

# Ariel L. Furst, Ph.D.

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## EDUCATION

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<b>California Institute of Technology</b> Ph.D. Chemistry Thesis: DNA-mediated charge transport devices for protein detection Advisor: Prof. Jacqueline K. Barton	2010 - 2015
<b>University of Chicago, Chicago, IL</b> B.S. Chemistry with Honors, GPA 3.92 Honors Thesis: Study of the solution state properties of the Snow Flea Antifreeze Protein	2008 - 2010
<b>Wesleyan University, Middletown, CT</b>	2007 - 2008

## RESEARCH EXPERIENCE

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<b>Assistant Professor of Chemical Engineering</b> <i>Massachusetts Institute of Technology</i>	2019 - present
<b>Arnold O. Beckman Postdoctoral Fellow with Prof. Matthew B. Francis</b> <i>University of California, Berkeley</i> <ul style="list-style-type: none"><li>Quantifying hormone disruptors with an engineered bacterial biosensor</li><li>Electrochemical coupling of DNA to catechols on gold surfaces</li></ul>	2015 - 2019
<b>Graduate Researcher with Prof. Jacqueline K. Barton</b> <i>California Institute of Technology</i> <ul style="list-style-type: none"><li>Development of novel DNA charge transport platforms to control DNA attachment</li><li>Creation and evaluation of electrochemical DNA sensor for aberrant activity of DNMT1</li></ul>	2010 - 2015
<b>Undergraduate Researcher with Prof. Stephen B. H. Kent</b> <i>University of Chicago</i> <ul style="list-style-type: none"><li>Presentation of honors thesis: 'Study of the solution state properties of the Snow Flea Antifreeze Protein'</li></ul>	2008 - 2010
<b>Research Assistant with Prof. Shelley Minteer</b> <i>Saint Louis University</i> <ul style="list-style-type: none"><li>Development of Krebs Cycle mimetic enzyme cascade for use in biofuel cell</li></ul>	2005, 2008

## HONORS & MEMBERSHIPS

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Remsen Bird Lecturer	2018
Travel Award to ACS P2F workshop	2017
Arnold O. Beckman Postdoctoral Fellowship	2016-2018
Gray-Hill Lecturer	2014
Phi Beta Kappa	2010
Graduated with Honors, University of Chicago	2010
Dean's List University of Chicago	2009-2010
Dean's List Wesleyan University	2008
American Chemical Society (ACS)	2012-present
Iota Sigma Pi	2015-present
American Institute of Chemical Engineers (AIChE)	2016-present
Women's Initiatives Committee (WIC) through AIChE	2017-present
Materials Research Society (MRS)	2019-present
Electrochemical Society (ECS)	2019-present

