Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information

A room-temperature environmentally friendly solution process to assemble silver nanowire architectures for flexible transparent electrodes

Y*e Yang,*[‡] *Jin-Long Wang,*[‡] *Lei Liu, Zhi-Hua Wang, Jian-Wei Liu* and Shu-Hong Yu**

Experimental Section

Materials. All chemicals and solvents were of analytical grade, purchased from Shanghai Chemical Reagent Co. Ltd., and used as received without further purification.

Synthesis of Ag nanowires with an average diameter of 60 nm

Uniform Ag nanowires were prepared by the polyol process method reported previously[1]. In a typical synthesis, polyvinylpyrrolidone (PVP, MW≈ 40000; 1.76 g) was dissolved in glycerol (57 mL) under stirring. A homogeneous solution formed by heating at 85 ^{o}C for 1h. Then the solution was cooled to room temperature naturally, and $AgNO_3$ (0.474 g) was added. After adding a NaCl solution (17.7 mg of NaCl dissolving in 0.15 mL of deionized water and 3 mL of glycerol), the temperature was raised from room temperature to 210 ^{o}C in 20 min under continuous stirring, then the heater was removed immediately. By adding deionized water (60 mL) into the product, the temperature was decreased to room temperature. After the colour turned into graygreen, the solution was centrifuged to remove the excess PVP, and the obtained Ag nanowires were collected and dispersed into an aqueous solution.

Synthesis of $CaCO_3$ nanowires with an average diameter of 100 nm and length of 20μm

$CaCO_3$ nanowires with an average diameter of 100 nm and length of 20μm were prepared by extracting from natural mussels. In a typical synthesis, 1g of the connecting part of two shell was peeled off and resolved in 10mL NaClO to remove organic compositions. After stirring gently for 1 day, a white solution formed. The obtained product was collected by centrifuging (2000 rpm for 3 min) and washed for several times with deionized water and ethanol, then dispersed in water.

Co-assembly of Ag and $CaCO_3$ nanowires by the Langmuir Blodgett (LB) techniques

1 mL Ag nanowire solution (0.037 mM) and 1 mL $CaCO_3$ nanowire solution (0.094 mM) were centrifuged, then Ag and $CaCO_3$ nanowires were added into a mixed solution of 1 mL *N,N*-dimethylformamide (DMF) and 1 mL $CHCl_3$ to form a homogeneous solution. The mixed solution was dispersed on the surface of water subphase drop by drop with a 50 μl syringe. After compressed with a rate of 20 cm^2min^{-1} for 30 min while the surface pressure was monitored with a Wilhelmy plate, the monolayer of aligned nanowires was lifted and deposited on polycarbonate (PC) substrate. The nanowire networks were gained by deposited a second layer of aligned parallel nanowires

perpendicular to the first layer. Then the $CaCO_3$ nanowires were removed by treating with acetic acid solution for 30 min. After washed with water, the electrode was dried by blowing N_2. An aqueous solution of PVA (10 wt%) was spin-coated at a speed of 800 rpm for 20 s onto the mesh-like Ag nanowire networks. Followed by thermal annealing at 80 °C for 3 h, the PVA matrix together with Ag nanowires was peeled off from the PC substrate.

