

# Ryan Scott Kingsbury

## Summary

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I work on **membrane materials for clean water and energy production**. I have expertise in **membrane separations, water desalination, ion exchange, electrochemistry, and drinking water treatment**, and am determined to accelerate development of these technologies by combining smart experimental design with cutting-edge computational tools.

My major expertise is in **electrochemical membrane processes for water purification**. Through a combination of industrial and academic research, I have worked on **electrodialysis** for water desalination, **reverse electrodialysis** for energy production and storage, **organic and inorganic membrane synthesis**, and **performance characterization** of membrane **materials and devices**.

## Education and Training

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- 2019-**        **Postdoctoral Researcher for the Materials Project at Lawrence Berkeley National Laboratory**  
Topic: Integrating a next-generation density functional into the Materials Project database  
Advisor: Kristin Persson
- 2015-2019**   **Ph.D. in Environmental Sciences and Engineering from the University of North Carolina at Chapel Hill\***  
Topic: Investigation of selective mass transport in ion exchange membranes for clean energy and water processes  
Advisor: Orlando Coronell
- 2008-2010**   **Master of Science in Environmental Engineering from the University of North Carolina at Chapel Hill**  
Topic: Effect of magnetic ion exchange and ozonation on disinfection by-product formation  
Advisor: Philip C. Singer
- 2003-2007**   **Bachelor of Science in Civil Engineering from the University of Texas at Austin**  
GPA 4.0/4.0
- 2003-2007**   **Bachelor of Arts in Plan II Honors from the University of Texas at Austin**  
GPA 4.0/4.0

## Industry Experience

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- 2018-**        **Senior Engineering Research Consultant, Membrion Inc., Seattle, WA**
- Guide development of low-cost ceramic ion exchange membranes for electrodialysis.
  - Conduct market research and identify potential applications for technology.
  - Train and mentor two Master's-level research scientists in electrochemical techniques and experimental design.
- 2013-2015**   **Founder and CEO, Bluecell Energy LLC, Research Triangle Park, NC**
- Invented and reduced to practice a novel energy storage technology based on reversible desalination.

- Oversaw design, fabrication, and testing of three laboratory-scale prototypes.
- Developed and validated a mass transport model to identify operating conditions for optimal device performance.
- Worked with co-founder and two business students to analyze system cost-effectiveness relative to market opportunity.
- Trained and supervised a Master's student research scientist.

**2010-2013 Environmental Engineer, CDM Smith, Raleigh, NC**

- Performed shop drawing reviews for a new water treatment plant.
- Commissioned remote systems for monitoring treated groundwater quality.
- Developed and conducted experiments to measure metal corrosion by drinking water.
- Analyzed feasibility of a biogas-fueled combined heat and power engine at a wastewater treatment plant.
- Evaluated water treatment residuals and wastewater biosolids disposal alternatives.

**2007-2008 Engineer-in-Training, CDM, Austin, TX**

- Designed chemical feed systems for a new drinking water treatment plant.
- Assessed the condition of an aging water treatment plant, identified capacity bottlenecks, and made recommendations for expansion based on site constraints.

## Peer-Reviewed Publications

(\* = Corresponding Author)

