Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Wearable and visual strain sensors based on Zn_2GeO_4@polypyrrole core@shell nanowire aerogels

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Experimental Section

Synthesis of Zn_2GeO_4 NWs: In a typical synthesis[1] of Zn_2GeO_4 NWs, 0.52 g of GeO_2 (2.5mmol) and 1.10 g of $Zn(CH_3COO)_2•2H_2O$(5 mmol) were added to 15 mL of solvents which includes 5 ml H_2O and 10 ml ethylenediamine (En). The mixture was stirred for 40 min and then transferred to a stainless Teflon-lined autoclave of 25 mL inner volume. The solvothermal synthesis was performed under an auto-generated pressure at 180 °C for 24 h in an electric oven, followed by cooling naturally to room temperature. The product was collected by centrifugation, washed thoroughly with deionized water and alcohol several times, and then dried at 60 °C for 12h. A white Zn_2GeO_4 NWs powder was finally obtained.

Synthesis of Zn_2GeO_4@PPy NW aerogels: Pyrrole, purity 99% (Aladdin) was stored in a refrigerator at 4 ^oC before use. The oxidant, silver nitrate, purity 99.9% (Aladdin), was used as received. Here, a new conjugate growth method was proposed firstly as show in Figure 1a. 2 mL pyrrole and 2 mM Zn_2GeO_4 NW were added to 120 mL isopropyl alcohol and stirred for 20 min to ensure penetration equilibrium of pyrrole into the NWs. The concentration of pyrrole was 0.2 M, mole ratio of oxidant to pyrrole was about 1. In the first phase, 2 mL pyrrole were added to 120 mL water or alcohol and stirred for 15 min. The aqueous solution of silver nitrate, composed of a calculated amount of silver nitrate and 30 mL water. After mixing both solutions, the polymerization of pyrrole was carried out under gentle stirring for 20 min at 4 ^oC using dry ice in order to reduce the reaction rate providing that it is essentially an exothermic. Then, the polymerization mixture was transferred to the desired container and was left standstill for 96 h. Finally, the aerogels were rinsed thoroughly with water to remove the unreacted pyrrole, followed by the freeze-drying.

Device Fabrication: The fabrication of wearable sensors are as follows. Firstly, three aluminum foils (2 mm × 100 mm × 0.2 mm) were pasted on the aseptic dressing (600 mm × 700 mm) horizontally. Then, 9 small obtained sponges (3 mm × 3 mm × 1 mm) were placed on the aluminum foils to form the 3 pixel × 3 pixel arrays. At last, another aseptic dressing with

three aluminum foils pasted lengthwise as opposite electrodes was covered on the top surface to seal the whole sponge.

Material Characterizations: The crystalline structure of the prepared aerogels were characterized by powder X-ray Diffraction (Bruker-AXS D8 Advance). SEM images of the films were taken by a Quant 250FEG instrument and optical microscope were taken by Nikon Eclipse Ti. The transmission electron microscopy (TEM) and high resolution transmission electron microscopy (HRTEM) images were obtained using a Tecnai G2 F30 S-TWIN instrument.

Device Measurements: The thickness of the PPy–hybrid membranes were determined by using a commercial screw gauge micrometer with digital display when different weights are placed on the aerogels. The *I-V* (current-voltage) and *I-t* (current-time) measurements of the aerogels based pressure sensors were obtained by a Keithley 6487. Videos about the detection of the disturibution of weights (Movie S1) and motions on the back of the hand when making the fist (Movie S2,3).

