Electronic Supplementary Information (ESI) for New Journal of Chemistry

Synthesis and catalytic performance of hierarchically structured beta zeolites by dual-functional templating approach

Kai Zhang, Zewei Liu, Min Wang, Xin Yan, Chao Li* and Hongxia Xi*

School of Chemistry and Chemical Engineering, South China University of Technology, 381 Wushan Road, Tianhe District, Guangzhou, China, 510641

* Corresponding authors:

Chao Li

Email: chemlic@scut.edu.cn; Tel.: +86 20 87113501; Fax: +86 20 87113735

Hongxia Xi

Email: cehxxi@scut.edu.cn; Tel.: +86 20 87113501; Fax: +86 20 87113735
Experimental section

Isopropylamine temperature programmed desorption (IPA-TPD) technique was used to determine the concentration of Brønsted acid sites of catalysts.\textsuperscript{1} The IPA-TPD was carried out on a Q500 TA instrument by following a procedure reported in literature.\textsuperscript{2,3} Typically, 15.0 mg of catalyst was dehydrated by ramping up the temperature to 823 K with a rate of 10 K min\textsuperscript{-1} under helium atmosphere at a flow rate of 100 mL min\textsuperscript{-1}. After cooling to 393 K, IPA vapor carried with helium flow was introduced and adsorbed on the sample for 10 min. After the sample was saturated with IPA, the gas flow was switched back to helium. The desorption procedure was carried out by increasing the temperature to 937 K at a ramping rate of 10 K min\textsuperscript{-1}. The quantity of Brønsted acid sites is calculated based on the total weight loss between 575 K and 650 K.\textsuperscript{1} 2,4,6-collidine (CLD, 99%, Alfa-Aesar) TPD was used to determine the acid sites on the external surface of the zeolites since CLD is too bulky to diffuse into micropore of MFI.\textsuperscript{4,5} The measurement process of CLD-TPD was similar to that of the IPA-TPD. The IPA-TPD and CLD-TPD measurements data are showing in Table S2.

Supporting Figures and Tables
Fig. S1 Catalytic activities of Conventional Beta zeolite and HBZ-C samples for the conversion of alkylation of benzene with benzyl alcohol.

Table S1 Acid strength distributions of conventional Beta and H-Beta zeolites (from NH$_3$-TPD measurement).

<table>
<thead>
<tr>
<th>Samples</th>
<th>Weak acid (mmol g$^{-1}$)</th>
<th>Medium-strong acid (mmol g$^{-1}$)</th>
<th>Total acid (mmol g$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>conventional Beta</td>
<td>0.61</td>
<td>0.46</td>
<td>1.07</td>
</tr>
<tr>
<td>HBZ</td>
<td>0.59</td>
<td>0.44</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Fig. S2 $^1$H NMR spectra of surfactant C$_{18}$-6-diphe
Table S2. The concentration of Brønsted acid sites of beta zeolite samples.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Brønsted Acid sites concentration (mmol g⁻¹)</th>
<th>( f_{B,ext} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (^a)</td>
<td>External surface (^b)</td>
</tr>
<tr>
<td>conventional Beta</td>
<td>1.02</td>
<td>0.078</td>
</tr>
<tr>
<td>HBZ</td>
<td>1.06</td>
<td>0.532</td>
</tr>
</tbody>
</table>

\(^a\) The number was determined by IPA-TPD measurement.

\(^b\) The number was determined by CLD-TPD measurement.

\(^c\) The fraction of external Brønsted acid sites calculated by (number of Brønsted acid sites from CLD-TPD profile / number of Brønsted acid sites from IPA-TPD profile).

References