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### Published

1. **Kingsbury, R.S.**, Bruning, K., Zhu, S., Flotron, S., Miller, C.T., Coronell, O.\* Influence of water uptake, charge, manning parameter and contact angle on water and salt transport in commercial ion exchange membranes. *Industrial & Engineering Chemistry Research* 58(40): 18663–18674, 2019. [DOI:10.1021/acs.iecr.9b04113](https://doi.org/10.1021/acs.iecr.9b04113)
2. **Kingsbury, R.S.**, Zhu, S., Flotron, S., Coronell, O.\* Microstructure determines water and salt permeation in commercial ion exchange membranes. *ACS Applied Materials & Interfaces* 10(46): 39745–39756, 2018. [DOI:10.1021/acsami.8b14494](https://doi.org/10.1021/acsami.8b14494)
3. **Kingsbury, R.S.**, Flotron, S., Zhu, S., Call, D. F., Coronell, O.\* Junction potentials bias measurements of ion exchange membrane permselectivity. *Environmental Science & Technology* 52(8):4929-4936, 2018. [DOI:10.1021/acs.est.7b05317](https://doi.org/10.1021/acs.est.7b05317)
4. Zhu, S., **Kingsbury, R.S.**, Call, D.F., Coronell, O. Impact of solution composition on the resistance of ion exchange membranes. *Journal of Membrane Science* 554: 39–47, 2018. [DOI:10.1016/j.memsci.2018.02.050](https://doi.org/10.1016/j.memsci.2018.02.050)
5. **Kingsbury, R.S.**, Liu, F., Zhu, S., Boggs, C., Armstrong, M.D., Call, D. F., Coronell, O.\* Impact of natural organic matter and inorganic solutes on energy recovery from five real salinity gradients using reverse electrodialysis. *Journal of Membrane Science* 541:621-632, 2017. [DOI:10.1016/j.memsci.2017.07.038](https://doi.org/10.1016/j.memsci.2017.07.038)
6. Wang, J., **Kingsbury, R.S.**, Perry, L., Coronell, O.\* Partitioning of alkali metal salts and boric acid from aqueous phase into the polyamide active layers of reverse osmosis membranes. *Environmental Science & Technology* 51(4): 2295-2303, 2017. [DOI:10.1021/acs.est.6b04323](https://doi.org/10.1021/acs.est.6b04323)

7. **Kingsbury, R.S.**, Coronell, O.\* Osmotic ballasts enhance faradaic efficiency in closed-Loop, membrane-based energy systems. *Environmental Science & Technology* 51(3): 1910-1917, 2017. DOI:10.1021/acs.est.6b03720
8. **Kingsbury, R.S.\***, Chu, K., and Coronell, O. Energy storage by reversible electro dialysis: the concentration battery. *Journal of Membrane Science* 495:502-516, 2015. DOI:10.1016/j.memsci.2015.06.050
9. **Kingsbury, R.S.\***, Singer, P.C. Effect of magnetic ion exchange and ozonation on disinfection by-product formation. *Water Research* 47(3):1060-1072, 2013. DOI:10.1016/j.watres.2012.11.015

### Under Review

10. **Kingsbury, R.S.**, Wang, J., Coronell, O.\* Comparison of water and salt transport properties of ion exchange, reverse osmosis, and nanofiltration membranes for desalination and energy applications.
11. Hossen, E., Gobetz, Z., **Kingsbury, R.S.**, Liu, F., Palko, H. C., Dubbs, L. L., Coronell, O., Call, D. F.\* Impact of temporal changes in coastal salinity gradient resources on power output in reverse electro dialysis.

### In progress

12. **Kingsbury, R.S.**, Coronell, O.\* Modelling and validation of concentration-dependence of ion exchange membrane permselectivity: significance of convection and Manning's counter-ion condensation theory. (Anticipated 2019 submission, draft available upon request).

### Non-Peer Reviewed Publications

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1. **Kingsbury, R.S.**, Dowbiggin, W.B., Edwards, M., and Singer, P.C. Impact of harbor deepening and seawater intrusion on treated drinking water quality. *Proceedings of the American Water Works Association Annual Conference and Exhibition*, 2012.
2. **Kingsbury, R.S.**, Marriott, B.D. Optimize climate-controlled sodium hypochlorite storage for cost savings and improved sustainability. *Proceedings of the NC-AWWA/WEA Annual Conference*, 2011.

### Presentations

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#### Invited and Departmental Presentations

1. **Kingsbury, R.S.** Selective mass transport in ion exchange membranes for water and energy processes. Joint Center for Artificial Photosynthesis polymers cross-cutting meeting, Lawrence Berkeley National Laboratory, Berkeley, CA, November 13, 2019.
2. **Kingsbury, R.S.** Selective mass transport in ion exchange membranes for water and energy processes. Water Wednesdays seminar series, Lawrence Berkeley National Laboratory, Berkeley, CA, September 18, 2019.
3. **Kingsbury, R.S.** Accelerating development of ion-selective membranes through experiment and computation. Presentation to the Materials Project, Lawrence Berkeley National Laboratory, Berkeley, CA, February 20, 2019.
4. **Kingsbury, R.S.** Energy from saltwater. Annual Presentation to Duke Energy Foundation, Duke Energy Offices, Raleigh, NC, June 8, 2017.