## PUBLICATIONS

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20. Sofen, L. E.; **Furst, A. L.** “Electrochemical sensors to monitor endocrine disrupting pollutants,” *J. Electrochem. Soc.* **2020**; *167*: 037524.
19. Dai, Y.; **Furst, A. L.**; Liu, C. C. “Strand Displacement Strategies for Biosensor Applications,” *Trends Biotechnol.* **2019**; *37*: 1367-1382.
- Featured on the cover of the December issue of Trends in Biotechnology*
18. **Furst, A. L.**; Muren, N. B.; Hill, M. G. “Toward multimarker and functional assays from crude cell lysates: controlling spacing and signal amplification in DNA-CT-based bioelectrochemical devices,” *Curr. Opin. Electrochem.* **2019**, *4*, 104-112.
17. García-Cerdán, J. G.; **Furst, A. L.**; McDonald, K.; Schuneman, D.; Francis, M. B.; Niyogi, K. K. “A Thylakoid-Bound and Redox Active Rubredoxin (RBD1) is Essential in *de novo* Assembly and Repair of Photosystem II Complexes in Photosynthetic Eukaryotes,” *Proc. Natl. Acad. Sci.* **2019**, *116* (33), 16631-16640.
16. **Furst, A. L.**; Klass, S. H.; Francis, M. B. “DNA hybridization to control cellular interactions,” *Trends Biochem. Sci.* **2019**, *44*, 342-350.
- Featured on the cover of the April issue of Trends in Biochemical Sciences*
15. **Furst, A. L.**; Francis, M. B. “Impedance-Based Detection of Bacteria,” *Chem. Rev.* **2019**, *119*, 700-726.
14. **Furst, A. L.**; Smith, M. J.; Lee, M. C.; Francis, M. B. “DNA hybridization to interface current-producing cells with electrode surfaces,” *ACS Cent. Sci.* **2018**, *4*, 880-884.
13. **Furst, A. L.**; Smith, M. J.; Francis, M. B. “New Techniques for the Generation and Analysis of Tailored Microbial Systems on Surfaces,” *Biochem.* **2018**, *57*, 3017–3026.
12. Olshansky, L.; Huerta-Lavorie, R.; Nguyen, A. I.; Vallapurackal, J.; **Furst, A.**; Tilley, T. D.; Borovik, A. S. “Artificial Metalloproteins Containing Co<sub>2</sub>O<sub>4</sub> Cubane Active Sites” *J. Am. Chem. Soc.* **2018**, *140*, 2739–2742.
11. **Furst, A. L.**; Smith, M. J.; Francis, M. B. “Direct Electrochemical Bioconjugation on Metal Surfaces,” *J. Am. Chem. Soc.* **2017**, *139*, 12610-12616.
10. Finbloom, J. A.; Han, K.; Slack, C.; **Furst, A. L.**; Francis, M. B. “Cucurbit[6]uril-promoted click chemistry for protein modification,” *J. Am. Chem. Soc.* **2017**, *139*, 9691-9697.
9. **Furst, A. L.**; Hoepker, A. C.; Francis, M. B. “Quantifying Hormone Disruptors with an Engineered Bacterial Biosensor,” *ACS Cent. Sci.* **2017**, *3*, 110-116.
- Featured in:* Swager, T.M. “Impedance for Endocrine Disruption Compounds,” *ACS Cent. Sci.* **2017**, *3*, 99-100.
- Underwood, J.G. “Sensing Xenoestrogens,” *ACS Chem. Biol.* **2017**, *12*, 313-315.
8. **Furst, A. L.**; Hill, M. G.; Barton, J. K. “Two-Electrode Platforms for Protein Biosensing based on Charge Transport through the DNA Double Helix,” *Electroanalytical Chemistry*, A. Bard; C. Zoski, ed., 2017, Taylor & Francis.
7. **Furst, A. L.**; Barton, J. K. “DNA Electrochemistry Shows DNMT1 Methyltransferase Hyperactivity in Colorectal Tumors,” *Chem. & Biol.* **2015**, *22*, 938-945.
- Featured in:* California Institute of Technology. “New approach holds promise for earlier, easier detection of colorectal cancer: Chemists develop technique that could one day lead to early detection of tumors,” *ScienceDaily*, 25 June 2015.
- Nunez, N. N.; Manlove, A. H.; David, S. S. “DNMT1 and Cancer: An Electrifying Link,” *Chem. & Biol.* **2015**, *22*, 810-811.
6. Barton, J. K.; **Furst, A. L.**; Grodick, M. A. “DNA Sensors using DNA Charge Transport Chemistry,” pp. 105-120 in *DNA in Supramolecular Chemistry and Nanotechnology*, E. Stultz; G. H. Clever, ed., 2015, Wiley.
5. **Furst, A. L.**; Hill, M. G.; Barton, J. K. “A Multiplexed, Two-Electrode Platform for Biosensing Based on DNA-Mediated Charge Transport,” *Langmuir* **2015**, *31*, 6554-6562.
4. **Furst, A. L.**; Muren, N. B.; Hill, M. G.; Barton, J. K. “Electrochemical Detection of DNMT1 Methyltransferase Activity in Tumors,” *Proc. Natl. Acad. Sci. USA* **2014**, *22*, 14985-14989.
- Featured in:* “Label-free electrochemical detection of methyltransferases,” *SciBX* **2014**, *7*.

3. **Furst, A. L.**; Hill, M. G.; Barton, J. K. "Electrocatalysis in DNA Sensors," *Polyhedron* **2014**, *84*, 150-159.
2. **Furst, A. L.**; Landefeld, S.; Hill, M. G.; Barton, J. K. "Electrochemical Patterning and Detection of DNA Arrays on a Two-Electrode Platform," *J. Am. Chem. Soc.* **2013**, *135*, 19099-19102.
1. **Furst, A. L.**; Hill, M. G.; Barton, J. K. "DNA-Modified Electrodes Fabricated Using Copper-Free Click Chemistry for Enhanced Protein Detection," *Langmuir* **2013**, *29*, 16141-16149.

