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# A Silver Wire Aerogel Promotes Hydrogen Peroxide Reduction for Fuel Cells and Electrochemical Sensors

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## Supplementary Figures

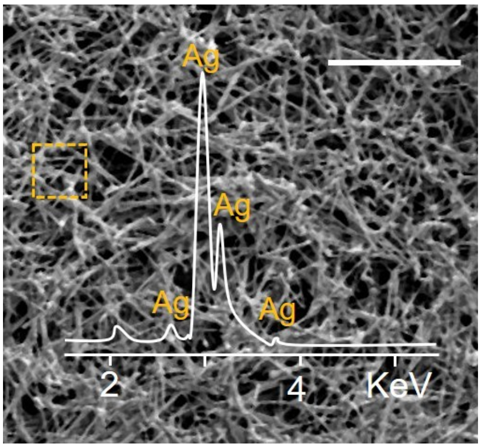


**Fig. S1** EDS spectrum of Ag Wire-gel taken from the area highlighted by the dashed box. Scale bar: 30 μm.

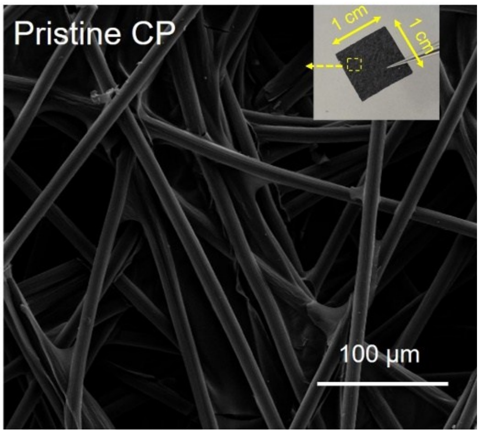


**Fig. S2** SEM image of pristine carbon fiber paper (CP). Inset: A photograph showing the size of a piece of the pristine CP.