5. **Kingsbury, R.S.**, Coronell, O. Osmotic ballasts make saltwater energy more efficient. UNC Innovation Showcase, Chapel Hill, NC, April 19, 2017.
6. **Kingsbury, R.S.** A novel approach to energy storage based on blue energy and saltwater. Annual Presentation to Duke Energy Foundation, UNC Institute for the Environment, Chapel Hill, NC, April 30, 2016.

### Oral Conference Presentations

1. **Kingsbury, R.S.**, Wang, J., Hegde, M., Dingemans, T., You, W., Coronell, O. Physically-crosslinked ion exchange membranes defy conductivity-selectivity tradeoff. Materials Research Society Spring Meeting, Phoenix, AZ, April 22-26, 2019.
2. **Kingsbury, R.S.**, Wang, J., Coronell, O. Beyond swelling degree: Counter-ion hydration and its effect on ion exchange membrane performance. 257th American Chemical Society National Meeting, Division of Environmental Chemistry, Orlando FL, March 31-April 4, 2019.
3. **Kingsbury, R.S.**, Bruning, K., Zhu, S., Flotron, S., Miller, C.T., Coronell, O. Towards understanding the conductivity-selectivity-permeability tradeoff in ion exchange membranes: Swelling modulates water and salt transport. North American Membrane Society Annual Meeting, Lexington, KY, June 10-13, 2018.
4. **Kingsbury, R.S.**, Coronell, O. Osmotic ballasts enhance efficiency in closed-loop membrane systems for energy conversion and storage. 11th International Congress on Membranes and Membrane Processes, San Francisco, CA, July 29-August 4, 2017.
5. **Kingsbury, R.S.**, Boggs, C., Liu, F., Zhu, S., Armstrong, M.D., Call, D. F., Coronell, O. Impact of natural organic matter and ionic composition on energy recovery from five real salinity gradients using reverse electrodialysis. AEESP Research and Education Conference, Ann Arbor, MI, June 20-22, 2017.
6. **Kingsbury, R.S.**, Coronell, O. Osmotic ballasts improve the energy efficiency of closed-loop electro-dialytic processes. 252nd American Chemical Society National Meeting, Division of Environmental Chemistry, Philadelphia, PA, August 21-25, 2016.
7. **Kingsbury, R.S.**, Chu, K., Coronell, O. Energy storage by reversible desalination: A concentration battery based on electrodialysis. 251st American Chemical Society National Meeting, Division of Environmental Chemistry, San Diego, CA, March 13-17, 2016.
8. **Kingsbury, R.S.** Impacts of harbor deepening and seawater intrusion on treated drinking water quality. AWWA Distribution System Security Conference, St. Louis, Missouri, September 10, 2012.
9. **Kingsbury, R.S.** Impacts of harbor deepening and seawater intrusion on treated drinking water quality. Georgia Association of Water Professionals Annual Conference, Savannah, Georgia, July 16, 2012.
10. **Kingsbury, R.S.** Impacts of harbor deepening and seawater intrusion on treated drinking water quality. AWWA Annual Conference and Exposition, Dallas, Texas, June 14, 2012.
11. **Kingsbury, R.S.** Impacts of harbor deepening and seawater intrusion on treated drinking water quality. North Carolina AWWA/WEA Spring Conference, Wilmington, North Carolina, April 17, 2012.
12. **Kingsbury, R.S.** Optimize climate-controlled sodium hypochlorite storage for cost savings and improved sustainability. NC-AWWA/WEA Annual Conference, Concord, North Carolina, November 15, 2011.

13. **Kingsbury, R.S.** Evaluation of MIEX pre-treatment on ozonation performance and disinfection by-product formation. AWWA Annual Conference and Exposition, Chicago, Illinois, June 21, 2010.

## Poster Presentations

1. **Kingsbury, R.S.**, Flotron, S., Zhu, S., Call, D. F., Coronell, O. Junction potentials bias measurements of ion exchange membrane permselectivity. Poster presented at the North American Membrane Society Annual Meeting, Lexington, KY, June 2018.
2. **Kingsbury, R.S.**, Coronell, O. Energy storage by reversible electrodialysis: the concentration battery. Poster presented at the Triangle Student Research Competition, Durham, NC, September 2015.

