Bettina V. Lotsch
Max Planck Institute for Solid State Research, Stuttgart

Real structure effects and light storage in molecular frameworks

Progress in energy science is contingent on new materials solutions that are both sustainable and scalable; it also requires new concepts and processes to enable 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.

In the first part of the talk I will discuss the structural (local and long range), morphological and catalytic boundary conditions guiding our design of carbon nitride and COF photocatalysts. In particular, I will highlight the importance of understanding real-structure effects in COFs and MOFs as a bottleneck – or design principle – to create precisely tailored porous frameworks.

Next, 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.

Bettina Lotsch is the Director of the Nanochemistry Department at the Max Planck Institute for Solid State Research (MPI-FKF) in Stuttgart, Germany. She studied Chemistry at the Ludwig-Maximilians-Universität München (LMU) and the University of Oxford and received her PhD from LMU Munich in 2006. After a postdoctoral stay at the University of Toronto she became professor at LMU Munich in 2009 and was appointed Director at MPI-FKF in 2017. Bettina also holds honorary professorships at LMU Munich and the University of Stuttgart, and is PI of the Munich-based Cluster of Excellence *e-conversion*.

Bettina's research explores the rational synthesis of new materials by combining the tools of molecular, solid-state and nanochemistry. Current research interests include molecular frameworks for solar energy conversion and storage, solid electrolytes for all-solid-state batteries, and "smart" photonic crystals for optical sensing.

Bettina was awarded an ERC Starting Grant (2014) and has been elected a Fellow of the Royal Society of Chemistry in 2014. Her work has been recognized by a number of awards, including the EU-40 Materials Prize 2017 of the European Materials Research Society.