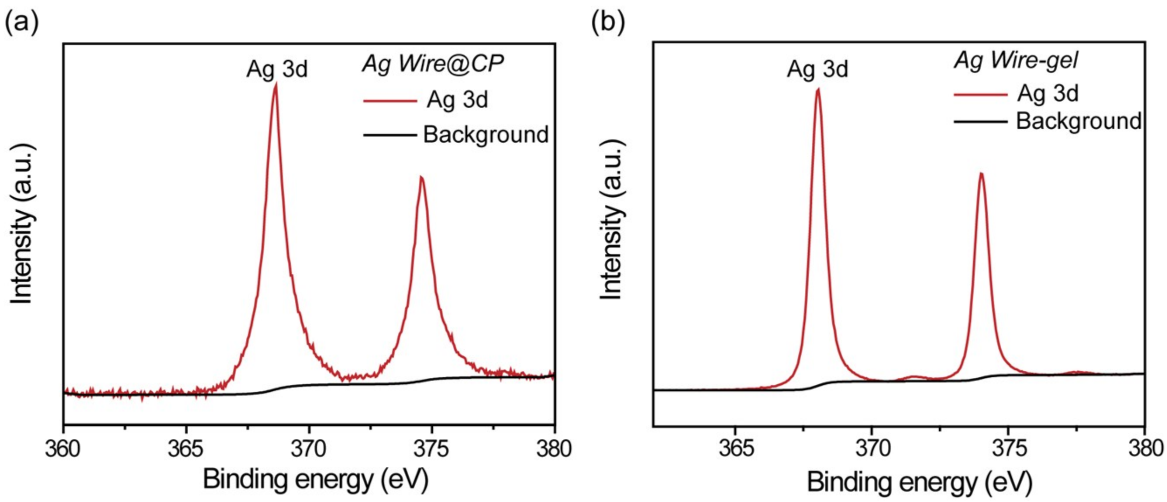


**Fig. S3** Ag 3d XPS spectra of (a) Ag Wire@CP and (b) Ag Wire-gel.

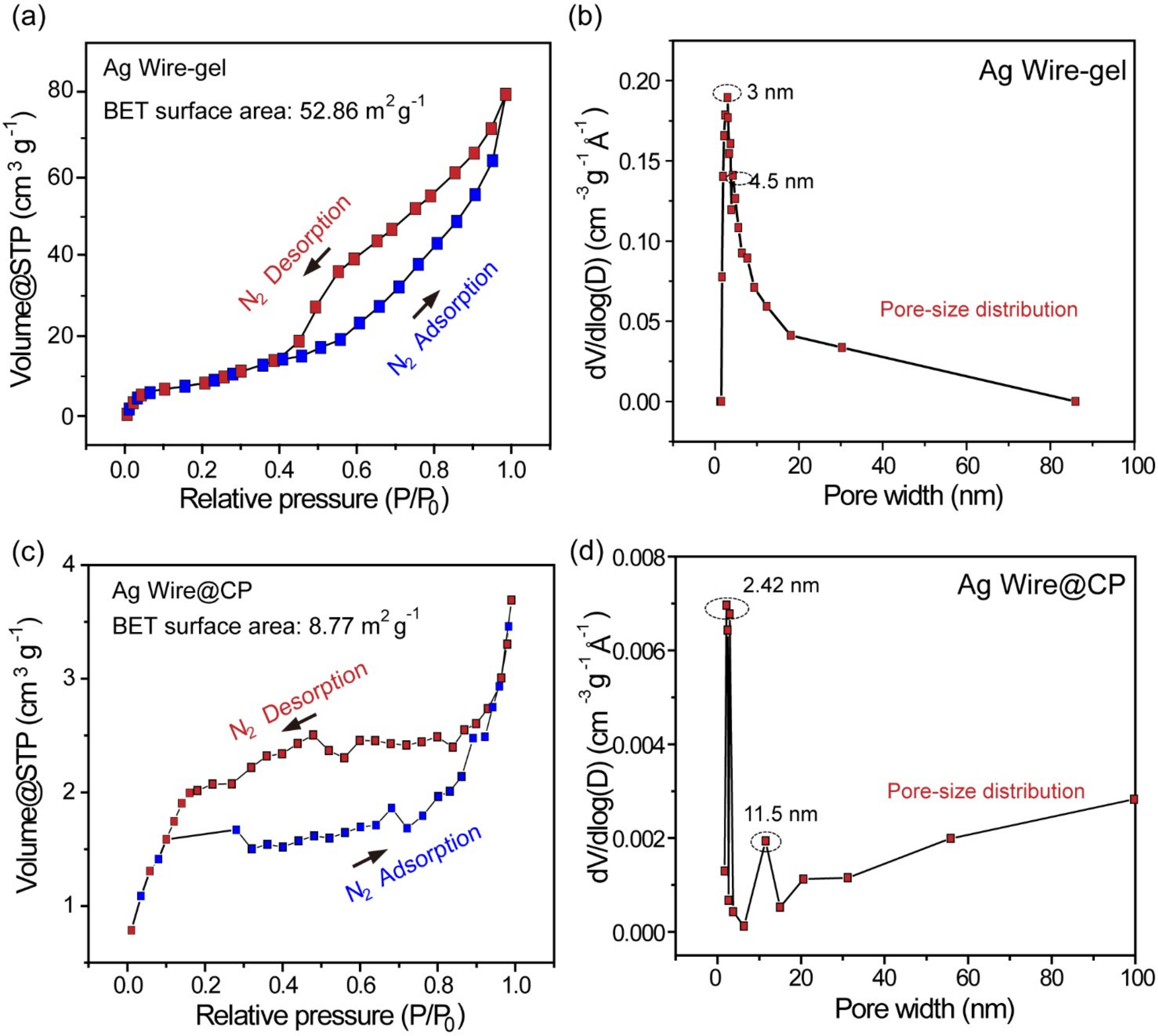


**Fig. S4** (a and c) $N_2$ adsorption (blue) - desorption (red) isotherms at 77 K and (c and d) pore size distributions of Ag Wire-gel (a, b) and Ag Wire@CP (c, d).

