Poly(cyclohexadiene)-Based Polymer Electrolyte Membranes for Fuel Cell Applications

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May 19, 2006

This presentation does not contain any proprietary or confidential information

Project ID #: FCP 3

Overview

Timeline

- Start: April 2006
- End: April 2011
- 1% complete

Budget

- Total project funding
  - DOE share $1.5M
  - Contractor share $500K
- Funding received in FY05: $300K
- Funding for FY06: $300K

Barriers

- Barriers addressed
  - Thermal stability of PEMs
  - High temperature, low RH proton conductivity
  - Cost

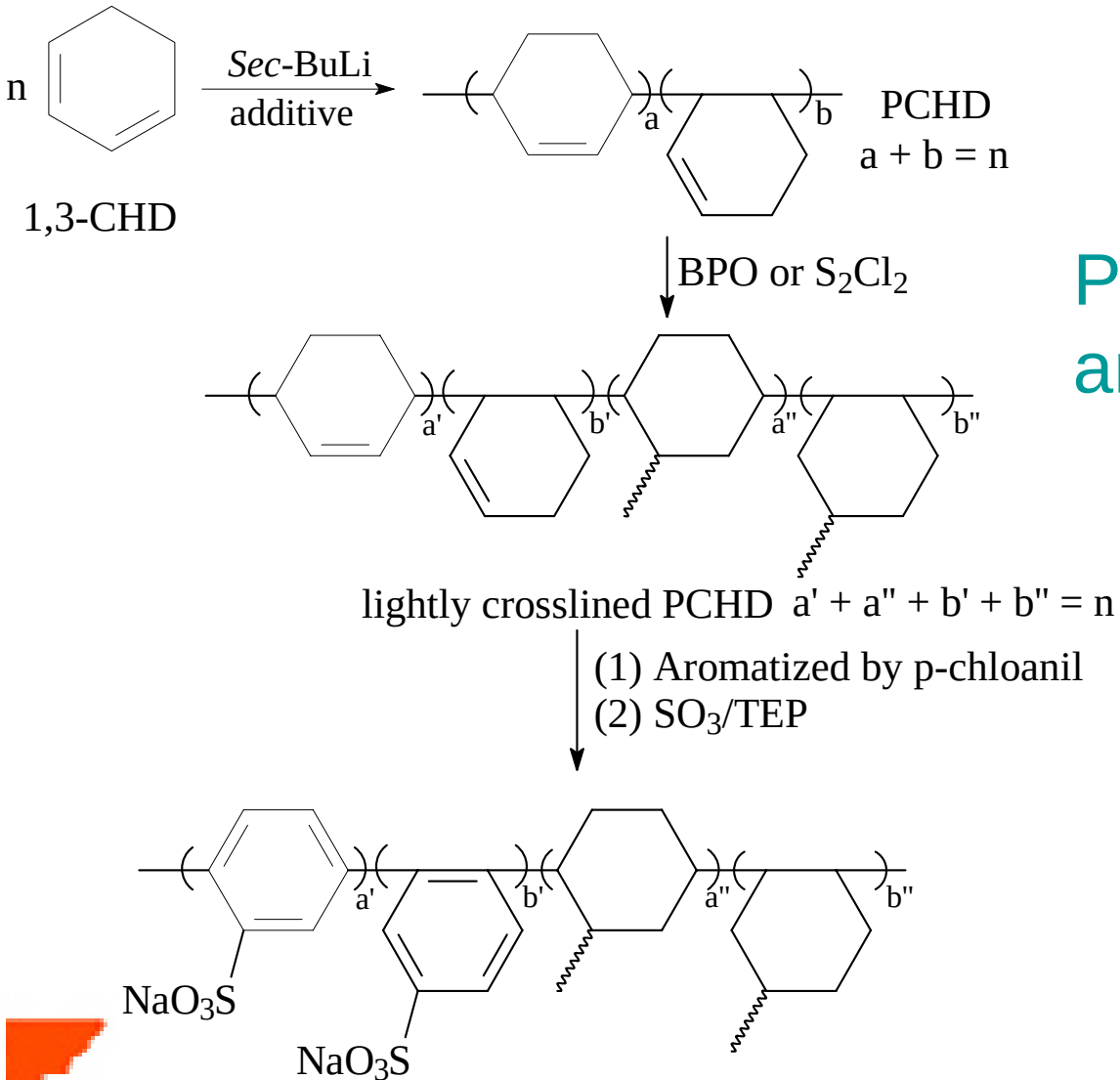
Partners

- Univ. of Southern Mississippi
- ORNL
- Battelle

Objectives

- Design, synthesize and characterize new non-Nafion PEM materials that conduct protons at low (25-50%) RH and at temperatures ranging from room temperature to 120 ºC.
- To achieve these objectives, a range of homopolymer and copolymer materials incorporating poly(cyclohexadiene) (PCHD) will be synthesized, derivatized, and characterized.