## PATENTS

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Francis, M.B.; **Furst, A.L.**; Hoepker, A.C. "Sensitive Detection of Chemical Species Using A Bacterial Display Sandwich." Submitted.

Barton, J. K.; **Furst, A. L.**; Hill, M. G.; Muren, N. B. "Electrochemical Substrate Patterning and Analyte Detection on a Two-Electrode Platform." Patent Number 10316354, June 11, 2019.

## SELECTED PRESENTATIONS

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*Oral Presentation* **Furst, A. L.** "DNA hybridization to interface cells with metal surfaces," Materials Research Society meeting, Boston, MA: 2019.

*Oral Presentation* **Furst, A. L.** "Pollutant detection with electrochemical biosensors," Materials Research Society meeting, Boston, MA: 2019.

*Invited Lecture* **Furst, A. L.** "Electrochemistry for Sensors and Energy," Boston University, Boston, MA: 2019.

*Invited Lecture* **Furst, A. L.** "Reagentless DNA attachment to metal surfaces," Materials in Chemical Engineering Symposium, University of Florida, Gainesville, FL: 2019.

*Oral Presentation* **Furst, A. L.** "Reagentless DNA bioconjugation to metal surfaces," American Institute of Chemical Engineers meeting, Orlando, FL: 2019.

*Oral Presentation* **Furst, A. L.** "Pollutant detection with electrochemical biosensors," American Institute of Chemical Engineers meeting, Orlando, FL: 2019.

*Invited Lecture* **Furst, A. L.** "Enabling Technologies for Bioelectrochemistry," MURI Review, MIT, Boston, MA: 2019.

*Invited Lecture* **Furst, A. L.** "Interfacing electron transfer proficient cells with metal surfaces using DNA," DIMENSIONS Meeting, Harvard University, Cambridge, MA: 2019.

*Invited Lecture* **Furst, A. L.** "Engineered bacteria for electrochemical pollutant detection," Bioelectronics Gordon Research Conference, Proctor Academy, NH: 2019.

*Oral Presentation* **Furst, A. L.**; Francis, M. B. "Tunable Attachment of Living Cells to Electroactive Surfaces." American Institute of Chemical Engineers meeting, Pittsburgh, PA: 2018.

*Remsen Bird Lecturer* **Furst, A. L.** "Electrochemical Biosensors," Occidental College, Eagle Rock, CA: 2018.

*Invited Lecture* **Furst, A. L.** "Interfacing electron transfer proficient cells with metal surfaces using DNA," Bioenergetics Seminar, Lawrence Berkeley Labs, Berkeley, CA: 2018.

*Oral Presentation* **Furst, A. L.**; Francis, M. B. "Interfacing electron transfer proficient cells with metal surfaces using DNA," 256th ACS National Meeting and Exposition, Boston, MA: 2018, COLL-344.

*Oral Presentation* **Furst, A. L.**; Francis, M. B. "Electrochemical biosensor for the detection of sub-nanomolar levels of environmental pollutants," 256th ACS National Meeting and Exposition, Boston, MA: 2018, ANYL-527.

*Invited Lecture* **Furst, A. L.** "DNA hybridization to interface current-producing cells with electroactive surfaces," Beckman Annual Symposium, Beckman Institute, Irvine, CA: 2018.

*Invited Lecture* **Furst, A. L.** "Electrochemical Activation for DNA Attachment to Surfaces," QB3 Postdoctoral Seminar, Berkeley, CA: 2017.

*Invited Lecture* **Furst, A. L.**; Hoepker, A. C.; Francis, M. B. "Bioelectrochemical Detection of Endocrine Disrupting Compounds," Supramolecular Chemistry and Self Assembly Gordon Research Seminar, Les Diabrets, Switzerland: 2017.

**Invited Lecture Furst, A. L.** “Hunting hormone contaminants with a bacterial biosensor,” Occidental College: Los Angeles, CA: 2017.

**Gray-Hill Lecturer Furst, A. L.** “Patterned DNA Arrays,” Gray-Hill Lecture Series, Occidental College, Los Angeles, CA: 2014.

