Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information

Highly enhanced performance of spongy graphene as oil sorbent

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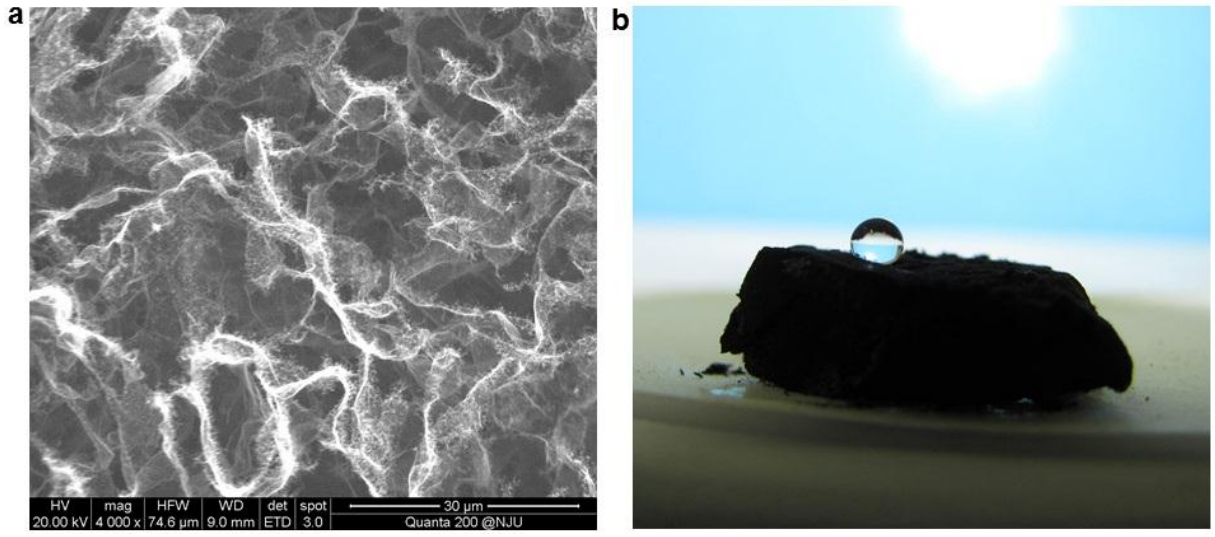

Figure S1. Morphology and wettability of SG-F after washing by adding water dropwisely for 15 min. a) SEM image of SG-F indicates that CNPs still adhere onto graphene sheets even though SG-F is subjected to long-time washing. b) SG-F still demonstrates good hydrophobicity.

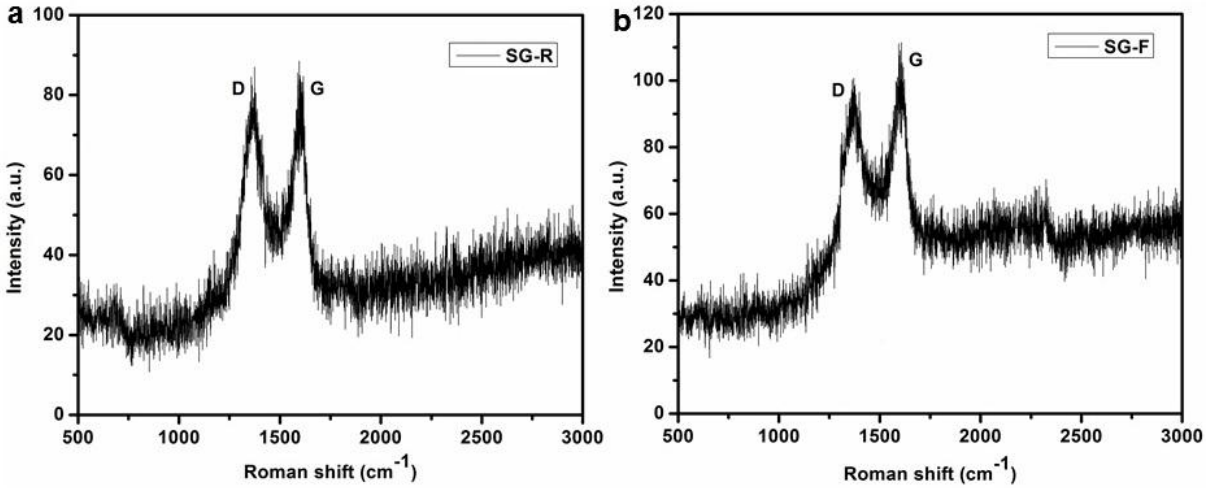

Figure S2. Raman spectra of SG-R and SG-F. The D peak at 1350 cm^{-1} and the G peak at 1580 cm^{-1} for both SGs represent disordered and graphitic structures.[1] SG-R and SG-F exhibit similar shapes and peak positions denoting that SG-F remains crystalline after flame soot treatment. The adhesion of CNPs leads to a little difference in intensity ratio of D and G peaks. All these above results show that the layer of CNPs is very thin or the CNPs have a structure similar to SG.[1,2]

