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FAKULTÄT FÜR CHEMIE

Einladung zum Vortrag von

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Multifunctional Nanostructured Materials: From Rational Design and Synthesis to Potential Applications in Catalysis, Energy and Nanomedicine

The development of novel nanomaterials with unique structures and multi-functional groups can lead to various miniaturized nanoscale devices and nanopatterned surfaces for various optical, electronics, photonics, catalysis, sensor, biological and medical applications. Furthermore, by using many of these materials, many fundamental studies at the nanoscale are possible. In this talk, efforts by my research group over the last several years on three different but related areas involving the development of various novel *multifunctional* nanomaterials for catalysis, energy and nanomedicine will be discussed. In the first part, I will describe how the rational assembly of multifunctional groups on nanostructured materials composed of metal oxides and mesoporous silicas can lead to novel nanocatalysts with efficient and synergistic catalytic activities for one-step or multi-step in one-pot (tandem) reactions. Some of the advantageous features of rationally juxtaposing two or more functional groups, ligands or metallic species within nanoscale cavities will also be discussed. In the second part, my group's recent efforts on the synthesis of heteroatom-doped, metal-free or noble metal-free carbon nanostructured and nanoporous materials and their composites that exhibit high catalytic and catalytic activities for reactions such as the oxygen reduction reaction (ORR), the hydrogen evolution reaction (HER), the oxygen evolution reaction (OER), and the hydrazine oxidation reaction (HOR)—reactions that are relevant to fuel cells and water splitting, or renewable energy in general—will be discussed. Particular focus will be given to the various novel design and "nanostructuring" as well as heteroatom doping synthetic approaches employed in my group to make a series of nanostructured and nanoporous carbon and their composite catalysts. Moreover, fundamental and theoretical studies that helped us to unravel catalytic active sites on some of these materials and the mechanisms by which they effectively catalyze some of these difficult-to-catalyze reactions will be discussed. In the last part, the ability of some of the nanomaterials mentioned to serve as drug delivery vehicles for various drugs, and their biocompatibility, efficacy and structure-dependent nanotoxicological properties will be discussed.

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