Modification of a commercial Pt/H-USY zeolite by Atomic Layer Deposition (ALD) making use of the $\text{AlCH}_3/\text{H}_2\text{O}$ process

1. $\text{OH} + \text{Al} (\text{CH}_3)_3 (g) \rightarrow \text{OH-Al} (\text{CH}_3)_2 + \text{CH}_4 (g)$
2. $\text{OH} + \text{Al} (\text{CH}_3)_3 (g) \rightarrow \text{O-Al} (\text{CH}_3)_2 + 2\text{CH}_4 (g)$

Parent material: CBV712

Hydrocracking experiments using $n$-decane

$W/F$ (s kg$_\text{cat}$ mol$_\text{H}_2\text{O}$)$^{-1}$ | $T$ (K) | $P$ (MPa) | $H_2$/HC
--- | --- | --- | ---
2520 | 403 - 533 | 0.45 | 375

Catalyst dried at 473 K for 6 h prior to ALD

<table>
<thead>
<tr>
<th>TMA pulse (s)</th>
<th># ALD cycli</th>
<th>$\Delta H_p$ (kJ mol$^{-1}$)</th>
<th>$\Delta H_p$ (kJ mol$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>10</td>
<td>72.8 (± 0.3)</td>
<td>102.4 (± 0.5)</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>72.0 (± 0.2)</td>
<td>100.4 (± 0.4)</td>
</tr>
<tr>
<td>120</td>
<td>5</td>
<td>72.8 (± 0.3)</td>
<td>101.1 (± 0.5)</td>
</tr>
<tr>
<td>120</td>
<td>10</td>
<td>72.9 (± 0.2)</td>
<td>101.2 (± 0.5)</td>
</tr>
<tr>
<td>120</td>
<td>30</td>
<td>78.5 (± 0.3)</td>
<td>110.6 (± 0.3)</td>
</tr>
</tbody>
</table>

Formation of new and possibly stronger sites inductively effective of extra-framework Al$_2$O$_3$(s)

Improvement of hydrocracking activity explained through an increase in average acid site strength

CONCLUSIONS

- The single-event methodology has proven to be a useful tool in the assessment of catalytic modifications
- Each ALD parameter has a specific effect on the hydrocracking behavior of the catalyst through changes in micropore volume, Brønsted acid site concentration and average acid site strength
- The creation of new acid sites through ALD opens up the route towards the production of new active materials tailored to the requirements of a target reaction

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