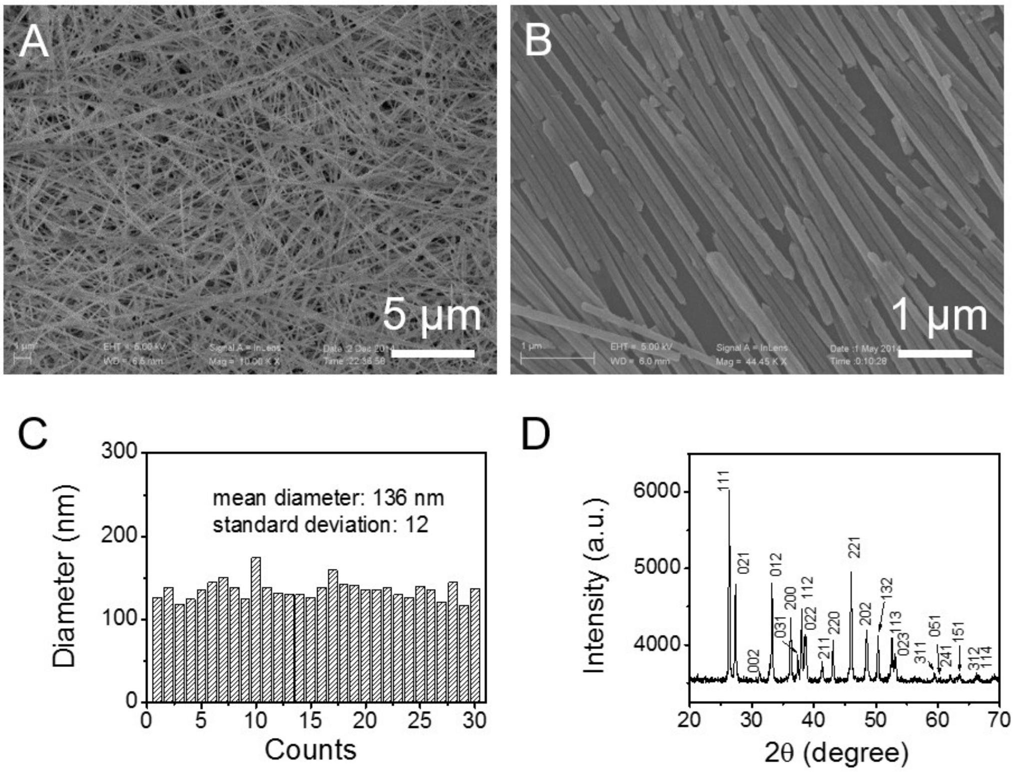

Figure S1. (A, B) SEM images of $CaCO_3$ nanowires obtained by dissolving the connection part of shells in NaClO with different magnification. (C) Histogram of the diameter distribution of the $CaCO_3$ nanowires. (D) XRD pattern of $CaCO_3$ nanowires extracted from shells.

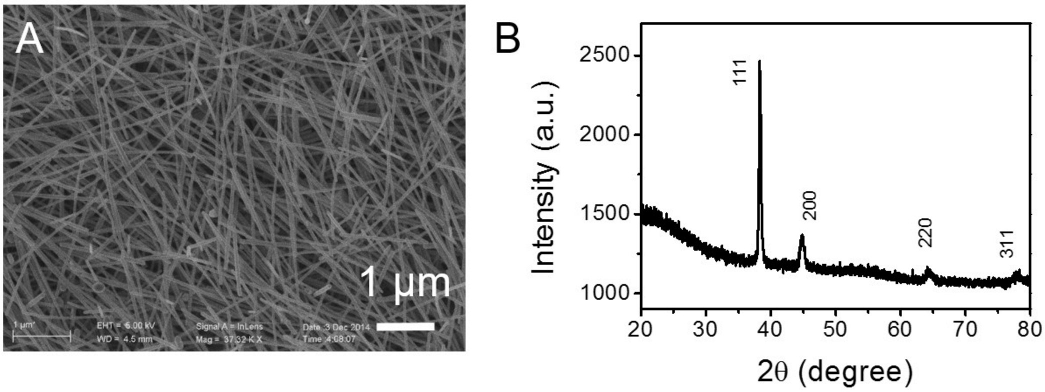

Figure S2. (A) SEM image of Ag nanowires. (B) XRD pattern of Ag nanowires.

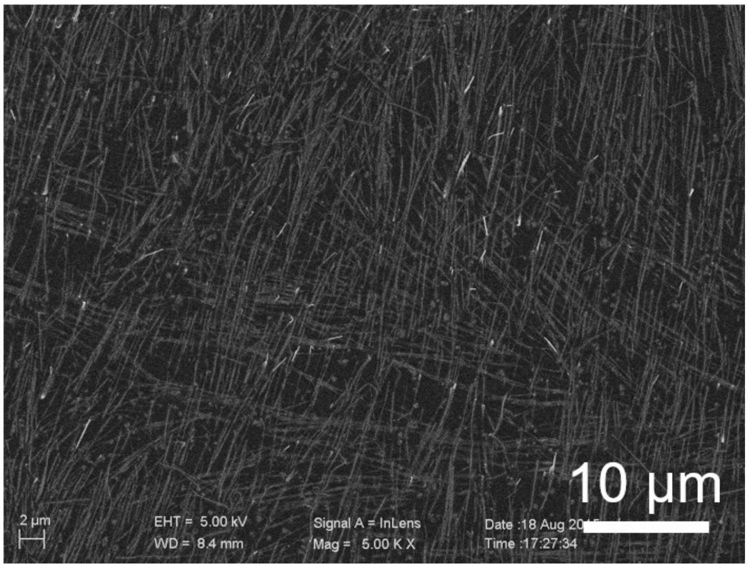

Figure S3. SEM images of Ag nanowires/PVA electrodes after more than 2000 bending cycles.

Reference

1. C. Yang, H. Gu, W. Lin, M. M. Yuen, C. P. Wong, M. Xiong and B. Gao, *Adv. Mater.*, 2011, **23**, 3052.