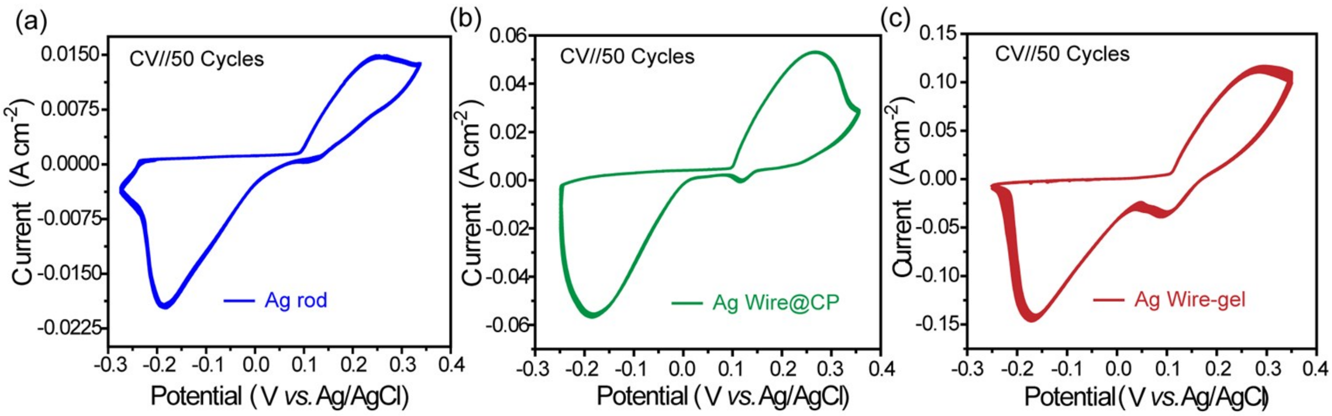


**Fig. S5** Cyclic voltammograms of (a) Ag rod, (b) Ag Wire@CP, and (c) Ag Wire-gel for 50 cycles.

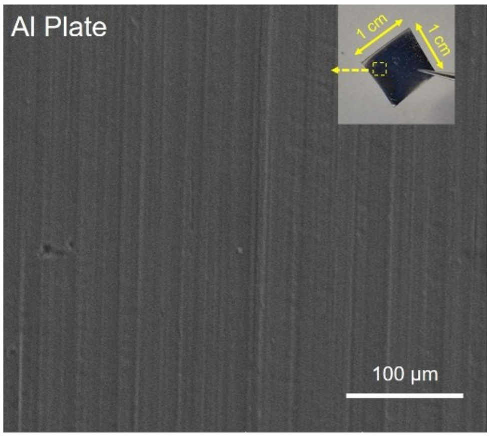


**Fig. S6** SEM image of Al plate, the fuel cell anode. Inset: Photograph showing the size of a Al-plate anode.

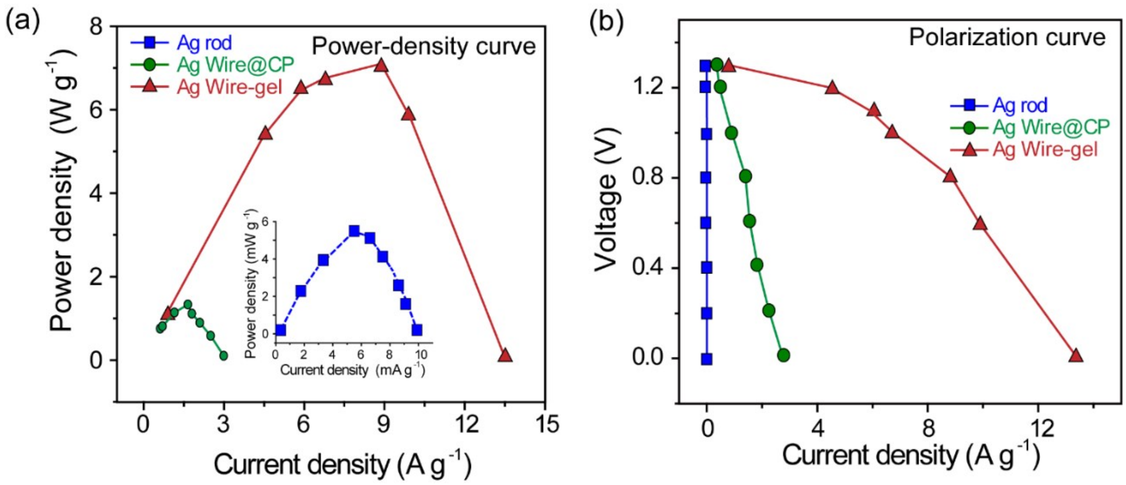


**Fig. S7** (a) Power-densities and (b) polarization curves of $H_2O_2$-fed fuel cells equipped with Ag rod, Ag Wire@CP, and Ag Wire-gel cathodes. The power densities and current densities were normalized to the Ag mass.

# Supplementary Tables

**Table S1**. Mass loadings of CP, Ag rod, Ag Wire@CP and Ag Wire-gel.

| | CP | Ag rod (diameter = 0.04 cm) | Ag Wire@CP | Ag Wire-gel |
|---|---|---|---|---|
| Mass loading (mg $cm^{-2}$) | 8 | 105.3 | 12 (4 for Ag wires) | 4 |

**Table S2.** Elementary composition of Ag Wire-gel determined by EDS.

| Element | Intensity (c s-1) | Content (wt.%) |
|---|---|---|
| C | 11.31 | 1.25 |
| Mg | 2.02 | 0.18 |
| Ag | 479.52 | 98.57 |

**Table S3.** Parameters and performances of selected μL-scale fuel cells.

| **Anodic Catalyst** | **Cathodic Catalyst** | **Electrolyte** | $I_{max}$ **(A $m^{-2}$)*** | $P_{max}$ **(W $m^{-2}$)*** | **Ref.** |
