Visit to TU Delft for Joint Research

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I visited Delft University of Technology (TU Delft) in the Netherlands on 20-26 February 2003 with a Ph. D. student in order to start a joint research. The laboratory in TU Delft I visited this time is the place at which I had studied as a post-doc fellow for one year in 1998-1999.

Prof. Moulijn, Prof. Kapteijn, and Dr. Zhu at the Laboratory of Reactor & Catalyst Engineering and Dr. Gora at the Laboratory of Organic Chemistry & Catalysis willingly supported us to carry out experiments. We discussed experimental plans for the zeolite coating on catalyst particles and reaction tests. After I left there, the Ph. D. student, Mr. Park, who is now a post-doc fellow in my group, had stayed there for 3 weeks to advance our research project. This visit was too short to complete our project, but a valuable opportunity for us to start collaboration. I really appreciate the COE grant-in-aid to give us a good chance for the joint research.

Prof. J. A. Moulijn and me (24. 2. 2003)

Project Summary

The project is “zeolite coating on catalyst particles for the shape-selective reactions”. The dimensions of zeolite pores are uniform and close to the molecular dimensions of small hydrocarbons and permanent gases. Therefore, highly selective separations can be expected in the membrane separation based on the molecular sieving and the adsorption-diffusion

properties of zeolites. New technologies using zeolite membrane reactors have become of interest with the development of preparation method of zeolite membranes. The basic concept of the membrane reactor is a coupling of a catalyst with a membrane that gives (1) selective addition of reactants to the reaction zone and (2) selective removal of products from the reaction zone. Although the preparation of zeolite membranes on porous supports has been extensively studied so far, the number of reports regarding the membrane reactors combined with zeolite membranes is still small.

In this study, we developed catalyst particles coated with a permselective membrane. The reaction models for the potential applications using this type of catalyst particles are shown in Fig. 1. In the first example, if diffusivity of reactant A is much larger than B, reactant A selectively diffuses to a catalyst particle through a membrane. The undesired reaction B to S or the adsorption of B in the case of poison on the catalyst can be prevented. In the second example, the reaction has a limited yield or selectivity controlled by the reaction equilibrium according to thermodynamics. The selective removal of desired product R from the catalyst particle gives enhancement of selectivity when diffusivity of product R is much greater than S. The catalyst with a permselective membrane has a larger membrane area per unit reactor volume compared to conventional membrane reactors.

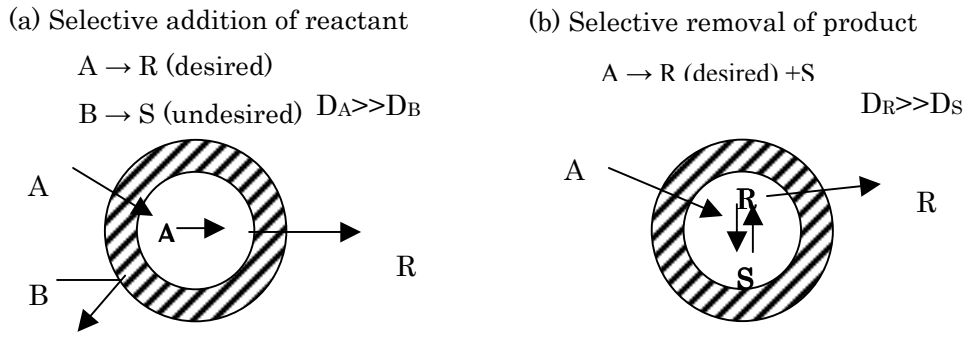

Fig. 1 Catalyst particle coated with permselective membrane.