FLORIDA STATE UNIVERSITY

Innovative Proton Conducting Membranes for Fuel Cell Applications & Protein Enhanced Proton Conduction Membranes for Advanced Fuel Cells

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Description: The objective of this proposal is to establish new research directions in the development of proton conducting materials for fuel cell applications. We will build novel high surface area silica particle based membranes as supports, and infuse in them newly discovered proton conducting protein nanomaterials as well as oxide-based nanocomposites. In order to test electrical transport mechanisms, we will build microfabricated electric testing structures, and subsequently integrate materials with fuel cell test setups.

Budget: $30,000

Progress Summary

Task 1: Fabrication of silica and latex-supported membranes and oxide-based nanocomposites

To help carry out this work, two students so far have been recruited – 1) Erin Holley: a graduate student (masters) has started school at FSU in the newly formed materials science and engineering department. Erin was an undergraduate at FSU in the department of chemical and biomedical engineering whom we have convinced to stay on and pursue graduate school due to her interest in the proposed research. 2) Mayra Gonzalez: A Junior in chemical and biomedical engineering has started working in our labs to help characterize the membranes and is working with Erin Holley. Recruiting these two students we feel is a key step forward in the project.

Experimental setup of equipment for gas and water permeability:
A considerable amount of time was spent by Erin in overcoming difficulties and in setting up the equipment for gas and water permeability measurements (Figure 1). Commercial membranes were then successfully characterized using the above equipment (Figure 2). Thus, we now have the capability to characterize membrane pore size and water permeability's in our capabilities and this will play an important role in characterizing the membranes.

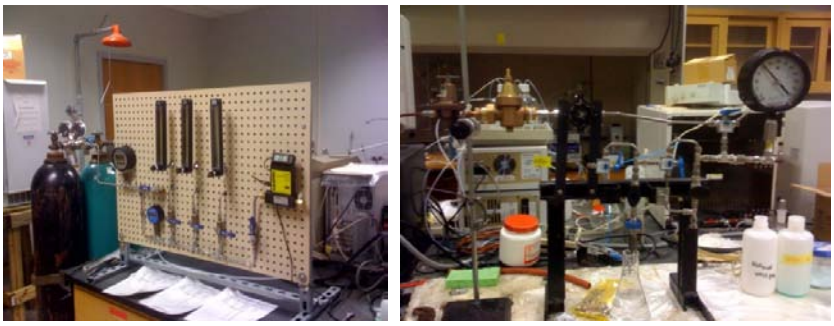

Figure 1: Experimental setup to measure pore size distribution and water permeability of membranes.

Future Work

- Integration of proteins & particle-based membranes
    - Protein infused silica → high porosity
    - Silica infused protein → low porosity
    - Assessment of adsorption and linking of proteins onto silica surfaces will be studied using Quartz Crystal Microbalance (QCM)
- Analysis of transport mechanisms in proteins

Future Funding

- Each PI submitted an NSF CAREER proposal (July 2009) building upon preliminary work enabled with IESES support
- DOE's Basic Energy Science (BES) program – 2010 submission
- NSF's Interdisciplinary Research (IDR) program – Dec 2009 submission is being considered