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Electronic Supplementary Information

Robust aerogel based on conjugated microporous polymers nanotubes with exceptional mechanical strength for efficient solar steam generation

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Porosity measurement of the CMPs aerogels. Round CMPs aerogels with 15 mm in diameter and 15 mm in thickness was firstly weighted and the weight was defined as W_i. Subsequently, the sample was immersed in 20 mL ethanol. The ethanol saturated aerogels was measured and the weight was W_f. The porosity of the aerogels was measured by using equation: Porosity(%)=$(W_f-W_i)/\rho*V_i$

Where ρ is the density (0.789 g/cm^3) of the ethanol and V_i is the volume of the aerogels.

Superhydrophilic treatment of the CMPs aerogels. The CMPs aerogels were firstly cut into a wafer with 5 mm in height and 32 mm in diameter by using a knife. Subsequently, the CMPs aerogels wafer wafer was immersed into 20 mL of ammonium peroxydisulfate saturated 1M H_2SO_4 for 24 h under stirring at room temperature. After that, the CMPs aerogels wafer was washed by the ultrapure water and ethanol for several times, respectively, to remove the residual acid and ammonium peroxydisulfate. Finally, the wafer was dried at 75 ^oC for 12 h to obtain a constant weight.

Solar steam generation test. The solar steam generation experiments was conducted at a lab-made, online, real-time measurement system which is composed by a solar light simulator (xenon arc lamp, CEL-S500, Ceaulight) with a solar filter (AM 1.5, Ceaulight), a test chamber with 80 mm in height 36 mm in diameter, (3) an analytical balance (FA 2004) (4) a computer to record the time-dependent mass change of water due to the stream generation (5) an infrared camera (Testo 869, Germany). Light intensity was measured by a full spectrum optical power meter (CEL-NP2000-2, Beijing Education Au-light Co., Ltd.). During each test, the room temperature was maintained at 20-22 ^oC and the humidity was ranged from 25 to 30%.

Characterization

The structure of the CMP-aerogels was investigated by the Solid-phase ^{13}C CP/MAS nuclear magnetic resonance (NMR Bruker AVANCE III 400 MHz NMR spectrometer) and Fourier transform infrared spectroscopy (FTIR Nicolet Nexus 670 FT-IR). The morphology of the CMP-aerogels was taken on Scanning electron microscope (SEM JSM-6701F) and Transmission electron microscope (TEM Tecnai G2TF20). The specific surface area and porosity of the as-prepared CMPs aerogels was measured by N_2 adsorption and desorption at 77.3 k using a volumetric sorption analyzer (micromeritics ASAP 2020). Before analysis, the samples were degassed at 120 ^oC for 12 h under vacuum. The elemental analyse was carried out on an elemental analyzer (Elementar Vario EL). Thermogravimetric analyse was measured by thermogravimeter analyzer (Perkin Elmer) from room temperature to 800 ^oC at a heating and cooling rate of 10 ^oC min^{-1} under nitrogen atmosphere. The compressive properties were performed by using an electrical universal material testing machine with equipped two flat-surface compression stages and a 500 N load cell (EZ-Test, SHIMADZU) at a stress rate of 5mm/min. The thermal conductivity of CMPAs was investigated on flash method thermal analyzer (LFA 447, Netzsch).

Calculation of the energy conversion efficiency

$\eta = m\, h_{Lv}/C_{opt}q_i$

where m is the mass flux of steam(the rate of water evaporation under the dark environmentis subtracted), C_{opt} is the optical concentration, q_i is the nominal direct solar irradiation 1 kW m^{-2}, h_{Lv} denotes total enthalpy of liquid-vapor phase change (including sensible heat and phase-change enthalpy), can be calculated as

$h_{Lv}=\lambda + C\Delta T$

where λ is latent heat of phase change (2260 kJ kg^{-1}),C is specific heat capacity of water (4.2 kJ kg^{-1} K^{-1}), and ΔT denotes the temperature increase of the water.

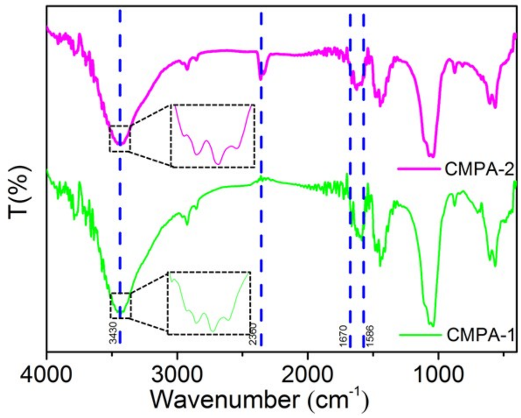

Figure S1 FTIR spectrum of CMPs aerogels.

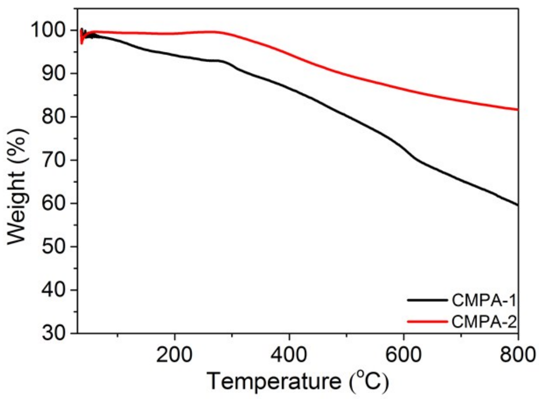

Figure S2 TGA curves of CMPs aerogels.

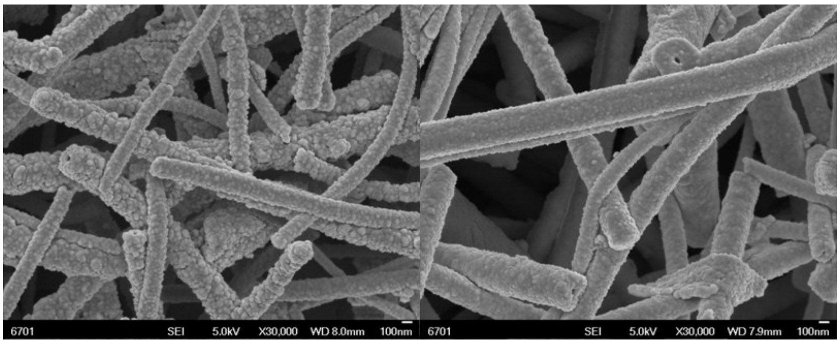

Figure S3 High magnification SEM images of (left) CMPA-1 and (right) CMPA-2.