

Prodip K. Das, Ph.D.

NSERC Post-doctoral Fellow
Lawrence Berkeley National Laboratory
1 Cyclotron Road, MS: 70-108B
Berkeley, CA 94720, USA

pkdas@lbl.gov
prodipdas@gmail.com
510-486-6590 (lab)
510-356-7062 (cell)

Education

- Ph.D. in Mechanical Engineering** (94.33% Average) 2010
University of Waterloo, Waterloo, Canada
Dissertation: Transport Phenomena in Cathode Catalyst Layer of PEM Fuel Cells
- M.Sc. in Mechanical Engineering** (93.33% Average) 2003
University of Alberta, Edmonton, Canada
Thesis: Electrostatic Double Layer Interactions in Confined and Many-Body Geometries
- M.Sc. in Mechanical Engineering** (91.75% Average) 2001
Bangladesh University of Engineering & Technology, Dhaka, Bangladesh
Thesis: Elastic-Plastic Behavior of a Circular Rod under Combined Torque and Tension
- B.Sc. in Mechanical Engineering** (97.25% Average) 1998
Bangladesh University of Engineering & Technology, Dhaka, Bangladesh
Thesis: Experimental and Theoretical Investigations of a Solar Water Heater
Gold Medal in Mechanical Engineering (ranked **first** in a class of 124 students)
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Research Experience

- NSERC Post-doctoral Fellow** 2010 – present
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory, Berkeley, USA
- Investigated nano-structured thin-film (NSTF) catalyst for proton-exchange-membrane (PEM) fuel cells
 - Developed multi-scale, multi-physics, dynamic models of PEM fuel cells with NSTF and conventional Pt/C catalyst layers
 - Developed an infrared and direct current electronic excitation method for detecting defects in fuel-cell components
 - Developed a reactive-flow-through model for detecting defects in gas-diffusion electrodes
 - Designed predictive diagnostic tools for detecting manufacturing defects in energy system components
 - Investigated two-phase water transport at the porous gas-diffusion-layer/flow-channel interface of fuel cells
 - Developed technique for measuring droplet adhesion force using sliding angle for porous and rough materials
 - Investigated water-droplets growth and detachment from porous and rough surfaces
 - Routinely interacted with collaborators, and prepared manuscripts and project reports

Doctoral Research Assistant 2006 – 2010
Department of Mechanical and Mechatronics Engineering
University of Waterloo, Waterloo, Canada

- Studied multi-scale, multi-phase reactive transport phenomena in PEM fuel cells
- Developed multi-scale transport model for PEM fuel cells
- Investigated the effects of catalyst-layer structure on fuel cell performance
- Analyzed fuel cell design criteria (physical dimensions, transport and material properties, and operating conditions) and optimized for improved performance

Visiting Scholar 2007 – 2008
Institute for Fuel Cell Innovation
National Research Council, Vancouver, Canada

- Investigated liquid water transport in fuel-cell catalyst-layer
- Developed correlations for estimating effective transport properties

Research Assistant 2001 – 2005
Department of Mechanical Engineering
University of Alberta, Edmonton, Canada

- Studied electrostatic interactions between colloidal particles in confined and many-body geometries
- Investigated electrokinetic phenomena in charged micro-capillaries
- Characterized micro-fabricated surfaces using atomic force microscopy
- Designed and demonstrated a colloidal micro-pump
- Designed a nano-scale spring-loaded valve utilizing colloidal forces
- Developed experimental protocols for patterning chemically heterogeneous surfaces using soft-lithography and micro-fabrication techniques

Teaching Experience

Lecturer 2009 – 2010
Department of Mechanical and Mechatronics Engineering
University of Waterloo, Waterloo, Canada

Teaching Assistant 2006 – 2009
Department of Mechanical and Mechatronics Engineering
University of Waterloo, Waterloo, Canada

Teaching Assistant 2001 – 2003
Department of Mechanical Engineering
University of Alberta, Edmonton, Canada

Assistant Professor (on leave) 2001 – 2006
Lecturer 1998 – 2001
Department of Mechanical Engineering
Bangladesh University of Engineering & Technology, Dhaka, Bangladesh

