Electronic Supplementary Material (ESI) for Energy & Environmental Science.

- SUPPLEMENTARY MATERIAL -

An Electrochemical Cell with Gortex-based Electrodes Capable of Extracting Pure Hydrogen from Highly Dilute Hydrogen-Methane Mixtures

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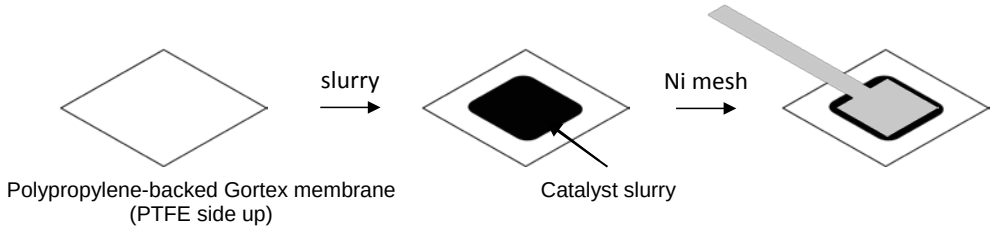


Figure S1. Preparation of slurry/mesh/Gortex membrane assemblies.

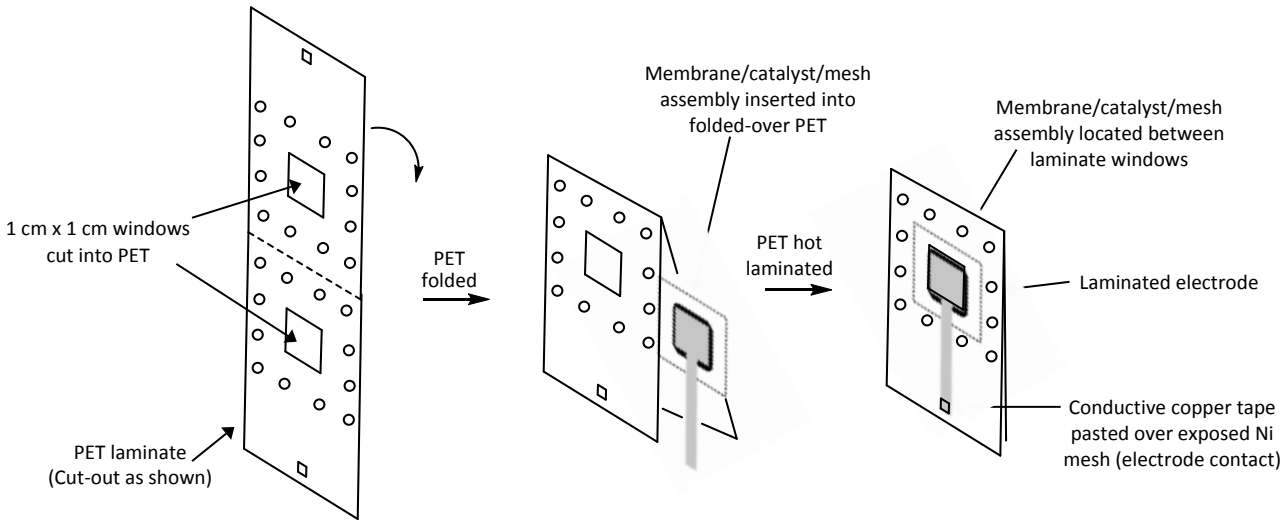
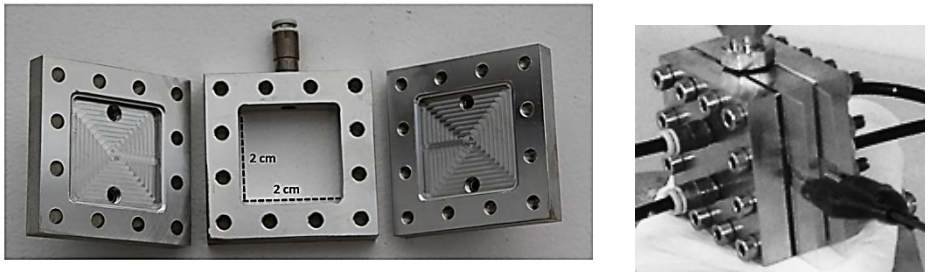


Figure S2. Preparation of laminate-mounted electrodes.