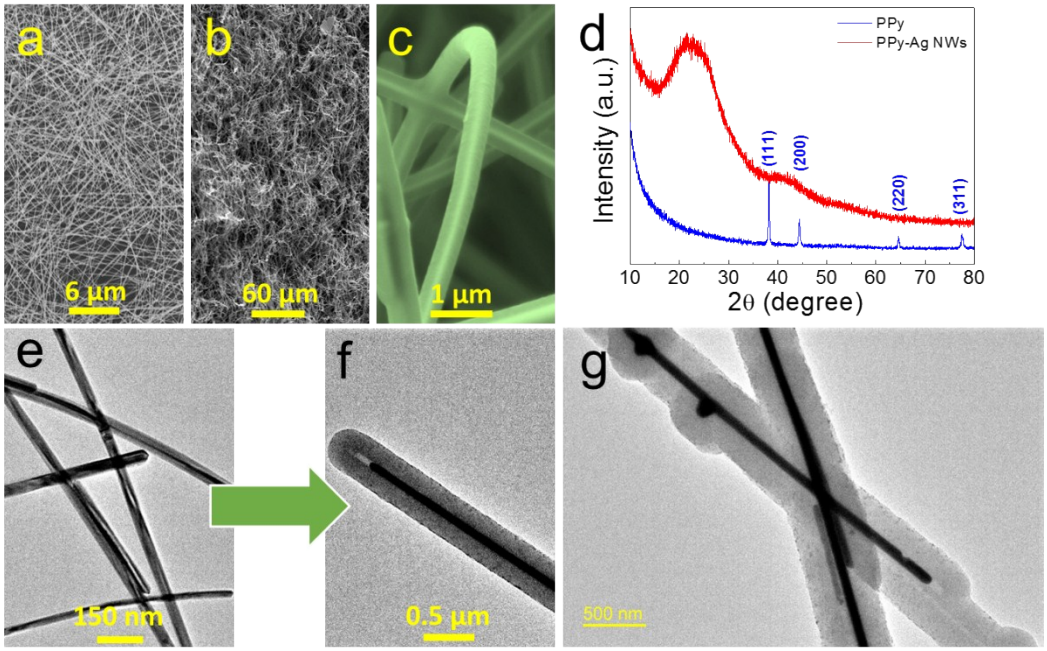

Figure S1. Microstructure of Ag NWs and PPy-Ag NW aerogels. (a) Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM) (e) images of Ag NWs. (b)

Low resolution and (c) High resolution SEM images of PPy-Ag NW aerogels. (d) XRD spectra of PPy-Ag NW hybrid aerogels and PPy. (f-g) TEM images of PPy-Ag NW aerogels

