

KEITH PETER BETHUNE

Hawaii Natural Energy Institute, University of Hawaii at Manoa
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PRESENT POSITION**Assistant Specialist****Hawai'i Natural Energy Institute, Univ. of Hawaii at Manoa**

May 2003 – Present

- Engineering Lab Manager
 - Oversee lab operations at the Hawaii Sustainable Energy Research Facility, formerly the Hawaii Fuel Cell Test Facility
 - Manage the development and construction of instrumentation, hardware, and supporting equipment used for research projects
 - Coordinate fuel cell testing equipment calibration and maintenance requirements, research assignments and scheduling between HiSERF employees, HNEI researchers, and project partners; perform monthly invoicing of services provided.
 - Train and supervise student technician/operators in lab safety, equipment/test system operation and maintenance.
- Research/Testing and Evaluation Engineer
 - Current primary role: Consulting, testing, and evaluation of fuel cell system components as part of ongoing multi-year collaboration with the Naval Research Lab Chemistry Division, Wash. DC's UAV/UUV internal development program.
 - Secondary role: Participation in various HNEI research projects providing variety of services including literature reviews, experimental design consulting, protocol development, hardware integration support, software development, test scripting, and experimental operation.
 - Perform confidential contract based testing for clients requiring non-disclosure agreements.
 - Project participation/consultation with variety of organizations and companies including Ford Motor Company, Treadstone Technologies, Ballard Fuel Cells, GM Research, UTC Fuel Cells, Protonex, Sierra Lobo, US Department of Energy, NREL, NASA, NAVSEA, NUWC Newport, NRL Washington D.C., USFCC, SAE, and JARI.
- Field Engineer @ NAVFAC Kaneohe Wave Energy Test Site (Sept 2014 to Dec 2016)
 - General engineering maintenance support of wave energy operations center at Kaneohe Marine Corps Base
 - Designed, built, and managed off-shore underwater acoustics monitoring platforms for environmental assessments in coordination with Univ. of Washington researchers; coordinated instrumentation deployments with Sea Engineering Marine Operations.

EDUCATION**University of Hawaii at Manoa**

Expected Graduation Spring 2021

Shidler College of Business, MBA Candidate**Florida Atlantic University at Seatech**

June 2000

M.Sc. in Ocean Engineering. Marine Materials Specialization

Thesis: Developed a first principles based equation for potential attenuation and anode current output projections for cathodically polarized marine pipelines and risers, focusing on optimization of anode spacing for retrofit cost reduction of aging cathodic protection systems of pipelines in the Gulf of Mexico.

Florida Atlantic University

May 1998

B.Sc. in Ocean Engineering

EXPERIENCE**Research Support**

July 2002 – May 2003

Hawaii Natural Energy Institute, Univ. of Hawaii at Manoa

- Provided mechanical engineering support for construction of the Hawaii Fuel Cell Test Facility, including design and implementation of the gas delivery and safety interlock system.
- Performed compliance reviews of facility building designs using existing Federal, State, City, and County Codes and Standards.
- Supervised installation and system integration of United Technologies Fuel Cells (UTCFC) test stands. Trained by UTCFC personnel in performance characterization and evaluation of full size, polymer electrolyte membrane fuel cells and test equipment.

Research Assistant

July 2000 – July 2002

Hawaii Natural Energy Institute, Univ. of Hawaii at Manoa

- Advanced electric vehicle battery evaluation, rapid charging algorithm development, battery cycle life prediction model validation, failure diagnosis, electric vehicle testing, data collection, and driving pattern analysis.

Consulting Engineer

May 1998 – June 2000

Hartt and Associates, Boca Raton, FL

- Developed rain-flow analysis algorithm for crack propagation simulations based on pressure cycles in a damaged offshore oil pipeline.
- Performed routine chloride analyses on concrete samples for Florida Dept. of Transportation

Research Assistant

May 1998 – June 2000

Center for Marine Materials, Florida Atlantic University at Seatech**Undergraduate Assistant**

1996 - 1998

Center for Marine Structures and Geotechnique, Florida Atlantic UniversityPROFESSIONAL AFFILIATIONS

2004 Outstanding Project Meritorious Award by the Hawaii Section of ASME

Member of the Electrochemical Society (ECS) since 2003

PROPOSAL SUBMITTED AND/OR AWARDED

ARPA-E Concept Paper Submittal to DE-FOA-0001858: OPEN 2018

Project Title: Metallo-ionic Liquid Draw Solutes for Energy Efficient Forward Osmosis Water Desalination,

