Supporting Information

High-Performance Supportless Silver Nanowire Catalyst for Anion Exchange Membrane Fuel Cells

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1. Estimation of the porosity of anode and cathode

For the anode, the density of carbon ($\rho_C$) is about 1.80 g cm$^{-3}$. The porous Vulcan XC-72 carbon has a total pore volume ($V_{pore}$) of 0.32 cm$^3$ g$^{-1}$. The density of porous carbon particle, $\rho_{Cp}$ is

$$\rho_{Cp} = \frac{1}{\frac{1}{\rho_c} + \frac{1}{V_{pore}}} = \frac{1}{\frac{1}{1.80} + 0.32} = 1.14 \text{ g cm}^{-3}$$

The density of 60 wt.% Pt/C, $\rho_{Pt(60\%)/C}$ is

$$\rho_{Pt(60\%)/C} = \frac{1}{\frac{x_{Pt}}{\rho_{Pt}} + \frac{x_{Cp}}{\rho_{Cp}}} = \frac{1}{\frac{0.6}{21.46} + \frac{0.4}{1.14}} = 2.64 \text{ g cm}^{-3}$$

In the anode, the active surface area and thickness are 5 cm$^2$ and 7.7×10$^{-4}$ cm, respectively. Hence, the volume occupied by Pt/C, $V_{Pt(60\%)/C}$ is

$$V_{Pt(60\%)/C} = \frac{\text{Active Area} \times \text{Pt loading}}{\rho_{Pt(60\%)/C}} = \frac{5 \times 0.4 \times 10^{-3}}{2.64} = 1.26 \times 10^{-3} \text{ cm}^3$$

The density of home-made ionomer determined by experiment is 0.94 g cm$^{-3}$.

Therefore, the volume occupied by ionomer, $V_{ionomer}$ is

$$V_{ionomer} = \frac{\text{Active Area} \times \text{ionomer} \times \text{Pt loading}}{\rho_{ionomer}} = \frac{5 \times 20 \times 0.4 \times 10^{-3}}{0.94} = 0.89 \times 10^{-3} \text{ cm}^3$$

The volume of the anode, $V_{anode}$ is

$$V_{anode} = \text{Active Area} \times \text{Thickness} = 5 \times 7.7 \times 10^{-4} = 3.85 \times 10^{-3} \text{ cm}^3$$

Therefore, the porosity of anode is

$$\varepsilon_{anode} = \frac{V_{anode} - V_{Pt(60\%)/C} - V_{ionomer}}{V_{anode}} \times 100\% = \frac{3.85 - 1.26 - 0.89}{3.85} \times 100\% = 44.16\%$$

For the cathode, the density of silver is 10.49 g cm$^{-3}$. If the loading of Ag NWs in the cathode is 1.05 mg cm$^{-2}$, hence the volume occupied by Ag NWs, $V_{Ag}$ is

$$V_{Ag} = \frac{\text{Active Area} \times \text{Ag loading}}{\rho_{Ag}} = \frac{5 \times 1.05 \times 10^{-3}}{10.49} = 1.26 \times 10^{-3} \text{ cm}^3$$

Also, the volume occupied by ionomer, $V_{ionomer}$ is
\[
V_{\text{ionomer}} = \frac{\text{Active Area} \times \frac{\text{ionomer}}{Ag} \times \text{Ag loading}}{\rho_{\text{ionomer}}} = \frac{5 \times \frac{20}{80} \times 1.05 \times 10^{-3}}{0.94} = 1.40 \times 10^{-3} \text{ cm}^3
\]

The volume of the cathode, \( V_{\text{cathode}} \) is

\[
V_{\text{cathode}} = \text{Active Area} \times \text{Thickness} = 5 \times 4.2 \times 10^{-4} = 2.10 \times 10^{-3} \text{ cm}^3
\]

Therefore, the porosity of \( \text{cathode} \) is

\[
\varepsilon_{\text{cathode}} = \frac{V_{\text{cathode}} - V_{Ag} - V_{\text{ionomer}}}{V_{\text{cathode}}} \times 100\% = \frac{2.10 - 0.50 - 1.40}{2.10} \times 100\% = 9.52\%
\]
2. Supplementary Figures

Figure S1. Low-resolution SEM image of as-prepared Ag NWs.
Figure S2. The dependence of electron transfer number on the potential for Ag NWs.
The inset shows Tafel plot for Ag NWs.
Figure S3. (a) A typical low-revolution TEM image of home-made Ag nanoparticles (NPs) supported on graphene nanosheets (Ag/GNS); (b) high-revolution TEM image of Ag NPs. The interfringe distance was measured to be 2.30 Å, which could be indexed to the (111) plane of the fcc-structured Ag.
Figure S4. Polarization curves (filled symbols) and power density curves (empty symbols) of \( \text{H}_2/\text{O}_2 \) AEMFCs with Ag NWs, Ag NWs physically mixed with 20 wt.% GNS, Ag/GNS and commercial Pt/C as the cathode catalyst. The Ag loading in the Ag-based catalyst was 1.05 mg\textsubscript{Ag} cm\textsuperscript{-2} while the Pt loading in commercial Pt/C catalyst was 0.5 mg\textsubscript{Pt} cm\textsuperscript{-2}. The ionomer loading in all the samples was controlled at 20 wt.%. Other operating parameters were stated in the experimental section.
Figure S5. CV curves of Pb UPD in Ag/GNS. The electrochemical surface area (ECSA) was 10.65 m² g⁻¹ through analyzing the charge associated with Pb underpotential deposition (UPD) on Ag nanoparticles.
Figure S6. AC impedance spectra of AEMFCs before and after constant current discharge (Frequency: 100 kHz-0.1 Hz; temperature: 60ºC; Anode: hydrated hydrogen gas, 500 sccm; cathode: hydrated oxygen gas, 500 sccm).