|---|---|---|---|---|---|
| **Aluminum** | **Ag Wire-gel** | ***Anolyte & Catholyte*: 0.1 M $H_2O_2$ & 1 M NaOH** | **634.7±26.6** | **299.3±33.7** | **This work** |
| Silver | Prussian Blue | *Anolyte & Catholyte*: 0.5 M $H_2O_2$ & 0.1 M HCl | 57 [a] | 8 [b] | [S1] |
| Nickel | Prussian Blue | *Anolyte & Catholyte*: 0.5 M $H_2O_2$ & 0.1 M HCl | 101 [a] | 15.5 [b] | [S1] |
| Ni/carbon Nanotube Sponge | Pt/C | *Anolyte*: 3 M Urea; *Catholyte*: $O_2$ | 230 [b] | 39 [b] | [S2] |
| Pt-Ru/C | $Pt_xSe_y$/C (x:y=5:1) | *Anolyte*: 5 M $CH_3OH$ *Catholyte*: $O_2$ | 409 [a] | 30 [a] | [S3] |
| Aluminum | Prussian Blue | *Anolyte & Catholyte*: 0.5 M $H_2O_2$ & 0.1 M HCl | 45 [a] | 10 [b] | [S4] |
| Pt-Ru/Au COP | Pt/CC (40 wt%) | *Anolyte*: 4 M $CH_3OH$ *Catholyte*: $O_2$ | 155 [a] | 32 [a] | [S5] |
| AuAg/C | Vulcan XC-72 | *Anolyte*: Laccase/Glucose *Catholyte*: $O_2$ | 19.6 [a] | 5 [b] | [S6] |
| Pt | Carbon Nitride Nanofibers | *Anolyte*: 2.1 M HCOOH *Catholyte*: 0.144 M $KMnO_4$ | 97.9 [a] | 34.3 [a] | [S7] |
| Pt | Pt | *Anolyte*: 2.1 M HCOOH *Catholyte*: 0.144 M $KMnO_4$ | 61.8 [a] | 30.9 [a] | [S7] |

