

Daniel Esposito

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EDUCATION

- Postdoctoral Fellowship** 2012-2014
National Institute of Standards and Technology, Gaithersburg, MD
National Research Council (NRC) Fellowship Program
Project Title: “In-situ Evaluation of the Properties and Performance of Metal-Insulator-Semiconductor (MIS) Photoelectrodes with High Spatial Resolution”
Advisors: Dr. Thomas Moffat, Dr. Alec Talin
- Ph.D., Chemical Engineering** Jan. 2012
University of Delaware, Newark DE
[Solar Hydrogen IGERT Program](#)
Dissertation: “Development of Tungsten-based Catalytic Materials for Photoelectrochemical Applications”
Advisors: Dr. Jinguang Chen, Dr. Robert Birkmire
- B.S., Chemical Engineering** May 2006
Lehigh University, Bethlehem PA
Graduated Tau Beta Pi, and with institutional honors

PROFESSIONAL EXPERIENCE

- Assistant Professor** 2014-present
Department of Chemical Engineering, Columbia University, New York, NY
- Postdoctoral Research (NRC Fellowship)** 2012-2014
National Institute of Standards and Technology, Gaithersburg, MD

RESEARCH INTERESTS

- **Photo(electrocatalytic) materials**
 - Electrocatalysts for PECs, fuel cells, and other electrocatalytic applications
 - Electrocatalyst design, synthesis, and characterization
 - Electroanalytical techniques to study interfacial charge transfer phenomena
 - High-throughput screening of catalytic and photocatalytic materials
 - Metal-Insulator-Semiconductor (MIS) photoelectrodes and PV cells
 - Thin-film PV, including use in integrated PV electrolysis reactors
- **Solar and electrochemical reactors** (Electrochemical Engineering)
 - Membraneless electrochemical and photoelectrochemical cells
 - Polymer electrolyte membrane (PEM) and alkaline electrolyzers

- Fuel cells and flow batteries
- Photovoltaic (PV)-electrolysis reactors
- Bubble dynamics in (photo)electrochemical reactors
- ***in-situ* imaging of PEC, PV, and catalytic materials and devices**
 - Scanning photocurrent microscopy (SPCM)
 - Scanning electrochemical microscopy (SECM)
 - High speed video analysis of operating electrochemical cells
 - Spectroelectrochemistry (Raman, SERS)

PUBLICATIONS & PRESENTATIONS

Peer Reviewed Articles

1. **D.V. Esposito**, “Membraneless Electrolyzers for Low-Cost Hydrogen Production in a Renewable Energy Future”. *Joule*, Accepted Perspective Article.
2. O.O. Talabi, A.E. Dorfi, G.D. O’Neil, **D.V. Esposito**, “Membraneless Electrolyzers for the Simultaneous Production of Acid and Base”. *Chemical Communications*, **53**, 8006-8009 2017. Part of the 2017 *Emerging Investigators Issue*. Download [here](#).
3. **D.V. Esposito***, Y. Lee, N.Y. Labrador, H. Yoon, P. Haney, A.A. Talin, V. Szalai, T.P. Moffat, “Deconvoluting the Influences of 3-D Structure on the Performance of Photoelectrodes for Solar-Driven Water Splitting”. *Sustainable Energy & Fuels*, **1**, 154-173, (2017). *Corresponding author. Download [here](#).
4. J.T. Davis, **D.V. Esposito**, “Limiting Photocurrent Analysis of a Wide Channel Photoelectrochemical Flow Reactor”, *Journal of Physics D: Applied Physics.*, vol. 50, 8, 11 pp, 2017. (Special Issue on Solar Fuels). Download [here](#)
5. N. Y. Labrador, X. Li, Y. Liu, J. T. Koberstein, R. Wang, H. Tan, T. P. Moffat, **D. V. Esposito**, “Enhanced Performance of Si MIS Photocathodes Containing Oxide-Coated Nanoparticle Electrocatalysts”. *Nano Letters*, **16**, 6452-6459, (2016).
6. G.D. O’Neil, C. Christian, D. Brown, J.T. Davis, D.E. Brown, **D.V. Esposito**, “A Simple and Scalable Membraneless Electrolyzer for Hydrogen Production from Water Electrolysis”. *J. Electrochemical Society*, vol. 163 (11) F3012-F3019 (2016). (JES Focus Issue on Electrolysis for Increased Renewable Energy Penetration).
7. **D.V. Esposito**, J.B. Baxter, J. John, N.S. Lewis, T.P. Moffat, T. Ogitsu, G.D. O’Neil, T.A. Pham, A.A. Talin, J.M. Velazquez, B.C. Wood. “Methods of Photoelectrode Characterization with High Spatial and Temporal Resolution.” *Energy & Environmental Science*. vol. 8, 2863-2885, (2015).
8. J. M. Velazquez, J. John, **D. V. Esposito**, A. Pieterick, R. A. Pala, G. Sun, X. Zhou, Z. Huang, S. Ardo, M. P. Soriaga, B. S. Brunshwig and N. Lewis. “A Scanning Probe Investigation of the Role of Surface Motifs in the Behavior of p-WSe₂ Photocathodes.” *Energy & Environmental Science*, (in press, doi: 10.1039/C5EE02530C), (2015).
9. **D.V. Esposito**, I. Levin, T.P. Moffat, and A.A. Talin. “Hydrogen Evolution at Si-based Metal-Insulator-Semiconductor Photoelectrodes Enhanced by Inversion Channel Charge Collection and Hydrogen Spillover.” *Nature Materials*, vol. 12, 562-568 (2013). **(Highlighted as a NIST tech beat item, in Clean Technica, and in EARTH Magazine)**
10. **D.V. Esposito***, R.V Forest*, Y. Chang, N. Gaillard, B.E. McCandless, S. Hou, K.H. Lee, R.W. Birkmire, and J.G. Chen, “Photoelectrochemical Reforming of Glucose for Hydrogen Production using a WO₃-based Tandem Cell Device”. *Energy & Environmental Science*, vol. 5, 9091-9099, 2012. *shared first authorship.

