Supporting Information


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1. Materials:

\( p \)-Xylene and \( n \)-octane were purchased from Junsei chemical company. Ethanol, hydrofluoric acid, hydrochloric acid, sulfuric acid and sodium nitrate were obtained from OCI Company. Benzothiophene (BT), quinoline (QUI), indole (IND) and graphite powder were obtained from Sigma-Aldrich. Chromium (III) nitrate nonahydrate were purchased from Samchun pure chemical company. Terephthalic acid (TPA), hydrogen peroxide and potassium permanganate were collected from Samsung petrochemical company, Junsei chemical and Daejung chemicals, respectively. All the chemicals required in this study were used without further purification.

2. MOF synthesis:

MIL-101 was prepared by a hydrothermal synthesis process. Chromium (III) nitrate, TPA, HF and H\(_2\)O were mixed with a molar ratio of 1:1.5:1:280 in a Teflon beaker, and heated for 10 h at 220 °C under autogeneous pressure. After synthesis, the MOF was purifed in three steps. In the first step, 1 g MOF was added to 300 ml water and stirred for 5 h at 70 °C. Then the MOF was filtered and dried for the second step. In the second step, the dried MOF was added to 250 ml ethanol. Then stirred at 60 °C for 3h and then filtered and dried by the similar way as mentioned above. In the third step, the MOF from the second step was added to 150 ml 30 mM NH\(_4\)F solution and stirred for 10 h at 60 °C. After that, it was filtered and washed at least five
times with hot water and then dried in a drying oven. GO/MIL-101 composites were also purified by similar process.

3. Langmuir isotherm:

The maximum adsorption capacity was calculated using the Langmuir adsorption isotherm \(^3\), \(^4\) after adsorption for sufficient time of 12 h. The adsorption isotherms in various conditions have been plotted to follow the Langmuir equation. \(^3\), \(^4\)

\[
\frac{C_e}{q_e} = \frac{C_e}{Q_o} + \frac{1}{Q_o b}
\]

Where,

- \(C_e\): equilibrium concentration of adsorbate (mg/L)
- \(q_e\): amount adsorbed at equilibrium (mg/g)
- \(Q_o\): Langmuir constant (maximum adsorption capacity) (mg/g)
- \(b\): Langmuir constant (L/mg)

The maximum adsorption capacity \(Q_o\), therefore, can be obtained from the reciprocal of the slope of a plot of \(C_e/q_e\) against \(C_e\).

References

**Table S1.** The pseudo-second-order kinetic constants ($k_2$) for various adsorbents with different adsorbates.

<table>
<thead>
<tr>
<th>Adsorbent</th>
<th>Pseudo-second-order kinetics constants $k_2$ (g/(mg-min))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QUI</td>
</tr>
<tr>
<td>MIL-101</td>
<td>$1.18 \times 10^{-1}$</td>
</tr>
<tr>
<td>0.10% GO/MIL-101</td>
<td>$1.39 \times 10^{-2}$</td>
</tr>
<tr>
<td>0.25% GO/MIL-101</td>
<td>$0.99 \times 10^{-2}$</td>
</tr>
<tr>
<td>0.50% GO/MIL-101</td>
<td>$1.06 \times 10^{-2}$</td>
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</tbody>
</table>
Figure S1. FT-IR spectra of MIL-101 and GO/ MIL-101s.
**Figure S2.** SEM images for the virgin and GO composed MIL-101: (a) MIL-101, (b) 0.25% GO/MIL-101 (c) 1.0% GO/MIL-101 and (d) 10% GO/MIL-101.
Figure S3. TGA profiles for the virgin and GO composed MIL-101.
Figure S4. $N_2$ adsorption isotherms of the MIL-101 and GO/MIL-101s used in this study.
Figure S5. Effect of contact time on the adsorption of (a) BT; (b) QUI and (c) IND over MIL-101 and GO/MIL-101s having different amount of GO. The hydrocarbon solution initially contains 600 ppm BT, 300 ppm QUI and 300 ppm IND.
Figure S6. (a) Effect of GO amount composed with MIL-101 on the adsorption of BT with different time and (b) Adsorption isotherm for BT over MIL-101 and 0.25%GO/MIL-101. In both cases data were taken in a combined system.
Figure S7. Langmuir plots for (a) BT; (b) QUI and (c) IND adsorption over MIL-101 and 0.25% GO/ MIL-101.