Improved performance of binder-free zeolite Y for low-temperature sorption heat storage

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Pore size distribution of parent zeolite Y and modified samples

Figure S1: Mesopore size distribution of granulated NaY and modified samples from adsorption isotherms

The pore size distributions (PSDs) were calculated from nitrogen adsorption data using an algorithm based on ideas of Barrett, Joyner, and Halenda (BJH) [1]. Pore size distribution of materials has been determined using
the BJH model widely used for this type of samples [2]. Although this model often underestimates pore sizes [3], it is appropriate for comparative purposes.

Minor mesoporosity is observed for acid treated samples, while broad mesopore size distribution of $\text{H}_4\text{EDTA}$ treated sample can be seen.


Structural characterization of modified samples after 20 cycles of adsorption and desorption

Figure S2: SEM images of samples after 20 cycles between temperatures of 140 °C and 40 °C under a water vapour pressure of 1.23 kPa
Table S1: Textural properties of samples after 20 cycles between temperatures of 140 °C and 40 °C under a water vapour pressure of 1.23 kPa

<table>
<thead>
<tr>
<th>Sample</th>
<th>$S_{\text{BET}}$</th>
<th>$V_{\text{tot}}$</th>
<th>$V_{\text{mic}}$</th>
<th>$V_{\text{me}}$</th>
<th>$S_{\text{ext}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(m$^2$g$^{-1}$)</td>
<td>(cm$^3$g$^{-1}$)</td>
<td>(cm$^3$g$^{-1}$)</td>
<td>(cm$^3$g$^{-1}$)</td>
<td>(m$^2$g$^{-1}$)</td>
</tr>
<tr>
<td>Parent NaY</td>
<td>656</td>
<td>0.331</td>
<td>0.300</td>
<td>0.032</td>
<td>40</td>
</tr>
<tr>
<td>0025HCl</td>
<td>625</td>
<td>0.318</td>
<td>0.282</td>
<td>0.026</td>
<td>44</td>
</tr>
<tr>
<td>005EDTA</td>
<td>676</td>
<td>0.355</td>
<td>0.282</td>
<td>0.071</td>
<td>94</td>
</tr>
<tr>
<td>MgNaY-0025HCl</td>
<td>609</td>
<td>0.313</td>
<td>0.273</td>
<td>0.040</td>
<td>49</td>
</tr>
</tbody>
</table>

$V_{\text{tot}}$ at $p/p_0=0.95$, $S_{\text{ext}}$ and $V_{\text{mic}}$ determined using the t-plot method, $V_{\text{me}}=V_{\text{tot}}-V_{\text{mic}}$

Figure S3: PSD of samples after 20 cycles between temperatures of 140 °C and 40 °C under a water vapour pressure of 1.23 kPa
Figure S4: Water isotherms of samples after 20 cycles gravimetrically measured at 25°C. Isotherms exhibit Type I isotherms typical for zeolites as highly hydrophilic materials.
Basic characterization of NaMSX

Figure S5: XRD pattern of NaMSX sample shows highly crystalline sample.

![XRD pattern of NaMSX sample](image)

Figure S6: SEM image of NaMSX

It shows round zeolite X crystals covered with binder (sticks).

Table S2: Textural properties of NaMSX sample

<table>
<thead>
<tr>
<th>Sample</th>
<th>S_BET (m² g⁻¹)</th>
<th>Vtot (cm³ g⁻¹)</th>
<th>Vmic (cm³ g⁻¹)</th>
<th>Vme (cm³ g⁻¹)</th>
<th>S_wet (m² g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaMSX</td>
<td>557</td>
<td>0.319</td>
<td>0.249</td>
<td>0.070</td>
<td>46</td>
</tr>
</tbody>
</table>


\[
V_{\text{tot}} \text{ at } p/p_0 = 0.95, \quad S_{\text{wet}} \text{ and } V_{\text{mic}} \text{ determined using the t-plot method, } \\
V_{\text{me}} = V_{\text{tot}} - V_{\text{mic}}
\]
Fig S7: Water adsorption isotherm of NaMSX sample measured at 25 °C.