JOEL L. KAAR
Department of Chemical and Biological Engineering
University of Colorado Boulder
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EDUCATION

Ph.D. Chemical Engineering, University of Pittsburgh, 09/2007
Dissertation title: Using enzyme structure-environment-activity relationships to enhance biocatalyst utility
Advisor: Dr. Alan J. Russell
B.S. Chemical Engineering, University of Pittsburgh, 12/2001

PROFESSIONAL EXPERIENCE

Assistant Professor, University of Colorado Boulder, Department of Chemical and Biological Engineering, 08/2010 – present
Postdoctoral Research Fellow, UK Medical Research Council Centre for Protein Engineering, University of Cambridge, 01/2008 – 07/2010
Advisor: Sir Alan R. Fersht, F.R.S.
Bayer Corporation, Leverkusen, Germany, 05/2000 – 08/2000
Bayer Corporation, Baytown, TX, 08/1999 – 12/1999
Bayer Corporation, Pittsburgh, PA, 01/1999 – 04/1999

HONORS AND AWARDS

NSF CAREER Award, 2015
University of Colorado College of Engineering Dean's Faculty Fellowship, 2013
US Army Research Office Young Investigator Award, 2012
UK Medical Research Council Career Development Fellowship, 2008
Tissue Engineering and Regenerative Medicine International Society Poster Session "Second Place Award for Best Paper", 2007
American Institute of Chemical Engineers Annual Student Poster Competition "First Place Award for Best Paper", 2001

PEER-REVIEWED PUBLICATIONS

(* denotes corresponding author, # denotes equal contribution)

From University of Colorado

1. Weltz JS, Schwartz DK, **Kaar JL**[*]. Surface-mediated protein unfolding as a search process for denaturing sites. (Submitted)

2. Nordwald EM[#], Plaks JG[#], Snell JR, Sousa MC, **Kaar JL**[*]. Crystallographic investigation of imidazolium ionic liquid effects on enzyme structure. *ChemBioChem* 2015. (In press)

3. MacConaghy KI, Chadly DM, Stoykovich MP[*], **Kaar JL**[*]. Label-free dection of missense mutations and methylation differences in the p53 gene using optically diffracting hydrogels. *Analyst* 2015;140(18):6354-6362.

4. Plaks JG, Falatach R, Kastantin M, Berberich JA, **Kaar JL**[*]. Multi-site clickable modification of proteins using lipoic acid ligase. *Bioconjug Chem* 2015;26(6):1104-1112.

5. MacConaghy KI, Chadly DM, Stoykovich MP[*], **Kaar JL**[*]. Understanding the role of hydrogel properties on the sensitivity of optically diffracting hydrogels as kinase biosensors. *Anal Chem* 2015;87(6):3467-3475.

6. Burney PR, Nordwald EM, Hickman K, **Kaar JL**, Pfaendtner J[*]. Molecular dynamics investigation of the ionic liquid/enzyme interface: application to engineering enzyme surface charge. *Proteins: Struct Funct Bioinf* 2015;83(4):670-680.

7. Swartzlander MD, Barnes CA, Blakney AK, **Kaar JL**, Kyriakides TR, Bryant SJ[*]. Linking the foreign body response and protein adsorption to PEG-based hydrogels using proteomics. *Biomaterials* 2015;41:26-36.

8. Nordwald EM, Armstrong GS, **Kaar JL**[*]. NMR-guided rational engineering of an ionic liquid tolerant lipase. *ACS Catal* 2014;4(11):4057-4064.

9. MacConaghy KI, Geary CI, **Kaar JL**[*], Stoykovich MP[*]. Photonic crystal kinase biosensor. *J Am Chem Soc* 2014;136(19):6896-6899.

10. Nordwald EM, Brunecky R, Himmel ME, Beckham GT, **Kaar JL**[*]. Charge engineering of cellulases improves ionic liquid tolerance and reduces lignin inhibition. *Biotechnol Bioeng* 2014;111(8):1541-1549.