## Patents

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### Full Patent Applications

1. **Kingsbury, R.S.**, Coronell, O. Osmotic ballasts for membrane-based energy processes. PCT Application No. [PCT/US17/40047](#), 2016.
2. **Kingsbury, R.S.** Energy generation and storage using electro-separation methods and devices. U.S. Patent Application No. [14/201,687](#), 2014.

## Grants, Fellowships, and Awards

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| <b>2019</b> | <b>UNC Graduate Student Transportation Grant Award</b>  |
| <b>2018</b> | <b>Finalist, University of North Carolina 3 Minute Thesis (3MT) competition</b><br>One of 10 finalists in a university competition to present research in plain language.   |
| <b>2018</b> | <b>North American Membrane Society (NAMS) Student Poster Award, 3rd Place in the Energy Category</b>  |
| <b>2017</b> | <b>American Environmental Engineering and Science Professors(AEESP)<br/>Hydromantis Student Scholarship Award</b><br>One of 22 travel awards for students and postdocs attending the 2017 AEESP meeting.  |
| <b>2017</b> | <b>North American Membrane Society (NAMS) Student Fellowship Award (2017)</b><br>One of 3 fellowships awarded to students and postdocs presenting at ICOM 2017.   |
| <b>2016</b> | <b>National Science Foundation Graduate Research Fellowship</b>   |
| <b>2015</b> | <b>UNC Duke Energy Fellowship</b><br>Awarded annually to two graduate students conducting energy-related research.  |
| <b>2010</b> | <b>UNC Bunker Award</b><br>The Bunker Award is given annually by the Department of Environmental Sciences and Engineering to a master's student in environmental engineering who shows the most outstanding scholarship and professional promise. |

**2010      UNC Order of the Golden Fleece**

The Order of the Golden Fleece is considered the highest honorary society at the University, and selects its members based upon service to the University via scholarship, motivation, creativity, loyalty, and leadership in academic and extracurricular pursuits.

**2009      UNC Order of the Old Well (2009)**

The Order of the Old Well recognizes students and faculty members of high character who have demonstrated outstanding humanitarian service and whose service has gone uncompensated and unrewarded.

**2008      American Water Works Association Thomas R. Camp Scholarship**

Sponsored by Camp Dresser and McKee, Inc., this scholarship provides support to outstanding graduate students doing applied research in the drinking water field.

## Teaching and Mentoring

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### Guest Lecturer at the University of North Carolina at Chapel Hill

- Physical / Chemical Processes for Water Treatment (ENVR 756; three 1-hr lectures)
- Membrane Technology for Water Purification (ENVR 890; two 3-hr lectures)
- Chemical Equilibria in Natural Waters (ENVR 419; three 1-hr lectures)

### Research Mentor

- Trained and supervised a Master's student research scientist (Bluecell Energy LLC, 2012-2013)
- Supervised research of two undergraduates and one Master's student (UNC, 2015-2017)
- Advised and trained two Master's-level research scientists (Membrion Inc., 2018-2019)
- Mentored an undergraduate student (Materials Project, 2019-)

## Professional Activities

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### Licensed Professional Engineer, North Carolina, License No. 040310

#### Peer Reviewer

- *ChemSusChem* (1 manuscript)
- *Journal of Membrane Science* (6 manuscripts)
- *Water Research* (1 manuscript)
- *Journal of the American Water Works Association* (1 manuscript)
- *Industrial & Engineering Chemistry Research* (1 manuscript)

#### Affiliations

- American Chemical Society
- Materials Research Society
- North American Membrane Society
- European Membrane Society

## Service and Outreach

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- Department Liason, Materials Research Society UNC student chapter (2018)
- Volunteer, STEM in the Park (middle school outreach activity, 2018)
- Volunteer, UNC Science Expo (public outreach activity, 2017-2018)
- High school outreach project with North Carolina School of Science and Math (2016-2017)
- Presenter, Science in the Stacks (elementary school activity, 2016)
- Member, American Water Works Association Climate Change Committee (2012-2013)
- Member, North Carolina American Water Works Association Drinking Water Rules and Regulations Seminar Planning Committee (2011-2012)
- President, Daniel A. Okun Chapter of Engineers Without Borders (2008-2009)