Submission Date: 2/12/2018

*Contribution to: Conceptualization (0%), Experimental Design (15%), Writing (10%)*COMMUNITY SERVICE

May 2018: Kumuola Foundation - People Power Project, Taro Patch Clearing in Manoa Valley

May 2018: Community Huki Volunteer, Malama Maunaloa

Nov 2017: Volunteered (1/2 Day) at VEX Pan Pacific Robotics Event at UH Manoa Campus Center

Aug 2017: Trust for Public Land's Waimea Valley Cleanup Volunteer Day

Department Coordinator for University of Hawaii's 2010 Aloha United Way Campaign

BOOK CHAPTERS

- [1] J. St-Pierre, M. Angelo, **K. Bethune**, J. Huizingh, T. Reshetenko, M. Virji, Y. Zhai (2017) Modern Fuel Cell Testing Laboratory. In: Breikopf C., Swider-Lyons K. (eds) Springer Handbook of Electrochemical Energy. Springer Handbooks. Springer, Berlin, Heidelberg

PUBLICATIONS

- [1] G. Severa, J. Head, **K. Bethune**, S. Higgins, A. Fujise, “Comparative studies of low concentration SO₂ and NO₂ sorption by activated carbon supported [C₂mim][Ac] and KOH sorbents”, *Journal of Environmental Chemical Engineering*, Vol 6, (2018) 718-727.
Contribution to: Conceptualization (10%), Analysis (10%), Writing (5%)
- [2] B. Polagye, P. Murphy, **K. Bethune**, P. Cross, L. Vega, “Acoustic Characterization of a Wave Energy Converter”, *The Journal of the Acoustical Society of America* 140, (2016) 3171.
- [3] M. Rubio, **K. Bethune**, A. Urquia, J. St-Pierre, “Proton exchange membrane fuel cell failure mode early diagnosis with wavelet analysis of electrochemical noise”, *International Journal of Hydrogen Energy* Vol 41, (2016) 14991-15001.
- [4] B. Gould, J. Rodgers, M. Schuette, **K. Bethune**, S. Louis, R. Rocheleau, and K. Lyons, “Performance of 3D-printed fuel cells and stacks”, *ECS Journal of Solid State Science and Technology*, 4 (2015) 3063-3068.
- [5] G. Severa, S. Higgins, R. Rocheleau, **K. Bethune**, “SO₂ sorption by activated carbon supported ionic liquids under simulated atmospheric conditions”, *Chemical Engineering Journal* 265 (2015) 249-258.
- [6] T. Reshetenko, **K. Bethune**, M. Rubio, and R. Rocheleau, “Study of low concentration CO poisoning of Pt anode in a proton exchange membrane fuel cell using spatial electrochemical impedance spectroscopy”, *J. Power Sources* 269 (2014) 344-362.
- [7] Y. Zhai, G. Bender, **K. Bethune**, and R. Rocheleau, “Influence of cell temperature on sulfur dioxide contamination in proton exchange membrane fuel cells”, *J. Power Sources* 247 (2014) 40-48.
- [8] G. Bender, M. Angelo, **K. Bethune**, and R. Rocheleau, “Quantitative analysis of the performance impact of low-level carbon monoxide exposure in proton exchange membrane fuel cells”, *J. Power Sources* 228 (2013) 159-169.
- [9] T. V. Reshetenko, G. Bender, **K. Bethune**, R. Rocheleau, “A segmented cell approach for studying the effects of serpentine flow field parameters on PEMFC current distribution”, *Electrochim. Acta* 88 (2013) 571-579.
- [10] Y. Zhai, **K. Bethune**, S. Dorn, G. Bender and R. Rocheleau, “Electrochemical Impedance Spectroscopy Analysis on SO₂ Contamination in PEMFCs”, *J. Electrochem. Soc.*, 159(5):B524-B530, 2012.
- [11] T. V. Reshetenko, **K. Bethune**, R. Rocheleau, “Spatial proton exchange membrane fuel cell performance under carbon monoxide poisoning at a low concentration using a segmented cell system”, *J. Power Sources* 218 (2012) 412-423.
- [12] T. V. Reshetenko, G. Bender, **K. Bethune**, R. Rocheleau, “Effects of local variations of the gas diffusion layer properties on PEMFC performance using a segmented cell system”, *Electrochim. Acta* 80 (2012) 368-376.
- [13] T. V. Reshetenko, G. Bender, **K. Bethune**, R. Rocheleau, “Application of a segmented cell setup to detect pinhole and catalyst loading defects in proton exchange membrane fuel cells”, *Electrochim. Acta* 76 (2012) 16-25.
- [14] T. V. Reshetenko, G. Bender, **K. Bethune**, R. Rocheleau, “Systematic studies of the gas humidification effects on spatial PEMFC performance distributions”, *Electrochim. Acta* 69 (2012) 220-229.

