

## DANIELLE TULLMAN-ERCEK

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### EDUCATION

#### **Doctor of Philosophy in Chemical Engineering**

University of Texas at Austin, 2006

*Dissertation:* Characterization and Engineering of the Twin-Arginine Translocation Pathway in *Escherichia coli* (Advisor: George Georgiou).

#### **Bachelor of Science in Chemical Engineering, Biotechnology Specialization**

Illinois Institute of Technology, Chicago, 2000

### EMPLOYMENT

#### July 2016 – present — **Associate Professor, Northwestern University**

Department of Chemical and Biological Engineering, McCormick School of Engineering

*Concurrent positions:*

2018 – present — Director, Master of Biotechnology Program

2018 – present — Director, Synthetic Biology Research Experience for Undergraduates

2016 – present — Faculty, Center for Synthetic Biology

2016 – present — Faculty, Chemistry of Life Processes

2016 – present — Investigator, Engineering Biology Research Consortium

#### July 2009 – June 2016 — **Assistant Professor, University of California Berkeley**

Department of Chemical and Biomolecular Engineering, College of Chemistry

*Concurrent positions:*

2011 – 2016 — Staff Scientist, Lawrence Berkeley National Laboratory, Molecular Biophysics and Integrated Bioimaging

2011 – 2016 — Faculty, Synthetic Biology Institute

2010 – 2016 — Faculty, Chemical Biology Graduate Program

2010 – 2016 — Core Faculty, Joint Graduate Group in Bioengineering

2010 – 2016 — Faculty, Quantitative Biosciences Institute

2009 – 2016 — Affiliate Principal Investigator, Synthetic Biology Engineering Research Center

#### November 2008 – June 2009 – **Post-doctoral Researcher, Lawrence Berkeley National Laboratory**

*Project:* Investigating the Role of Carbohydrate-Binding Modules on Cellulose Hydrolysis. (Advisors: Rajat Sapra and Blake Simmons)

#### January 2007 – October 2008 – **Post-doctoral Researcher, University of California – San Francisco**

*Project:* Reprogramming the *Salmonella* Type III Secretion System for Heterologous Protein Production. (Advisor: Christopher Voigt)

#### August – December 2000 – **Undergraduate Research Assistant, Illinois Institute of Technology**

*Project:* Squeeze Flow Modeling of Viscoelastic Fluids. (Advisor: David C. Venerus)

#### May – August 1998 – **Engineering Intern, Titanium Metals Corporation**

*Project:* Modeling of the Vacuum Arc Remelting Process for Titanium Alloys. (Advisor: Charles Clay)

### HONORS AND AWARDS

Outstanding Young Alumna Award, Illinois Institute of Technology ChBE, 2018

Searle Leadership Award, 2015

Merck Chair in Biochemical Engineering, 2015-2016  
Exxon Knowledge Build Award, 2015-2016  
National Academy of Engineering - Frontiers of Engineering invited attendee, 2014  
NSF CAREER Award, 2012  
Hellman Family Faculty Fund Award, 2012  
Paper of the Year, Journal of the Taiwan Institute of Chemical Engineers, 2010  
Charles Wilke Endowed Chair in Chemical Engineering, 2009 - 2014  
National Science Foundation Graduate Research Fellow, 2002-2005  
Howard Hughes Medical Institute Predoctoral Fellowship Alternate, 2002  
National Institute of Health Predoctoral Training Grant, 2001-2002