| | | | | | |
|---|---|---|---|---|---|
| Pt | Au | *Anolyte*: 2.1 M HCOOH<br>*Catholyte*: 0.144 M $KMnO_4$ | 60.4 [a] | 27.2 [a] | [S7] |
| Pt-Ru | Pt | *Anolyte*: 0.5 M $CH_3OH$<br>*Catholyte*: $O_2$ | 1400 [b] | 200 [b] | [S8] |
| Pt | Pt/C | *Anolyte*: $H_2$<br>*Catholyte*: $O_2$ | 1000 [b] | 221 | [S9] |
| None | None | *Anolyte*: $V^{2+}/V^{3+}$<br>*Catholyte*: $VO_2^{+}/VO^{2+}$ | 225 | 160 | [S10] |
| Bacteria | Pt/C | *Anolyte*: Acetate<br>*Catholyte*: $O_2$ | 0.88 | 0.019 | [S11] |
| Nickel Foam | Prussian Blue | *Anolyte & Catholyte*: 0.33 M $H_2O_2$ & 0.067 M HCl | 3.68 | 0.58 | [S12] |
| None | None | *Anolyte*: 0.75 M $H_2O_2$ & 0.75 M NaOH<br>*Catholyte*: 0.75 M $H_2O_2$ & 0.325 M $H_2SO_4$ | 210 [b] | 31.2 | [S13] |

*Note: Numbers with superscripts a and b represent the reported values and the estimated values from figures, respectively.

**Table S4.** Fuels, oxidants and open-circuit voltages of selected μL-scale fuel cells.

| Fuel | Oxidant | Open-circuit potential (V) | Ref. |
|---|---|---|---|
| **$H_2O_2$** | **$H_2O_2$** | **1.3** | **This work** |
| $CH_4$ | $O_2$ | 0.7 | [S14] |
| $H_2O_2$ | $H_2O_2$ | 0.26 | [S15] |
| $H_2$ | $O_2$ | 0.81 | [S16] |
| MeOH | $O_2$ | 0.93 | [S17] |
| $CH_3COONa$ | Ferricyanide | 0.56 | [S18] |

**Table S5.** Parameters and performances of selected $H_2O_2$ sensors.

| Electrode* | Potential (V)** | Sensitivity (μA $mM^{-1}$ $mm^{-2}$) | Limit of Detection (μM) | Linear range (μM) | Ref. |
|---|---|---|---|---|---|
| **Ag Wire-gel** | **-0.5 [a]** | **4.178** | **2.1** | **2.1-1000** | **This work** |
| Ag-SWCNTs | -0.3 [b] | 10.92 | 2.76 | 16-18085 | [S19] |
| Pt-Pd/MWCNTs | 0.25 [b] | 4.148 | 1.2 | 2.5-125 | [S20] |
| Se/Pt Nanocomposites | 0.0 [a] | 0.313 | 3.1 | 10-1500 | [S21] |
| Ag NPs | -0.3 [a] | ~0.476 | 38.9 | 100-180000 | [S22] |
| Pt/MWCNTs-PANI | -0.25 [b] | 7.484 | 2.0 | 7-2500 | [S23] |
| Pt-MnO-Graphene | -0.15 [a] | 1.295 | 1.0 | 2-13330 | [S24] |
| Carbon Fiber Microelectrodes | -0.4 [a] | —— | 1.9 | 1.9-2000 | [S25] |
| Nitrogen-Doped CNTs | +0.3 [b] | 0.18 | 1.2 | 2-140 | [S26] |

Note:

*Acronyms: SWCNT: single-wall carbon nanotube; MWCNT: multi-wall carbon nanotube; NP: nanoparticle; PANI: polyaniline.

** Potentials with superscripts a and b are *vs.* Ag/AgCl and *vs.* saturated calomel electrode (SCE), respectively.

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