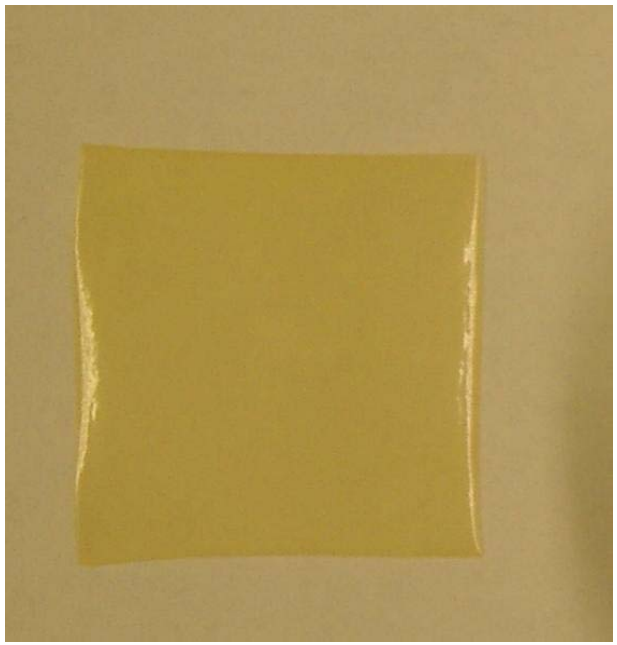
Accomplishments

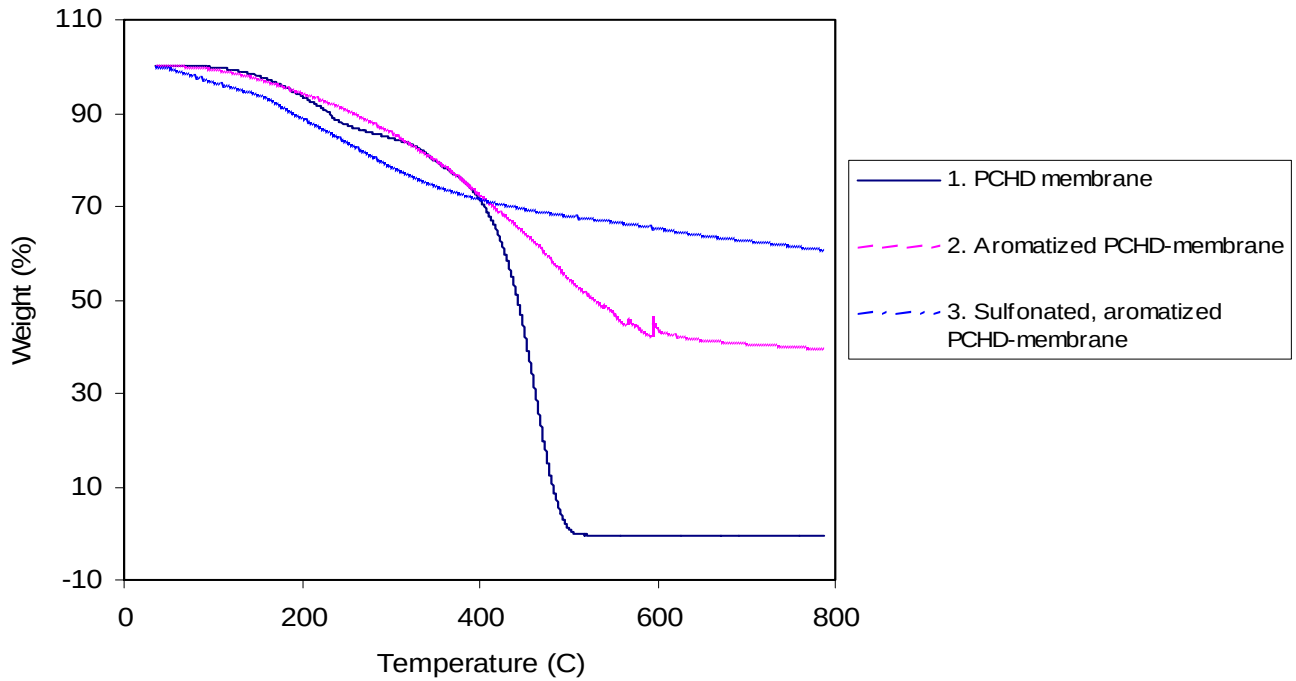


Polymer Synthesis and Modification

aromatization is optional or may be controlled

Accomplishments Slides (con't)





Left: A photograph of a cross-linked 2.5"X2.5" PCHD membrane; Right: TGA curves 1) for the cross-linked PCHD membrane, 2) after aromatization, 3) after aromatization and sulfonation

Accomplishments Slides (con't)

- Materials were characterized by FT-IR, SEM, and elemental analysis

- A membrane of crosslinked, aromatized (90 mol %),and sulfonated (13 mol %) PCHD was tested.
- Water uptake was 5.3 wt %.
- Proton conductivity was measured for this membrane using a 4-point fixture immersed in water (J. Sayre, Battelle): 1.2 E-02 S/cm at room temperature and 2.8 E-02 S/cm at 80 ºC.

- A membrane of crosslinked, non-aromatized, and sulfonated (47 mol %) PCHD was tested. Water uptake was 4 wt %.
- Proton conductivity: 1.6 E-02 S/cm at room temperature and 3.6 E-02 S/cm at 80 ºC.

Future Work

- A milestone by the end of Year 1 is the synthesis of additional PCHD-based membranes, as described above, with optimization of molecular parameters, including extent of aromatization and degree of sulfonation. These membranes will be thoroughly characterized.
- Sol-gel chemistry will be used to grow hydrophilic nanophases within the membranes.
- Materials synthesis work will expand to incorporate fluorinated species through post-polymerization chemistry and copolymerization.