HTMWG Meeting Washington DC
May 19, 2006

Lead Research and Development Activity for High Temperature, Low Relative Humidity Membrane Program

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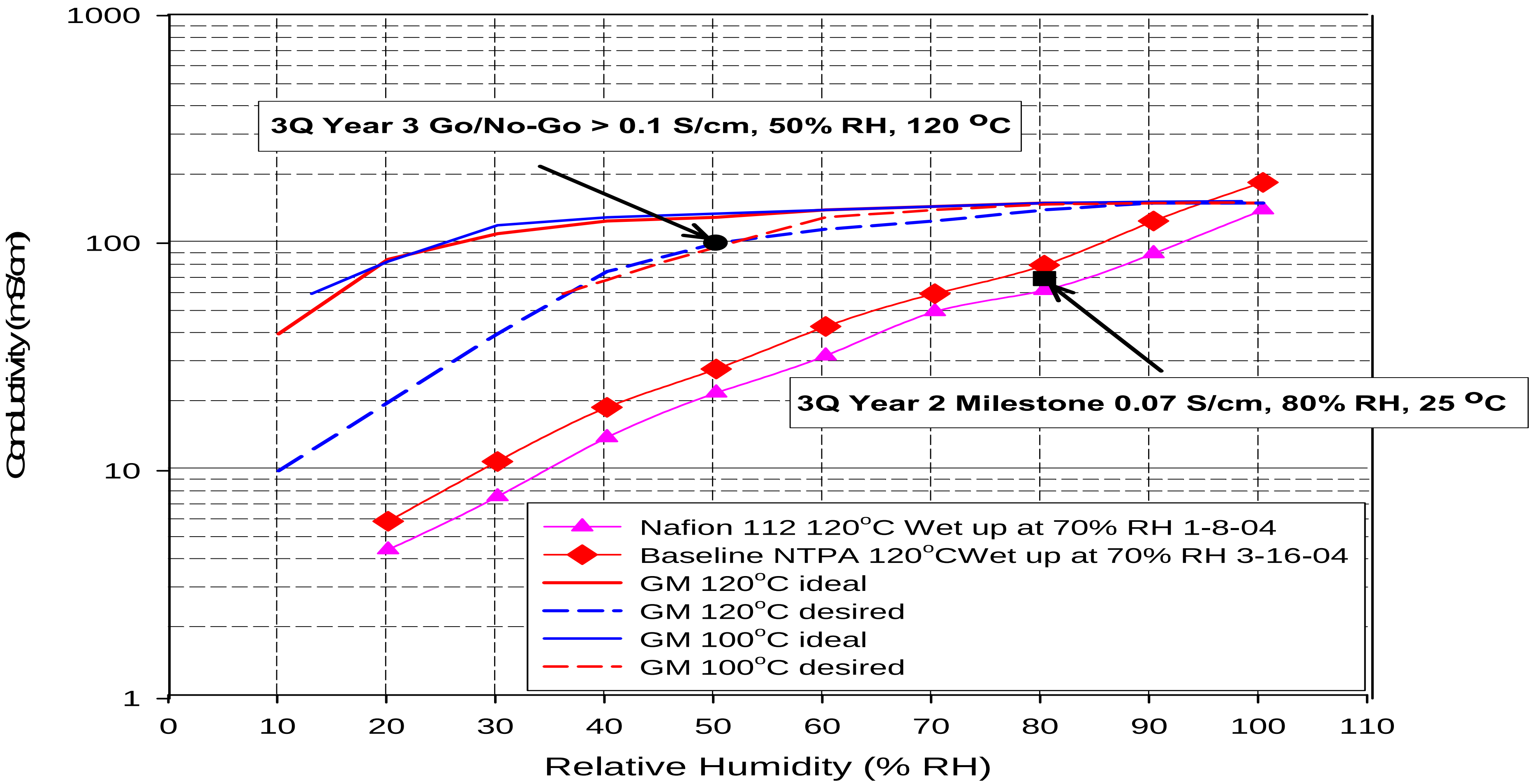
Research Team at UCF FSEC:
Fenton, Slattery, Linkous, Mohajeri, Kunz, Bonville, Sheinkopf, Jiang, and Xu

Research Team at Bekktech: Bekkedahl, Bekkedahl

Research Team at Scribner & Associates: Scribner, Cooper

Targets



Mathias, M. F., and Gasteiger, H. A., In *Proceedings of the Proton Conducting Membrane Fuel Cells III Symposium*; The Electrochemical Society: 2002.