### **RESEARCH ACTIVITIES: PUBLICATIONS IN CHRONOLOGICAL ORDER**

**Bolded** names indicate co-authors that were undergraduate researchers

1. DeLisa M.P., Tullman D., Georgiou G. (2003) "Folding quality control in the export of proteins by the bacterial twin-arginine translocation pathway." *Proc. Natl. Acad. Sci. USA* **100**: 6115-20.
2. Lee, P.A., Tullman-Ercek D., Georgiou G. (2006) "The bacterial twin-arginine translocation pathway." *Ann. Rev. of Microbiol.* **60**: 373-95.
3. Tullman-Ercek D., DeLisa M.P., Kawarasaki Y., **Iranpour P.**, Ribnicky B., Palmer T., Georgiou G. (2007) "Export pathway selectivity of *Escherichia coli* twin-arginine translocation signal peptides." *J. Biol. Chem.* **282**(11): 8309-16.
4. Temme K.T., Salis H., Tullman-Ercek D., Levskaya A., Hong S.H., Voigt C.A. (2008) "Induction and relaxation dynamics of the regulatory network controlling the type III secretion system encoded within *Salmonella* pathogenicity island I." *J. Mol. Biol.* **377**:47-61.
5. Fisher A.C., Kim J.Y., Tullman-Ercek D., Henderson L.A., DeLisa M.P. (2008) "Exploration of twin-arginine translocation for expression and purification of correctly folded proteins in *Escherichia coli*." *Microbial Biotechnol.* **1**(5):403-15.
6. Widmaier D.W., Tullman-Ercek D., Mirsky E.A., Hill R., Govindarajan S., Minshull J., Voigt C.A. (2009) "Engineering the *Salmonella* type III secretion system to export spider silk monomers." *Mol. Syst. Biol.* **5**:309.
7. Lee Y.F., Hsieh H.Y., Tullman-Ercek D., Chiang T.K., Turner R.J., Lin S.C. (2010) "Enhanced translocation of recombinant proteins via the Tat pathway with chaperones in *Escherichia coli*." *Taiwan Inst. Chem. Eng.* **41**(5):540-6. [Awarded Paper of the Year for this journal.]
8. Bokinsky G., Peralta-Yahya P.P., George A., Holmes B.M., Steen E.J., Dietrich J., Soon Lee T., Tullman-Ercek D., Voigt C.A., Simmons B.A., Keasling J.D. (2011) "Synthesis of three advanced biofuels from ionic liquid-pretreated switchgrass using engineered *Escherichia coli*." *PNAS.* **108**(50): 19949-54.
9. Glasgow J.E., Capehart S.L., Francis M.B., Tullman-Ercek D. (2012) "Osmolyte-mediated encapsulation of proteins inside MS2 viral capsids." *ACS Nano* **6**(10):8658-64.
10. Kim E.Y., Tullman-Ercek D. (2012) "Engineering nanoscale protein compartments for synthetic organelles." *Curr. Opin. Biotechnol.* **24**(4):627-32.
11. Fisher M.A., Tullman-Ercek D. (2013) "Change, exchange, and rearrange: protein engineering for the biotechnological production of fuels, pharmaceuticals, and other chemicals." *Curr. Opin. Biotechnol.* **24**(6):1010-6.