- [15] T.V. Reshetenko, G. Bender, **K. Bethune**, and R. Rocheleau, “Systematic Study of Back Pressure and Anode Stoichiometry Effects on Spatial PEMFC Performance Distribution”, *Electrochimica Acta*, 56, 23, p. 8700-8710, 2011.
- [16] B. D. Gould, G. Bender, **K. Bethune**, S. Dorn, O. A. Baturina, R. Rocheleau, and K. E. Swider-Lyons, “Operational Performance Recovery of SO₂-Contaminated Proton Exchange Membrane Fuel Cells”, *J. Electrochem. Soc.* 157, B1569, 2010.
- [17] G. Bender, M. Angelo, **K. Bethune**, S. Dorn, T. Thampan, R. Rocheleau, “Method Using Gas Chromatography to Determine the Molar Flow Balance for Proton Exchange Membrane Fuel Cells Exposed to Impurities”, *Journal of Power Sources*, Vol 193 p. 713-722, 2009.
- [18] Y. Hashimasa, N. Yoshimura, D. Ebata, H. Tomioka, M. Akai, S. Watanabe, **K. Bethune**, R. Rocheleau, “Study of Performance Reproducibility of JARI Standard Single Cell-Cell Performance Crosscheck between HNEI and JARI,” *JARI Research Journal*, Volume 29, No. 1, p. 43-48, 2007.
- [19] B.Y. Liaw, **K.P. Bethune**, and X.G. Yang, “Advanced Integrated Battery Testing and Simulation,” *Journal of Power Sources*, Volume 110, Issue 2, p. 330-340, 2002.
- [20] P. Pierson, **K.P. Bethune**, W.H. Hartt, and P. Ananthkrishnan, “A New Equation for Projection of Potential Attenuation and Anode Current Output for Cathodically Polarized Marine Pipelines and Risers,” *Corrosion, The Journal of Science and Engineering*, Vol. 56, No.6, 2000.

EXTENDED BIBLIOGRAPHY

CONFERENCE PROCEEDINGS / PRESENTATIONS / POSTERS

- [1] Y. Zhai, J. Qi, K. Bethune, J. St. Pierre, “Contamination of Low Platinum Catalyst Loading Cathodes for Proton Exchange Membrane Fuel Cells,” Invited Tutorial Presented at the 233rd Electrochemical Society Meeting, May 13-17 2018, Seattle, WA. *Contribution to: Conceptualization (10%), Analysis (10%), Writing (10%)*
- [2] B. Gould, J. Rodgers, M. Schuette, K. Bethune, S. Louis, R. Rocheleau, and K. Lyons, “Performance of 3D-printed fuel cells and stacks” Presented at the 226th Electrochemical Society Meeting, Oct. 5-9 2014, Cancun, Mexico.
- [3] J. St.-Pierre, M. Angelo, K. Bethune, J. Ge, S. Higgins, T. Reshetenko, M. Virji, and Y. Zhai, “PEMFC Contamination – Fundamentals and Outlook”, *ECS Trans.* 2014 61(23): 1-14.
- [4] M. Angelo, K. Bethune, and R. Rocheleau, “A Study of the Durability and Performance of a Proton Exchange Membrane Electrode Assembly Used in the Separation of Hydrogen From Helium”, Presented at the 224 Electrochemical Society Meeting, Oct.27-Nov. 1, 2013, San Francisco, CA, USA.
- [5] T. V. Reshetenko, J. St-Pierre, K. P. Bethune, K. Artyushkova, R. Rocheleau, and P. Atanassov, “Multi-Analytical Study of Gas Diffusion Layer PTFE Content Local Variation”, *ECS Trans.* 2013 50(2): 591-599
- [6] M. Angelo, K. Bethune, and R. Rocheleau, “Calculating Hydrogen Mass Transport Coefficients in a PEMFC at Different Operating Conditions Using a Hydrogen Pump Configuration”, *ECS Trans.* 2013 50(2): 313-323.
- [7] Y. Zhai, S. Dorn, K. Bethune, J. St.-Pierre, R. Rocheleau, “Effect of Potential on SO₂ Adsorption onto Pt/C Catalyst for PEMFCs”, 219 Electrochemical Society Meeting, May 1-6, 2011, Montreal, Canada.

