Characterization of Catalysts on the Oxidation of Lactic Acid in Direct Lactic Acid Fuel Cells

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Objective

- Characterizing the performances of different catalysts Pt, Pd, Pt-Ru, and MoC on the oxidation of lactic acid to generate current for fuel cell application

Lactic Acid

- Mostly known by the achy sensation one gets after an intense workout
- Widely used in various industries such as food and cosmetics
- Mostly produced from fermentation of crops
- 130,000 tons of lactic acid are produced annually in the US
- Contact with concentrated lactic acid may cause skin peeling

Properties of Lactic Acid

- Boiling Point = 122°C
- Melting Point = 17°C
- Density = Lactic acid: water = 1.2:1
- Solubility: readily miscible in water
- Contact with concentrated lactic acid may cause skin peeling

Production of Lactic Acid

Glucose and Sorbitol

Key Terms

- Anode – the negatively charged terminal of the fuel cell that electric current travels from
- Cathode - the positively charged terminal of the fuel cell that electric current travels to
- Open cell potential (OCP) – the highest voltage obtainable with no current
- Load – applied resistance to obtain current
- Mass transport – the transport of hydrogen ions by water molecules through the MEA from anode to cathode

Kinetic of Lactic Acid

- CH₃-CH(OH)-COOH → CH₃-CH(OH)-COO⁻ + H⁺ + e⁻ (natural reaction in water)
- CH₃-CH(OH)-COOH + CH₃CHO + CO₂ + 2H⁺ + 2e⁻ (acetaldehyde)
- CH₃-CH(OH)-COOH → CH₃CO-COO⁻ + 2H⁺ + 2e⁻ (pyruvic acid)
- CH₃-CH(OH)-COOH + 3H₂O → 3 CO₂ + 12H⁺ + 12e⁻ (complete oxidation to water and carbon dioxide)

Conclusion & Future Works

Pt-Ru and Pd are possible candidates that can generate a viable current for the fuel cell. Their performances possess the potential of enhancement with further research. From the CV test results, Pd was found to show undetectable kinetics that needs to be studied further. Analysis of the byproducts would help identify the chemical reactions that have taken place.

References


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