12. Reyes-Ortiz V., Heins R.A., Cheng G., Kim E.Y., **Vernon B.C.**, **Elandt R.B.**, Adams P.A., Sale K.L., Hadi M.Z., Simmons B.A., Kent M.S., Tullman-Ercek D. (2013) "Addition of a carbohydrate-binding module enhances cellulase penetration into cellulose substrate." *Biotechnol. Biofuels* 6(1):93.
13. Tullman-Ercek D. (2013) "An assay for the bacterial sweet spot." *Biotechnol. J.* 8(12):1377-8. [Invited commentary]
14. Fisher M.A., Boyarskiy, S., **Yamada M.R.**, **Kong N.**, Bauer, S.A., Tullman-Ercek D. (2014) "Enhancing tolerance to short-chain alcohols by engineering *Escherichia coli* AcrB to secrete the non-native substrate n-butanol." *ACS Synth. Biol.* 3(1):30-40. [Cover article January 2014; Featured in C&ENews September 2013.]
15. Kim E.Y., Tullman-Ercek D. (2014) "A rapid flow cytometry assay for the relative quantification of protein encapsulation into bacterial microcompartments." *Biotechnol. J.* 9(3): 348-54.
16. Glasgow J.E., Tullman-Ercek D. (2014) "Production and applications of engineered viral capsids." *Applied Microbiol. Biotechnol.* 98(13):5847-58.
17. Kim E.Y., Slininger M.Y., Tullman-Ercek D. (2014) "The effects of time, temperature, and pH on the stability of Pdu bacterial microcompartments." *Prot. Sci.* 23(10):1434-41.
18. Metcalf K.J., **Finnerty C.**, Azam A., **Valdivia E.**, Tullman-Ercek D. (2014) "Using transcriptional control to increase titer of secreted heterologous proteins by the type III secretion system." *Appl. Environ. Microbiol.* 80(19):5927-34.
19. Kim E.Y., Jakobson C.M., Tullman-Ercek D. (2014) "Engineering transcriptional regulation to control Pdu bacterial microcompartment formation." *PLOS One* 9(11):e113814.
20. Tullman-Ercek D. (2015) "Metabolism: 'Channeling' Hans Krebs." *Nat. Chem. Biol.* 11(3):180-1. [Invited commentary]
21. Glasgow J.E., Asensio M.A., Jakobson C.M., Francis M.B., Tullman-Ercek D. (2015) "The influence of electrostatics on small molecule flux through a protein nanoreactor." *ACS Synth. Biol.* 4(9):1011-9.
22. Boyarskiy S., Tullman-Ercek D. (2015) "Getting pumped: Membrane efflux transporters for enhanced biomolecule production." *Curr. Opin. Chem. Biol.* 28:15-9.
23. Jakobson C.M., Kim E.Y., Slininger M.F., Chien A., Tullman-Ercek D. (2015) "Localization of proteins to the 1,2-propanediol utilization microcompartment by non-native signal sequences is mediated by a common hydrophobic motif." *J. Biol. Chem.* 290(40):24519-33.
24. Azam A., Metcalf K.J., **Li C.**, Tullman-Ercek D. (2016) "Type III secretion as a generalizable strategy for the development of peptide-based biomaterials." *Biotechnol. Bioeng.* 113(11):2313-20.
25. Boyarskiy S., Davis López S., **Kong N.**, Tullman-Ercek D. (2016) "Transcriptional feedback regulation of efflux protein expression for increased tolerance to and production of n-butanol." *Metab. Eng.* 33: 130-7.
26. Azam A., Tullman-Ercek D. (2016) "Type-III secretion filaments as scaffolds for inorganic nanostructures." *J. R. Soc. Interface* 13(114):20150938.
27. Jakobson C.M., Tullman-Ercek D. (2016) "Dumpster diving in the gut: bacterial microcompartments as part of a host-associated lifestyle." *PLoS Pathogens* 12(5):e1005558.

