Advanced membrane reactors: first membrane preparations and tests

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Introduction
The research is aimed at CO₂ capture by using a membrane reactor with a porous membrane based on hydrotalcite.

Coating and in-situ impregnation
For coating you need small particles to obtain small pores:

Many solvents and dispersants have been tried:

For in-situ impregnation, with or without promoter K₂CO₃, the synthesis takes place inside the pores:

Membrane transport mechanisms
- Dense membrane
- Molecular sieving
- Dissolution-diffusion
- Affinity based

Results

<table>
<thead>
<tr>
<th>Membrane</th>
<th>CO₂/H₂</th>
<th>CO₂/He</th>
<th>CO₂/N₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coated</td>
<td>0.43</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>In-situ</td>
<td>0.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-situ promoted</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions
- Very small particles of hydrotalcite are produced without aggregates with a size of about 15 nm.
- A hydrotalcite defect-free layer was obtained by coating.
- The results obtained from the 1st experiments show affinity for CO₂ but the selectivity is still far from the target.
- K₂CO₃ promotion increases the selectivity.
- Strong indication for affinity based separation, to be confirmed with mixed gas measurements.
- Support and coating procedures have to be optimized.

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