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SYNTHESIS AND CHARACTERIZATION OF BIOMASS-BASED POLYMER ELECTROLYTES FOR CO2 REDUCTION OF IN-SITU RESOURCE UTILIZATION APPLICATIONS

Abstract

Purpose: The utilization of *in-situ* resources such as food waste or plants grown on Mars combined with the available Martian regolith and atmosphere presents a path towards battery separators with increased sustainability, energy density, and durability. Separators that focus on CO2 reduction take advantage of both a highly relevant source of materials on Mars and a solution to an increasingly relevant problem of the increase of atmospheric CO2 on Earth.

Methodology: Testing the most efficient extraction methods of soybean hull and tomato pectins from inedible biomass to determine yield and efficiency through a system of acid dissolution and a cycle of centrifugation and washing with alcohol is studied. Chemicals and metal ions in this process could be extracted from Martian regolith, while soy and tomato are chosen for their designation as “plants of interest” for NASA deep space missions. Changing solvent and precipitant concentration will define polymer performance by characterizing molecular weight, degree of methoxylation, galacturonic acid content, and degree of blockiness. Cross-linking and ionic activity of the pectin-based polymer gels will be determined by integration of a monovalent (Na) and divalent (Ca) cation seperately to determine optimum viscosity, conductivity, and transmittance.

Results: Well-defined extraction products and method, as well as a polymer with reproducible characteristics are synthesized and characterized. A high yield of pectin, ideal characteristics, and polymer with higher energy conductivity are expected. The most important result is the comparison of ionic conductivity of the polymer and the functionality in a CO2 reduction cell to other leading methods. While the current project is still in its initial stage, a previous study shows commercial pectins producing promising levels of ionic conductivity when applied as films, as well as stability over temperature ranges [1]. This study lays the groundwork for application to different extraction processes, ionic solutions, and chemical conversions.

Conclusions: A biomass-based polymer electrolyte provides a novel method of using in-situ resources for chemical conversion and energy storage that is critical for long-term space travel. While this project is still in the initial stages, the benefits in sustainability, durability, and energy density that it could provide are substantial.

Areas for discussion: At what point does the availability of resources and chemical conversion efficiency outweigh previous high performing methods with more circumstantially rare components.

References:

[1] J. R. Andrade, E. Raphael, and A. Pawlicka, Plasticized pectin-based gel electrolytes, *Electrochimica Acta*, vol. 54, no. 26, pp. 6479-6483, Nov 2009.