28. Jakobson C.M., **Chen Y.**, Slininger M.F., **Valdivia E.**, Kim E.Y., Tullman-Ercek D. (2016) "Tuning the catalytic activity of subcellular nanoreactors." *J. Mol. Biol.* 28(15):2989-96.
29. Asensio M., Morella N., Jakobson C.M., Hartman E.C., Glasgow J.E., Sankaran B., Zwart P.H., Tullman-Ercek D. (2016) "A single-point mutation in the capsid protein alters the assembled geometry of the bacteriophage MS2 capsid." *Nano Letters* 16(9):5944-50.
30. Metcalf K.J., Bevington J.L., **Rosales S.L.**, Burdette L.A., **Valdivia E.**, Tullman-Ercek D. (2016) "Proteins adapt a functionally active conformations in the media following type III secretion." *Microb. Cell Fact.* 15(1):213.
31. Metcalf K.J., Tullman-Ercek D. (2017) "Use of Transcriptional Control to Increase Secretion of Heterologous Proteins in T3S Systems." *Methods Mol. Biol.* 1531:71-79.
32. Jakobson C.M., Slininger Lee M.F., Tullman-Ercek D. (2017) "De novo design of signal sequences to localize cargo to the 1,2-propanediol utilization microcompartment." *Protein Sci.* 26(5):1086-1092.
33. Glasgow A.A., Wong H.T., Tullman-Ercek D. (2017) "A secretion-amplification role for *Salmonella enterica* translocon protein SipD." *ACS Synth. Biol.* 6(6):1006-1015.
34. Jakobson C.M., Slininger M.F., Tullman-Ercek D., Mangan N. (2017) "A systems-level model reveals that 1,2-Propanediol utilization microcompartments enhance pathway flux through intermediate sequestration." *PLoS Comp. Biol.* 13(5):e1005525.
35. Slininger Lee M.F., Jakobson C.M., Tullman-Ercek D. (2017) "Evidence for Improved Encapsulated Pathway Behavior in a Bacterial Microcompartment through Shell Protein Engineering." *ACS Synth. Biol.* 6(10):1880-1891.
36. Slininger Lee M.F., Tullman-Ercek D. (2018) "Practical considerations for the encapsulation of multi-enzyme cargos within the bacterial microcompartment for metabolic engineering." *Curr. Opin. Sys. Biol.* (in press).
37. Hartman E.C., Jakobson C.M., **Favor A.H.**, **Benedicto E.A.**, Francis M.B., Tullman-Ercek D. (2018) "Quantitative characterization of all single amino acid variants of a viral capsid-based drug delivery vehicle." *Nature Comm.* 9(1): 1385.
38. Lopez S.D., Griffith D.A, **Choi B.**, Cate J., Tullman-Ercek D. (2018) "Evolutionary engineering improves tolerance for short-chain alcohols in *Saccharomyces cerevisiae*." *Biotechnol. Biofuels* 11: 90.
39. Basler G., Thompson M., Tullman-Ercek D., Keasling J. (2018) "A *Pseudomonas putida* efflux pump acts on short-chain alcohols." *Biotechnol. Biofuels* 11: 136.
40. Basler G., Thompson M., Tullman-Ercek D., Keasling J. (2018) "A *Pseudomonas putida* efflux pump acts on short-chain alcohols." *Biotechnol. Biofuels* 11: 136.
41. Jakobson C.M., Tullman-Ercek D., Mangan N.M. (2018) "Spatially organizing biochemistry: choosing a strategy to translate synthetic biology to the factory." *Scientific Reports* 8(1): 8196.
42. Glasgow A.A. and Tullman-Ercek D. (2018) "Type III secretion filaments as templates for metallic nanostructure synthesis." *Methods Molecular Biology* 1798: 155-71.
43. Kang M.K., Tullman-Ercek D. (2018) "Engineering expression and function of membrane proteins." *Methods* 147:66-72.

44. Metcalf K.J., Slininger Lee M.F., Jakobson C.M., Tullman-Ercek D. (2018) "An estimate is worth about a thousand experiments: using order-of-magnitude estimates to identify cellular engineering targets." *Microbial Cell Factories* 17(1):135.
45. Burdette L.A., Leach S.A., Wong H.T., Tullman-Ercek D. (2018) "Developing Gram-negative bacteria for the secretion of heterologous proteins." *Microbial Cell Factories* 17(1): 196.
46. Hartman E.C., Lobba M.J., **Favor A.H.**, **Robinson S.A.**, Francis M.B., Tullman-Ercek D. (2019) "Experimental evaluation of co-evolution in a self-assembling particle." *Biochemistry* 58(11): 1527-38.
47. Brauer D.D., Hartman E.C., Bader D.L.V., **Merz Z.N.**, Tullman-Ercek D., Francis M.B. (2019) "Systematic engineering of a protein nanocage for high-yield, site-specific modification." *JACS* 141(9): 3875-84.
48. Nichols T.M., Kennedy N.W., Tullman-Ercek D. (2019) "Cargo encapsulation in bacterial microcompartments: Methods and analysis." *Methods Enzymol.* 617: 155-86.