- [8] M. Angelo, J. St. Pierre, K. Bethune, and R. Rocheleau, "Gas Chromatography Study of Carbon Monoxide Reactions at Different Temperatures and a Trace Concentration Level within a PEMFC", 219 Electrochemical Society Meeting, May 1-6, 2011, Montreal, Canada.
- [9] Y. Zhai, K. Bethune, S. Dorn, G. Bender and R. Rocheleau, Electrochemical Impedance Spectroscopy Analysis on SO₂ Contamination in PEMFCs", in ECS Transactions - Vancouver, Canada Volume 28, "Electrode Processes Relevant to Fuel Cell Technology", 2010.
- [10] M. S. Angelo, K. P. Bethune and R. E. Rocheleau, "The Impact of sub ppm Carbon Monoxide and ppm Level CO/Toluene and Methylcyclohexane/CO Mixtures on PEMFC Performance and Durability" in ECS Transactions - Vancouver, Canada Volume 28, "Electrode Processes Relevant to Fuel Cell Technology", 2010.
- [11] T.V. Reshetenko, K. Bethune, R. Rocheleau "Study of Spatial PEMFC Performance under CO Poisoning Using Segmented Cell Approach". 217 Electrochemical Society Meeting, April 25-30, 2010, Vancouver, Canada, B7 – 621.
- [12] B. D. Gould, O. A. Baturina, Y. Garsany, G. Bender, K. Bethune, S. Dorn, K. Swider Lyons, "Recovery Methods for Sulfur Deactivated Fuel Cell Cathodes", 238th Meeting of the American Chemical Society, Aug. 16 -20, 2009, Washington DC, USA.
- [13] K. Swider Lyons, Y. Garsany, B. Gould, O. Baturina, D. Ramaker, G. Bender, K. Bethune, S. Dorn, "Performance Degradation and Recovery of Sulfur-Contaminated PEFC Cathodes", Gordon Research Conference on Fuel Cells, July 26 – 30, 2009, Smithfield, Rhode Island, USA.
- [14] S. Dorn, G. Bender, K. Bethune, M. Angelo, R. Rocheleau, "The Impact of Trace Carbon Monoxide / Toluene Mixtures on PEMFC Performance", ECS Transactions, 16 (2), 659 (2008).
- [15] M. Angelo, G. Bender, S. Dorn, K. Bethune, T. Hossain, D. Posey, J. Gazda, A. Ghatak-Roy, R. Rocheleau, "The Impacts of Repetitive CO Poisoning on MEA Performance and Durability", ECS Transactions, 16 (2), 669 (2008).
- [16] Y. Zhai, G. Bender, S. Dorn, M. Angelo, K. Bethune, and R. Rocheleau, "Sulfur Dioxide Contamination in PEMFCs: Degradation and Recovery of Performance", ECS Transactions 16 (2), 873 (2008).
- [17] G. Bender, K. Bethune, M. Angelo, S. Dorn, R. Rocheleau, "The Anode Overpotential Dependence on Oxygen Permeation During PEMFC Operation with CO", Presented at 212th Electrochemical Society Meeting, Washington DC, October 7-12, 2007.
- [18] "The Impact of Low Level CO Impurities on Cell Degradation", G. Bender, K. Bethune, M. Angelo, S. Dorn, D. Wheeler, R. Rocheleau, Presented at poster session, Fuel Cell Seminar, October 15-19, 2007, San Antonio, Texas, USA.
- [19] G. Bender, M. Angelo, K. Bethune, S. Dorn, R. Rocheleau, "Impurity Testing at HNEI, University of Hawaii", Modeling Workshop, Argonne National Laboratory, August 30, 2007.
- [20] Y. Hashimasa, N. Yoshimura, D. Ebata, H. Tomioka, M. Akai, S. Watanabe, K. Bethune, R. Rocheleau, "Study of Performance Reproducibility of JARI Standard Single Cell-Cell Performance Crosscheck between HNEI and JARI," Presented at the 5th The Fifth International ASME Conference on Fuel Cell Science, Engineering and Technology, New York NY, June 18-20, 2007, New York NY.