11. **D.V. Esposito**, S.T. Hunt, Y. Kimmel, and J.G. Chen, “A New Class of Electrocatalysts for Hydrogen Production from Water Electrolysis: Metal Monolayers Supported on Low-Cost Transition Metal Carbides”. *Journal of the American Chemical Society*, vol. 134, 3025-3033, 2012. **(Highlighted in Chemical & Engineering News)**
12. M. C. Weidman, **D.V. Esposito**, Y.C. Hsu, and J.G. Chen, “Comparison of Electrochemical Stability of Transition Metal Carbides (WC, W₂C, Mo₂C) Over a Wide pH Range”. *Journal of Power Sources*, vol. 202, 11-17, 2012.
13. Y. Kimmel, **D.V. Esposito**, R.W. Birkmire, and J.G. Chen, “Effect of Surface Carbon on the Hydrogen Evolution Reactivity of Tungsten Carbide (WC) and Pt-modified WC Electrocatalysts”. *International Journal of Hydrogen Energy*, vol. 37, 3019-3024, 2012.
14. **D.V. Esposito** and J.G. Chen, “Monolayer Platinum Supported on Tungsten Carbides as Low-Cost Electrocatalysts: Opportunities and Limitations”. *Energy & Environmental Science*, vol. 4, 3900-3912, 2011. **(Invited Perspective, selected as a high impact review article on electrocatalysis research on EES website)**
15. I.J. Hsu, **D.V. Esposito**, E. Mahoney, A. Black, and J.G. Chen, “Particle Shape Control using Pulse Electrodeposition: Methanol Oxidation as a Probe Reaction on Pt Dendrites and Cubes”. *Journal of Power Sources*, vol. 196, 8307-8312, 2011.
16. **D.V. Esposito**, Y. Chang, J.G. Chen, R.W. Birkmire, and N. Gaillard, “Hydrogen Production from Photo-driven Electrolysis of Biomass-derived Oxygenates: A Case Study on Methanol using Pt-modified WO₃ Thin Film Electrodes”. *International Journal of Hydrogen Energy*, vol. 36, 9632-9644, 2011.
17. **D.V. Esposito**, S.T. Hunt, A.L. Stottlemeyer, K.D. Dobson, B.E. McCandless, R.W. Birkmire, and J.G. Chen, “Low-Cost Hydrogen Evolution Catalysts Based on Monolayer Platinum on Tungsten Monocarbide (WC) Substrates”. *Angewandte Chemie International Edition*, vol. 49, 9859-9862, 2010. **(Cover article and Angewandte Chemie press release)**
18. M. C. Weidman, **D.V. Esposito**, I.J. Hsu, and J.G. Chen, “Electrochemical Stability of Tungsten and Tungsten Monocarbide (WC) Over Wide pH and Potential Ranges”. *Journal of the Electrochemical Society*, vol. 157, F179-F188, 2010.
19. W. Y. Yin, **D.V. Esposito**, S. Yang, C. Ni, J. G. Chen, G. Zhao, Z. Zhang, C. Hu, M. Cao, and Bingqing Wei, “Controlling Novel Red-Light Emissions by Doping In₂O₃ Nano/Microstructures with Interstitial Nitrogen”. *J. Phys. Chem. C*, vol. 114, 13234-13240, 2010.
20. **D.V. Esposito**, O.Y. Goue, K.D. Dobson, B.E. McCandless, J.G. Chen, and R.W. Birkmire, “A New Photoelectrochemical Test Cell and Its Use for a Combined Two- and Three-Electrode Approach to Cell Testing”. *Review of Scientific Instruments*, vol. 80, 125107, 2009.
21. **D.V. Esposito**, K.D. Dobson, B.E. McCandless, R.W. Birkmire, and J.G. Chen, “Comparative Study of Tungsten Monocarbide and Platinum as Counter Electrodes in Polysulfide-Based Photoelectrochemical Solar Cells”. *Journal of the Electrochemical Society*, vol. 156, pp. B962-B969, 2009.
22. E.C. Weigert, **D.V. Esposito**, and J.G. Chen, “Cyclic Voltammetry and XPS studies of Electrochemical Stability of Clean and Pt-Modified Tungsten and Molybdenum Carbide (WC and Mo₂C) Films”. *Journal of Power Sources*, vol. 193, pp. 501-506, 2009.
23. J.M. Meacham, M.J. Varady, **D.V. Esposito**, F.L. Degertekin, and A.G. Fedorov, “Micromachined Ultrasonic Atomizer For Liquid Fuels”. *Atomization and Sprays*, vol. 18, pp. 163-190, 2008.

