



... for a brighter future

High Temperature Membrane Working Group

May 14, 2007



U.S. Department
of Energy

UChicago ►
Argonne_{LLC}

A U.S. Department of Energy laboratory
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High Temperature Membrane Working Group Meeting Agenda

■ AGENDA

- 4 p.m. *Welcome and Introductions* John Kopasz/Amy Manheim
- 4:15 pm *Discussion overview* James Fenton
- 4:30 p.m. *Universal Membrane Classification Scheme* John Kopasz, Argonne
- 5:00 pm *Membrane/MEA Durability Test Conditions* Tom Benjamin, Argonne
- 5:30 pm *Classification and Durability Discussion*
- 6:30 pm *Dinner on your own*
- 7:30 pm *Membrane Conductivity In-Plane Testing Results*
Tim Bekkedahl, BekkTech
Kevin Cooper, Scribner
- 8:30 pm *CARISMA - A Networking Project for High Temperature PEMFC MEA Activities in Europe*
Anca Faur Ghenciu,
Johnson Matthey Fuel Cells
- 9:00 pm *Questions and Discussion*
- 9:15 pm *Adjourn Working Group Meeting*

EERE Membrane Schedule at DOE HFCIT Review AM

Wednesday, May 16					Schedule as of:
Number	Time	Presenter	Organization	Title	
FC 8	8:00 AM	John Vogel	Plug Power	Development of Polybenzimidazole-based High Temperature Membrane and Electrode Assemblies for Stationary Applications	
FC 9	8:30 AM	Jung Yi	Arkema Chemicals	Development of a Low-cost, Durable Membrane and MEA for Stationary and Mobile Fuel Cell Applications	
FC 10	9:00 AM	Mike Yandrasits	3M	MEA and Stack Durability for PEM Fuel Cells	
FC 11	9:30 AM	Robert Moore	U of So. Mississippi	Improved Membrane Materials for PEM Fuel Cell Applications	
Break	10:00 AM				
FC 12	10:30 AM	Morton Litt	Case Western Reserve University	Poly(p-phenylene Sulfonic Acid)s with Frozen-in Free Volume for use in High Temperature Fuel Cells	
FC 13	10:50 AM	Jimmy Mays	U of Tennessee	Poly(cyclohexadiene)-Based Polymer Electrolyte Membranes for Fuel Cell Applications	
FC 25	11:10 AM	Peter Pintauro	Case Western Reserve University	NanoCapillary Network Proton Conducting Membranes for High Temperature Hydrogen/Air Fuel Cells	
FC 15	11:30 AM	James Fenton	U of Central Florida	Lead Research and Development Activity for High Temperature, Low Relative Humidity Membrane Program	
Lunch	12:00 PM				

EERE Membrane Schedule at DOE HFCIT Review PM

Wednesday, May 16

Schedule as of:

Lunch 12:00 PM

FC	16	1:15 PM	Dominic Gervasio	Arizona State	Protic Salt Polymer Membranes: High-Temperature Water-Free Proton-Conducting Membranes
FC	17	1:35 PM	Andrew Herring	Colorado School of Mines	Novel Approaches to Immobilized Heteropoly Acid (HPA) Systems for High Temperature, Low Relative Humidity Polymer-Type Membranes
FC	18	1:55 PM	Ludwig Lipp	FuelCell Energy, Inc.	High Temperature Membrane With Humidification-Independent Cluster Structure
FC	19	2:15 PM	Ryo Tamaki	General Electric	Design and Development of High-Performance Polymer Fuel Cell Membranes
FC	20	2:35 PM	Stephen Creager	Clemson	Fluoroalkylphosphonic-acid-based proton conductors

Break 3:15 PM

<u>Number</u>	<u>Time</u>	<u>Presenter</u>	<u>Organization</u>	<u>Title</u>	
FC	21	3:30 PM	Cortney Mittelsteadt	Giner	Dimensionally Stable High Temperature Membranes
FC	22	3:50 PM	Serguei Lvov	Penn State	New Proton Conductive Composite Materials with Co-continuous Phases Using Functionalized and Crosslinkable TFE/VDF Fluoropolymers
FC	23	4:10 PM	James McGrath	Virginia Tech	Advanced Materials for Proton Exchange Membranes
FC	24	4:30 PM	Han Liu	Giner Inc.	Dimensionally Stable High Performance Membrane
FC	14	4:50 PM	Denise Katona	Chemsultants International	Center for Intelligent Fuel Cell Materials Design Phase 1

BES Membrane Projects at DOE HFCIT Review

Thursday, May 17

Schedule as of:

Number	Time	Presenter	Organization	Title
	8:00 AM	Harriet Kung		Welcome Address
BES 1	8:10 AM	Hector Abruna	Cornell University	Transport Phenomena and Interfacial Kinetics in Planar Microfluidic Membraneless Fuel Cells
BES 2	8:35 AM	Raymond Gorte	University of Pennsylvania	The Development of Nano-Composite Electrodes for Natural Gas-Assisted Steam Electrolysis for Hydrogen Production
BES 3	9:00 AM	Lutgard De Jonghe	Lawrence Berkeley Nat. Lab.	Nanocomposite Proton Conductors
BES 4	9:25 AM	Joseph DeSimone	U of North Carolina at Chapel Hill	Proton Exchange Membranes for Next Generation Fuel Cells
BES 5	9:40 AM	Klaus Schmidt-Rohr	Iowa State University	Water Nanochannels in Nafion: Quantitative Scattering Analysis and NMR
Break	10:05 AM			
BES 6	10:25 AM	Michel Dupuis	Pacific Northwest Nat. Lab.	Charge Transfer, Transport, and Reactivity in Complex Molecular Environments: Theoretical Studies for the Hydrogen Fuel Initiative
BES 7	10:50 AM	William Goddard, III	California Inst. of Tech.	Polymer Functionalized Zeolite Proton Exchange Membrane (PFZ-PEM) for Medium Temperature (>120oC) Fuel Cells from Theory, Simulation, and Experiment
BES 8	11:15 AM	Gregory Voth	University of Utah	Computer Simulation of Proton Transport in Fuel Cell Membranes
BES 9	11:40 AM	Steven Regen	Lehigh University	Porous and Glued Langmuir-Blodgett Membranes
Lunch	12:05 PM			

Membrane Posters at DOE HFCIT Review

Basic Energy Sciences Posters, Thursday May 1 Schedule as of:

Number	Presenter	Organization	Title
BESP 17	Brian Benicwicz	RPI	Sol-Gel Based Polybenzimidazole Membranes for Hydrogen Pumping Devices
BESP 18	Stephen Creager	Clemson	New Proton-Conducting Fluoropolymer Electrolytes for PEM Fuel Cells
BESP 19	Benny Freeman	U.Texas Austin	Hydrogen Purification Using Advanced Polymeric Membranes
BESP 20	Michael Heben	NREL	Carbon Nanotube Materials for Substrate Enhanced Control of Catalytic Activity
BESP 21	G. Kane Jennings	Vanderbilt	Surface-Initiated Ionomer Films Based on Modified Poly(n-alkylnorbornene)s
BESP 22	David Keffer	U. Tenn.	A Unified Computational, Theoretical and Experimental Investigation of Proton Transport through the Electrode/Electrolyte Interface of Proton Exchange Membrane Fuel Cell Systems
BESP 23	Bryan Pivovar	LANL	Fundamentals of Hydroxide Conducting Systems for Fuel Cells and Electrolyzers
BESP 24	David Sholl	Carnegie Mellon	Ab Initio Screening of Ternary Alloys for Hydrogen Purification
BESP 25	Helmut Strey	Stony Brook	Electrostatically Self-assembled Amphiphiles
BESP 26	Philip Taylor	Case Western	Theory, Modeling, and Simulation of Ion Transport in Ionomer Membranes
BESP 27	Matthew Yates	U of Rochester	Preparation of Composite Fuel Cell Membranes Containing Electric Field Aligned Inorganic Particles

Fuel Cells Sub-Program Posters, Thursday May Schedule as of:

Number	Presenter	Organization	Title
FCP 31	Scott Gaboury	Arkema	Improved, Low-Cost, Durable Fuel Cell Membranes
FCP 32	Steven Hamrock	3M	Membranes and MEA's for Dry, Hot Operating Conditions
FCP 33	John Kerr	LBNL	New Polyelectrolyte Materials for High Temperature Fuel Cells



New Targets Proposed for Membranes

Characteristic	Units	2006 status	2005 target	2010 target	2015 target
Maximum operating temperature	°C	80	120	120	120
Area specific resistance at: Maximum operating temp and water partial pressures from 40 – 80 kPa	Ohm cm ²	0.03	0.02	0.02	0.02
80°C and water partial pressures from 25 - 45 kPa	Ohm cm ²	0.03	0.02	0.02	0.02
30°C and water partial pressures up to 4 kPa	Ohm cm ²	0.04	0.03	0.03	0.03
-20°C and water partial pressures up to 0.1 kPa	Ohm cm ²	0.3	0.2	0.2	0.2
Oxygen cross-over ^a	mA/cm ²	5	5	2	2
Hydrogen cross-over ^a	mA/cm ²	5	5	2	2
Cost ^b	\$/m ²	15 ^c	200	20	20
Durability with cycling At operating temp ≤80°C	hours	~2000 ^d	2000	5000 ^e	5000 ^e
At operating temp >80°C	hours	(not avail. ^f)		2000	5000 ^e
Unassisted start from	°C	-20	-30	-40	-40
Thermal cyclability in presence of condensed water		Yes	Yes	Yes	Yes