Mentoring Experience

- Lawrence Berkeley National Laboratory, Berkeley, USA** 2010 – present
- Supervised four summer interns and a graduate student
 - A second-year undergraduate student from the University of Nevada – Reno
 - A fourth-year undergraduate student from the University of California – Berkeley
 - A second-year undergraduate student from Princeton University
 - A third-year undergraduate student from the University of Florida
 - A graduate student from the University of California – Davis
 - Project topics: PEM fuel cells; Computational modeling; Interfacial phenomena; Effective transport properties
- University of Waterloo, Waterloo, Canada** 2009
- Supervised twenty-two graduate course projects
 - Project topics: Fuel cells; Energy conversion; Energy efficiency in building; CFD modeling
- University of Alberta, Edmonton, Canada** 2001 – 2005
- Supervised three undergraduate students
 - Project topics: Microfluidics; Electrokinetic phenomena; COMSOL modeling
- Bangladesh University of Engineering & Technology, Dhaka, Bangladesh** 1998 – 2001
- Supervised fourteen undergraduate students
 - Project topics: Solar energy; Convection heat transfer; CFD modeling
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Awards and Fellowships

- Postdoctoral Fellowship, Natural Sciences and Engineering Research Council, Canada, 2010.
 - \$80,000 for two years for investigating water transport in PEM fuel cells
- Ontario Graduate Scholarship, Ministry of Training, Colleges & Universities, Canada, 2008.
 - \$30,000 for two years for studying transport phenomena in PEM fuel cells
- National Research Council Graduate Scholarship, Institute for Fuel Cell Innovation, Canada, 2007.
 - \$15,000 for two year for studying transport phenomena in fuel cell catalyst layer and developing correlations for effective transport properties
- University of Waterloo Graduate Scholarship, University of Waterloo, Canada 2008 – 2010.
- Faculty of Engineering Graduate Scholarship, University of Waterloo, Canada, 2008.
- Dr. Chandrashekar Memorial Award in Sustainable Energy, University of Waterloo, Canada, 2007.
- Mechanical Engineering Teaching Assistant Excellence Award, University of Waterloo, Canada, Spring 2006, Fall 2006, Winter 2008, Spring 2008 and Spring 2009.
- President's Graduate Scholarship, University of Waterloo, Canada, 2006.
 - \$40,000 for four years for studying transport phenomena in PEM fuel cells

- Alexander Graham Bell Canada Graduate Scholarship, Natural Sciences and Engineering Research Council, Canada, 2005.
 - \$70,000 for two years for studying transport phenomena in PEM fuel cells
 - Honorary Izaak Walton Killam Memorial Scholarship, University of Alberta, Canada, 2004.
 - J. Gordin Kaplan Graduate Student Award, University of Alberta, Canada, 2003.
 - Alberta Ingenuity Fund Studentship, Alberta Heritage Foundation for Science and Engineering Research, Canada, 2002.
 - \$1,10,000 for five years for investigating electrokinetic phenomena in micro-capillaries and designing colloidal micro-devices
 - R.R. Gilpin Memorial Scholarship, University of Alberta, Canada, 2002.
 - Awarded to two outstanding graduate students in Mechanical Engineering
 - Master’s Scholarship, University of Alberta, Canada, 2001.
 - Dr. V.G. Desa Gold Medal, Bangladesh University of Engineering & Technology (BUET), Bangladesh, 2001.
 - Best Student Speaker Gold Medal, International Conference on Applied Mathematics and Mathematical Physics, Bangladesh, 2000.
 - Werner von Siemens Excellence Award, Siemens Bangladesh Limited, Bangladesh, 1998.
 - DEAN’S List Award, Faculty of Engineering, BUET, Bangladesh, 1994 – 1998.
 - For securing GPA 3.75 or higher in an academic year
 - BUET Merit Scholarships and Engineering Award, BUET, Bangladesh, 1994 – 1998.
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Publications

Book Chapter

1. A.Z. Weber, S. Balasubramanian and P.K. Das, “ Proton Exchange Membrane Fuel Cells,” In *Fuel Cell Engineering*, Advances in Chemical Engineering, 41:65–144, 2012.

