Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Mechanically robust, chemically inert superhydrophobic charcoal surfaces

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Table of Contents

I. Preparation of the superhydrophobic charcoal composites

The 100 mesh activated charcoal particles were from Sigma-Aldrich. 400 mesh charcoal particles were separated from a suspension of this sample in ethanol by using a 400 stainless mesh and dried in air. The ground charcoal particles were obtained by manual grinding of the 400 mesh particles in a mortar. A double-sided Scotch tape (3M) attached on a glass slide was covered with the charcoal particles. The surface was flattened by pressing with a glass slide. Sufficient volume of isopropanol (approximately 0.05 mL cm^{-2}) was then dropped onto the charcoal surface, and the surface was allowed to dry five minutes in air. This procedure was repeated three times. The resulting composite was dried 20 minutes in air, and the surface was cleaned with a stream of air. The surface density of the particles was 0.6 ± 0.1 mg cm^{-2}. Several other common solvents (methanol, ethanol, acetone, dichloromethane, hexane and ethyl acetate) were applied instead of isopropanol and other commercially available tapes (Nichiban double-sided tape, Trusco tape and Miracle tape) were also used but did not yield better adherence.

II. Surface characterization

The ATR-IR experiments were performed on Agilent Technologies Cary 670 FTIR spectrometer. The contact angles were measured using dataPhysics OCA 15EC Contact Angle (sessile drop, manual fitting) instrument. The SEM images were recorded on FEI Quanta 450FEG (HV/LV/ESEM). The in-water microscopic image and video were recorded on Olympus BX51WI microscope equipped with LumPlanFL N 40×/0.8 w objective lenses, XC10 camera and U-TV1XC camera adapter. The optical microscopic images and videos were recorded on Nikon SMZ1500 or SMZ745T microscope, equipped with Nikon COOLPIX P7800 digital camera. The videos of the water droplet bouncing off the surface were recorded with Mic HotShot 1280 CC high-speed digital camera operating at frame rate of 1000 s^{-1}. The abrasion tests were performed on a MTI Fullam SEMtester DAQ system. A composite charcoal surface with area of approximately 0.5 cm^2 was used in the abrasion tests. The photothermal effect experiments were recorded by InfraTec ImageIR 8300 with a light source of Schott KL 1500 LED plus (380~780 nm, < 1 mW). To calculate density by area, the weight of the deposited charcoal (calculated from the difference in weight after and before deposition) was divided by the area of the substrate.

