

## 2D or not 2D?

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

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Transitioning towards a sustainable energy economy is contingent on new materials solutions. 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 well-defined and robust metal-free semiconductors for photocatalysis.

In this talk, we will discuss recent developments and challenges lying ahead in the emerging field of “soft photocatalysis” using 2D frameworks as photoabsorbers, with a focus on the hydrogen evolution reaction. We will then explore the rich interface between optoelectronic and optoionic properties in ionic poly(heptazine imide)-type carbon nitrides (PHI), which represent a new generation of “light storing” materials. The intricate interplay between light harvesting and charge storage in PHI will be exemplified by the concepts of “dark photocatalysis” and direct solar batteries. Finally, we will showcase the design of light-driven microswimmers with photocapacitive properties, building a bridge between energy converting and autonomous systems.