Other publications or products: (not peer reviewed)

1. **D.V. Esposito** and D. Steingart, “[Additive Manufacturing and Electrochemistry](#)” ECS Interface, Vol. 25, Editorial published in Spring 2016 Special Issue of ECS Interface.

2. D. Steingart and **D.V. Esposito**, “Open Source Tools for Electrochemists”, website for online repository of 3D printer design files used for electrochemical science and applications. Available at: <http://echem.io/>
3. **D.V. Esposito** and V. Alt. “Estimating solar energy requirements to meet U.S. energy needs: an outreach event”, *NCSL International Workshop & Symposium Proceedings*, 2014.

Patents: 1 patent issued, 1 provisional patent filed, 1 disclosure submitted, 1 in preparation (not listed).

1. **D.V. Esposito**, J. Wright, G.D. O’Neil, H. Kuo, “Continuous Multi-Dimensional Scanning Probes (CMDPs) for Scanning Probe Microscopy” (Invention disclosure report submitted to Columbia)
2. **D.V. Esposito**, G.D. O’Neil, “Membraneless Electrochemical Flow-Through Reactor”. (U.S. provisional patent applied for, Docket Number 103921-100, submitted October 2015)
3. **D.V. Esposito**, A.A. Talin, and T.P. Moffat, “Photoactive article, process for making, and use of same”. US Patent No. 9,562,292. (2017)

TEACHING EXPERIENCE

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|---|-------------|
| <p>Course Instructor, CHEN E4330 “Advanced Chemical Kinetics”, Columbia University</p> <ul style="list-style-type: none"> ▪ Graduate class covering reaction kinetics, reactor design, and special kinetics topics such as photocatalysis and electrochemical reactions. ▪ Designed course, taught biweekly lectures, developed HW and exam problems. | 2014-2017 |
| <p>Course Instructor, CHEN E4231 “Solar Fuels”, Columbia University</p> <ul style="list-style-type: none"> ▪ Graduate-level class covering the fundamentals and applications of electrochemical, solar, and photoelectrochemical technologies for converting sunlight into chemical fuels. Course included a problem-based learning project. ▪ Designed course, taught biweekly lectures, developed HW and exam problems. | 2016-2017 |
| <p>Mentor for undergraduate research, University of Delaware, NIST</p> <ul style="list-style-type: none"> ▪ Served as the primary mentor for six undergraduate students, teaching them various laboratory techniques, data analysis methods, and critical thinking skills while providing direction and guidance on their research projects. ▪ Co-published six different journal articles with four of these students. ▪ Three of my mentees have received NSF graduate fellowships, and one of my mentees received a Barry M. Goldwater Award for excellence in academics and research. | 2008 – 2013 |
| <p>Guest lecturer and course development , University of Delaware
Course: Special Topics in Energy Engineering</p> <ul style="list-style-type: none"> ▪ Developed two lectures on “Photoelectrochemical Systems”, which included discussions on the fundamental solid-state physics, kinetics, thermodynamics, and basic design principles of photoelectrochemical cells. ▪ Gave one of these lectures to a class of ~40 students. | Spring 2011 |
| <p>Teaching Assistant, University of Delaware</p> | Fall 2008 |

Course: Applied Mathematics for Chemical Engineers

- Undergraduate class with ~60 students. Course consisted of three classroom lectures and one computer lab session per week. In the lab, students were taught to use Matlab and Simulink software to solve problems using math skills learned in class lectures.
- Developed lab assignments, led several lab sessions, attended lectures, held weekly office hours, and graded course assignments, lab write-ups, and exams.

