Coupling of separation and reaction in zeolite membrane reactor for hydroisomerization of hydrocarbons

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A silicalite-1 membrane reactor concept for the hydroisomerization of *n*-hexane was applied experimentally. In this application a feed mixture is passed over the membrane whereby the linear molecules are separated and fed to the catalyst bed of the zeolite membrane reactor. Platinum oxide chlorinated alumina was used as a catalyst. The silicalite-1 membrane was synthesised on a tubular support of TiO_2/SS having a surface area ~30 cm^2. The membrane, uniform along its length, was 15 μm thick (Fig.1.) and was fully characterised using C_4, C_6 alkane mixtures before using it as a membrane reactor for hydroisomerization experiments. The membrane is selective in separation of linear from branched hydrocarbons. The selectivities of 50:50 *n*-C4/*i*-C4 and *n*-C6/3 MP are 13.8 and 28 respectively at 120^{O}C. The membrane reactor performance on C_6 hydroisomerization has been studied as a function of temperature and of sweep gas flow rate. The composition of the feed, permeate (experiment with no reaction) and product stream (experiment with reaction) as well as the product selectivities are given in the Table as an example of obtained results.

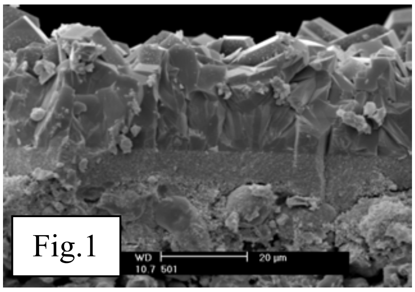

Fig.1

Component i	Distribution (%)			S_i (%)
	Feed	Permeate	Reaction product	
n-C_6	80	98.99	26.42	-
3-MP	-	-	16.02	22.08
2-MP	20	1.01	30.59	40.76
2,3-DMB	-	-	10.58	14.58
2,2-DMB	-	-	15.79	21.76
Cracked (<C_6)	-	-	0.60	0.82

The conversion of the separated *n*-C_6 from 2MP (selectivity 24) amounts 72%, with 36% selectivity towards di-branched isomers (at 393 K, H_2 sweep 50 ml/min). The results indicate that platinum oxide-chlorinated alumina/silicalite-1 membrane reactor has a potential in upgrading octane values. However, a further improvement in the membrane quality is needed in order to separate low quantity of linear components from feed (containing less than 10% of *n*-C_6) with high efficiency (*n*-C_6 permeation fraction ≈100%). A selective, high flux membrane is essential. In order to meet above requirements we successfully developed thin *b*-oriented silicalite-1 membrane (Fig.2). Hydroisomerization utilizing this membrane in a membrane reactor is in progress.

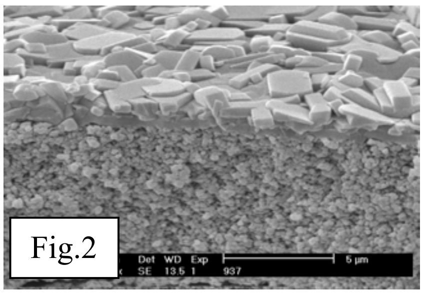

Fig.2