(a)



(b)

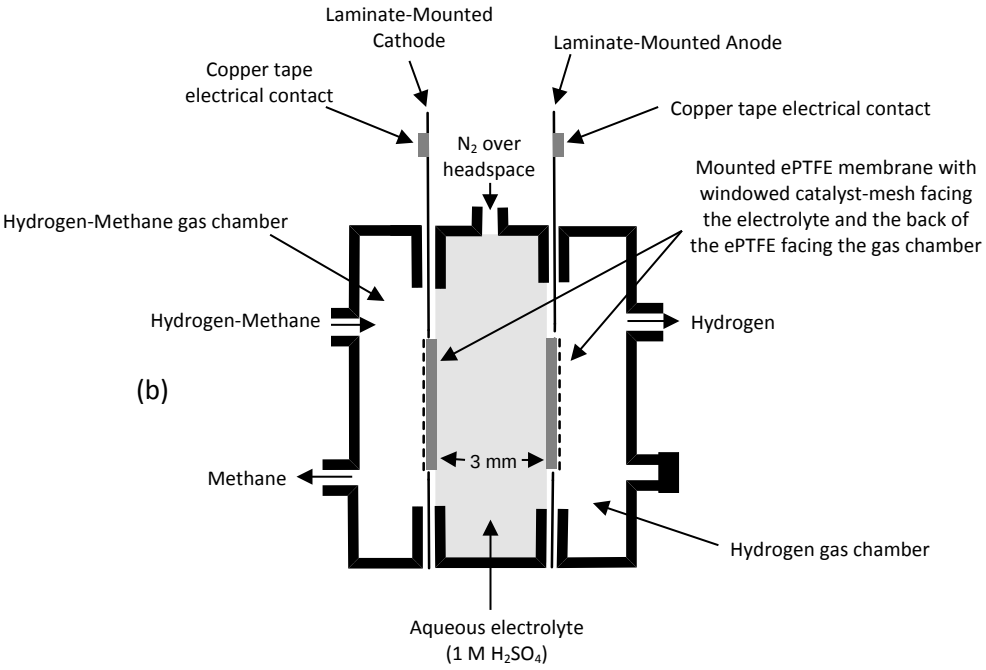
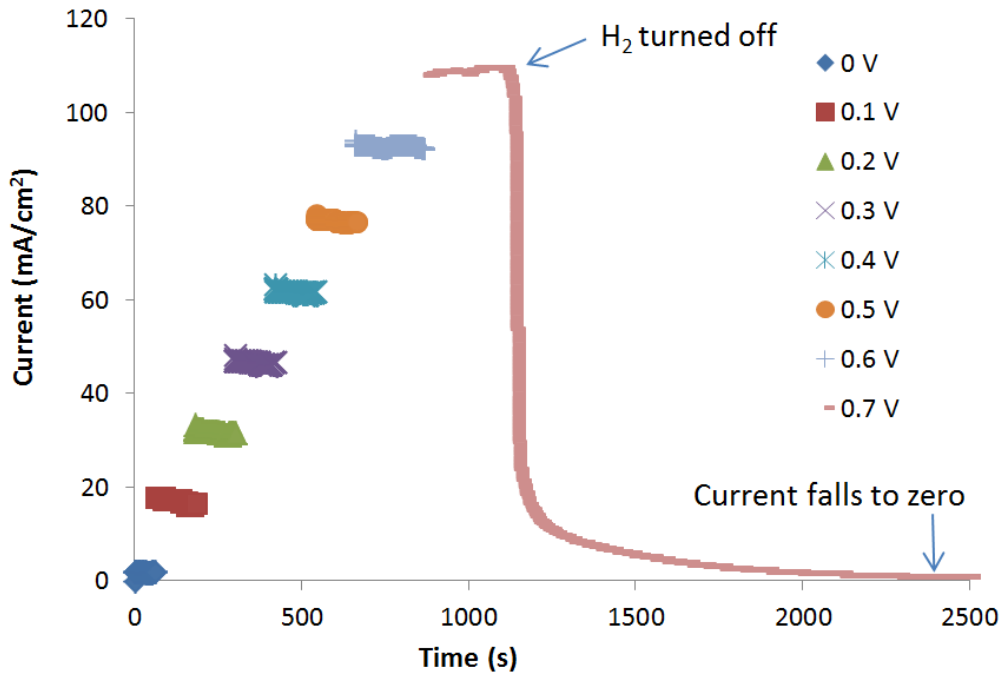


Figure S3. Photographs (a) and cross-sectional schematic (b) of the test cell, showing the electrical and gas connections.