Teaching Assistant, University of Delaware

Spring 2008

Course: Advanced Transport Phenomena

- Graduate level course with ~15 students. Core course for the graduate curriculum on the theory of heat, mass, and fluid transport phenomena.
- Attended lectures, held review sessions, held weekly office hours, developed homework problems, and graded assignments and course projects.

TEACHING INTERESTS

- Kinetics and reactor design
- Mass and energy balance
- Transport phenomena (Fluid mechanics, Heat, Mass)
- Electrochemistry (electrocatalysis, corrosion chemistry, fuel cells)
- Matlab-based engineering coursework
- Photovoltaics and solar fuel technologies
- General energy and sustainability coursework

AWARDS & HONORS

- Named as a 2017 [Scialog Fellow](#) for a multi-year interdisciplinary initiative on “Advanced Energy Storage”.
- [NRC Postdoctoral Fellowship](#), National Institute of Standards and Technology National Research Council Postdoctoral Research Associateship Program-2011
- Graduate Fellowship, University of Delaware, [Bill N. Baron Fellowship Award](#)-2010
- Graduate Fellowship, University of Delaware, [NASA Delaware Space Grant College and Fellowship Program](#)-2008
- Graduate Fellowship, University of Delaware, [Solar Hydrogen IGERT Program](#)-2006
- American Chemical Society Award for outstanding senior in Chemical Engineering at Lehigh University-2006
- [First place winner](#), oral presentation at Lehigh’s Undergraduate Engineering Research Symposium-2006
- Undergraduate Award, Lehigh University, Chandler Award for excellence in Chemical Engineering – 2004

PROFESSIONAL AFFILIATIONS

American Institute of Chemical Engineers, Electrochemical Society, American Chemical Society, Tau Beta Pi Engineering Honor Society

PROFESSIONAL SERVICE

Activity	Date(s)
Lead organizer for new symposium on “Light-Driven Chemistry” to be held at ACS Spring meetings. 2017 symposium featured 6 sessions involving ~65 talks, including ~ 15 invited speakers from leading researchers in the field.	2016-present
Co-lead organizer for NSF- and ARL-funded workshop on solar fuels production by photovoltaic-electrolysis, hosted by the University of Delaware. Organized sessions, invited speakers, lead break-out sessions	March 2016
Guest editor for special issue on 3D printing in ECS Interface Magazine	2015-2016
Contributor/editor for a book chapter on “photoelectrochemical energy conversion” for electrochemical engineering text book being developed by John Harb (BYU) and Tom Fuller (Georgia Tech.).	2016
Co-organizer for session on electrochemistry at annual AIChE meeting. (3 years running)	2013-present
Served as a reviewer of grant proposals for the following funding agencies: DOE/EERE (3 times), NSF (3 times).	2013-2017
Actively involved with the DOE working group on photoelectrochemistry, attending biannual meetings, and organizing/participating in collaborative white papers.	2013-present
Referee for > 10 journals including the following: <i>Angewandte Chemie</i> , <i>Energy & Environmental Science</i> , <i>Nature Materials</i> , <i>PNAS</i> , <i>Nature Communications</i> , <i>Journal of Physical Chemistry</i> , <i>ChemPhysChem</i> , <i>Applied Catalysis B</i> , <i>Applied Surface Science</i> , <i>Journal of Vacuum Science</i> , <i>Review of Scientific Instruments</i> .	2011-present

COMMUNITY SERVICE & OUTREACH (2015-present)

Activity	Organization/Program	Date(s)
Esposito group hosted Lab tours for ~25 high school students through CU SHAPE (Summer High School Academic Program for Engineers)	CU SEAS SHAPE program	August 2017
Gave lecture on solar energy conversion to ~ 10 high school students in summer program for underrepresented students	Upward Bound	July 2017
Hosted two high school researchers through SEAS E.N.G. program.	SEAS E.N.G.	Summer 2017
Gave lunch time seminar to ~ 20 summer REU students at Columbia; sponsored by SEAS.	SEAS REU	June 2017
Gave presentation on solar fuels to graduate student energy club at Columbia (~ 20 students)	CU student club	April 2017
Esposito group hosted Lab tours for 25-30 6th-8th graders through the CU Society of Hispanic Professional Engineers (SHPE)	CU SHPE	Oct. 2016

Hosted two high school researchers through SEAS E.N.G. program.	SEAS E.N.G.	Summer 2016
Esposito group hosted Lab tours and presentation for ~ 25 female high school students	GOALS for Girls Summer Program	July 2016
Gave lunch time seminar on solar fuels to ~ 20 summer REU students at Columbia; sponsored by MRSEC program.	NSF MRSEC Program	June 2016
Esposito group hosted Lab tours for ~40 high school students	CU SEAS Outreach office	May 2016
Organized student selection for MRSEC summer REU program	NSF MRSEC program	March 2016
Gave evening lecture on solar fuels to ~ 30 SEAS students through CU undergrad energy club.	CU student club	November 2015