III. Supplementary figures

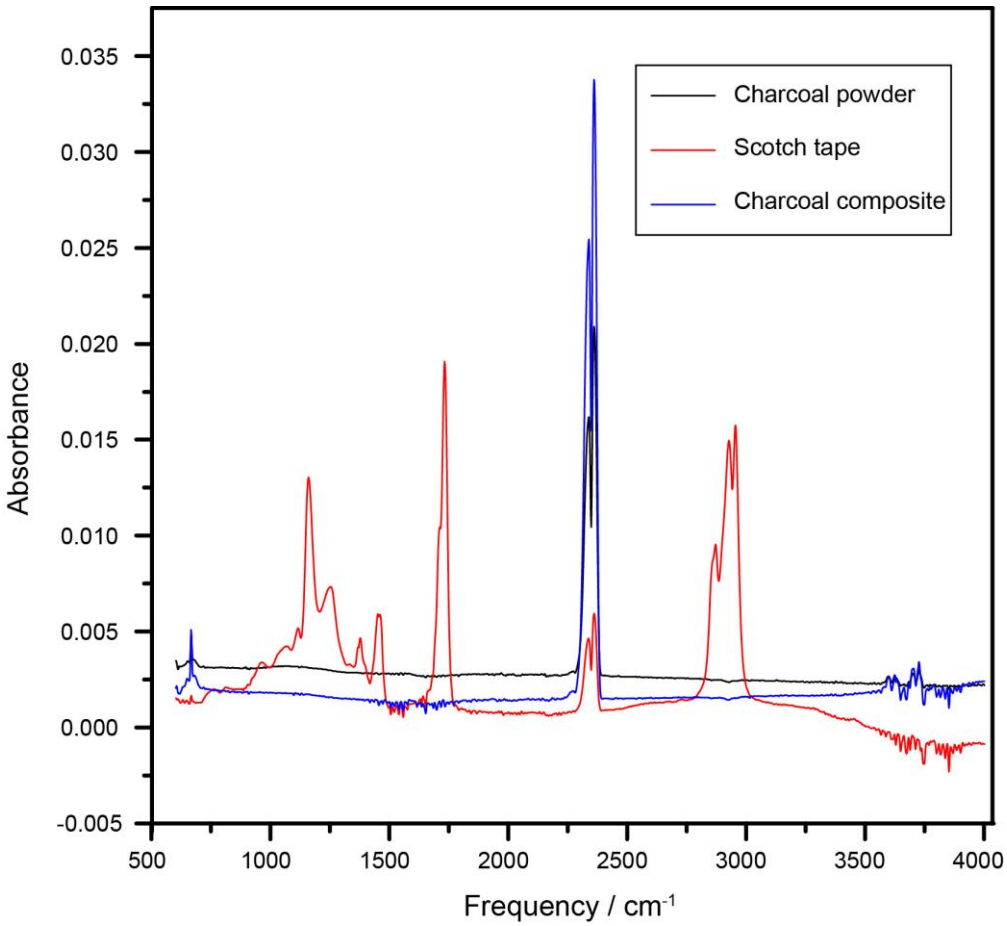

Fig. S1 ATR-IR spectra of the composite of charcoal powder (400 mesh) and Scotch tape (3M). The spectra confirm that the superhydrophobic charcoal surface is not contaminated with the glue from the adhesive tape or with the solvent that was used to fix the particles.

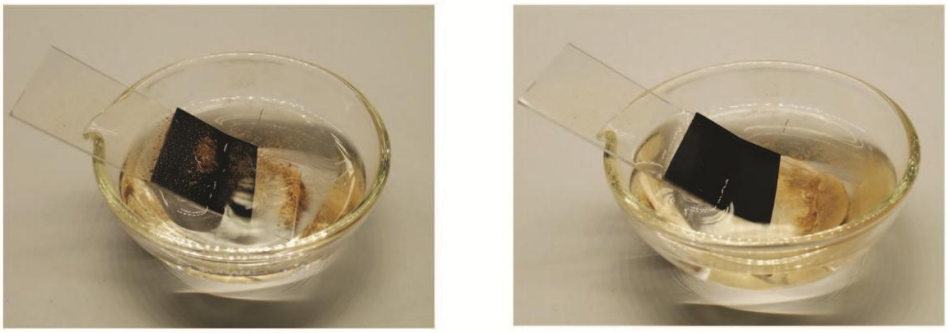

Fig. S2 Self-cleaning capability of the superhydrophobic charcoal surface immersed in hexane. The soil was partially submerged into a solution of hexane. Several droplets of water dropped onto the soil were sufficient to clean the surface.

