Supporting Information

Thermal Insulation and Superhydrophobicity Synergies for Passive Snow Repellency

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Table S1. The static water contact angles (CAs) and contact angle hysteresis (CAH) of the fabricated superhydrophobic PC, PTFE and Al sheets.

<table>
<thead>
<tr>
<th>Superhydrophobic sheets</th>
<th>Static water CAs (°)</th>
<th>Water CAH (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>160 ± 1</td>
<td>3 ± 1</td>
</tr>
<tr>
<td>PTFE</td>
<td>160 ± 1</td>
<td>2.5 ± 1.5</td>
</tr>
<tr>
<td>Al</td>
<td>160.5 ± 0.5</td>
<td>1.0 ± 0.5</td>
</tr>
</tbody>
</table>

Table S2. The static water contact angles (CAs) and contact angle hysteresis (CAH) of superhydrophobic PC before and after 5 cycles of deposition/tilting process.

<table>
<thead>
<tr>
<th></th>
<th>Static water CAs (°)</th>
<th>CAH (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before deposition/tilting process</td>
<td>160 ± 1</td>
<td>3 ± 1</td>
</tr>
<tr>
<td>After 5 cycles of deposition/tilting process</td>
<td>160 ± 1</td>
<td>3 ± 1</td>
</tr>
</tbody>
</table>
Figure S1. Designed snow holder for different sizes of compacted snow. a) A 3D model of the snow holder with a surface area of 30 mm × 30 mm, and a schematic for how the snowpack was formed and deposited using the snow mold and plunger. b) Assembled snow holder on rotary beam with a lock keeping it in place at higher rotational velocities. A thick aluminum plate (13 mm) was placed inside the PLA holder as a base surface for snow deposition.
Figure S2. SLF snow sensor utilized to measure density and LWC of snow.

Figure S3. The cohesive fracture of snow caused by the conventional push-off ice adhesion test.
Figure S4. (a) Superhydrophobic, pristine, superhydrophilic Al sheets and their advancing (adv) and receding (rec) water contact angles. (b) The microstructure of the superhydrophobic Al surface.

Figure S5. The snow melting and refreezing process observed on superhydrophobic surfaces with and without thermal insulation, in which the 0.13 mm thick superhydrophobic Al sheet was directly adhered to the 13 mm Al substrate prior to snow deposition.
Figure S6. The uneven capillary rise front of meltwater caused by the tortuous liquid pathway and the heterogeneous snow porosity.

Figure S7. Schematic of a superhydrophobic sheet and how it repels interfacial meltwater droplets. The superhydrophobic surface forces the droplets into the pores of the snowpack (snow absorption height $h_2 > h_1$) and reduces the areal fraction of the snow-solid contact (contact area $a_2 > a_1$).
Figure S8. Passive snow shedding on the silica aerogel insulated, superhydrophobic PC sheet with an initial surface temperature at 40 °C.

Figure S9. (a) Images showing a snowpack being cut into four equal pieces, and (b) their corresponding snow density distributions.