Development of Electrolyte Additive for Self-Corrosion Control of Aluminum Air Battery Electrodes

Al Logmani, Jamal (School: King Fahd University of Petroleum and Minerals (KFUPM) Boys High School)

The growing demand for energy sparked the transition from fossil fuels, which contribute to climate change, to sustainable solutions, by storing renewable energy in batteries. Lithium-ion batteries are widely used, but their viability has been questioned due to their low-energy density, high-cost, safety concerns, and contribution to water contamination. A proposed solution lies in aluminium-air batteries (AAB), which address these limitations. Nonetheless, AABs are limited by a self-parasitic reaction which diminishes effectiveness and shortens lifespan. The introduction of additives to the electrolyte has been proposed as one of the solutions to address this challenge. This project aims to develop hydroxyethyl cellulose (HEC) as a novel anti-corrosive electrolyte additive and study the effect of its concentration on the corrosion rate of the anodic Al electrode, battery performance and hydrogen evolution reaction of the cathodic electrode using NaOH as the electrolyte. Weight-loss, potentiodynamic polarization (PDP), and linear polarization resistance (LPR) tests were conducted to assess HEC's effectiveness. Additionally, the synergistic effect of dioctyl sulfosuccinate sodium salt (DOS) was also explored. The results show that increasing the concentration of HEC improved the effectiveness of the additive. Electrochemical data show an increase in inhibition efficiency (82% at optimum concentration) upon the addition of DOS whilst not altering HEC's inhibition mechanism. Surface analysis using 3D optical profilometry coupled with FTIR showed that the corrosion inhibition mechanism of HEC occurs by adsorption of HEC molecules on the Al surface. In conclusion, the utilization of the developed additives addresses the challenges of AABs, expanding their applicability.