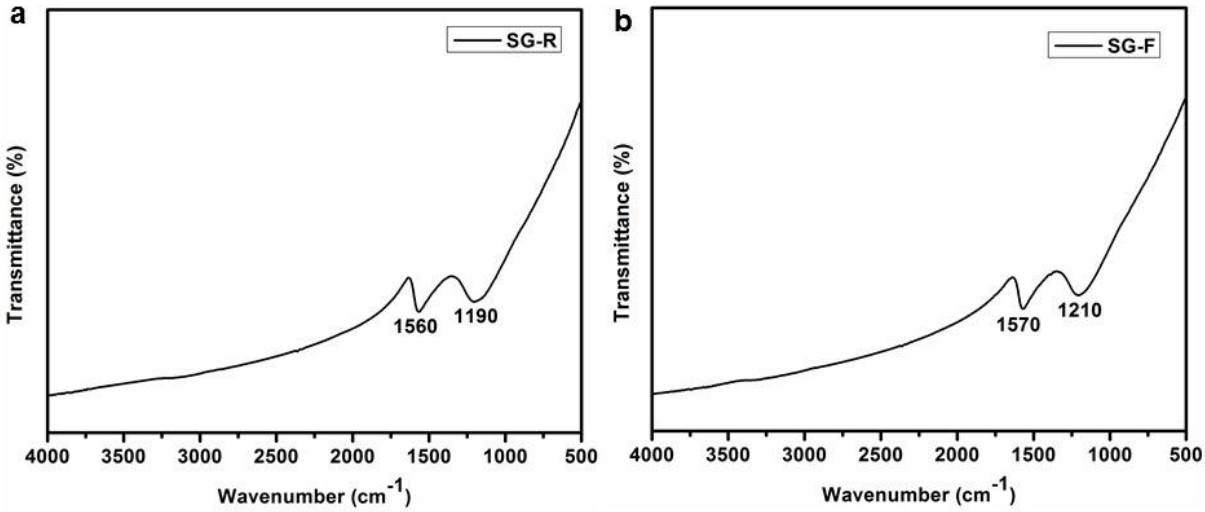

Figure S3. IR spectra of (a) SG-R and (b) SG-F. Compared with the spectra of GO,[2] both SGs lack absorption peaks, which indicates that GO sheets are thoroughly reduced. The absorptions at 1560 cm^{-1} for SG-R or 1570 cm^{-1} for SG-F indicate the skeletal vibrations of graphene.[3,4]

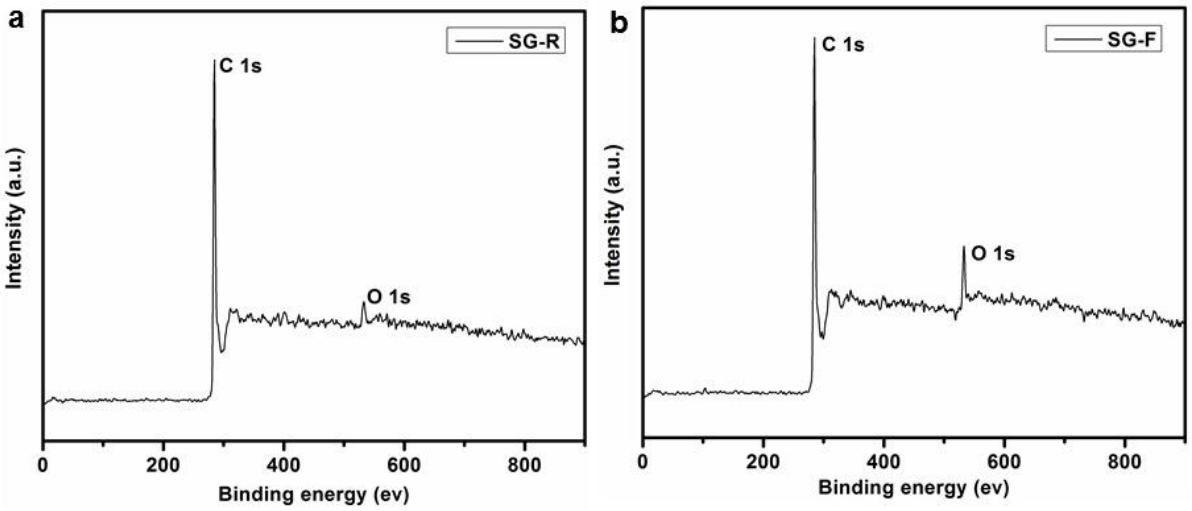

Figure S4. X-ray photoelectron spectroscopy of (a) SG-R (b) and SG-F. The atomic concentrations of C1s and O1s are 96.36 and 3.64 for SG-R, as well as 92.4 and 7.6 for SG-F, respectively. Both SGs contain a high concentration of C, which provide good stability.[2] The composition of CNPs of SGs only slightly differ from the graphene sheets.