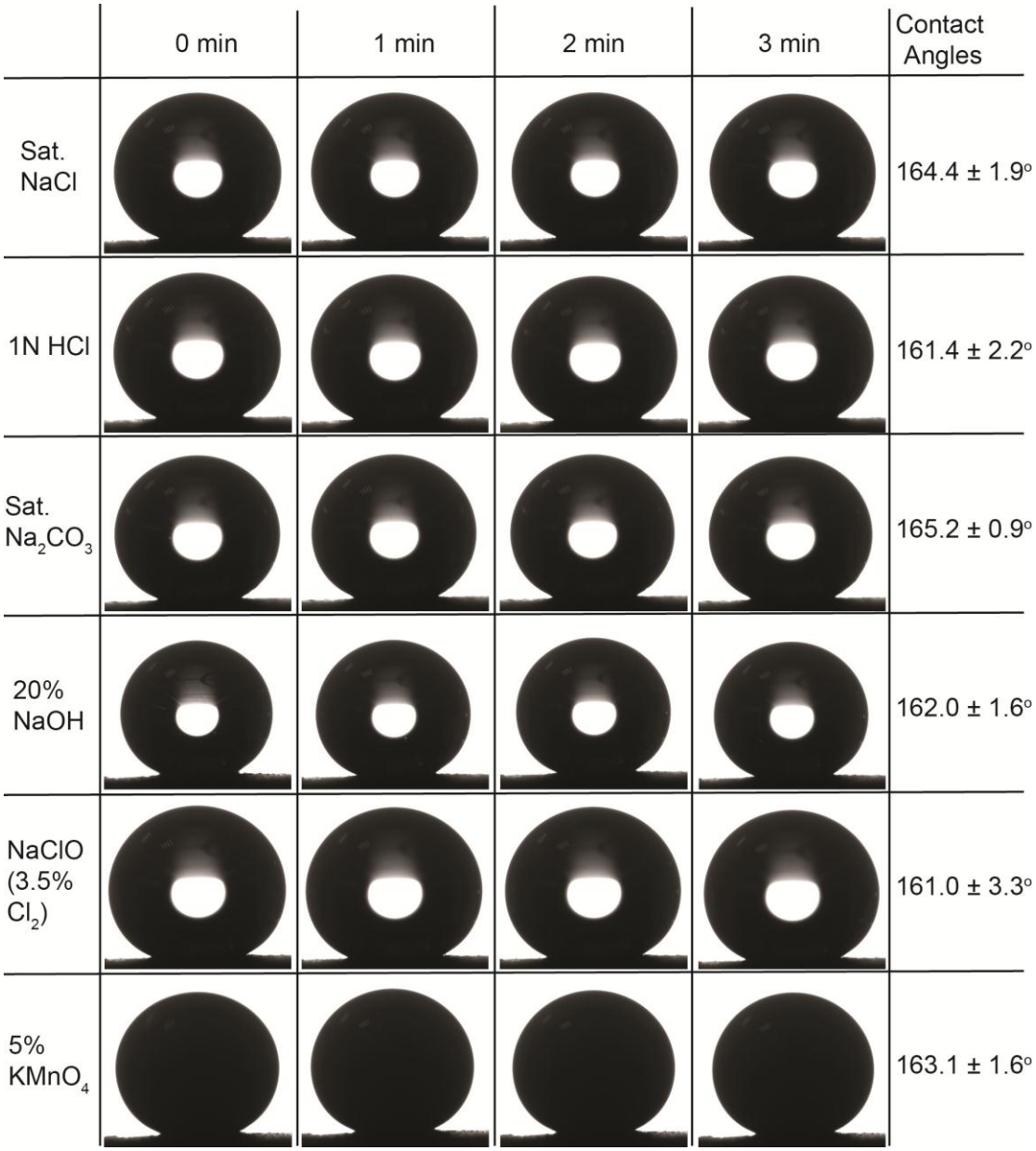

Fig. S3 Chemical inertness of the charcoal surface. Droplets containing solutions of chemicals in the left column (7.0 μL) were put onto the charcoal surface (400 mesh). In all cases, the surface retained the hydrophobicity and the contact angles did not decrease significantly with time.

