Overview on the Department of Industrial Chemistry I
University of Oldenburg
Prof. Dr. Jürgen Gmehling

The Chair of Industrial Chemistry is part of the Chemistry Department. Apart from different special courses the main fields of teaching are: Introduction to Chemical Engineering, Chemical Reaction Engineering, Unit Operations and Chemical Processes. The main research activities are directed towards the synthesis and design of thermal separation processes and heterogeneous catalysis. This includes:

- development of reliable thermodynamic models (fl-models, equations of state, group contribution methods) for the prediction of phase equilibria, excess properties and pure component properties.
- development of computerized devices for the determination of physical properties.
- measurement of phase equilibria, heats of mixing, pure component properties and reaction rates.
- development of software tools for the synthesis and design of separation processes and development of new computerized data bases.
- experimental investigations involving various unit operations (reactive distillation, adsorption, membrane processes, separation of enantiomers...) and application of thermodynamic models to process development, environmental protection, biotechnology and labor safety.
- heterogeneous catalysis using ion exchange resins

Many of the experimental facilities are operated by the associated institute LTP GmbH (Laboratory for Thermophysical Properties).

In addition there is a close cooperation with DDBST GmbH, Oldenburg, a company which engages in the update of thermodynamic data bases (DDB) and the development of software packages (DDBSP).

One of the long-term activities of the group deals with the development or further development of group contribution methods for the description of the real behavior of pure components and mixtures. Well known models like mod. UNIFAC, PSRK and LIFAC originate from this group and are constantly improved. These models are used for process simulation by thousands of engineers worldwide.

The Department of Industrial Chemistry offers a variety of different courses for students having finished the intermediate tests after the second year of study as well as special continued education courses for external participants (in collaboration with GVT, DEHEMA, Aspen Tech, chemical industry).

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Differential Recycle Reactors mounted with Zeolite-covered Structured Packing
Prof. Dr. Axel Brehm

Introduction
To improve the hydrodynamic aspects (heat and mass transfer, pressure drop and uniformity of distribution) Sulzer Chemtech Ltd developed open crossflow channel catalysts and catalyst supports based on the well known structured packing concept <1>. The preparation of thin film molecular sieves (MFI-types) on various supports is described (Jansen et al. <2>). In our lab ZSM-5 cover has been produced by the in situ crystallization on structured packings as supports <3>. Here the preparation of ZSM-5 zeolite was based on the alkaline-free synthesis (Müller and Unger <4>) using wire supports (e.g. Sulzer-packings) included in the hydrogel.

Characterization of ZSM-zeolite film
- X-ray diffraction was used to check the zeolite type.
- Micrographs and scanning electron micrographs (SEM) showed several aspects of the crystallization, especially the habit, size, orientation and degree of coverage.
- Thermic stability was shown via repeated shock-cooling from 773 K to 273 K. This operation did not result in a significant loss of zeolite material and facilitated the calcination of the zeolite films.
- Mechanical scratch techniques demonstrated the stability of the crystal on the substrate (figure 1).
- Figure 2 shows the back of the zeolite film. The sample was prepared by dissolving the metal substrate with HCI.
- EDX-spectroscopy was used to determine the platinum- and palladium-dispersion (as the catalytic active metals).

In the course of the present work the activity of the catalyst was determined with hydrogenation and oxidation reactions. Reactions of interest were:

- the catalytic removal of dissolved oxygen from water
- the hydrogenation of 1-tetradecene and toluene.
- The reduction of Oxygen dissolved in Water served as a model reaction. With the aid of a fluidized bed reactor the reaction kinetic is limited by external mass transfer resistance even if the Palladium loading is smaller 0.6 % <5>.
- The catalytic activity of the structured packing is limited by external mass transfer resistance even if the Palladium loading is smaller than 2.5 %. Compared to the aid of a fluidized bed reactor, the Palladium loading can be increased by a factor of 4 without diffusional limitation in the external film.

References
2. Z. Phys. Chem. A 196, 241, 1951