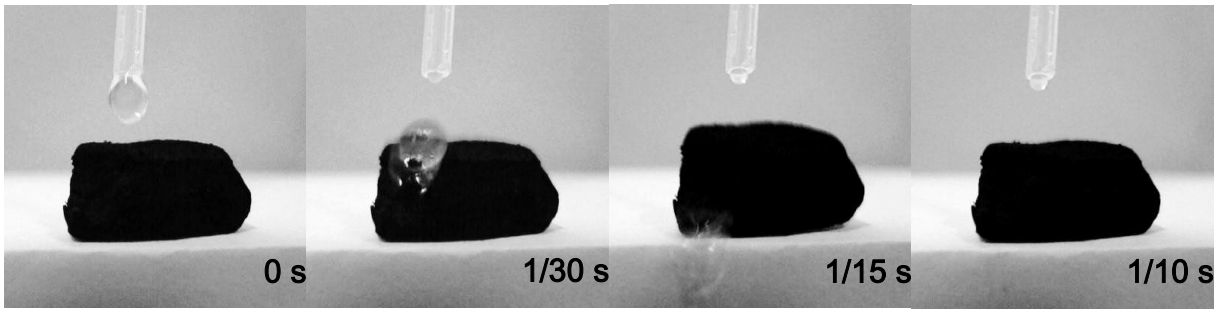

Figure S5. A water drop quickly slips on an inclined (2° to 3°), self-cleaning surface (SG-F).

Images are taken every 1/30 s.

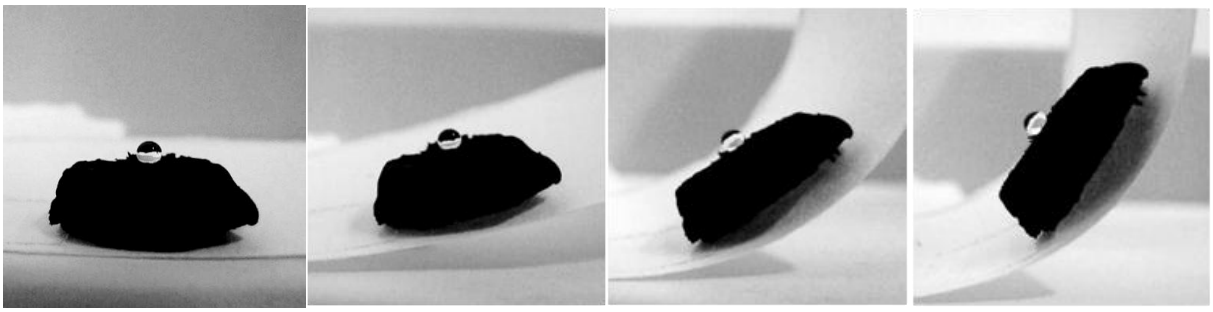

Figure S6. A water drop firmly stays on the surface of SG-R until the surface is tilted to more than 60°. The surface of SG-R is not flame treated and thus does not have self-cleaning ability.

Movie S1. Crude oil floating on artificial seawater is quickly absorbed by SG-F block. The SG-F block passively absorbs oily liquids in contact with the interface, attracts, and then absorbs nearby liquid molecules, which may be due to the surface tension between the liquid and wetting property of SG. Ions in the water do not show any visible effect of absorption.

Movie S2. SG-F absorbs phenixin (red) from the bottom of the beaker containing water.

Table S1. Comparison of various sorbents.

Absorbent material	***Absorbed substance***	***Absorption capacity (g g^{-1})***	***Cost***	***Refs.***
Wool-based nonwoven	Diesel, crude oil, SN 150	9–15	low	5
Vegetable fiber	Crude oil	1–100	low	6
Polymers	Oils and organic solvents	5–25	medium	7
Nanowire membrane	Oils and some organic solvents	4–20	low	8
Exfoliated graphite	Heavy oil	60–90	low	9
Activated carbons	Benzene, toluene	<1	low	10
Carbon nanotube sponges	Oils and organic solvents	80–180	high	11
Magnetic exfoliated graphite	Oils	30–50	high	12
Graphene/a-FeOOH composite	Cyclohexane, toluene, vegetable oil, etc.	10–30	high	13
Graphene/CNT foam	Compressor oil, sesame oil, organic solvents	80-140	high	14
Graphene-based sponges	Oils and organic solvents	60–160	high	15
Carbonaceous nanofiber aerogel	Oils and organic solvents	40–115	high	16
Graphene sponge	Oils and organic solvents	60–160	high	17
Reduced graphite oxide foam	Cyclohexane, chlorobenzene, toluene, petroleum, motor oil	5–40	high	18
Nitrogen–doped graphene foam	Oils and organic solvents	200–600	high	19
Marshmallow-like gels	Oils and organic solvents	6–15	high	20
CNT sponge doped with boron	Oils and organic solvents	25–125	high	21
CNF aerogels	Oils and organic solvents	106–312	very low	22
TCF aerogels	Oils and organic solvents	50–192	quite low	23
SG-F	Oils and organic solvents	125–615	low	present work

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