### **PROFESSIONAL ACTIVITIES**

*Seminars and Conference Presentations: >70 invited talks by Tullman-Ercek and >100 additional conference presentations (>30 talks) by Tullman-Ercek and lab members on ongoing research.*

#### *Professional Organizations – Membership:*

Engineering Biology Research Consortium, American Institute of Chemical Engineers, American Chemical Society, Society of Biological Engineers, Synthetic Biology Practices Working Group (past), American Society for Microbiology (past)

#### *Professional Service Activities:*

Engineering Biology Research Consortium, Steering Committee and Education and Outreach Chair, 2018 – present  
 ASM mSystems, Editor, 2017 – present  
 T3S Bio, Scientific Advisory Board Member, 2017 – present  
 Genome Project Write, Scientific Executive Committee Member, 2017 – present  
 ACS Synthetic Biology, Editorial Board Member, 2011 – present  
 American Chemical Society, BIOT Interfaces Area Coordinator 2020, National Meeting Area Coordinator, 2014, Theme Committee 2013, Session Chair, 2013  
 American Institute of Chemical Engineers, Annual Meeting Session Chair, 2010 – present  
 American Society of Microbiology, Annual Meeting Plenary Session Organizer, 2012  
*Ad hoc* Reviewer of >30 papers in past four years, for journals such as Nature Chemical Biology, Nature Chemistry, ACS Synthetic Biology, Journal of the American Chemical Society, Biotechnology and Bioengineering, and Chemical Engineering Science.  
*Ad hoc* Grant Reviewer and Review Panelist on 8 panels in past four years, for agencies such as National Science Foundation and Department of Energy, and the Biotechnology and Biological Sciences Research Council (United Kingdom)

#### *University Service – Department of Chemical and Biological Engineering at Northwestern University:*

Committee member for faculty searches and graduate admissions  
 Chair of Graduate Admissions  
 Undergraduate academic advisor for cohorts of ~10 – 15 students per semester

#### *University Service – Department of Chemical and Biomolecular Engineering at University of California Berkeley:*

Committee member for undergraduate research awards, undergraduate education, faculty searches, colloquium organization, and graduate admissions  
 Chair of Graduate Admissions  
 Undergraduate academic advisor for cohorts of ~20 – 30 students per semester

**Public Service:**

Ethics of Engineering Biology, Speaker, From Page to Stage, The Writer's Theater, 2019  
 Exploring Ethics: Across Art, Humanities, and Science, Speaker and Panelist, 2019  
 Conversations in Synthetic Biology, Invited panelist, 2015  
 Building with Biology, Chabot Center event presenter, 2015  
 Tullman-Ercek D. "From the Periodic Table to the Dinner Table" *Mom the Chemistry Professor* Eds. Cole R., Marzabadi C., Webster G., Woznack K. Cham:Springer, 2014. 113-128.  
 Bay Area Science Festival, Energy Biosciences Institute Booth, 2012 and 2014  
 Bay Area Science Festival, Co-organizer of Energy Biosciences Institute Booth, 2011  
 Soroptimist Club of San Francisco, Invited speaker, 2011  
 Bay Area Science Café, Invited speaker, 2011  
 Diablo Valley College International Exchange Center, Mentor and host of one to two international undergraduates per semester, 2010 – 2016

**TEACHING AND MENTORING**

***Courses Taught as Primary Instructor at Northwestern, Department of Chemical and Biological Engineering:***

476-1: Bioprocess Engineering I: Kinetics, Energetics, Bioreactor Design, Spring 2019, 38 students.  
 375: Biochemical Engineering, Winter 2019, class size ~15 students.  
 395: Protein Engineering, Winter 2018, class size ~35 students.  
 211: Thermodynamics, taught twice with class sizes ~30 students.

