

# 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
- Ph.D., Chemical Engineering** Jan. 2012  
University of Delaware, Newark DE  
Solar Hydrogen NSF IGERT Program
- 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

- **Electrocatalytic and photocatalytic materials**
  - Oxide-encapsulated electrocatalysts and photocatalysts
  - Electrocatalysis and photocatalysis at buried interfaces
  - Electrocatalyst design, synthesis, and characterization
  - Electroanalytical techniques to study interfacial charge transfer phenomena
  - Metal-Insulator-Semiconductor (MIS) photoelectrodes
- **Electrolyzers and photoelectrochemical devices**
  - Membraneless electrochemical and photoelectrochemical cells
  - Photovoltaic (PV)-electrolysis reactors, including for seawater electrolysis
  - Polymer electrolyte membrane (PEM) and alkaline electrolyzers
  - Fuel cells
  - Understanding and controlling bubble dynamics in (photo)electrochemical reactors
- ***in-situ* imaging of PEC, PV, and catalytic materials and devices**
  - Scanning electrochemical microscopy (SECM)
  - Non-local scanning probes for high areal scan rates and high throughput screening of materials
  - Scanning photocurrent microscopy (SPCM) / laser beam induced current (LBIC)
  - High speed video analysis of operating electrochemical cells
  - Spectroelectrochemistry

## PUBLICATIONS

### Peer Reviewed Articles (\*corresponding author)

1. N. Labrador, J. Robinson, B. Xu, B. Sartor, **D.V. Esposito\***, “Silicon Oxide-Encapsulated Platinum Thin Films as Highly Active Electrocatalysts for Carbon Monoxide and Methanol Oxidation”. *ACS Catalysis*, vol. 8, pp 11423–11434, 2018. Download [here](#).
2. M. Beatty, H. Chen, B. Lee, N. Labrador, **D.V. Esposito\***, “Structure-Property Relationships Describing the Buried Interface Between Silicon Oxide Overlayers and Electrocatalytic Platinum Thin Films”. *vol. 6*, pp 22287-22300, 2018. Download [here](#). (**Emerging Investigators 2018 Issue**)
3. G.D. O’Neil, H. Kuo, D. Lomax, J. Wright\*, **D.V. Esposito\***, “Scanning Electrochemical Microscopy: Beyond the Point Probe”, *Analytical Chemistry*, vol. 90 (19), pp 11531–11537, 2018. Download [here](#).
4. A. M. Dadgar, D. Scullion, K. Kang, **D. Esposito**, E. H. Yang, I. P. Herman, M. A. Pimenta, E.-J. G. Santos, and A. N. Pasupathy , “Strain Engineering and Raman Spectroscopy of Monolayer Transition Metal Dichalcogenides”, *Chemistry of Materials*, vol. 30 (15) pp 5148-5155. Download [here](#).
5. N. Y. Labrador, E. L. Songcuan, C. De Silva, Han Chen, Sophia Kurdziel, Ranjith K. Ramachandran, Christophe Detavernier, **D.V. Esposito\***, “Hydrogen Evolution at the Buried Interface between Pt Thin Films and Silicon Oxide Nanomembranes”. *ACS Catalysis*, vol. 8, pp 1767–1778, 2018. Download [here](#).
6. **D.V. Esposito\***, “Membrane Coated Electrocatalysts—an Alternative Approach to Achieving Stable and Tunable Electrocatalysis”. *ACS Catalysis*, vol. 8, pp 457–465, (2018). Download [here](#) . (Perspective article).
7. J.T. Davis, J. Qi, X. Fan, J. Bui, **D.V. Esposito\***, “Floating Membraneless PV-Electrolyzer Based on Buoyancy-Driven Product Separation”, *International Journal of Hydrogen Energy*, vol. 43 (3), pp 1224–1238, (2018). **Highlighted in Newsweek, Smithsonian.com, NBC News, Materials World, and more.**
8. A. E. Dorfi, A.C. West, **D.V. Esposito\***, “Quantifying Losses in Photoelectrode Performance due to Single Hydrogen Bubbles”, *Journal of Physical Chemistry C.*, vol. 121 (48), pp 26587–26597, (2017). Download [here](#).
9. **D.V. Esposito\***, “Membraneless Electrolyzers for Low-Cost Hydrogen Production in a Renewable Energy Future”. *Joule*, 1, 1-8, (2017). Download [here](#). (Invited Perspective article)
10. 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](#).
11. **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). Download [here](#).
12. 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](#)
13. 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).
14. 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).
15. **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).

16. 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. Brunschwig and N. Lewis. “A Scanning Probe Investigation of the Role of Surface Motifs in the Behavior of p-WSe<sub>2</sub> Photocathodes.” *Energy & Environmental Science*, (in press, doi: 10.1039/C5EE02530C), (2015).
17. **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)**
18. **D.V. Esposito**<sup>^</sup>, R.V Forest<sup>^</sup>, 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 WO<sub>3</sub>-based Tandem Cell Device”. *Energy & Environmental Science*, vol. 5, 9091-9099, 2012. <sup>^</sup>shared first authorship.
19. **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)**
20. M. C. Weidman, **D.V. Esposito**, Y.C. Hsu, and J.G. Chen, “Comparison of Electrochemical Stability of Transition Metal Carbides (WC, W<sub>2</sub>C, Mo<sub>2</sub>C) Over a Wide pH Range”. *Journal of Power Sources*, vol. 202, 11-17, 2012.
21. 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.
22. **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)**
23. 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.
24. **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 WO<sub>3</sub> Thin Film Electrodes”. *International Journal of Hydrogen Energy*, vol. 36, 9632-9644, 2011.
25. **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)**
26. 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.
27. 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 In<sub>2</sub>O<sub>3</sub> Nano/Microstructures with Interstitial Nitrogen”. *J. Phys. Chem. C*, vol. 114, 13234-13240, 2010.
28. **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.

