

Electronic Supplemental Information (ESI)

Preparation of radiation-grafted powders for use as anion exchange ionomers in alkaline polymer electrolyte fuel cells

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University of Connecticut (UConn) Electrode Preparation and Fuel Cell Setup

Materials

The AAEM and AEI as described in the primary text were supplied to the UConn team by the Surrey team. 50% mass Pt/Vulcan (BASF) was used at both the anode and cathode. Carbon paper gas diffusion layers (GDL), without a microporous layer (Toray), were used at both electrodes. To make the ink, reagent grade isopropanol (Fisher) was employed. All materials were used as received and 18 M Ω cm deionized water (produced from a Millipore Direct-Q 3UV system) was used throughout.

Electrode preparation

The ETFE-g-poly(VBTMAC) AEI powder was ground with a pestle and mortar for 10 min to reduce the amount of aggregated particles. Next, the Pt/C catalyst and AEI were mixed in a 15:85 mass ratio and ground together with a mortar and pestle with 1 mL water for 10 min until a visually homogeneous ink was produced. Third, 10 mL IPA was added to the mortar and pestle and ground for a further 5 min; then the catalyst ink was transferred to a secondary container and mixed with a magnetic stir plate for 15 minutes before being homogenised ultrasonically for 1 h. The catalyst ink was subsequently sprayed onto the 5 cm² GDL. The total Pt loading of the resulting gas diffusion electrodes (GDEs) were 0.55 ± 0.05 mg_{Pt} cm⁻² for all of the electrodes.

Fuel Cell Assembly and beginning of life testing

After their preparation, the electrodes were immersed in water for 10 min to hydrate the AEI. During this hydration process (and before conversion of the polymer electrolyte components of the MEA to the OH⁻ form), no electrocatalyst or AEI particles were observed to wash off the electrode surface, showing adequate adhesion of the electrodes onto the GDL for fuel cell testing. All AEI-containing electrodes and AAEMs were then immersed in aqueous 1 mol dm⁻³ KOH for 1 h, then washed thoroughly with copious deionized water to remove excess KOH species.

The GDEs and AAEM were layered (GDE/AAEM/GDE) and secured between two graphite plates with 5 cm² serpentine flow channels and PTFE gaskets with no prior hot-pressing (5.1 N m torque with a 20% pinch). An 850e Scribner Fuel Cell Test Station was used for the testing (the same equipment as used by the Surrey team). The fuel cell temperature was 60 °C. The H₂ and O₂ gas feeds were supplied to the anode and cathode, respectively, at 750 cm³ min⁻¹ at 100% relative humidity with no back-pressure. Polarization curves were collected under potentiometric control at 10 mV s⁻¹.

Results and Discussions

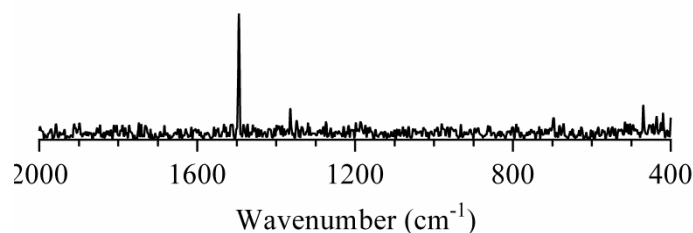


Fig. ESI1 FT-Raman spectra of empty sample chamber: Spurious peak is an artefact of an aging Laser Line Filter in Surrey's instrument.

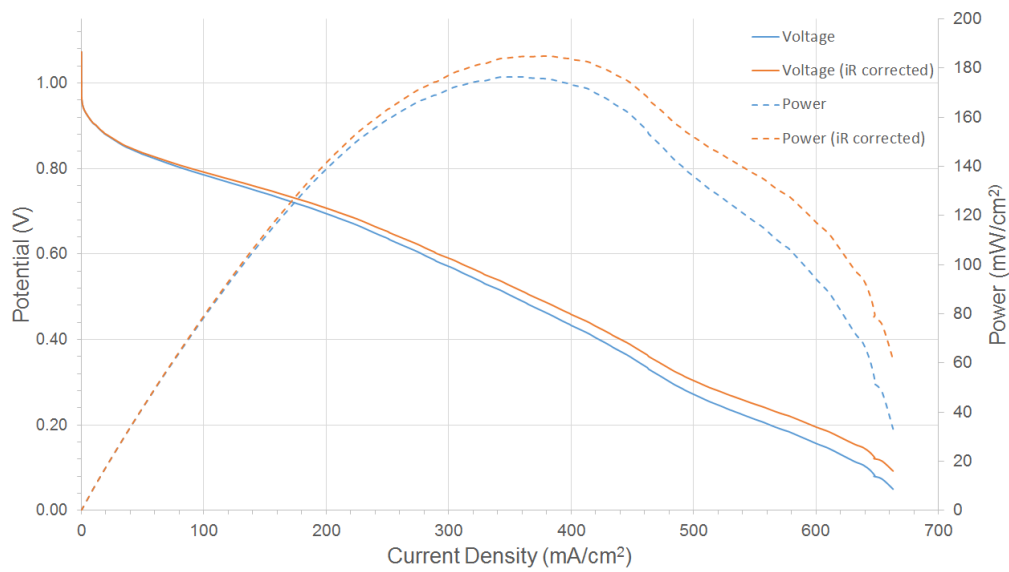


Fig. ESI2 The *iR*-corrected and non-*iR* corrected polarization curves for the MEAs made at the University of Connecticut.