## TEACHING EXPERIENCE

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### Massachusetts Institute of Technology

*Instructor, Course Developer, Special Topics in Chemical Engineering: Bioelectrochemistry* 2019

### California Institute of Technology

*Head Teaching Assistant, Protein Thermodynamics* 2015

*Teaching Assistant, Protein Thermodynamics* 2011-2014

*Teaching Assistant, Biophysics of Macromolecules* 2012

*Teaching Assistant, General Chemistry Laboratory* 2010-2011

### Saint Louis University

*Teaching Assistant, General Chemistry Lecture* 2008

*Teaching Assistant, General Chemistry Laboratory* 2008

## MENTORING

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### Postdoctoral Researchers Mentored

• *Dr. Amruta Karbelkar, MIT* 2019-

### Graduate Researchers Mentored

• *Akiva Gordon, MIT* 2019-

• *Erin Reynolds, MIT* 2019-

• *Laura Sofen, UC Berkeley.* Chemical modification of carbon surfaces for bioconjugation. 2018-2019

• *Amanda Bischoff, UC Berkeley.* Rotation Project. Biosensor-based detection of trace pharmaceuticals in wastewater. **Received NSF GRFP funding based on this project.** 2018

• *Johnathan Maza, UC Berkeley.* Rotation Project. Diazonium-based coupling of biomolecules to carbon electrodes. 2017

• *Alex Ramsey, UC Berkeley.* Rotation Project. Detection of foodborne pathogens with a DNA aptamer-based sensor. 2017-2019

### Undergraduate Researchers Mentored

• *Michael Lee, UC Berkeley.* Electrochemical coupling of proteins to catechol-modified electrodes. **Received NSF GRFP funding based on this project.** Currently a graduate student at the University of Illinois at Urbana-Champaign. 2017

• *Lisa Pangilinan, California Institute of Technology.* Development of novel DNA-based biosensors. Ph.D. candidate in chemistry at the University of California, Los Angeles. 2013-2015

• *Katherine Hess, Occidental College.* Development of DNA monolayer chemistries on gold bead electrodes. Educator with Teach for America. 2012-2013

• *Sally Landefeld, Occidental College.* Electrochemical Patterning and Detection of DNA Arrays on a Two-Electrode Platform. Ph.D. candidate in biogeochemistry at the University of Washington. 2012

## LEADERSHIP

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### AIChE

• Area Co-chair Sensors Topical 2019-present

• Session Chair “Electrochemical Interfaces” 2019-present

• Session Chair “Electrochemical Short Courses” 2019-present

• Session Co-chair “Sensors Student Competition” 2018-2019

### MIT Rising Stars Mentor

Worked with women late in their Ph.D. and early in their Postdoc positions to discuss faculty life and help hone their faculty application packages. 2019-present

### MIT ACCESS Program Mentor

Met with students to discuss graduate education and career opportunities. 2019-present

<i>Bay Area Science Festival Discovery Day Demonstrator</i>	2018
Developed and performed demonstration on combustion at the Bay Area Science Festival Discovery Day at AT&T Park, attended by 32,000 residents	
<i>Women's Initiatives Committee (WIC)</i>	2018-present
<ul style="list-style-type: none"> <li>• Chair of Social Media Outreach</li> <li>• Moderator for the morning session of the Women's Undergraduate Workshop, including an industry recruiting panel and a panel on graduate school</li> <li>• Member of the planning committee and organizer for the Graduate Student Life session at the AIChE annual meeting</li> </ul>	
<i>256th ACS National Meeting</i>	2018
Session Chair, Biomaterials and Biointerfaces: Engineering the Interface	
<i>Chemical Tools for Complex Biological Systems</i>	2017
Chair of Invertebrate Chemistry session, Janelia Farms, VA: 2017.	
<i>QB3 Postdoc Seminar</i>	2016-present
Organized and moderated monthly talks by postdocs in the QB3 program at UC Berkeley	
<i>Women in STEM program</i>	2012-2015
Guided laboratory tours and led discussion groups with high school women about higher education and careers in STEM	
<i>Girl Scouts</i>	2014-2015
Developed science demonstrations and presentations for visiting Girl Scout troops	
<i>Project Science Academy</i>	2014-2015
Developed and performed science demonstrations and conducted laboratory tours for students in the Project Science Academy	
<i>School on Wheels</i>	2011-2013
Tutored homeless middle and high school students in mathematics and science	