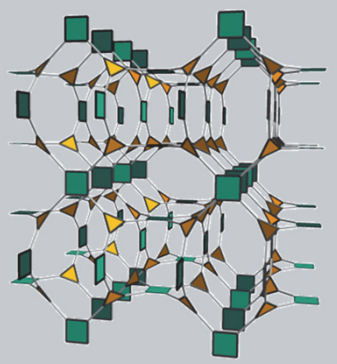
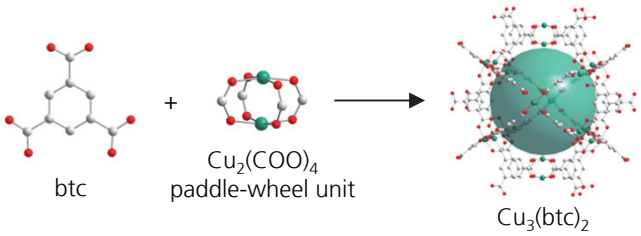


Metal-Organic Frameworks (MOFs)

Metal-Organic Frameworks (MOFs) are a new class of porous materials, which are characterized by a highly specific surface area and a pore volume of up to 7000 m^2g^{-1} and 3,60 cm^3g^{-1}. These materials are made of an inorganic metal-(oxo) cluster (e. g. Cu, Cr, Zn) and functional organic ligands. Due to the modular concept, the targeted design with specific properties (pore diameter and specific functionalities integrated into the organic linker molecule) becomes feasible for a wide range of applications. Thus the number of synthesized MOF-materials continuously increases. Furthermore the possible post-functionalization offers additional degrees of freedom concerning the synthetic variety and thus modularity of MOFs. By choosing the building blocks a targeted, application-specific setting of the pore dimension and chemical properties of the pore walls are possible. Based on their outstanding properties MOFs outperform traditional materials such as zeolites and activated carbons and are thus ideally suited for applications in gas adsorption, separation and sensor processes. Up to now mainly fundamental research has been done in the field of MOFs. Therefore most of the published structures are well characterized concerning their structural and characteristic physicochemical properties.



Project partners

- Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS, Dresden
- Fraunhofer-Institut für Chemische Technologie ICT, Pfinztal
- Fraunhofer-Institut für Keramische Technologien und Systeme IKTS, Dresden
- Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg
- Fraunhofer-Institut für Grenzflächen- und Bioverfahrenstechnik IGB, Stuttgart
- Fraunhofer-Institut für Umwelt-, Sicherheits- und Energietechnik UMSICHT, Oberhausen

Project duration
01.03.2012 – 28.02.2015

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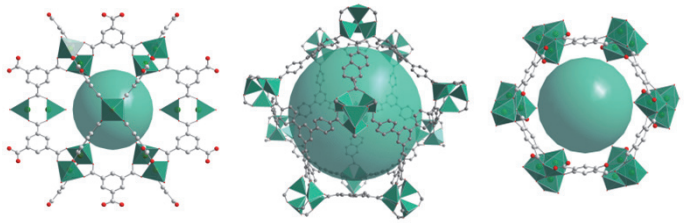
Metal-Organic Frameworks (MOFs)

Technology and market development for a new class of highly porous materials



www.mof2market.fraunhofer.de

Project Content

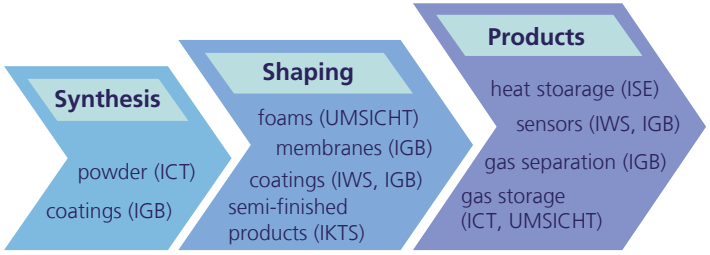
In the context of the project "MOF2market", new MOF-based applications, based on economically scalable MOF synthesis routes, have been developed. They are especially applied in the fields of solar and membrane technology, sensor systems, diagnostics, gas storage, chemical process engineering and they show better performances and address numerous markets. The project focuses on scalable MOF-production processes and on specific MOF-based products, which have received little evaluation so far:

MOF-production

- reaction and process techniques for MOF-production
- semi-finished MOFs and substrates for MOF-coatings

MOF-based products / systems

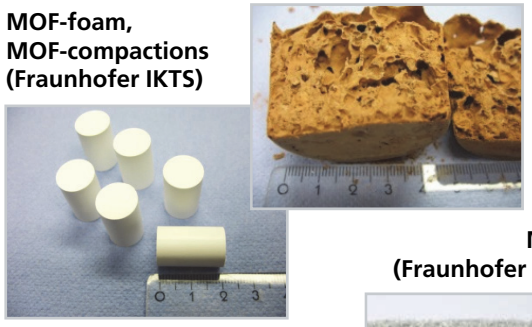
- storage systems for highly reactive gases and gaseous fuels for mobile applications
- thermally powered heat pumps and cooling machines as well as heat storage processes based on adsorptive heat transformation
- separation membranes for selective gas cleaning processes
- sensors for the selective gas detection by printed MOF-structures and optical detection



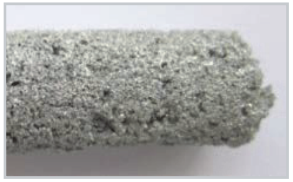
Synthesis / Shaping

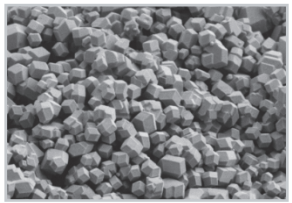
An important requirement for application-oriented product development is the enhancement of the availability of MOF-materials for the exploration of MOF-applications and implementation of MOF-products. For the integration into an industrial environment, MOF-production has to be developed regarding reaction and process engineering work and from an economical point of view. For the development of MOF-based products, technologies and procedures for their further processing and shaping are of central significance. Shaping techniques need to be adapted in that manner that MOF-materials can be processed as granulate, extrudate, foams, foils, coatings, etc. and typical MOF-properties (specific surface area and porosity) are maintained during the processing and shaping.

MOF-foam, MOF-compactions (Fraunhofer IKTS)



MOF-foam (Fraunhofer UMSICHT)





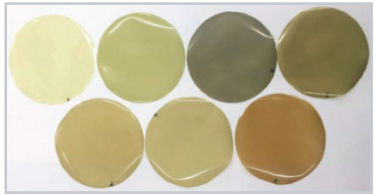
SEM picture of ZIF-8 (Fraunhofer ICT)

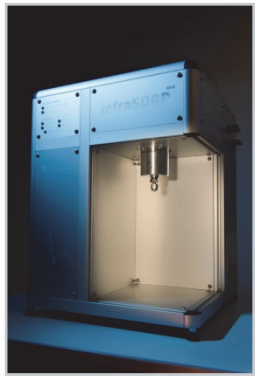
Products

Technical synthesis and shaping of the novel class of material create a basis for product innovation in diverse application fields whereby the optimized material design plays a crucial role. The main focus is on highly promising technical MOF-applications and their potential marketing in the application fields separation process (membrane technology), energy and mobility, catalysis and sensor techniques.

MOF-coated heat exchanger (Fraunhofer ISE)

Matrimide/MIL-101 membrane (Fraunhofer IGB)





Measuring instrument for characterization of porous materials using optical calorimetry (Fraunhofer IWS)