Silicalite-1 Membrane Encapsulated Rh/Activated-Carbon Catalyst for Selectively Hydroformylation of 1-hexene to Normal Aldehyde

非常勤研究員　Chunlin Li

The concept of capsule catalyst with a core catalyst/zeolite membrane structure was used for the selective hydroformylation of 1-hexene to normal Aldehyde. A tailor-made silicalite-1 membrane encapsulated catalyst has been synthesized directly over the activated-carbon supported Rh catalyst pellet with a size of 0.45 to 0.90 mm to form a core–shell structure by a hydrothermal synthesis method (Figure 1). In the hydroformylation reaction of 1-hexene, the capsule catalysts present more excellent catalytic performance for both the conversion of 1-hexene and the normal to iso ratio of the aldehyde products compared to the Rh/C core catalyst.

Thought repeating the process of hydrothermal synthesis treatment could increase the thickness of the silicalite-1 membrane, the membrane became compact and uniform, resulting in promoting the selectivity to normal aldehyde but the conversion of 1-hexene decreases significantly. The modification by tetraethyl orthosilicate (TEOS) can reduce the zeolite crystalline gaps in the thin silicalite-1 membrane of the capsule catalyst, consequently improving the selectivity to normal aldehyde, and at the same time avoid decreasing the conversion compared to the unmodified capsule catalyst (Figure 2).

This capsule catalyst is efficient to produce and simultaneously separate the aimed product from the multiple products in one-step with the spatial confined structure of the catalytic-inert silicalite-1 membrane.

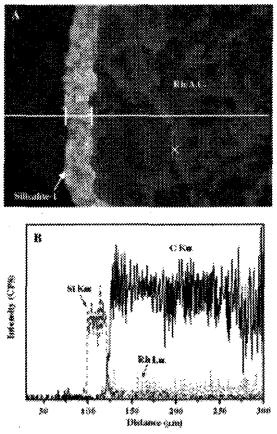

Figure 1 Cross-sectional SEM image and EDX analysis of the capsule catalyst.

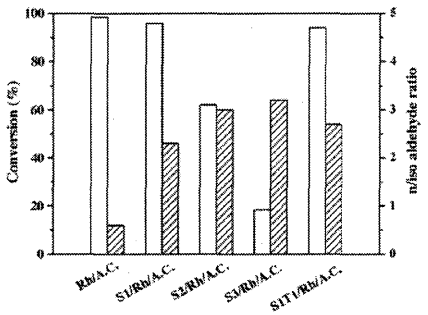

Figure 2 the Conversion of 1-hexene (blank column) and molar ratio of normal to iso aldehyde in the products (shadow column) of the catalysts. Sx/Rh/A.C.: x present for the repeat times of hydrothermal synthesis and S1T1/Ru/A.C. for the modified sample by TEOS

Publication papers:

"Silicalite-1 membrane encapsulated Rh/activated-carbon catalyst for hydroformylation of 1-hexene with high selectivity to normal aldehyde" ***Journal of Membrane Science***, in press