Journal Articles (h-index = 9)

1. P.K. Das, A. Grippin, A. Kwong and A.Z. Weber, “Liquid Water-Droplet Adhesion-Force Measurements on Fresh and Aged Fuel-Cell Gas-Diffusion Layers,” *Journal of the Electrochemical Society*, 159(5):B489–B496, 2012. **(4 citations)**
2. N.V. Aieta, P.K. Das, A. Perdue, B. Guido, A.M. Herring, A.Z. Weber and M.J. Ulsh, “Applying Infrared Thermography as a Quality-Control Tool for the Rapid Detection of Proton-Exchange-Membrane-Fuel-Cell Catalyst-Layer-Thickness Variations,” *Journal of Power Sources*, 211(1):4–11, 2012.
3. P.K. Das, X. Li, Z. Xie and Z.S. Liu, “Effects of Catalyst Layer Structure and Wettability on Liquid Water Transport in PEM Fuel Cells,” *International Journal of Energy Research*, 35(15):1325–1339, 2011. **(2 citations)**
4. P.K. Das, X. Li and Z.S. Liu, “Analysis of Liquid Water Transport in Cathode Catalyst Layer of PEM Fuel Cells,” *International Journal of Hydrogen Energy*, 35(6):2403–2416, 2010. **(24 citations)**

5. P.K. Das, X. Li and Z.S. Liu, "Effective Transport Coefficients in PEM Fuel Cell Catalyst and Gas Diffusion Layers: Beyond Bruggeman Approximation," *Applied Energy*, 87(9):2785–2796, 2010. **(26 citations)**
6. P.K. Das, X. Li and Z.S. Liu, "A Three-dimensional Agglomerate Model for the Cathode Catalyst Layer of PEM Fuel Cells," *Journal of Power Sources*, 179(1):186–199, 2008. **(24 citations)**
7. P.K. Das, X. Li and Z.S. Liu, "Analytical Approach to Polymer Electrolyte Membrane Fuel Cell Performance and Optimization," *Journal of Electroanalytical Chemistry*, 604(2):72–90, 2007. **(19 citations)**
8. P.K. Das and S. Bhattacharjee, "Electrostatic Double Layer Force between a Sphere and a Planar Substrate in the Presence of Previously Deposited Spherical Particles," *Langmuir*, 21(10):4755–4764, 2005. **(17 citations)**
9. P.K. Das and S. Bhattacharjee, "Finite Element Estimation of Electrostatic Double Layer Interaction between Colloidal Particles inside a Rough Cylindrical Capillary: Effect of Charging Behavior," *Colloids and Surfaces A*, 256(2-3):91–103, 2005. **(2 citations)**
10. J. Fuchser, P.K. Das, W. Moussa and S. Bhattacharjee, "A Nano-scale Spring Loaded Valve Actuated by Colloidal Forces," *Journal of Computational and Theoretical Nanoscience*, 1(1):81–87, 2004. **(2 citations)**
11. P.K. Das and S. Bhattacharjee "Electrostatic Double Layer Interaction between Spherical Particles inside a Rough Capillary," *Journal of Colloid and Interface Science*, 273(1):278–290, 2004. **(9 citations)**
12. P.K. Das, S. Bhattacharjee and W. Moussa, "Electrostatic Double Layer Force between Two Spherical Particles in a Straight Cylindrical Capillary: Finite Element Analysis," *Langmuir*, 19(10):4162–4172, 2003. **(14 citations)**
13. P.K. Das, S. Mahmud, T.H. Tasnim and A.K.M.S. Islam, "Effect of Surface Waviness and Aspect Ratio on Heat Transfer inside a Wavy Enclosure," *International Journal of Numerical Methods for Heat & Fluid Flow*, 13(8):1097–1122, 2003. **(5 citations)**
14. P.K. Das and S. Mahmud, "Numerical Investigation of Natural Convection inside a Wavy Enclosure," *International Journal of Thermal Sciences*, 42(4):397–406, 2003. **(42 citations)**
15. S. Mahmud, P.K. Das and N. Hyder, "Laminar Natural Convection around an Isothermal Square Cylinder at Different Orientations," *International Communications in Heat and Mass Transfer*, 29(7):993–1003, 2002. **(2 citations)**
16. S.H. Tasnim, S. Mahmud and P.K. Das, "Effect of Aspect Ratio and Eccentricity on Heat Transfer from a Cylinder in a Cavity," *International Journal of Numerical Methods for Heat & Fluid Flow*, 12(7):855–869, 2002. **(3 citations)**
17. S. Mahmud, P.K. Das, N. Hyder and A.K.M.S. Islam, "Free Convection in an Enclosure with Vertical Wavy Walls," *International Journal of Thermal Sciences*, 41(5):440–446, 2002. **(42 citations)**
18. S. Mahmud, A.K.M.S. Islam and P.K. Das, "Numerical Prediction of Fluid Flow and Heat Transfer in a Wavy Pipe," *Journal of Thermal Science*, 10(2):133–138, 2001. **(3 citations)**
19. P.K. Das and S. Mahmud, "Effect of Eccentricity and Radius Ratio on Fluid Flow and Heat Transfer inside an Eccentric Semicircular Enclosure," *Journal of Thermal Science*, 9(2):135–140, 2000.

