Research and internship life at Delft in Netherlands

Netherlands!!! The country of Windmill, Tulip, Canal and etc!!! I stayed in delft from 20 February to 18 March by the COE internship fellow. The Research institute was DelfChemTech in Delft University. In this internship period, I researched on the zeolite coating on porous catalyst particles with the member of laboratory for applied organic chemistry and catalysis.

The introduction of our research and the brief were as follows:

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. Recently, titania plate-supported platinum catalyst covered with a silicalite layer has been developed by van der Pauil et al. who used the titania/Pt/silicalite composite for hydrogenation of a linear and a branched alkene.

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. So far, a silica-alumina catalyst covered with a silicalite membrane was used for disproportionation of toluene to produce xylene isomers. The zeolite-coated catalyst showed that high para-selectivity because of selective removal of *p*-xylence from the catalyst.

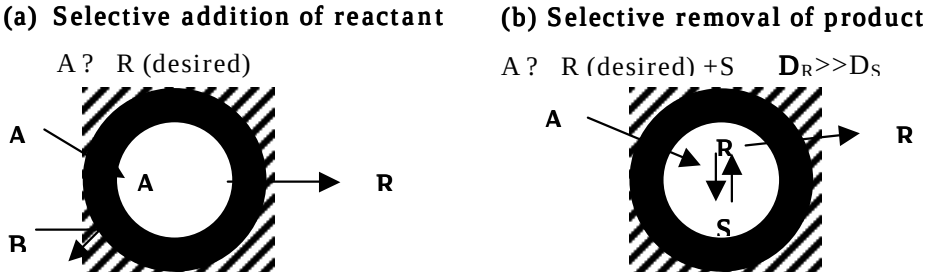

Fig. 1 Catalyst particle coated with permselective membrane.

During the COE internship, we carried out zeolites coating on various porous particles using hydrothermal synthesis. we carried out zeolites coating on various porous particles (silica, Ni-silica, alumina, and Ptalumina) using hydrothermal synthesis. The tetraethyl orthosilicate (silica source), tetrapropylammoniumhydroxide and bromide, and deionized water were used for the zeolite synthesis. Fig. 2 shows the surface of silica after hydrothermal synthesis. The whole part of the catalyst surface was uniformly coated with silicalite crystals. The coverage of the surface depended on the composition of the precursor solutions.

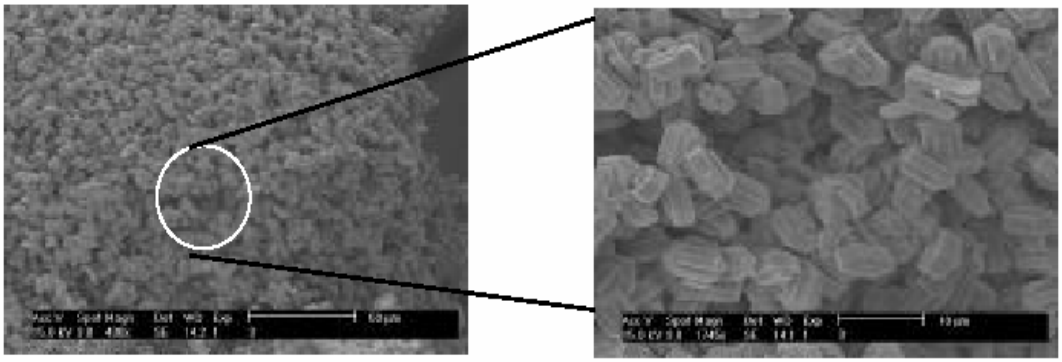

Fig. 2 SEM images of zeolite-coated silica particle

Beside the research, I made friends with many foreign student and researchers. I had three roommates, South African, Bolivian and Italian. Of course, dialogue was English. I think the individual meeting of these various countries people is very rare thing. We all were busy but had good time to know about each countries culture, thinking and their researches even very short time. Last night in Delft, my roommates took a party for me. Except research, making friends with worldwide researchers was very interesting and unforgettable experience to me. I thank COE for the COE internship and recommend strongly the worldwide relationship with researchers.

with Prof.dr. J.A. Moulijn