UNIVERSITÄT LEIPZIG

Faculty of Chemistry and Mineralogy

ENKE Sustainable • Porous • Materials Group

Chemical Reaction Engineering

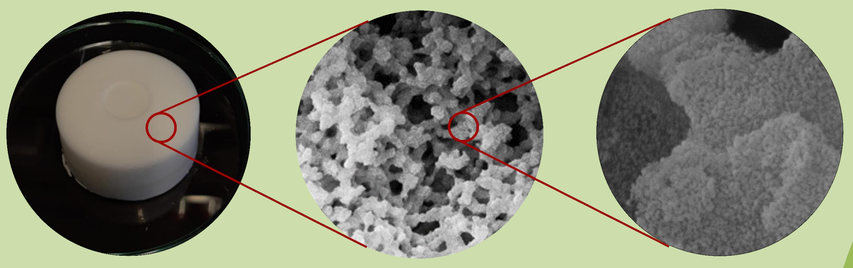
The Research Group of Prof. Enke

In order to reduce energy consumption in Germany and worldwide, it is necessary to develop efficient insulation materials. With their help, energy consumption for heating can be significantly reduced.

Foam glass is a stable, inorganic, non-flammable thermal insulation material. It can be produced from waste glass and can thus play an important role in the circular economy.

Monolith of a foam glass.

One of the most promising materials are **silica xerogels**, which are produced using the sol-gel process. This highly porous gel has a low thermal conductivity, a comparatively high stability and significantly lower manufacturing costs.

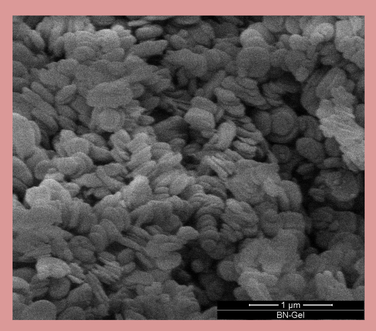


Hierarchical pore structure of a xerogel monolith.

Thermal Insulation

Adsorption is one of the central focuses in chemical technology. Applications range from filters, storage, drying, waste gas purification to water treatment. Two adsorbents that show promising properties are boron nitride and silica composites.

Boron nitride is a compound isostructural to graphite, which withstands high temperatures. At the same time, it is excellently suited for the adsorption of dipolar contaminants. However, it also exhibits high water instability. Our interest is to increase the water stability of the boron nitride while maintaining a certain degree of porosity.



SEM image of Boron nitride.

C-SiO2-Composites combine carbon and silica of a nano or micro scale. Carbon is conductive and hydrophobic, while silica is insulating and hydrophilic. The composite is hydrothermally and mechanically morestable than the pure silica or carbon material. Our aim is to synthesize these composites in a sustainable way.

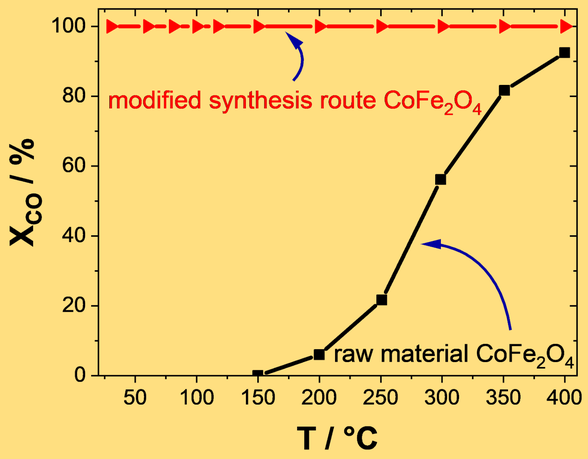
Adsorbents

Different processing states starting with rice husks (left), grounded rice husks (mid) and hydrocarbon (right).

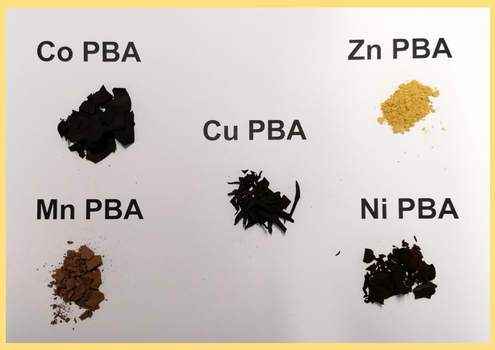
Catalysts

The importance of catalysis can be emphasized by the aspect of resource conservation and energy saving.

Therefore, we are trying to break new ground in the development of catalysts which have the particular task of reducing pollutants. One of our approaches is the oxidation of toxic CO to CO_2 with the help of mixed metal oxides. These are produced via a special precursor named **Prussian Blue Analogues**.



Temperature-conversion curves for CO oxidation.



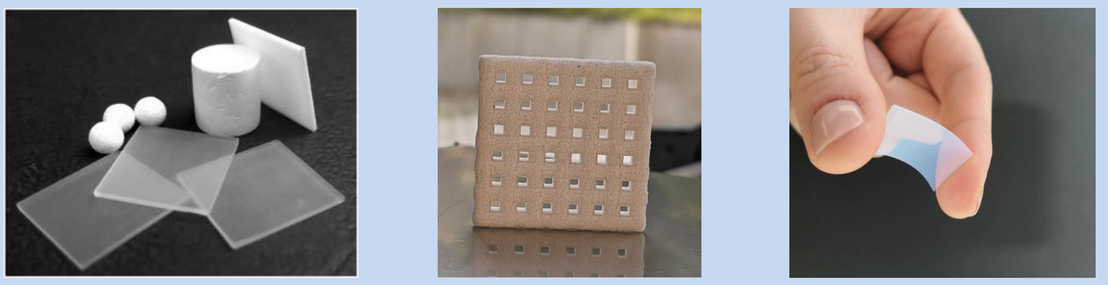
Different Prussian Blue Analogues.

Porous Glass

A wide variety of glasses can be produced from different starting materials with varying compositions. In order to increase their application-related benefits different processes can be used to implement a pore structure in the glass. These include the **VYCOR®-process** and **selective laser sintering**.

Porous glasses are amorphous materials with narrow pore size distribution in range of 0.3 to 1000 nm. Their flexible geometric shape, the tunable pore sizes and the reactive surface secure their spot as an important material in a multitude of practical applications.

Our research focuses on the development of **sustained drug release** model-materials based on porous glasses in the field of **personalized medicine**.



Various porous glass monoliths and membranes.

Analytical Methods

In the Enke Group a wide range of characterization methods is used to analyze different materials with their unique properties:

- **Nitrogen sorption**:
  - For micro-/ mesoporous materials
  - Information regarding pore structure, specific surface area, pore size and pore volume
- **Scanning electron microscopy and EDX**:
  - Surface topography
  - Chemical composition
- **Mercury intrusion**:
  - For meso-/ macroporous materials
  - Information regarding pore size distribution, pore volume and porosity
- **Inverse gas chromatography**:
  - For porous materials, powders, fibers
  - Information regarding physicochemical properties, acidity and roughness of the surface
- **Other methods**: Particle size analysis, Thermal conductivity measurements, Thermo-gravimetry, X-ray diffraction, Helium pycnometry, CO-oxidation, Compressive strength measurements

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