Supplementary information

TEMPO-functionalized mesoporous silica particles as heterogeneous oxidation catalysts

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^1H-NMR spectra of (3-azidopropyl)trimethoxysilane

Elemental analysis of functionalized material (loading 0.6 mmol/g)

<table>
<thead>
<tr>
<th>Material</th>
<th>w.% (N)</th>
<th>w.% (C)</th>
<th>w.% (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica-azide (0.2 equiv. Az-PTMS, 10 w.-% H_2O)</td>
<td>2.4</td>
<td>2.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Silica-TEMPO</td>
<td>3.0</td>
<td>10.5</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Reaction setup for multi-step catalysis

Post-experiment analysis of material

N$_2$-Physisorption
CHN-analysis

<table>
<thead>
<tr>
<th></th>
<th>w.% (N)</th>
<th>w.% (C)</th>
<th>w.% (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fresh material</td>
<td>3.0</td>
<td>10.5</td>
<td>1.7</td>
</tr>
<tr>
<td>after 5th recycling run</td>
<td>2.7</td>
<td>10.0</td>
<td>1.6</td>
</tr>
</tbody>
</table>

FTIR-spectroscopy

- Fresh material: 1733 cm\(^{-1}\)
- After 5th recycling run: 1733 cm\(^{-1}\)
TEMPO decomposition test with acetic acid

30 mg TEMPO and 0.45 mL acetic acid were stirred in 20 mL acetonitrile with for two days. Acetic acid and acetonitrile were removed under reduced pressure. The residue was analyzed with ESI-MS.

m/z 142.1592: (M+H+) 2,2,6,6-tetramethylpiperidine (calculated: 142.1590)

TEMPO reference:

m/z 179.1282: (M+Na+) TEMPO (calculated 179.1286)