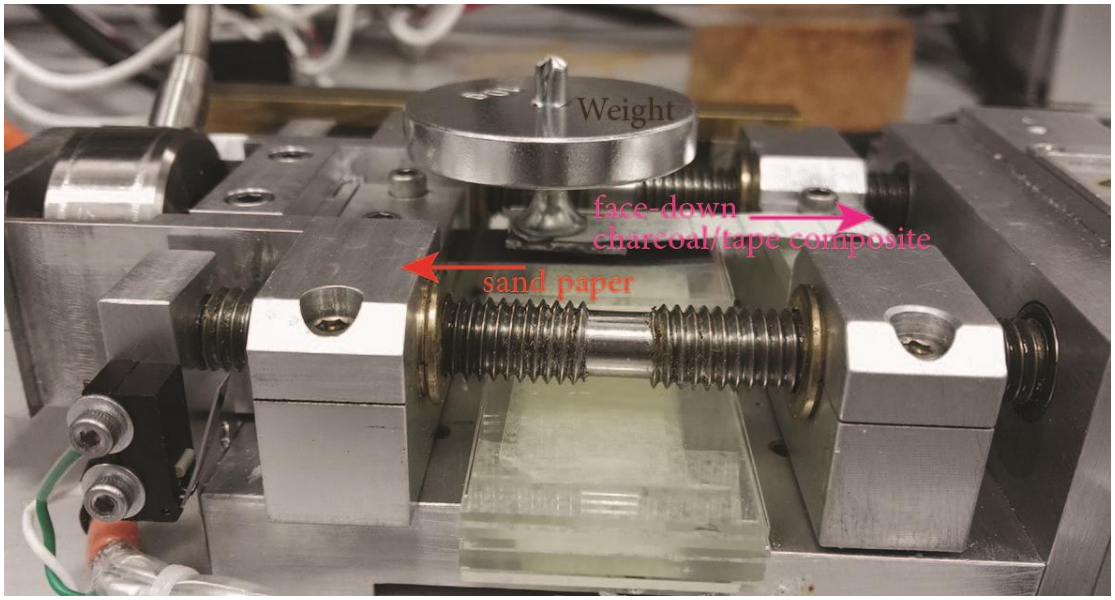

Fig. S4 Abrasion tests. Sand paper was placed horizontally with face up, while the charcoal/tape composite (0.5 cm^2) attached to a glass slide was put in contact with the sand paper with face down. A weight (10 g) was put onto the glass slide to increase the friction. The charcoal/tape composite and the sandpaper were moved in opposite directions, with an approximate speed of 0.53 cm min^{-1}. The average force of friction was about 0.3 N cm^{-2} and the relative movement was about 1.9 cm in each cycle.

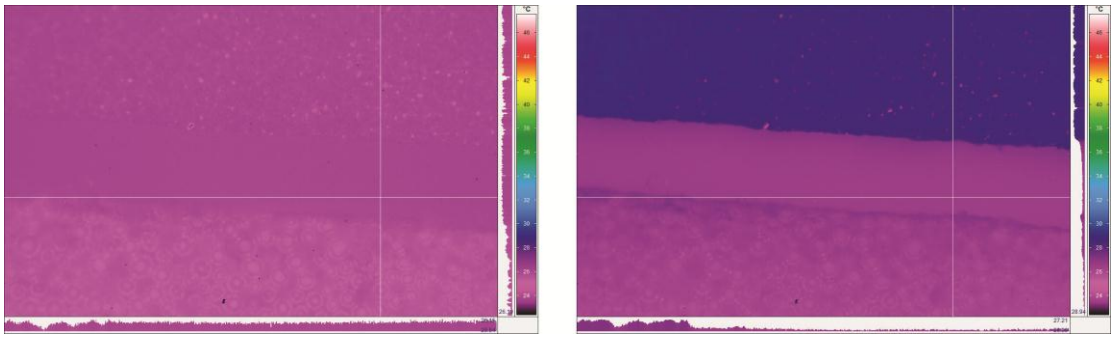

Fig. S5 Photothermal effects on the superhydrophobic surface. The charcoal/tape composite and the bare tape were attached closely to a glass slide. The adjacent domains were irradiated by a light source of Schott KL 1500 LED plus (380~780 nm, < 1 mW). The surficial temperature of charcoal/tape composite was raised from 26 ºC to 29 ºC in about 7.5 seconds after irradiation.

