Mechanically and chemically robust ZIF-8 monoliths with high volumetric adsorption capacity

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S1 Transmission Electron Microscopy (TEM)

Fig. S1 TEM image of ZIF-8.
**S2 X-ray Powder Diffraction**

**Fig. S2** X-ray diffraction patterns of ZIF-8 monoliths before grinding (a-c) and after grinding (d-f) compared with the simulated pattern (g). Note that the position of the peaks and relative intensities from monolithic and grinded samples are similar.
**S3 N₂ adsorption isotherm**

**Fig. S3** N₂ Adsorption isotherms at 77 K for ZIF-8LT, red squares, ZIF-8HT, green triangles, ZIF-8LT-HT, black diamonds, and ZIF-8ER, purple circles, in a semi-logarithmic (*left*) and linear (*right*) scale.

**Table S1** Gravimetric and volumetric BET areas ($S_{BET}$), micropore volume ($W_0$), meso- and macropore volume ($V_2$), total pore volume ($V_{Tot}$) and bulk density ($\rho_b$) for the different ZIF-8 structures.

<table>
<thead>
<tr>
<th>Material</th>
<th>$S_{BET}$</th>
<th>$W_0$</th>
<th>$V_2$</th>
<th>$V_{Tot}$</th>
<th>$\rho_b$</th>
<th>$S_{BET}$(vol)</th>
<th>$W_0$(vol)</th>
<th>$V_2$(vol)</th>
<th>$V_{Tot}$(vol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZIF-8HT</td>
<td>1387</td>
<td>0.552</td>
<td>0.277</td>
<td>0.829</td>
<td>0.35d</td>
<td>403</td>
<td>0.193</td>
<td>0.097</td>
<td>0.29</td>
</tr>
<tr>
<td>ZIF-8LT</td>
<td>1359</td>
<td>0.532</td>
<td>0.011</td>
<td>0.543</td>
<td>1.14</td>
<td>1594</td>
<td>0.606</td>
<td>0.013</td>
<td>0.619</td>
</tr>
<tr>
<td>ZIF-8LT-HT</td>
<td>1423</td>
<td>0.543</td>
<td>0.003</td>
<td>0.546</td>
<td>1.05</td>
<td>1494</td>
<td>0.570</td>
<td>0.003</td>
<td>0.573</td>
</tr>
<tr>
<td>ZIF-8ER</td>
<td>1395</td>
<td>0.535</td>
<td>0.010</td>
<td>0.545</td>
<td>1.19</td>
<td>1660</td>
<td>0.637</td>
<td>0.012</td>
<td>0.648</td>
</tr>
</tbody>
</table>
**S4 Mercury porosimetry**

Based on Archimedes’ method, it allows measuring the total volume including the volume of the skeleton and the porosity of the MOF samples since mercury at ambient pressure does not penetrate any micro-, meso- and macroporosity. Bulk densities of the samples can be calculated by dividing the mass of the sample by the total volume. Figure S20 shows the pore size distribution of the macro- and mesoporosity of the samples.

![Pore size distribution of the macro- and mesoporosity of ZIF-8LT and ZIF-8ER](image)

**Fig. S4** Pore size distribution of the macro- and mesoporosity of ZIF-8LT and ZIF-8ER
S5 Nanoindentation

**ZIF-8LT:**
45 indents of 1000 nm were performed (10 below on graph)

**Fig. S5** Load-displacement data for 20 indents on ZIF-8LT, showing excellent consistency.

**Fig. S6** 2 Rows of 1000 nm indents made on a sample (5 x 5 mm) of ZIF-8LT.
**Fig. S7** Elastic moduli of ZIF-8LT as a function of indentation depth, each error bar arises from the standard deviation of 45 indents.

**Fig. S8** Hardness of ZIF-8LT as a function of indentation depth, each error bar arises from the standard deviation of 45 indents.
ZIF-8LT-HT:

**Fig. S9** Load-displacement data for 20 indents on ZIF-8LT-HT.

**Fig. S10** 2 Rows of 1000 nm indents made on a sample (5 x 5 mm) of ZIF-8LT-HT.
**Fig. S11** Elastic moduli of ZIF-8LT-HT as a function of indentation depth, each error bar arises from the standard deviation of 45 indents.

**Fig. S12** Hardness of ZIF-8LT-HT as a function of indentation depth, each error bar arises from the standard deviation of 45 indents.
ZIF-8ER

A) 15 indents of 1000 nm depth performed on one monolith
B) 6 indents of 3000 nm performed on a second monolith.

A) 3000nm data set:

![Graph](image1)

**Fig. S13** Load-displacement data for 6 indents on ZIF-8ER.

![Graph](image2)

**Fig. S14** Elastic moduli of ZIF-8ER as a function of indentation depth, each error bar arises from the standard deviation of 6 indents.
**Fig. S15** Hardness of ZIF-8ER as a function of indentation depth, each error bar arises from the standard deviation of 6 indents.

**Fig. S16** 1000 nm indent made on a sample (5 x 5 mm) of ZIF-8ER.
B) 1000 nm data set:

Fig. S17 Load-displacement data for 15 indents on ZIF-8ER.

Fig. S18 Hardness of ZIF-8ER as a function of indentation depth, each error bar arises from the standard deviation of 15 indents.
**Fig. S19** Elastic moduli of ZIF-8ER as a function of indentation depth, each error bar arises from the standard deviation of 15 indents.

**Fig. S20** 2 Rows of 1000 nm indents made on a sample (5 x 5 mm) of ZIF-8ER.
Fig. S21 PXRD patterns of ZIF-8-ER immersed in boiling water alongside a simulated pattern of ZIF-8.