Experiment number	Flow conditions at anode	Potential applied	Observation
1	10 mL/min, pure (100%) CH_4	None (3-electrode; vs Ag/AgCl)	No bubbles due to CH_4 crossover observed at cathode when monitored for 20 min
2	50 mL/min, pure (100%) CH_4	None (3-electrode; vs Ag/AgCl)	No bubbles due to CH_4 crossover observed at cathode when monitored for 20 min
3	10 mL/min, pure (100%) CH_4	-0.2 to +0.4 V (3-electrode; vs Ag/AgCl)	No current observed and no bubbles oberved at cathode
4	50 mL/min, pure (100%) CH_4	-0.2 to +0.4 V (3-electrode; vs Ag/AgCl)	No current observed and no bubbles oberved at cathode
5	During potential sweep: 10 ml/min CH_4 + 10 ml/min H_2 (i.e. 50% H_2 & 50% CH_4). After potential sweep (at +0.4 V): H_2 flow turned off (i.e.becomes 100% CH_4)	-0.2 V to +0.4 V (3-electrode; vs Ag/AgCl)	Increasing currents observed with increasing potential. At +0.4V vs Ag/AgCl, when H_2 flow was stopped, the current fell to zero (with CH_4 flow still on).
6	During potential sweep: 10 ml/min CH_4 + 10 ml/min H_2 (i.e. 50% H_2 & 50% CH_4). After potential sweep (at +0.7 V): H_2 flow turned off (i.e.becomes 100% CH_4)	-0.2 V to +0.7 V (2-electrode)	Increasing currents observed with increasing potential. At +0.7 V, when H_2 flow is stopped, current falls to zero. (Graph shown below)

Table S1. Experiments to assess methane reactivity at the anode and methane crossover to the cathode during cell operation.

Graphical data from experiment 6 above:



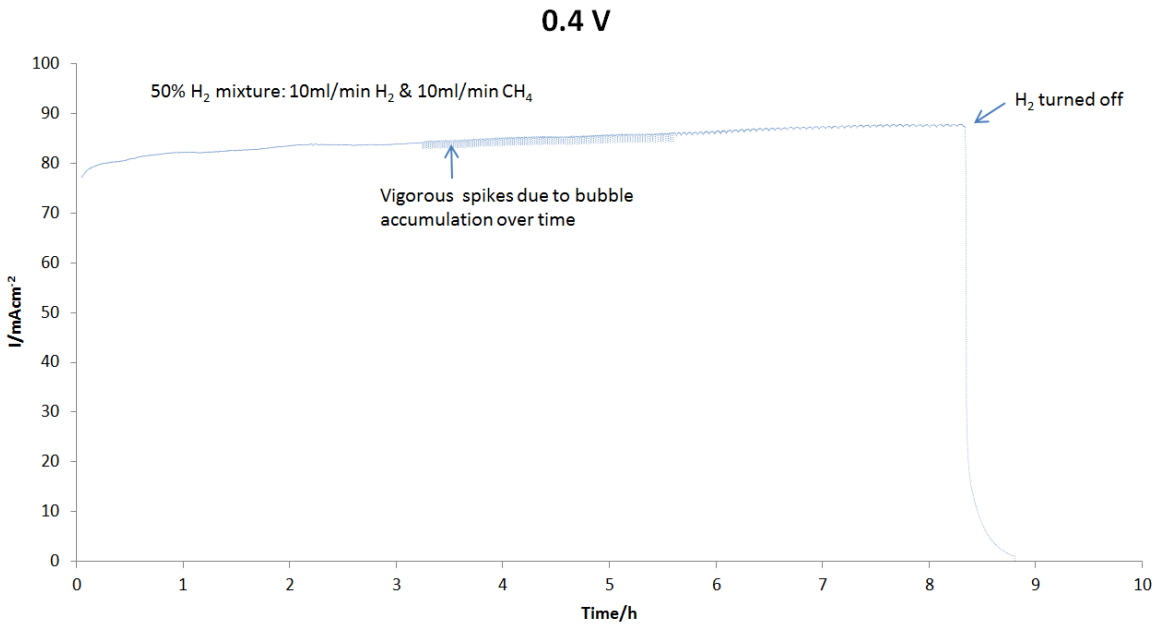


Figure S4. Long-term performance of the cell at 0.4 V (vs. Ag/AgCl) with a mixture of 10 mL/min hydrogen and 10 mL/min methane flowing through the anode.