Supporting Information

A one-step-assembled three-dimensional network of silver/polyvinylpyrrolidone (PVP) nanowires and its application in energy storage

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Figure S1. Optical images of Ag-PVP nanowire (AgPNW) hydrogel (AgPNWH) synthesized at different PVP-Ag⁺ molar ratios: (a) 1.5, (b) 2.3 and (c) 3.8. Here, all other parameters were kept constant (PVP-55 at 0.27 M, CuCl₂ at 0.064 mM). (d) The SEM image of AgPNWs synthesized at the PVP-Ag⁺ ratio of 1.5.



Figure S2. The SEM images of AgPNWs synthesized at different PVP-Ag⁺ molar ratios: (a) 1.5, (b) 2.3 and (c) 3.8.



Figure S3. SEM and optical images of AgPNWH synthesized at different amounts of CuCl₂: (a) 0.032 mM, (b) 0.064 mM, (c) 0.13 mM, and (d) 0.26 mM. These correspond to the CuCl₂-Ag⁺ molar ratios of 0.27×10^{-3} , 0.54×10^{-3} , 1.08×10^{-3} and 2.2×10^{-3} , respectively. Here, all other parameters were kept constant (PVP-55 at 0.27 M, AgNO₃ at 0.12 M). In (a)-(d), *L* is the NW length and λ is the NW diameter.



Figure S4. Schematics of the formation mechanism of AgPNW hydrogel/aerogel. Here, CPD is the critical point drying process.

FTIR Analysis of pure PVP-55 and AgPNWA

Fig. 2a shows the FTIR spectra of the samples. The 1420 cm⁻¹ peak is the characteristic absorption of pyrrolidinyl group. The 1651 cm⁻¹ peak is stretching vibration region of C=O. The 2950 cm⁻¹ peak is due to the C-H stretching vibration.¹ The 1285 cm⁻¹ peak can be assigned to the stretching vibration of C-N.²



Figure S5. TGA curves of pure PVP-55 and AgPNWA.



Figure S6. (a) DTG and (b) TGA curves of pristine paraffin (PP) and the AgPNWA-paraffin (AgPNWA-P) composite.



Figure S7. SEM images of (a) top, (b) bottom and (c) side views of an AgPNWA, where the insets show images of higher magnification. Here, the arrows in (c) point to the up direction (from the sample bottom to its top). (d) The composites' thicknesses (normalized by their original thicknesses) vs. the thermal cycle number.



Figure S8. (a) FTIR spectra of the samples. (b) XRD patterns of the samples.

The FTIR spectrum of the samples are shown in Fig. S8a. For pristine paraffin, the 1378 cm⁻¹ peak is related to C-H bending vibration of CH₃. The 1463 cm⁻¹ peak is related to C-H bending vibration of CH₃. The 719 cm⁻¹ peak is related to the CH₂ rocking band. The 2955 cm⁻¹ peak is related to the CH₃ asymmetric stretching. The 2849 and 2914 cm⁻¹ peaks are related to the CH₂ symmetric and asymmetric stretching, respectively.³⁻⁶ Fig. S8b shows the XRD patterns of the samples. The XRD pattern of pristine paraffin corresponds to the orthorhombic structure.^{5,7}



Figure S9. Measured and effective latent heats vs. f_{NW} during cooling. ΔH_{SS-C} and ΔH_f are the latent heats of the solid-solid and solid-liquid (freezing) phase transformation, respectively. Here, the total latent heat $\Delta H_{t-C} = \Delta H_{SS-C} + \Delta H_f$. The superscript "*E*" indicates that they are the corresponding effective values, through the normalization by the paraffin weight fraction f_p (=1- f_{NW}) in the composite, e.g., $\Delta H_f^E = \Delta H_f f_p$. Here, the subscript "*C*" indicates that they correspond to the cooling process.



Figure S10. (a) The ratio (H/H_{PP}) of composites' hardness to pristine paraffin's hardness H_{PP} vs. strain rate. (b) The ratio (E/E_{PP}) of composites' modulus to pristine paraffin's modulus E_{PP} vs. strain rate.



Figure S11. Optical images of (a) the ethanol-saturated AgPNW network and (b) the dried network on a Teflon disk.

Reference

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