- [21] T. Thampan, R. Rocheleau, K. Bethune, D. Wheeler, "Effect of Trace Contaminants on PEM Fuel Cell Performance", in *Generation, Storage and Fuel Cells*, edited by Anne Dillon, Charles Olk, Constantina Filiou, Jim Ohi (Mater. Res. Soc. Symp. Proc. 885, Warrendale, PA, 2006), 0885-A01-05
- [22] T.Thampan, R. Rocheleau, D.J. Wheeler, and K. Bethune, "Effect of Trace Contaminants on PEM Fuel Cell Performance", In Proceedings of the 209th Electrochem. Soc. Meetings. Denver, CO 2006.
- [23] T.Thampan, R. Rocheleau, D.J. Wheeler, and K. Bethune, "Impact of Hydrogen Quality on PEM Performance" In Proceedings of the FUEL CELLS 2005 seminar, Palm Springs, CA, 2005.
- [24] R. Rocheleau, E. Miller, K. Bethune, and D.J. Wheeler, "Full Scale PEM Fuel Cell Research at the Hawaii Fuel Cell Test Facility: Recent Progress," In Proceedings of the 206th Electrochem. Soc. Meetings, Honolulu, HI, 2004.
- [25] B.Y. Liaw, K.P. Bethune, and C.S. Kim, "Time-Series Field Trip Data Analysis Using Adaptive Recognition Approach; Analysis on Driving Patterns and Vehicle Usage for Electric Vehicles," Proc. 19th International Battery, Hybrid, and Fuel Cell Electric Vehicle Symposium. Busan, Korea, 2002.
- [26] B.Y. Liaw, K.P. Bethune, and X.G. Yang, "Modeling Rapid Charge Conditions in a VRLA Traction Battery," In Proceedings of the 200th Electrochem. Soc. Meetings, San Francisco, CA, 2001.
- [27] B.Y. Liaw, X.G. Yang, and K.P. Bethune, "Integrated Battery Simulation and Characterization," In Solid State Ionics as a special edition of the Proceedings of SSI 2001, an invited paper for SSI 2001, Cairns, Australia, 2001.
- [28] B.Y. Liaw, X.G. Yang, and K.P. Bethune, "Advanced Battery Modeling and Rapid Charging Development," Proc. CIBF 2001. Beijing, China, p. 59, 2001.
- [29] B.Y. Liaw and K.P. Bethune, "On Validation of the Modeling of Overcharge Process in VRLA Cells," IEEE-01TH8533, Proc. 16th Annual Battery Conference on Applications and Advances, Long Beach, CA, p. 187-192, 2001.
- [30] K.P. Bethune and W.H. Hartt, "A Novel Approach to Cathodic Protection Design for Marine Pipelines: Part I – An Inclusive Attenuation Equation," paper no. 673, presented at CORROSION/2000, Orlando, FL, March 26-31, 2000.
- [31] K.P. Bethune and W.H. Hartt, "A Novel Approach to Cathodic Protection Design for Marine Pipelines: Part II - Applicability of the Slope Parameter Method," paper no. 674, presented at CORROSION/2000, Orlando, FL, March 26-31, 2000.
- [32] W.H. Hartt, P. Pierson, and K.P. Bethune, "A Newly Developed Methodology for Projection of Potential Attenuation and Anode Current Output for Cathodically Polarized Pipelines," presented at the 3rd International Pipeline Technology Conference, Brugge, Belgium, May 22-24, 2000.
- [33] P. Pierson, W.H. Hartt, and K.P. Bethune, "Potential Attenuation and Anode Current Output Determination Alternatives for Marine Pipelines and Risers," paper no. 628, presented at CORROSION/99, San Antonio, TX, April 25-30, 1999.
- [34] D.V. Reddy, S.K. Lee, R.N. Sailappan, W. Ahn, G.V. Jeedigunta, and K.P. Bethune, "Corrosion Resistance and Fracture Toughness of High Performance Concrete in the Marine Environment," Proc. of the 6th CANMET/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, Bangkok, Thailand, May 31-June 5, 1998.