***Courses Taught as Primary Instructor, Department of Chemical and Biomolecular Engineering:***

170A: Biochemical Engineering I, 3 units, taught three times with class sizes ~50 students  
 170B: Biochemical Engineering II. 3 units, taught three times with class sizes ~20 students  
 C270: Protein Engineering (Graduate elective). 3 units, taught three times with class sizes ~35 students  
 141: Chemical Engineering Thermodynamics. 4 units, taught twice with class sizes of ~130 students

***Supervised Students – Postdoctoral Researchers:***

Dr. Svetlana Ikononova (PhD Chem. Eng., University of Maryland), September 2017 to present.  
 Dr. Min-Kyoung Kang (PhD Ag. Biotech., Seoul National Univ., Korea), January 2017 to present.  
 Dr. Douglas Griffith (PhD Biochemistry, University of Kent, UK), January 2016 to Dec 2017.  
 Dr. Georg Basler (PhD Bioinformatics, University of Potsdam, Germany), July 2015 to Dec 2016.  
 Dr. Michael Fisher (PhD Molecular Biology, Princeton University), 2009 to 2013 (Current: Senior Fellow, Federation of American Scientists).

***Supervised Students – Graduate Students:***

Julie Liang (University of California Berkeley), Interdisciplinary Biological Sciences, 2018 to present.  
 Tanner Cook, Master of Biotechnology Program, 2018 to 2019 (Current: Zymergen).  
 Samuel Leach (Georgia Institute of Technology), Chemical and Biological Engineering, 2017 to present.  
 Nolan Kennedy (University of Minnesota), Interdisciplinary Biological Sciences, 2017 to present.  
 Shobhit Pratoria, Master of Biotechnology Program, 2016 to 2018 (Current: Gilead).  
 Qi (Maria) Wang, Master of Biotechnology Program, 2016 to 2018 (Current: PhD student at Rice).  
 Lan (Amber) Wang, Master of Biotechnology Program, 2016 to 2018 (Current: LanzaTech).  
 Zachary Cowden, Master of Biotechnology Program, 2016 to 2018 (Current: LanzaTech).  
 Charlotte Abrahamson, Chemical and Biological Engineering, 2016 to present.  
 Bon Ikwuagwu, Chemical and Biological Engineering, 2016 to present.

Taylor Nichols, Chemical and Biological Engineering, 2016 to present.  
Han-Teng Wong, Plant and Microbial Biology, 2015 to present.  
Emily Hartman, Chemistry, 2015 to present.  
Lisa Burdette, Chemical Engineering, 2014 to present.  
Marilyn Slininger, Chemical Engineering, 2012 to 2017 (Current: NRC Postdoc at ARL Edgewood Chemical Biological Center).  
Christopher Jakobson, PhD in Chemical Engineering, 2012 to 2016 (Current: Postdoc at Stanford, Jarosz Lab).  
Kevin Metcalf, PhD in Chemical Engineering, 2010 to 2016 (Current: Postdoc at UCSF, Werb Lab).  
Stephanie A. Davis Lopez, PhD in Chemistry, 2011 to 2015 (Current: Scientist at Next Interactions).  
Anum Azam, PhD in Bioengineering, 2011 to 2015 (Current: Postdoc at UCSF, Kortemme Lab).  
Sergey Boyarskiy, PhD in Bioengineering, 2010 to 2015 (Current: Scientist at Atreca).  
Michael Asensio, MS Bioengineering, 2013 to 2015 (Current: Scientist at Gigagen).  
Jeff E. Glasgow, PhD Chemistry, 2010 to 2014 (Current: Postdoc at UCSF, Wells Lab).  
Vimalier Reyes-Ortiz, PhD Bioengineering, 2009 to 2013 (Current: Process Engineer, Advent Engineering Services).  
Edward Y. Kim, PhD Chemical Engineering, 2008 to 2013 (Current: Data Scientist, Vevo).

*58 undergraduate researchers were also trained under my supervision, of whom 12 went on to graduate school, 1 is faculty at University of Delaware, and 21 are still completing their bachelor's degrees.*