ELECTRONIC SUPPLEMENTARY DATA

Tuneable Ultra High Surface Area Specific Surface Area Mg/Al-CO$_3$ Layered Double Hydroxides

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Surface area theoretical prediction

A simply approach to estimate the theoretical specific surface area is shown as below: A simple supercell was constructed including 4 x 4 x 1 unit cells. The formula of this LDH supercell was estimated from TGA results as $\text{Mg}_{12}\text{Al}_4(\text{OH})_{32}(\text{CO}_3)_2\cdot5.6(\text{H}_2\text{O})\cdot1.92(\text{CH}_3\text{COCH}_3)$. The cell parameters $a$ and $c$ are 3.05 and 7.78 Å, respectively (obtained from XRD).

The volume of a supercell ($V_{sc}$) is:

$$V_{sc} = \frac{\sqrt{3}}{2} (4a)^2 \times c$$

The density of the LDH ($\rho$) can be:

$$\rho = \frac{M}{N_A \times V_{sc}}$$

where, $M$ is the molecular mass of $\text{Mg}_{12}\text{Al}_4(\text{OH})_{32}(\text{CO}_3)_2\cdot5.6(\text{H}_2\text{O})\cdot1.92(\text{CH}_3\text{COCH}_3)$, $N_A$ is Avogadro’s number ($6.022\times10^{23}$).

To simplify, assume the LDH particles are cylinder shape, the total surface area ($S_{\text{particle}}$) of a LDH particle can be obtained from its particle size (diameter $d$) and thickness ($t$).

$$S_{\text{particle}} = 2 \times \pi \times \left(\frac{d}{2}\right)^2 + \pi \times d \times t$$

The volume of a LDH particle ($V_{\text{particle}}$) is:

$$V = \pi \times \left(\frac{d}{2}\right)^2 \times t$$

The specific surface area (SSA) is:

$$SSA = \frac{S_{\text{particle}}}{\rho \times V_{\text{particle}}}$$
Fig. S1 XRD pattern of Mg$_3$Al-CO$_3$ LDH (prepared at pH = 10) with different particle sizes (A) 200 nm, (B) 50 nm and (C) 20 nm. (*) are the Bragg diffraction from the sample holder.
**Figure S2.** Specific surface area and LDH layers of 3 g AMO-LDH flowers dispersed in acetone (300 mL) for different durations.
Figure S3. Specific surface area and LDH layers of 3 g AMO-LDH flowers washed with acetone (300 mL) for different dispersion cycles.
Figure S4. Specific surface area and LDH layers of 3 g AMO-LDH plates treated with different volumes of acetone.
Figure S5. Specific surface area and LDH layers of 3 g AMO-LDH plates washed with acetone (300 mL) for different dispersion cycles.

Table S1. Specific surface area of AMO-LDH plates dried in different methods

<table>
<thead>
<tr>
<th>Drying method</th>
<th>Specific surface area (m²/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oven</td>
<td>141</td>
</tr>
<tr>
<td>Vacuum</td>
<td>180</td>
</tr>
<tr>
<td>Spray dryer</td>
<td>248</td>
</tr>
</tbody>
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Figure S6. XRD pattern of Mg$_3$Al-CO$_3$ LDH (prepared a pH $= 10$) (A) without AMOST treatment, (B) with AMOST treatment. (*) are the Bragg diffraction from the sample holder.