Refereed Conference Articles/Abstracts

1. P.K. Das and A.Z. Weber, "Water Management in PEMFC with Ultra-Thin Catalyst-Layers," *ASME 2013 11th Fuel Cell Science, Engineering and Technology Conference*, Minneapolis, USA, Jul. 14–19, 2013. (accepted)
2. P.K. Das and A.Z. Weber, "Water-Droplet Adhesion Force on Fuel-Cell Gas-Diffusion Layers: Beyond Contact-Angle Measurements," *ASME 2012 10th International Conference on Nanochannels, Microchannels and Minichannels*, Puerto Rico, USA, Jul. 8–12, 2012.
3. P.K. Das, S. Haussener, A. Kwong, G. Hwang, H.P. Gunterman and A.Z. Weber, "Physicochemical Characterization of Fuel-Cell Diffusion Media," *ASME 2012 10th International Conference on Nanochannels, Microchannels and Minichannels*, Puerto Rico, USA, Jul. 8–12, 2012.
4. P.K. Das, A. Grippin and A.Z. Weber, "Detachment of Liquid-Water Droplets from Gas-Diffusion Layers," *ECS Transactions*, Vol. 41(1), pp. 459–468, 220th Electrochemical Society Meeting, Boston, USA, Oct. 9–14, 2011.
5. N.V. Aieta, A.S. Perdue, P.K. Das, A.Z. Weber and M.J. Ulsh, "Detecting Loading Variation in Pt/PEMFC Electrodes using IR Thermography," *American Chemical Society, Division of Fuel Chemistry*, Vol. 56(2), pp. 262–263, 242nd ACS National Meeting, Denver, USA, Aug. 28–Sept. 1, 2011.
6. P.K. Das, X. Li, Z. Xie and Z.S. Liu, "Effect of Catalyst Layer Structure and Wettability on Liquid Water Transport in PEM Fuel Cells," *Proc. of 5th International Green Energy Conference*, Waterloo, Canada, Jun. 1–3, 2010.
7. P.K. Das, X. Li and Z.S. Liu, "Modeling of Liquid Water Transport in Cathode Catalyst Layers of PEM Fuel Cells," *Proc. of ASME 2009 7th International Fuel Cell Science, Engineering & Technology Conference*, pp. 491–500, Newport Beach, USA, Jun. 8–10, 2009.
8. P.K. Das, X. Li and Z.S. Liu, "Estimation of Effective Transport Properties for PEM Fuel Cells," *Proc. of 4th International Green Energy Conference*, pp. 164–174, Beijing, China, Oct. 20–22, 2008.
9. P.K. Das and S. Bhattacharjee, "Electrostatic Interactions between Nano-particles in Confined Spaces: Influence of Confining Wall Roughness," *Proc. of International Conference on MEMS, NANO, and Smart Systems*, pp. 263–268, Banff, Canada, Jul. 20–23, 2003.
10. S. Mahmud, P.K. Das, N. Hyder and A.K.M.S. Islam "Buoyancy Induced Flow and Heat Transfer inside an Inclined Wavy Enclosure," *Proc. of International Conference on Applied Mathematics and Mathematical Physics*, Sylhet, Bangladesh, Jan. 6–9, 2003.
11. P.K. Das, S. Bhattacharjee and W. Moussa, "Electrostatic Force Modulation as a Flow Control Mechanism in Micro-fluidic Devices," *Proc. of International Workshop on System-on-Chip for Real-Time Applications*, pp. 299–308, Banff, Canada, Jul. 6–7, 2002.
12. P.K. Das, N. Hyder and S. Mahmud, "Flow and Heat Transfer inside a Wavy-Walled Enclosure," *Proc. of 5th International Symposium on Experimental and Computational Aerothermodynamics of Internal Flows*, pp. 583–590, Gdansk, Poland, Sept. 4–7, 2001.
13. S. Mahmud, A.K.M.S. Islam and P.K. Das, "Structure of Separated Flow in a Pipe with Wavy Surface," *Proc. of 5th International Symposium on Experimental and Computational Aerothermodynamics of Internal Flows*, pp. 855–862, Gdansk, Poland, Sept. 4–7, 2001.