Objectives

- *New polymeric electrolyte PTA membranes*
- Standardized Characterization Methodologies
  - Conductivity f(RH, T, Phys. Props.) {In & Through Plane; As MEA}
  - Characterize mechanical, mass transport and surface properties of membranes
  - Predict durability of membranes and MEAs fabricated from other eleven HT Low RH Membrane Programs
- Provide HTMWG members with standardized tests and methodologies (short courses)
- Organize HTMWG bi-annual meetings

Approach

Task 1. Non-Nafion® based Poly[perfluorosulfonic acid] - phosphotungstic acid composite membrane and membrane electrode assembly, MEA, fabrication

Task 2. Sulfonated poly(ether ketone ketone) or sulfonated poly(ether ether ketone) - Phosphotungstic Acid Composite Membrane and MEA, fabrication

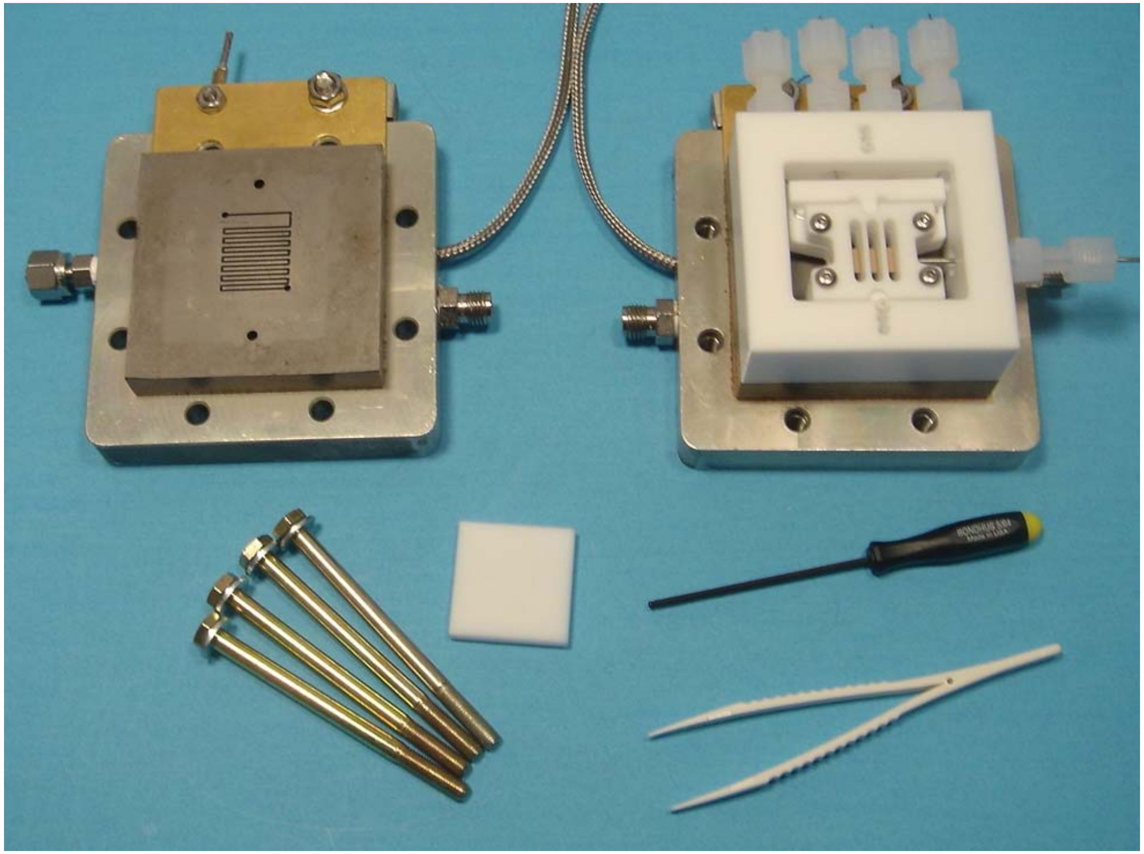
Task 3. In-Plane Conductivity Measurement

