth-abundance and low cost, carbon-based materials have become the backbone of a variety of sustainable energy technologies ranging from photovoltaics to supercapacitors. While many carbon materials lack structural definition, 2D frameworks such as carbon nitrides and covalent organic frameworks (COFs) are molecularly precise, crystalline and porous, and as such have the potential to put a new spin on the development of tunable energy materials made from earth-abundant raw materials.

This talk will discuss recent developments and challenges in the emerging field of “soft photocatalysis” using 2D carbon-based frameworks as a modular platform for artificial photosynthesis. Using the light and dark reactions in natural photosynthesis as a blueprint, we explore the potentially rich interface between solar energy conversion and energy storage enabled by a new generation of “light storing” carbon nitrides, exemplified by the concepts of “dark photocatalysis” and direct solar batteries. We will further showcase the dual functionality of these carbon nitrides enabling simultaneous photocatalytic energy conversion and charge storage by the design of light-driven microswimmers with photocapacitive properties, which builds a bridge between energy converting and autonomous systems.