Hydrogen production from short-chain alcohols using polymeric proton conductors

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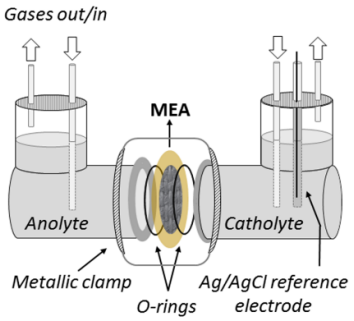
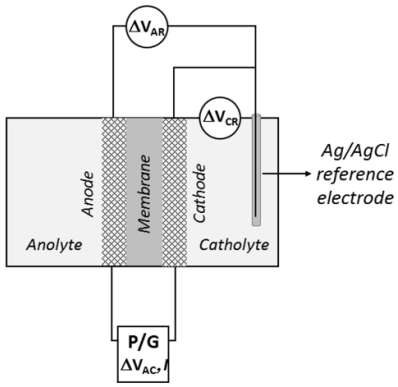
Alcohol electrolysis or electrochemical reforming of alcohols : An alternative approach for H2 production with low power demands

Current status:

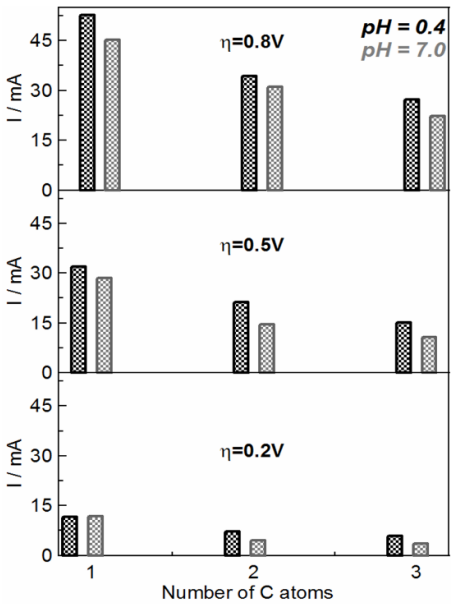
- Alcohol electrooxidation in single-chamber reactors: Electrocatalysts supported on glassy-carbon substrates, The effect of the cathodic is not evaluated.
- Alcohol electrolysis with polymeric membranes: The effect of anolyte's pH is ignored. No studies with alcohol mixtures.

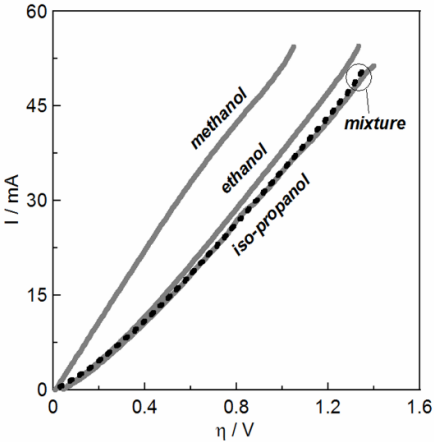
We used H^+ conducting polymeric electrolytes for H_2 production through electrolysis of different short-chain alcohols and of an alcohol mixture. An alternative reactor design allowed us to quantify individual potential losses, while we also examined the role of the anolyte solution's pH on the performance of each step.

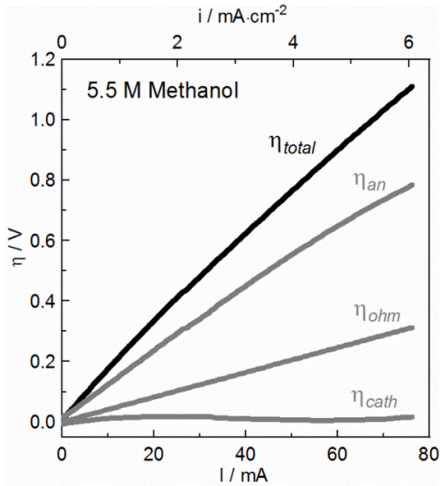




The aqueous phase in our study allows the utilization of a standard Ag/AgCl reference electrode for monitoring the anodic and cathodic overpotentials. Ohmic overpotential was quantified via Electrochemical Impedance Spectroscopy.







Main findings:

- The overall performance is mainly (~75%) affected by the sluggish anodic reaction (i.e. alcohol electrooxidation).
- Proton transport through the electrolytic membrane has a smaller contribution while the cathodic overpotential is negligible in all cases.
- Cell currents under standard applied potentials decrease as the number of C-atoms in the alcohol increases, due to the formation of strongly adsorbed intermediates and to the need for breaking the C-C bond.
- When using alcohol mixtures, the heaviest alcohol dictates the cell performance.
- Changes in the pH of the anolyte solution within the acidic regime affect the anodic half-reaction, in a way that the presence of ionic agents in the solution extends the reaction zone and thus increases reaction rates.

References:

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