Task 4. Through-Plane Conductivity Measurements

Task 5. Characterize Performance of MEAs

Task 6. Membrane and MEA Durability

Task 7. Meetings and Activities of HTMWG



BT-112 BekkTech Conductivity Cell Assembled with the Fuel Cell Technologies Fuel Cell Hardware

MEA Evaluation: CV, LSV, R & σ

Membrane Resistance/Conductivity

DC or AC Impedance

2 or 4-point electrodes

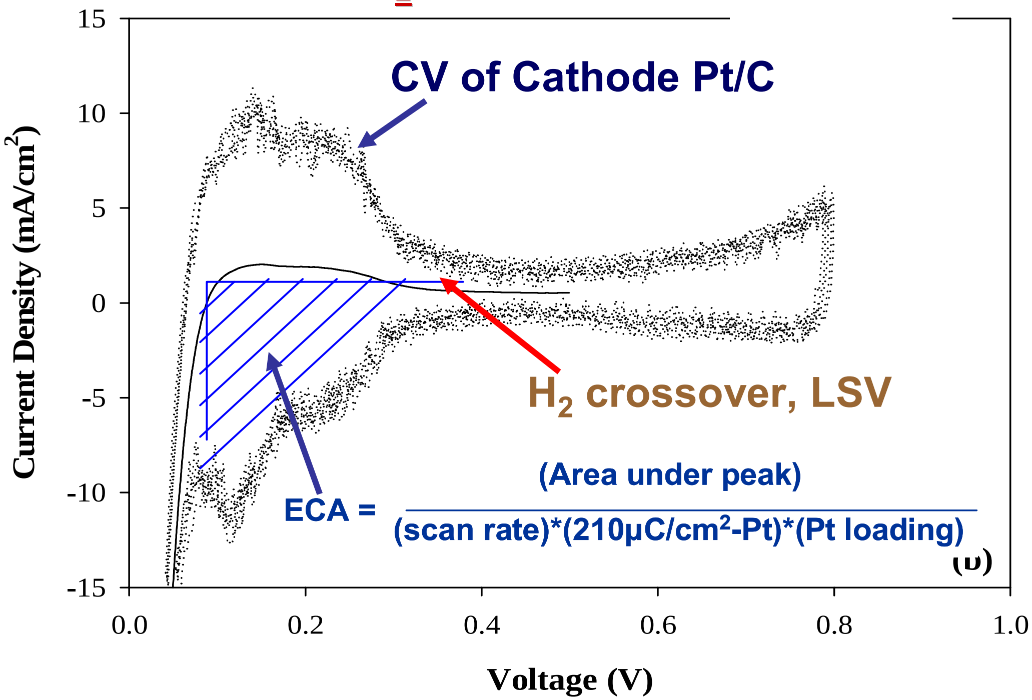
Current Interrupt

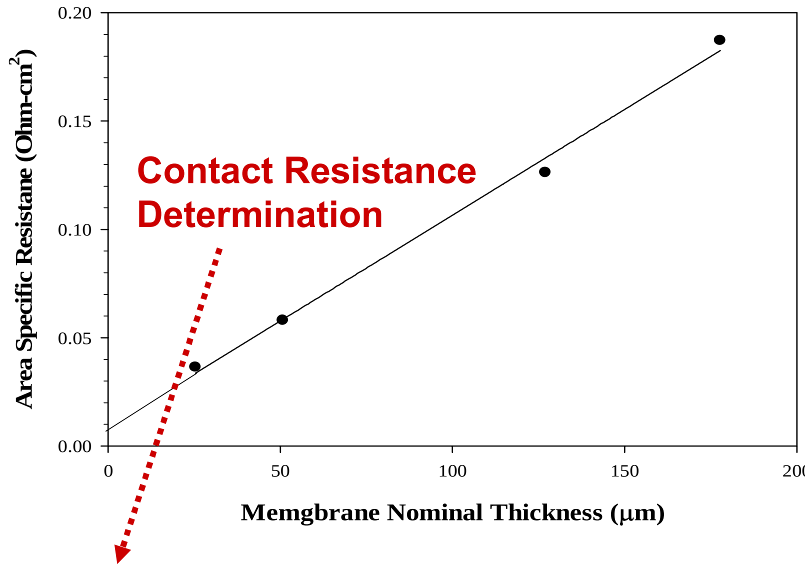
2-point electrodes

$$\sigma = \frac{1}{R} \times \frac{L}{A}$$

CV —> ECA

LSV —> H_2 Crossover





Future Work

- FY 06
  - In-plane conductivity measurements
    - Apparatus and protocols defined and verified
    - Commercially available membranes and baseline NTPA tested
- FY 07
  - Apparatus for testing membranes will be built and verified
  - Test protocols will be conducted
  - Results from in-plane conductivity measurements on commercial samples will be submitted
  - Test apparatus and protocols for through-plane conductivity measurements will be developed and verified (milestone)
  - Comparison of in-plane to through-plane conductivity will be completed (milestone)

High Temp Low Relative Humidity

Membrane Requirements

- Improved water management
  ---- Lower electroosmotic drag
  ---- Higher conductivity
  ---- Lower hydrogen cross-over with conductivity maintained
- Low cost
- High longevity and endurance in fuel cell environment
- Mechanical integrity and good chemical properties

Catalyst Layer Requirements

- Sufficient ionic conductivity within the catalyst layer
- Sufficient reactant permeability within the catalyst layer
- Uniformly distributed components
- Low cost