29. **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.
30. 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 Mo<sub>2</sub>C) Films”. *Journal of Power Sources*, vol. 193, pp. 501-506, 2009.
31. 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, 2 provisional patents filed, 1 disclosure submitted.

1. **D.V. Esposito**, S. Kawashima “Method for Harvesting Metal Hydroxides from Seawater”. (Invention disclosure filed with CTV)
2. **D.V. Esposito**, J. Wright, G.D. O’Neil, H. Kuo, “Continuous Multi-Dimensional Scanning Probes (CMDPs) for Scanning Probe Microscopy” (Provisional Patent # 62/661,823 filed with USPTO)
3. **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)
4. **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><b>Course Instructor</b>, CHEN E4330 “Advanced Chemical Kinetics”, Columbia University</p> <ul style="list-style-type: none"> <li>▪ Graduate class covering reaction kinetics, reactor design, and special kinetics topics such as photocatalysis and electrochemical reactions.</li> <li>▪ Designed course, taught biweekly lectures, developed HW and exam problems.</li> </ul>                                                                                                                                                                                | 2014-2018 |
| <p><b>Course Instructor</b>, CHEN E4231 “Solar Fuels”, Columbia University</p> <ul style="list-style-type: none"> <li>▪ Graduate-level class covering the fundamentals and applications of electrochemical, solar, and photoelectrochemical technologies for converting sunlight into chemical fuels. Course includes a problem-based learning project that incorporates crowd-sourcing principles for the generation and evaluation of clean energy technologies.</li> <li>▪ Designed course, taught biweekly lectures, developed HW and exam problems.</li> </ul> | 2016-2017 |

## 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

- 2018-NSF CAREER Award. See Columbia [press release](#).
- 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
- Chandler Award for excellence in Chemical Engineering, Lehigh University – 2004

## PROFESSIONAL AFFILIATIONS

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

## PROFESSIONAL SERVICE

Activity	Date(s)
Co-organizer for upcoming 2-day Gerischer Conference on Photocatalysis. Location: Boulder, Colorado.	Aug. 2018
Co-organizer for Closing the Carbon Cycle Workshop, which included ~ 25 experts from university, industry, and national labs to discuss “Fuel Generation in Remote Locations”. Co-sponsored by the Lenfest Center, Arizona State University, Denmark Technical University (DTU). Location: Columbia University	October 2017
Lead organizer for new symposium on “Light-Driven Chemistry” to be held at ACS Spring meetings. 2017 symposium featured 6 sessions involving ~65 talks.	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	2016

electrochemical engineering text book being developed by John Harb (BYU) and Tom Fuller (Georgia Tech.).	
Co-organizer for tutorial session on electrochemistry at annual AIChE meeting. (4 years running)	2013-present
Served as a reviewer of grant proposals for the following funding agencies: DOE/EERE (4 times), NSF (5 times).	2013-2017
Actively involved with the DOE working group on photoelectrochemistry, attending biannual meetings, and organizing/participating in collaborative white papers.	2013-present
Regular referee for top journals covering energy-related science/engineering, including: <i>Angewandte Chemie</i> , <i>Energy &amp; Environmental Science</i> , <i>Nature Materials</i> , <i>Nature Energy</i> , <i>Joule</i> , <i>PNAS</i> , <i>Nature Communications</i> , <i>Journal of Physical Chemistry</i> , <i>ChemPhysChem</i> , and <i>Applied Catalysis B</i> .	2011-present

## DEPARTMENTAL AND UNIVERSITY SERVICE

<b>Activity</b>	<b>Dept./University</b>	<b>Beginning</b>	<b>Ending</b>
Undergraduate committee (advising, recruitment events, student lunches & resume workshops)	Chem. Eng. (Columbia)	Sept. 2014	present
Lead organizer for department seminar series and student colloquium	Chem. Eng. (Columbia)	Spring 2015	present
Served as internal reviewer for SEAS seed funding programs (RISE, SIRS).	CU SEAS	Fall 2015	present
Department liaison with the Societe de Chimie Industrielle in coordinating summer fellowships	Chem. Eng. (Columbia)	Summer 2016	present
Served on ~7 PhD proposal defense committees	Chem. Eng. (Columbia)	Summer 2015	present
Assisted Robert Bozic with write-up for new senior lab activity	Chem. Eng. (Columbia)	Jan. 2016	Jan 2016
Scribe for monthly department meetings	Chem. Eng. (Columbia)	Sept. 2014	Dec. 2016
Active participant in faculty candidate recruitment ( $\approx$ 24 candidates in 3 years)	Chem. Eng. (Columbia)	Spring 2015	Spring 2017
Advisor to the Columbia Energy Club	Columbia	2017	present
Served on Panel: "Preparing for the Academic Search Process Panel   SEAS Path to the Professorship Workshop"	Columbia	Oct. 2017	
Member of Columbia University Climate Council Task Force	Columbia	Nov. 2017	present

## COMMUNITY SERVICE & OUTREACH (2015-present)

Activity	Organization/ Program	Date(s)
Served on AIChE /Chemist Club career panel event	AIChE / chemist Club	April 2018
Esposito group members ran a hands-on solar outreach activity for a science/engineering fair for high school females.	Society of Women Engineers (SWE)	March 2018
Esposito group hosted Lab tours for ~30 high school students through the SEAS Inside Engineering Program.	SEAS Inside Engineering	March 2018
Gave Lecture on Solar Fuels to ~ 100 parents and students as a part of the Columbia Family Weekend program.	Columbia Family Weekend	October 2017
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