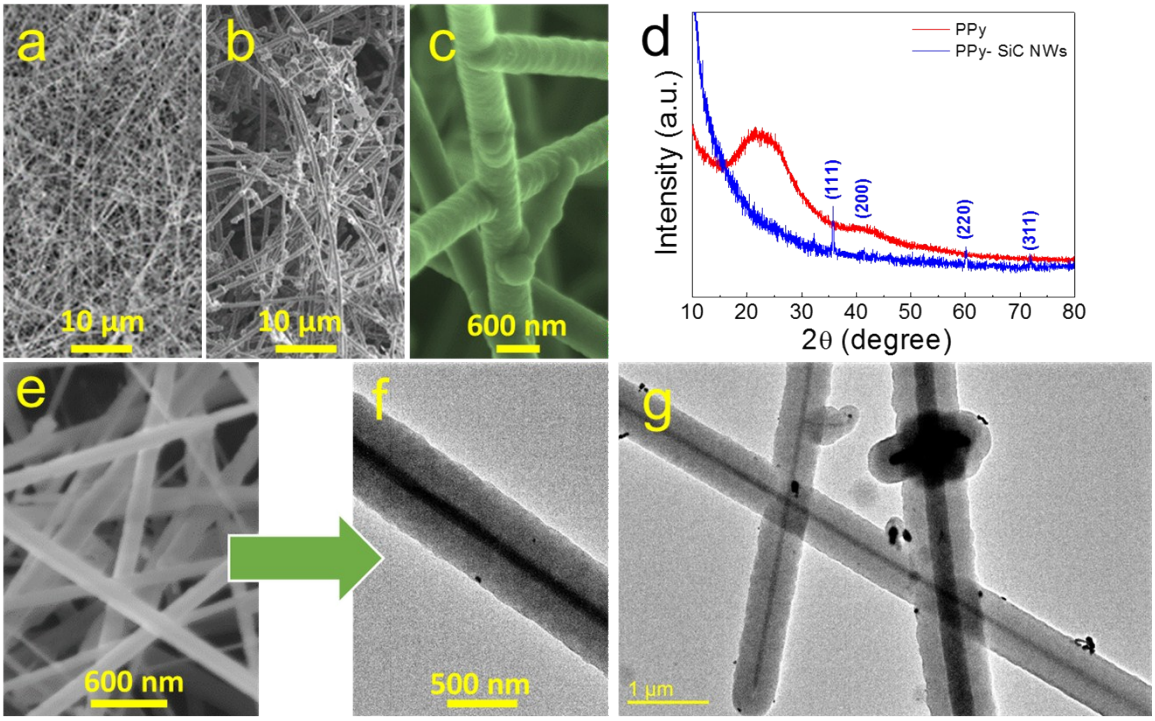

Figure S2. Microstructure of SiC NWs and PPy- SiC NW aerogels. (a) Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM) (e) images of SiC NWs. (b) Low resolution and (c) High resolution SEM images of PPy- SiC NW aerogels. (d) XRD spectra of PPy-SiC NW hybrid aerogels and PPy. (f-g) TEM images of PPy-SiC NW aerogels

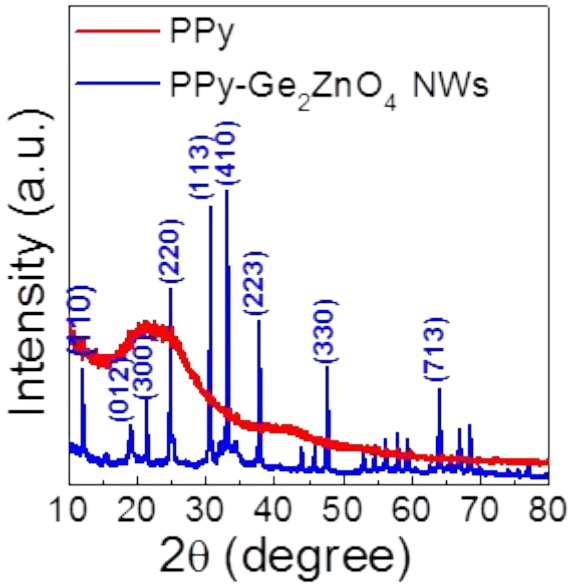

Figure S3. XRD spectra of PPy-Zn_2GeO_4 NW hybrid aerogels and PPy.

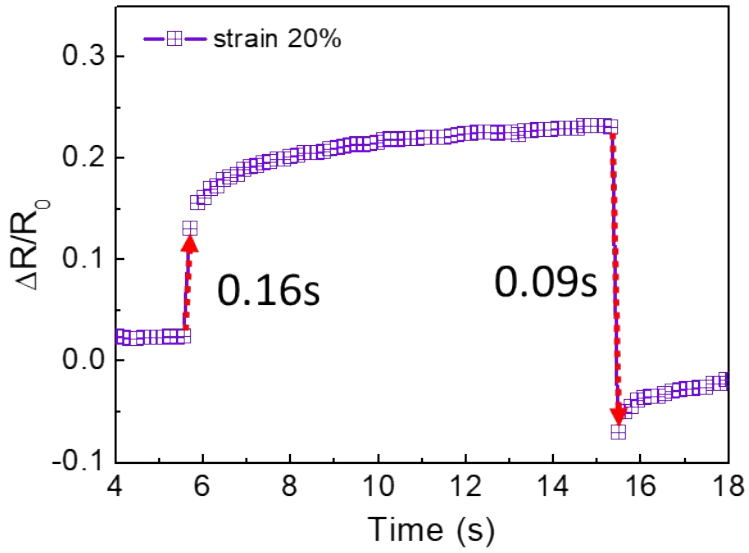

Figure S4. The strain-response showing rise and decay time of Zn_2GeO_4@PPy NW aerogels under 20% strain.

1. Q. Liu, Y. Zhou, J. Kou, X. Chen, Z. Tian, J. Gao, S. Yan and Z. Zou, *J. Am. Chem. Soc.*, 2010, **132**, 14385-14387.