- Intrinsic highly reliable and active catalyst
- Advanced cathode structure for oxygen reduction

Gas Diffusion Layer Requirements

- Supply fuel (H_2) to anode oxidant (O_2/air) to cathode
- Conduct electrons
- Support membrane
- Deliver out water (or hold it in?)

Summary

- Relevance: Optimize fuel cell thermal and water management and increase membrane durability
- Approach: Develop new polymeric electrolyte composite membranes with a conductivity of 0.1 S/cm at 50% relative humidity and 120 ^{o}C
- Technology Transfer/Collaborations: Membranes from other working group members will be tested using standardized protocols. Training in test methodologies will be provided.

EChronicle > archives > 2006-Q2 > Fuel Cell Course

April 2006

FSEC's First Fuel Cell Course a Big Success!

It was standing-room only during the laboratory sessions at "The 2006 Short Course in Fuel Cell Technology," held at FSEC February 5 – 8. Three days of presentations and hands-on lab sessions were led by FSEC director Jim Fenton, Kevin Cooper of Scribner Associates, Russ Kunz of the University of Connecticut and Vijay Ramani of the Illinois Institute of Technology.

Fuel cell course participants received hands-on instruction in FSEC's lab.
(Photo: Nick Waters)

The course was presented by FSEC and co-sponsored by Scribner Associates and the Electrochemical Society. Attendees included industry members, scientists, engineers, students and others from around the country interested in this new short course on basic and applied aspects of fuel cell technology, with an emphasis on polymer electrolyte and direct methanol fuel cells. The course is planned to be held again later this year at the center.

