SUPPORTING INFORMATION

MXene Ti$_3$C$_2$: an Effective 2D Light-to-Heat Conversion Material

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Optical path length calibration

As shown in the schematic above, the diameter of the laser beam spot (D) is 0.86 mm and the diameter of the droplet is 2.6 mm. The laser beam forms a cylinder space along its optical path inside the droplet. In the center of this cylinder, the optical path length (L₁) equals to the diameter of the droplet, which is 2.6 mm. Apart from the center of the spot, the optical path length is slightly shorter than that in the center due to the curvature of the droplet surface. The shortest optical length is located at the edge of the laser beam cylinder (L₂), which is calculated to be 2.5 mm according to the equation list as follows:

\[ L_2 = 2b = 2\sqrt{r^2 - a^2} \]

Where \( r \) is radius of the droplet, which is 1.3 mm, and \( a \) is the radius of the laser beam cylinder, which is 0.43 mm.

According to this calculation result, only a minor difference (L₁-L₂) in optical length is caused by the curvature of the droplet surface, given also the relatively small spot diameter of the laser beam. This result indicates that it is reasonable to directly use the diameter of the droplet as the optical path length in light adsorption calculation give to the minor influence caused by the droplet surface curvature.
Figure S1. IR image of light-to-heat conversion efficiency test setup with laser light on

Figure S2. The temperature profile of the aqueous droplets with different MXene mass concentrations under 785 laser irradiation
**Figure S3.** The temperature profile of the aqueous droplets with different MXene mass concentrations under 473 laser irradiation

**Figure S4.** The temperature profile of the aqueous droplets with MXene and CNT concentration at 0.1mg/ml under wide spectrum of visible light and Vis+NIR laser irradiation
**Figure S5** SEM image of MXene film, showing a thickness of 3.1\(\mu\)m with 4 mg MXene mass loading.

**Figure S6.** EDX spectrum of the as prepared PDMS modified MXene thin membrane. Si peak shows a rather low signal strength, indicating small amount of PDMS on the membrane surface.
Figure S7. Light to water evaporation efficiency of photothermal membrane with different Ti$_3$C$_2$ MXene mass loading.

**Light to water evaporation efficiency (EF) calculation:**

Light to water evaporation efficiency (EF) is calculated based on following equation:

\[
Q_e = \frac{d_m \times H_e}{d_t} = \nu \times H_e
\]

\[
EF = \frac{Q_e}{Q_s}
\]

Where $Q_e$ is energy consumed for water evaporation, $Q_s$ is the incident simulated solar light power (1000 W/m$^2$), $m$ is the mass of evaporated water recorded by the balance, and $H_e$ is the enthalpy of vaporization of water (2266 KJ/kg).

Taking the Ti$_3$C$_2$ MXene photothermal membrane with the polystyrene foam heat barrier as an example, its water evaporation rate curve is shown in the following figure.
Figure S8. Time-dependent water evaporation rate under one sun light irradiation by the MXene membranes with polystyrene (PS) foam heat barrier

We consider the first 60 minutes as the stabilization period and thus read the mass difference between 60 and 150 minutes, which is 2.0 kg m$^{-2}$. Thus,

$$EF = \frac{Q_e}{Q_s} = \frac{2kg \times 2266KJ/Kg}{90 \text{ min} \times 60 \frac{s}{\text{min}} \times 1000W} \times 100\% = 83.93\%$$

Table S1 Light to water Evaporation efficiency of different batches of experiments.

<table>
<thead>
<tr>
<th>1 mg</th>
<th>2 mg</th>
<th>3 mg</th>
<th>4 mg</th>
<th>5 mg</th>
<th>10 mg</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporated mass (kg/m$^2$ 90 min)</td>
<td>1.194</td>
<td>1.373</td>
<td>1.514</td>
<td>1.528</td>
<td>1.558</td>
<td>1.758</td>
</tr>
<tr>
<td>Evaporation efficiency</td>
<td>50.1 %</td>
<td>57.6 %</td>
<td>63.5 %</td>
<td>64.1 %</td>
<td>65.4 %</td>
<td>73.8 %</td>
</tr>
</tbody>
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