Supporting Information

Stretchable and super-robust graphene superhydrophobic composite
for electromechanical sensor application

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The surface chemical composition of the graphene superhydrophobic composite was analyzed by XPS (Thermo ESCALAB 250XI, USA) at room temperature, and the binding energies were calibrated with respect to the signal for adventitious carbon (284.8 eV). As shown in Figure S3a, the Si 2p, C 1s, O 1s and F 1s peaks are detected from the survey spectra of the sample. Curve-fitted F 1s core-level spectra of the sample are displayed in Figure S6b. The F 1s peak in both cases was
observed at 688.42 eV, which corresponds to fluorine bonded as CF$_x$ in the FAS chain indicating that F is present in same bonding environment as that of FAS [1-3]. Figure S3c shows the curve-fitted Si 2p spectra. The Si 2p core-level spectra shows a dominant peak at 103.20 eV, which could be due to SiO2-based network [4,5]. Low-intense component peak around 104.54 eV corresponds to -Si-OH or Si-F$_x$ species [6]. Fig. S6d shows the multi-element spectra of C 1s, observed peaks at 284.00, 284.84, 286.14, 289.05, 291.35 and 293.53 eV are ascribed to C-Si, C-C, C-O, C-CF, CF$_2$ and CF$_3$, respectively [2,7,8].

Figure S3. XPS measurement of the graphence superhydrophobic composite. (a) Survey XPS spectrum of the as-prepared superhydrophobic surface; (b) F 1s, (c) Si 2p and (d) C 1s XPS spectrum of the sample.
Figure S4. The picture of the graphene composite prepared without pre-stretch process.

Figure S5. Cross-sectional SEM images of the graphene superhydrophobic composite.

Figure S6. The picture of the graphene composite after treatment at 200 °C for 2h.
Although the superior sensitivity of graphene superhydrophobic sensor has been presented, it is crucial to analyze reversibility of the electrical response [9, 10]. With this purpose, the cyclic stretching-release test was performed. As shown in Fig. S7, the $\Delta R/R_0$ of the graphene superhydrophobic sensor maintained very stable in the ten cycles of the cyclic stretching-releasing test at both 10% (Fig. S7a) and 20% strain (Fig. S7b), indicating the long working life and reversibility of the presented graphene sensors.

**Figure S7.** Electrical response of the graphene composite during 10 cycles with settled maximum strain: (a) 10% and (b) 20%.

The response time of the sensor is another crucial factor. In this research, the response time was measured according to the method shown in reference 11. As shown in the inset of Fig. S8, this graphene superhydrophobic sensor shows immediate response time of ~330 ms under tension condition, which was comparable with recent values of other nanocomposite sensors (300-3800 ms) [11, 12]
Figure S8. Electrical response of the graphene composite that was subjected to periodic tensile force. The inset is one enlarged peak showing the rise-time.

S9 Profilometer measurement

The surface roughness of the sample was further assessed using the Profilometer (Dektak XT). From the Figure S9a-e and Table S1, it can be found that the surface roughness become smoother as the strain of the graphene composited afforded become larger.

Figure S8. The Profilometer images of graphene composite at strain of 0% (a), 100% (b), 200% (c), 300% (d) and 400% (e).
Table S1 The surface roughness of the graphene composite under different strains.

<table>
<thead>
<tr>
<th>Strain (%)</th>
<th>Roughness (µm)</th>
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<tbody>
<tr>
<td>0</td>
<td>5.22</td>
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<tr>
<td>100</td>
<td>4.28</td>
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<tr>
<td>200</td>
<td>3.99</td>
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<td>300</td>
<td>3.31</td>
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<tr>
<td>400</td>
<td>1.93</td>
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</table>

S10 The mechanism of water repellency after oil contamination

Nature is a ‘Top university’ in the world and researchers can learn there for free. One of the fascinating branches of nature is the superhydrophobicity of lotus leaves. Inspired by the lotus leaves, the graphene superhydrophobic composite was prepared in this research (Fig. S10a). Another fascinating branch of nature is the slippery surface from *Nepenthes* pitcher plant, which use them to lock-in an intermediary liquid that then acts by itself as the repellent surface [13]. When the graphene superhydrophobic composite was immersed in oil, the oil gradually penetrated into the surface and then worked as a lubricating fluid (Fig. S10b). Due to dual supporting by both lubricating fluid and inherent superhydrophobicity, water droplets still remained marble-shaped [14].

![Figure S10. The schematic of superhydrophobic surface (a) and slippery surface (b).](image)

**Figure S10. The schematic of superhydrophobic surface (a) and slippery surface (b).**

**Supplementary References**


