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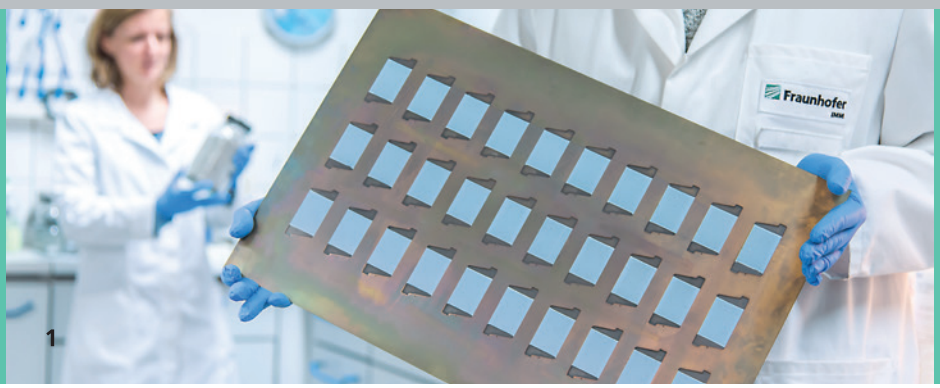

1 *Stainless steel sheet with an array of 30 reaction plates coated with catalyst layer.*

DEVELOPMENT, DEPOSITION, AND TESTING OF CATALYSTS

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Introduction

The Energy and Chemical Technology division at Fraunhofer IMM covers the entire technology chain from catalyst development and stability testing, process simulation, system design and control to development of low-cost fabrication techniques, reactor construction and complete system integration and testing.

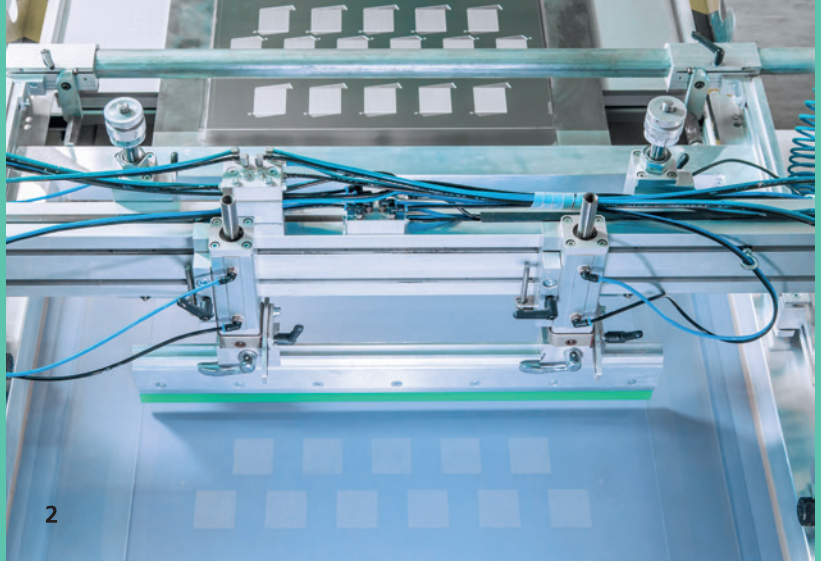
Customized catalyst development and optimization