14. F.M. Chowdhury, S.A.M.M. Alam, S. Mahmud and P.K. Das, "Natural Convection inside Corrugated Plate," *Proc. of 5th International Symposium on Experimental and Computational Aerothermodynamics of Internal Flows*, pp. 563–571, Gdansk, Poland, Sept. 4–7, 2001.
15. P.K. Das and S. Mahmud, "Effect of Eccentricity and Radius Ratio on Fluid Flow and Heat Transfer inside an Eccentric Semicircular Enclosure," *Proc. of Millennium International Symposium on Thermal and Fluid Science*, pp. 160–161, Xian, China, Sept. 18–22, 2000.
16. S. Mahmud, A.K.M.S. Islam, and P.K. Das, "Numerical Prediction of Fluid Flow and Heat Transfer in a Wavy Pipe," *Proc. of Millennium International Symposium on Thermal and Fluid Science*, pp. 112–113, Xian, China, Sept. 18–22, 2000.
17. P.K. Das and S. Mahmud, "Numerical Investigation of Natural Convection inside a Wavy Enclosure," *Proc. of International Conference on Applied Mathematics and Mathematical Physics*, pp. 161–169, Sylhet, Bangladesh, Sept. 11–15, 2000.
18. S. Mahmud, S.H. Tasnim and P.K. Das, "Effect of Aspect Ratio and Eccentricity on Heat Transfer from a Cylinder in a Cavity," *Proc. of International Conference on Applied Mathematics and Mathematical Physics*, pp. 193–201, Sylhet, Bangladesh, Sept. 11–15, 2000.
19. N. Hyder, P.K. Das, S.R. Bhuiyan, S. Hossain and S. Mahmud, "Free Convection around an Isothermal Square Cylinder at Different Orientation," *Proc. of International Conference on Applied Mathematics and Mathematical Physics*, Sylhet, Bangladesh, Sept. 11–15, 2000.
20. A.M.A. Huq, P.K. Das and M.A.H. Mamun, "Pressure Drop and Heat Transfer in an Internally Finned Tube," *Proc. of International Conference of Applied Mathematics and Mathematical Physics*, Sylhet, Bangladesh, Sept. 11–15, 2000.
21. P.K. Das and S. Mahmud, "Effect of Radius Ratio on Natural Convection Heat Transfer inside an Eccentric Semicircular Enclosure," *Proc. of 6th International Conference on Mechanical Engineering*, pp. 46–53, Dhaka, Bangladesh, Feb. 17–19, 2000.
22. P.K. Das, M.W. Mohiuddin, G.M.M. Huq and M.I. Hossain, "An Experimental Investigation of a Novel Built-in Storage Solar Water Heater," *Proc. of 6th International Conference on Mechanical Engineering*, pp. 39–45, Dhaka, Bangladesh, Feb. 17–19, 2000.
23. M.A. Alim, P.K. Das and S. Mahmud, "Free Convection Flow and Heat Transfer inside a Vertical Convergent-Divergent Enclosure," *Proc. of 6th International Conference on Mechanical Engineering*, pp. 305–311, Dhaka, Bangladesh, Feb. 17–19, 2000.
24. P.K. Das and S. Mahmud, "Buoyancy Induced Flow and Heat Transfer inside a Semicircular Eccentric Enclosure," *Proc. of 3rd International Conference on Fluid Mechanics and Heat Transfer*, pp. 270–275, Dhaka, Bangladesh, Dec. 15–16, 1999.

