

Preparation of ZSM-5 Zeolite Film on Metal Support

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To lower the permanent pressure drop across a fixed bed, the catalytic particles may be shaped to have increased void volume. To improve the hydrodynamic aspects (heat and mass transfer, pressure drop and uniformity of distribution of concentration, temperature and velocity) the *Sulzer Chemtech Ltd.* (Winterthur, Switzerland) developed open crossflow channel catalysts and catalyst supports based on the well known structured packing <1>. The preparation of thin films of molecular sieves (MFI-types) on various supports (especially metallic substrates) is described by Jansen, Nugroho and van Bekkum <2>, Calis et al. <3> prepared such films on wire (stainless steel) gauze. In our lab ZSM-5 films have been produced by the *in situ* crystallization on structured packings as supports <4>.

Experimental

The hydrothermal synthesis of ZSM-5 zeolite films (in this work) is based on the preliminary studies on the alkaline-free synthesis of large crystals of ZSM-5 by Müller and Unger <5>. During the *in situ* synthesis the wire supports (for example *Sulzer* structured packings) were added. The autoclave was placed in an oven ($T = 453\text{ K}$) under hydrothermal pressure for a period of 90 hours at least. After the crystallization the degree of coverage (increase in sample weight is caused the zeolite film on the supports) was determined after intensive cleaning with a high-pressure water jet (flow: $300\text{ dm}^3/\text{h}$, nozzle diameter: 4 mm, distance between nozzle and samples: 2 cm) and defined drying conditions.

Micrographs and scanning electron micrographs (SEM) give information about the crystallization, especially the habit, the size, the orientation and the degree of coverage. Figure 1 and 2 clearly show a support covered with more than 90 % of a continuous crystal film.

The stability of the crystal on the support material was tested by a mechanical scratch with a sharp spatula. The chemical stability against formic acid ($\text{pH} = 1.5$) was proved during a period of 5 as well as 48 hours.

Results

The preparation of ZSM-5 zeolite film has been studied on various supports. In this paper we present the results of the use of wire (stainless steel) gauze. Other supports such as copper and different kinds of glasses were used. These results will be published in one of the next papers.

Using wire gauze the following parameters (apart from temperature, reaction time, ...) were varied

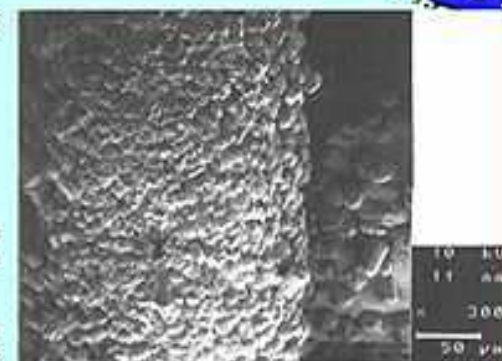
- the type of stainless steel (5 typical materials of *Sulzer* structured packings),
- the form of the support (for example *Sulzer* structured packings),
- the surface structure, influence of corrosive action by HCl.

ad a) All analysis, especially the micrographs (SEM) and the analysis by weighting, show an excellent regular zeolite film with as many crystal faces as possible exposed. The crystals show a minimum intergrowth. There is no difference between the 5 types of stainless steel.

ad b) Using *Sulzer* structured packings the regularity of the zeolite film was analyzed as a function of the packing position. Figure 1 shows the micrographs (SEM) for 4 typical positions (inside - center, bottom, periphery - inner side and outside).

ad c) Figure 2 clearly shows pronounced intergrowths of the crystals in the zeolite film. A corrosive action by HCl can be very promising with regard to systems with an insufficient wettability and special adsorption processes.

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