# SINCHEM 2016 doctoral research subject

## Molecular Material Design for Future Energy Applications

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**PROJECT DETAILS**: Future energy generation will strongly rely on renewable energy sources such as wind, water and solar. However, these sources create a fluctuating energy supply causing the need for suitable energy storage on different time scales. Chemistry and especially catalysis can significantly contribute to tackle the challenges of future energy systems. Potential contributions of catalytic conversions for energy storage comprehend a (photo)electro-catalytic water splitting in hydrogen and oxygen, the transformation of renewable carbon sources such as $CO_2$ or biomass feedstock with renewable hydrogen into liquid target molecules of high energy density and the efficient energy release based on these energy storage systems.

Despite intense research in the described fields, catalyst systems of sufficient activity, selectivity and stability for technical applications are still missing. In the scope of the project, the potential of tailor-made materials for selected chemical transformations in future energy systems will be evaluated. The project focusses on the potential of covalent organic frameworks, metal-organic framework as well as nano-porous polymers. These materials offer the unique opportunity to design molecularly defined catalytically active sites within a material matrix of controlled chemical properties, structure and porosity. To name a material example: Covalent triazine frameworks have demonstrated the ability to act as solid ligands offering bipyridine-like coordination sites for coordination of various metal centres. In selected applications comparable activity to homogeneous catalyst analogues could be reached but separation and stability were significantly enhanced. Additionally, such solid molecular systems drive molecular catalyst systems independent of the surrounding solvent system.

Interested candidates should be highly motivated to work in an interdisciplinary research field. Synthesis of novel materials with focus on crosslinked polymers, metal organic framework and covalent organic frameworks requires an excellent chemical knowledge and very good experimental capabilities including basis knowledge of organic and organometallic synthesis. At the same time, successful candidates possess a broad knowledge on material characterisation such as physisorption, NMR, FTIR, etc. and at least theoretical knowledge concerning fundamental aspects of catalysis on the surface of solid materials including transport phenomena.