Selected Presentations

- "Understanding Water Management as a Function of Catalyst-Layer Thickness," ECS Meeting and Electrochemical Energy Summit, Honolulu, HI, USA, Oct. 2012.
- "Modeling Polymer-Electrolyte-Membrane Fuel Cells," Joint Center for Artificial Photosynthesis, Berkeley, CA, USA, Sept. 2012.
- "Water-Droplet Adhesion Force on Fuel-Cell Gas-Diffusion Layers: Beyond Contact-Angle Measurements," ASME Tenth International Conference on Nanochannels, Microchannels and Minichannels, Rio Grande, Puerto Rico, USA, Jul. 2012.

- “Modeling Reactive-Flow through Gas-Diffusion Electrodes for Detecting Defects,” National Renewable Energy Laboratory, Golden, CO, USA, Feb. 2012.
 - “Nano-Structured Thin-Film Electrode Modeling,” Department of Energy (DOE) Annual Review Meeting, Lawrence Berkeley National Laboratory, Berkeley, CA, USA, Jan. 2012.
 - “Measuring Droplet Adhesion Force,” DOE Transport Modeling Working Group Annual Meeting, Lawrence Berkeley National Laboratory, Berkeley, CA, USA, Jan. 2012.
 - “Detachment of Liquid-Water Droplets from Gas-Diffusion Layers,” ECS Meeting and Electrochemical Energy Summit, Boston, MA, USA, Oct. 2011.
 - “Modeling IR Thermography for Detecting Defects in Membrane Electrode Assembly,” National Renewable Energy Laboratory, Golden, CO, USA, Mar. 2011.
 - “Transport Phenomena in Cathode Catalyst Layer of PEM Fuel Cells,” Department of Mechanical and Aerospace Engineering, Carleton University, Ottawa, ON, Canada, Jul. 2010.
 - “Effect of Catalyst Layer Structure and Wettability on Liquid-Water Transport in PEM Fuel Cells,” Fifth International Green Energy Conference, Waterloo, ON, Canada, Jun. 2010.
 - “Modeling of Liquid Water Transport in Cathode Catalyst Layers of PEM Fuel Cells,” ASME Seventh International Fuel Cell Science, Engineering and Technology Conference, Newport Beach, CA, USA, Jun. 2009.
 - “Effect of Catalyst Layer Structure on PEM Fuel Cell’s Performance,” Ulm Electrochemical Talks, Ulm, Germany, Jun. 2008.
 - “Estimation of Effective Transport Properties for PEM Fuel Cells,” Fourth International Green Energy Conference, Beijing, China, Oct. 2008.
 - “Electrostatic Interactions between Nano-Particles in Confined Spaces: Influence of Confining Wall Roughness,” International Conference on MEMS, NANO, and Smart Systems, Banff, AB, Canada, 2003.
 - “Electrostatic Double Layer Interactions in Confined and Many-Body Geometries,” Department of Mechanical Engineering, University of Alberta, Edmonton, AB, Canada, Mar. 2003.
 - “Electrostatic Double Layer Force between Two Spherical Particles in a Straight Cylindrical Capillary: Finite Element Analysis,” Electrochemistry and Nanotechnology, Electrochemical Society Meeting, Edmonton, AB, Canada, Nov. 2003.
 - “Numerical Investigation of Natural Convection inside a Wavy Enclosure,” International Conference on Applied Mathematics and Mathematical Physics, Sylhet, Bangladesh, Sept. 2000.
 - “Pressure Drop and Heat Transfer in an Internally Finned Tube,” International Conference on Applied Mathematics and Mathematical Physics, Sylhet, Bangladesh, Sept. 2000.
 - “Effect of Radius Ratio on Natural Convection Heat Transfer inside an Eccentric Semicircular Enclosure,” International Conference on Mechanical Engineering, Dhaka, Bangladesh, Feb. 2000.
 - “Buoyancy Induced Flow and Heat Transfer inside a Semicircular Eccentric Enclosure,” International Conference on Fluid Mechanics and Heat Transfer, Dhaka, Bangladesh, Dec. 1999.
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Professional Services

Reviewer of

- Applied Energy
 - ASME International Fuel Cell Science, Engineering & Technology Conference
 - Energy & Fuels
 - International Green Energy Conference
 - International Journal of Energy Research
 - International Journal of Green Energy
 - International Journal of Hydrogen Energy
 - Journal of Fluids Engineering
 - Journal of Heat Transfer
 - Journal of Power Sources
 - SAE World Congress
 - The Electrochemical Society
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