If you're interested in getting more information on this program, contact JoAnn Stirling at 321-638-1014 or joann@fsec.ucf.edu

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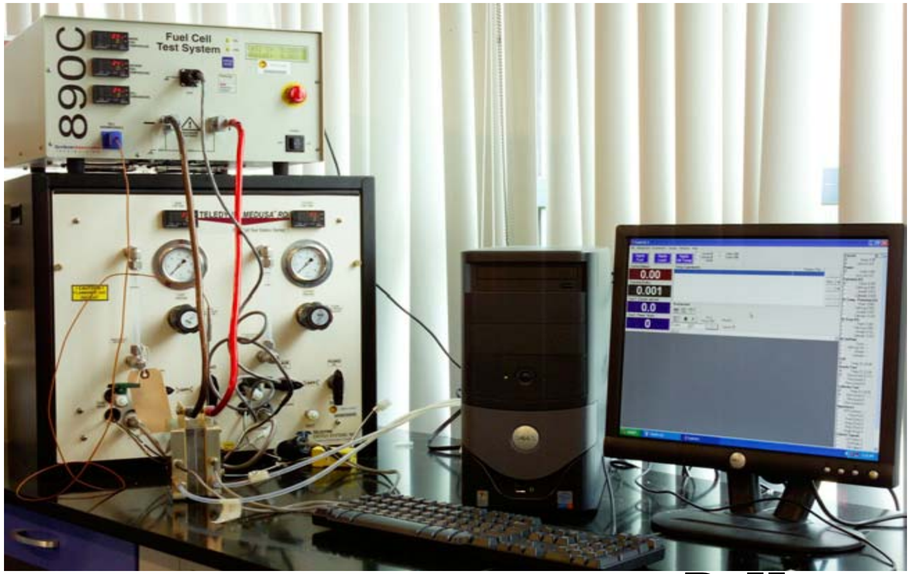
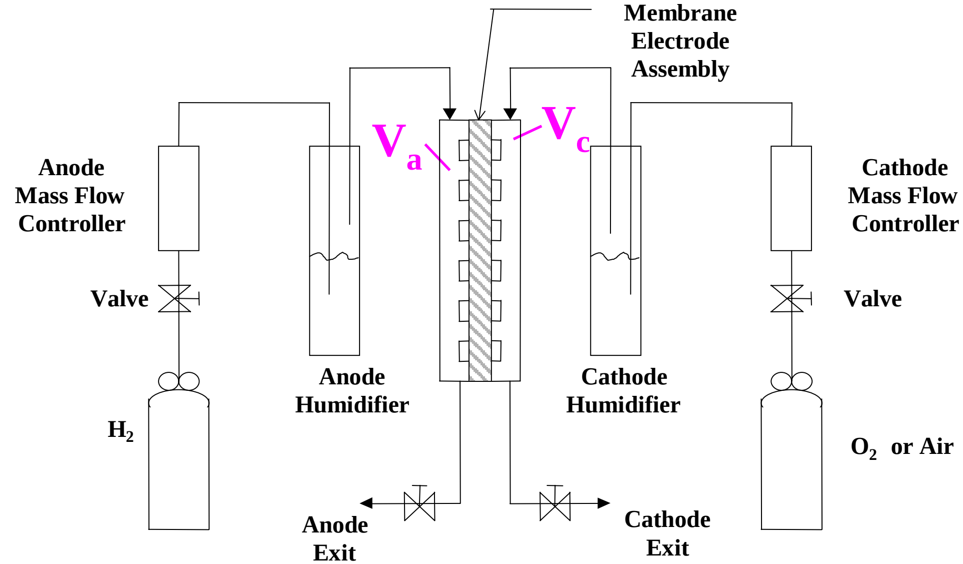
Polarization Curve Test Apparatus