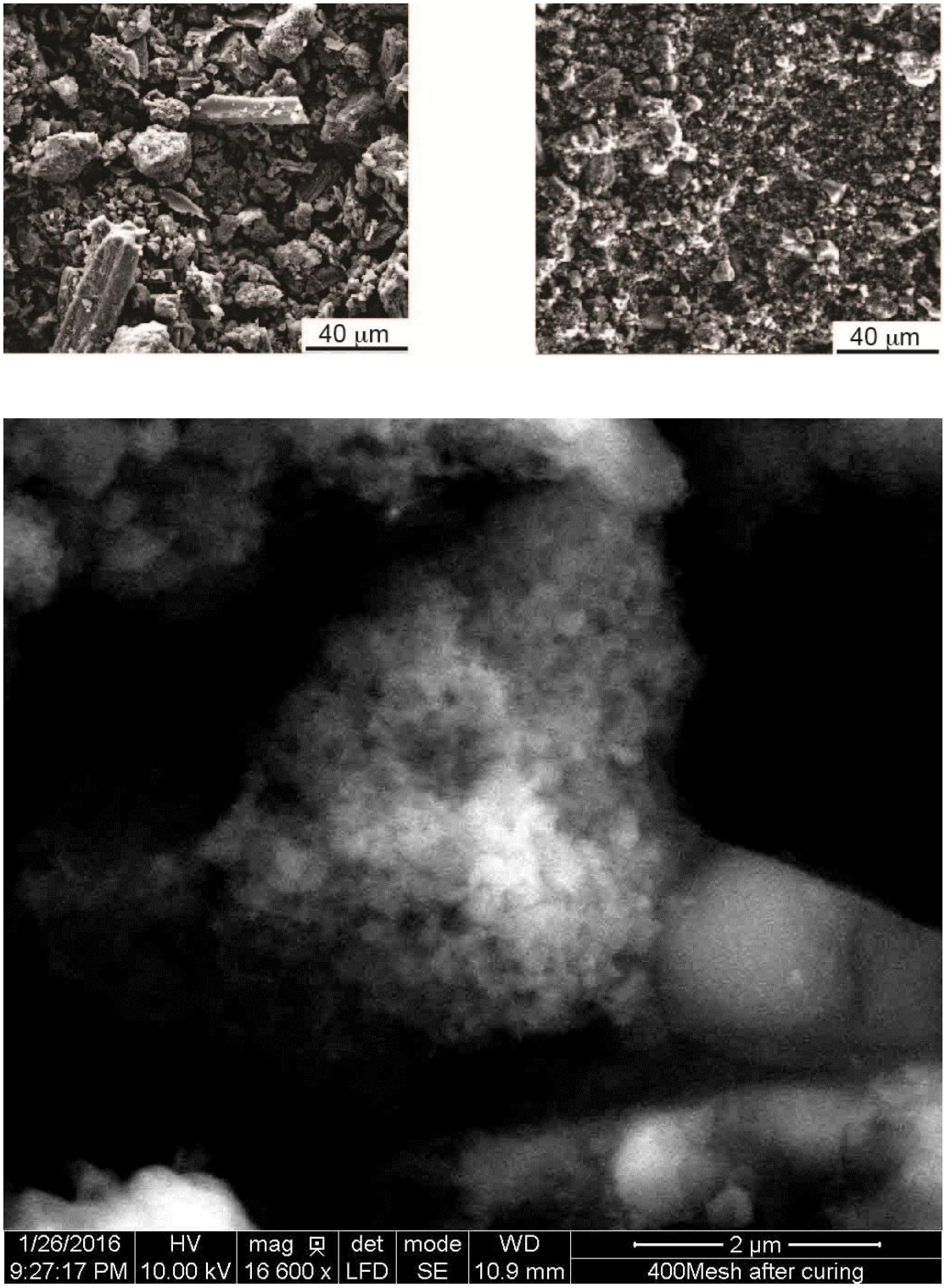

Fig. S6 Variation of roughness with particle size. The 100 mesh charcoal particles (top left) and the ground charcoal particles (top right, ground from 400 mesh particles) were fixed onto Scotch tape with isopropanol. The different average particle size and size distributions contribute to the different morphologies of the surfaces and to the apparent roughness. The bottom panel shows a higher resolution image of the surface roughness.