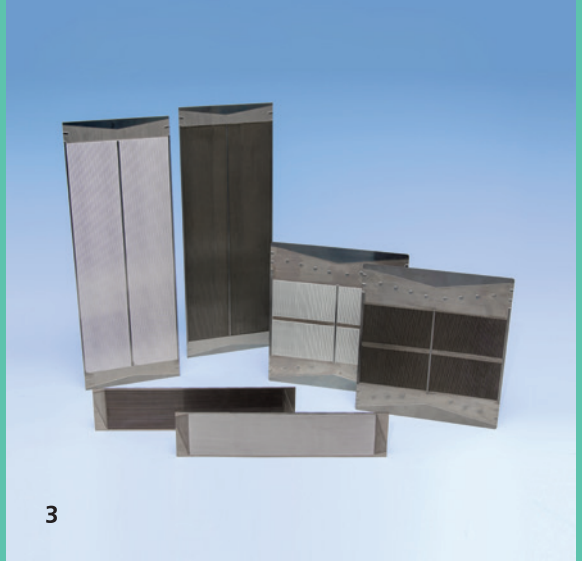
You can benefit from our expertise in developing new catalysts and coating catalysts. Both, catalysts and catalytic coatings, are tailor-made for the reactors and processes envisaged.
Our core competencies are the development of new catalysts, the optimization of existing catalyst formulations with respect to selectivity and activity and the improvement of the robustness of catalysts under real process conditions.
In addition, you can also benefit from our existing portfolio of long-term stable catalyst formulations for various heterogeneously catalyzed gas-phase reactions.

Focus of catalyst development

To date, the development of catalysts has been mainly focused on the energy sector:

- Hydrogen generation by reforming of various fuels (methane, propane, butane, diesel, methanol, ethanol and polyalcohols)
- Partial oxidation of hydrocarbons (propane, biogas)
- Thermocatalytic decomposition of propane





- Catalytic combustion for internal heating of the plate heat exchanger reactors (hydrocarbons, alcohols)
- Catalytic combustion of flue gas containing VOC, carbon monoxide, or hydrogen
- Syngas adjustment and clean-up by water-gas shift, methanation, and preferential oxidation
- Production of synthetic fuels through Methanol-To-Gasoline (MTG), biodiesel synthesis
- Synthesis of oxygenated hydrocarbons, e.g. methanol, dimethylether
- Carbon dioxide conversion with hydrogen to methane (power to gas)

Catalyst preparation

The standard repertoire of preparation methods includes

- precipitation,
- wet impregnation,
- incipient wetness, and
- impregnation using dispersed nanoparticles.

Other preparation procedures can be developed and applied at the request of clients.

Pretreatment of catalyst powders

If required, the catalyst powders can be grounded and sieved according to the specifications of the customer.
With respect to the investigation of catalysts in fixed bed reactors, also procedures for pelletizing, crushing and separation of different size fractions by sieving are available.

Deposition of catalysts by surface coating

For deposition, the catalyst powders are suspended in appropriate solvent/binder systems. The resulting suspensions are then filled into the channels of monoliths or structured substrates.
After a final drying and calcination step, the catalyst remains as a thin layer (10-30 µm) on the surface of the microchannels.
For catalyst screening or small reactor prototypes, the filling step is carried out by hand. For larger quantities and production purposes, a unique screen printing technology is available.

Catalyst testing

Besides in-house development of catalytic formulations, we offer also the testing of catalysts as powders in fixed bed reactors or as thin layers on structured substrates made of steel, aluminum or other materials.
For test purposes small chip-type reactors are applied. Such reactors can be loaded with a catalyst amount of 15-30 mg and higher.
For catalyst testing, twelve test rigs are available which can be operated 24/7. All rigs are equipped with online analysis instruments such as GC, GC-MS and online MS.
The rigs can be prepared to operate reactors at temperatures up to 1000 °C and pressures up to 100 bar. Adaptations towards higher temperatures and pressures or other requirements are feasible and will be carried out according to the specifications defined by our customer.
Catalyst tests can be performed to investigate the catalyst activity and selectivity at various conditions, e.g., feed composition, temperature, pressure, and WHSV. Long-term tests (typically 1000 h, longer upon request) are within the range of services offered.

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Micro reactor hydrogen production from ethylene glycol reforming using Rh catalysts supported on CeO_2 and La_2O_3 promoted alpha-Al_2O_3
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2 *Screen printing machine used for depositing a catalyst layer onto the reaction plates.*

3 *Various microstructured reaction plates coated with different catalysts.*