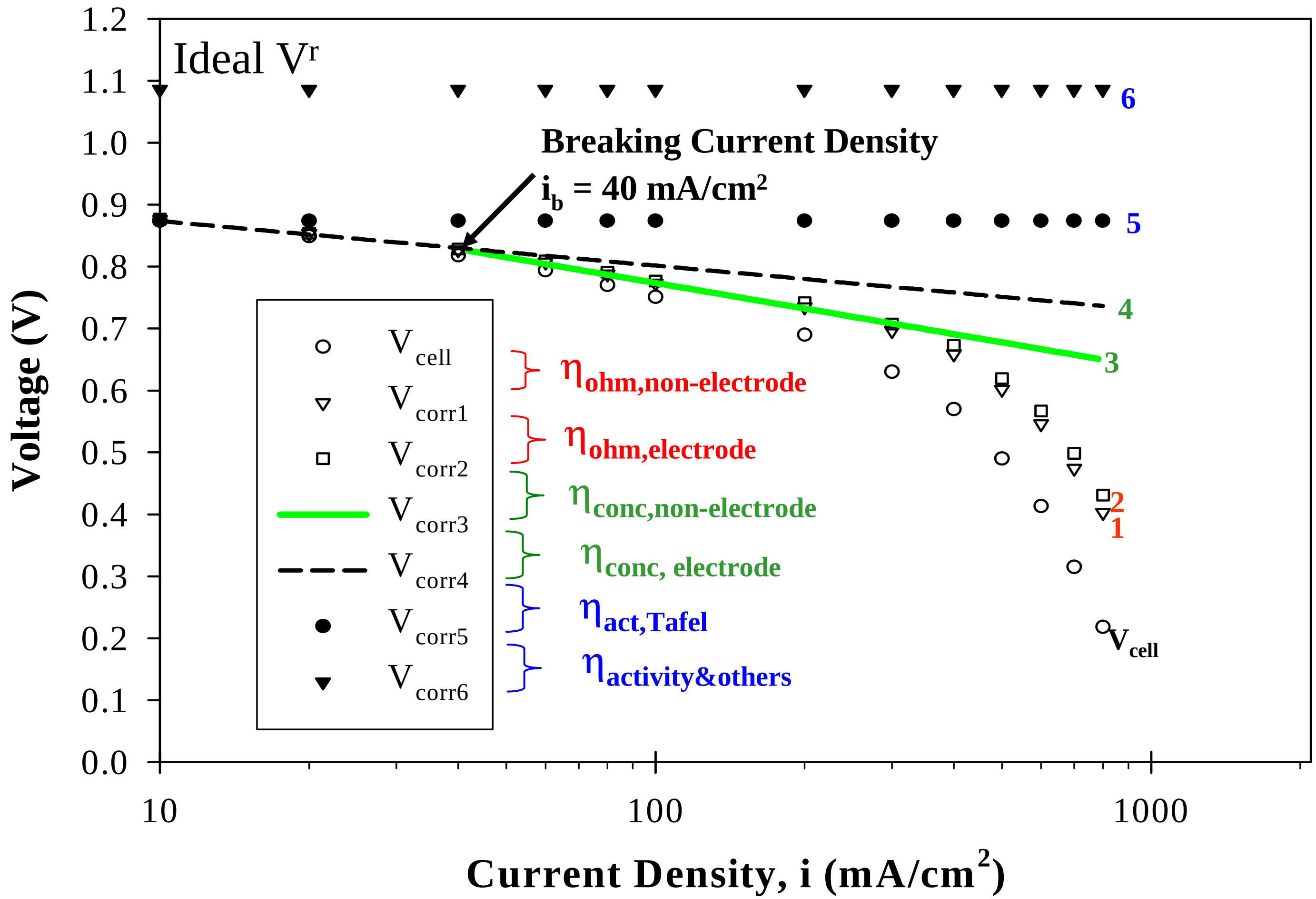




T_{cell}	$T_{cathode\ humidifer}$	R. H. $_{Inlet}$ Cathode	P_{total}	Inlet P_{H2O}	Inlet P_{O2} in Air
°C	°C	%	kPa	kPa	kPa
80	73	75	101	35	13.86
100	90	70	101	70	6.51
100	65	25	150	25	26.25
120	90	35	101	70	6.51
120	82	25	150	51	20.79
120	100	50	150	101	10.29

Air and Oxygen Performance →
Six Sources of Polarization

Air Only 120°C/ 35%R.H.



Williams, M.V., H.R. Kunz, and J.M. Fenton. 2005. "Analysis of Polarization Curves to Evaluate Polarization Sources in Hydrogen/Air PEM Fuel Cells." Journal of the Electrochemical Society, 152, A635 (2005).