Microgravity effects of nanoscale mixing on diffusion limited processes using electrochemical electrodes

Problem Statement

- The test/design of the electrodes is directed towards optimizing the Electrochemical Ammonia Reduction (EAR) subsystem, critical to the Forward Osmosis Secondary Treatment (FOST) system. This project is covered by the Office of the Chief Technologist Next Generation Life Support project.

- In previous research by Micro-G CANM1 the electrochemical oxidation of ammonia in microgravity using different nano-materials led to 20-65% decrease in the catalytic current. This flight opportunity is to test mitigation approaches to improve electrode technology and better understand the phenomenon.

Technology Development Team

Principle Investigators: Dr. Carlos Cabrera,University of Puerto Rico (UPR), carlos.cabrera2@upr.edu; and Michael Flynn, NASA Ames.

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Organizations involved: Department of Chemistry, NASA URC Center for Advanced Nanoscale Materials, UPR & NASA ARC.

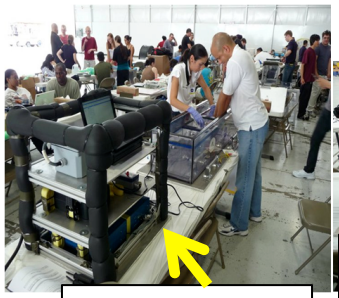
Proposed Flight Experiment

Experiment Readiness: Experiment will be ready for flight for the September 2012 campaign.

Test Vehicles: Parabolic Flight

Test Environment: The equipment flew on June 2011 via the 2011 NASA Microgravity University / Minority Institution Flight Week Program (Proposal Number 2011-25329) and now it's been approved via proposal NOCT110 Call #3.

Test Apparatus Description: The Electrochemical Microgravity Laboratory (EML) is comprised of 2 major components: (a) Electronics Rack (ELR) to control the electrochemical operation and (b) Experimental Equipment Box (EEB) double contained Makrolon™ box safely containing the electrochemical cells (triple containment in overall).



Electronics Rack

Experiment Equipment Box

Technology Maturation

- The proposed research is TRL 5.

- Component validation in a microgravity environment is imperative. The design of the electrodes for the EAR is critical to its correct sizing and integration to the FOST system. The EAR has delivery date of Jan 2013. Without this flight opportunity on Sept 2012 this milestone will not be met.

Objective of Proposed Experiment

Objectives: Test approaches developed to mitigate the decrease in catalytic current by: (1) inducing hydrodynamic turbulent mixing at three different flow rates; (2) the reengineering of the electrode geometry and pore structure by: (a) utilizing bulk electrolysis and (b) changing the pore size employing three different mesoporous carbon supports (average diameters of: 64, 100 and 137 Å).

Environmental Control and Life Support Systems (ECLSS) and Habitation Systems - Water Recovery and Management