11. McLoughlin SY[#], Kastantin M[#], Schwartz DK, **Kaar JL**[*]. Single Molecule resolution of protein structure and interfacial dynamics on biomaterial surfaces. *Proc Natl Acad Sci U S A* 2013;110(48):19396-19401.

12. Nordwald EM, **Kaar JL**[*]. Mediating electrostatic binding of 1-butyl-3-methylimidazolium chloride to enzyme surfaces improves conformational stability. *J Phys Chem B* 2013;117(30):8977-8986.

13. Nordwald EM, **Kaar JL**[*]. Stabilization of enzymes in ionic liquids via modification of enzyme charge. *Biotechnol Bioeng* 2013;110(9):2352-2360.

14. Nordwald EM, Garst A, Gill, RT, **Kaar JL**[*]. Synthetic biology-enabled protein engineering. *Curr Opinion Biotechnol* 2013;24(6):1017-1022. Invited peer-reviewed article for special issue on Chemical Biotechnology.

Prior to University of Colorado

15. Brandt T, **Kaar JL**, Fersht AR, Veprintsev DB[*]. Kinetic and equilibrium stability of p53 homologs. *PLoS One* 2012;7(10):e47889.

16. **Kaar JL**[*]. Lipase activation and stabilization in room temperature ionic liquids. *Methods Mol Biol* 2011;679:25-35. Invited peer-reviewed article for special issue on Enzyme Stabilization and Immobilization.

17. **Kaar JL**, Basse N, Joerger AC, Stephens E, Rutherford TJ, Fersht AR[*]. Stabilization of mutant p53 vial alkylation of cysteines and effects on DNA binding. *Protein Sci* 2010;19(12):2267-2278.

18. Basse N[#], **Kaar JL**[#], Joerger AC, Rutherford TJ, Fersht AR[*]. Towards the rational design of p53 stabilizing drugs: probing the surface of the oncogenic Y220C mutant. *Chem Biol* 2010;17(1):46-56.

19. Chen CZC, Peng YX, Wang ZB, Fish PV, **Kaar JL**, Koepsel RR, Russell AJ, Lareu RR, Raghunath M[*]. The scar-in-a-jar: studying antifibrotic lead compounds from the epigenetic to extracellular level in a single well. *Br J Pharmacol* 2009;158(5):1196-1209.

20. **Kaar JL**, Li Y, Blair HC, Asche G, Koepsel RR, Huard J, Russell AJ[*]. Matrix metalloproteinase-1 treatment of muscle fibrosis. *Acta Biomater* 2008;4(5):1411-1420.

21. Depp V, **Kaar JL**, Russell AJ, Lele BS[*]. Enzyme sheathing enables nanoscale solubilization of biocatalyst and dramatically increases activity in organic solvent. *Biomacromolecules* 2008;9(4):1348-1351.

22. **Kaar JL**[#], Oh H[#], Russell AJ, Federspiel WJ[*]. Towards improved artificial lungs through biocatalysis. *Biomaterials* 2007;28(20):3131-3139.

23. Bedair H, Liu TT, **Kaar JL**, Badlani S, Russell AJ, Li Y[*], Huard J. Matrix metalloproteinase-1 therapy improves muscle healing. *J Appl Physiol* 2007;102(6):2338-2345.

24. Xu H, **Kaar JL**, Russell AJ, Wagner WR[*]. Characterizing the modification of surface proteins with poly(ethylene glycol) to interrupt platelet adhesion. *Biomaterials* 2006;27(16):3125-3135.

25. Sharma NK, Tickell MD, Anderson JL, **Kaar J**, Pino V, Wicker BF, Armstrong DW[*], Davis JH Jr[*], Russell AJ[*]. Do ion tethered functional groups affect solvent properties? The case of sulfoxides and sulfones. *Chem Commun* 2006;6:646-648.

26. Russell AJ[*], **Kaar JL**, Berberich JA. Using biotechnology to detect and counteract chemical weapons. *The Bridge* 2003;33(4):19-24. Invited peer-reviewed article published by the National Academy of Engineering.

27. Berberich JA, **Kaar JL**, Russell AJ[*]. Use of salt hydrate pairs to control water activity for enzyme catalysis in ionic liquids. *Biotechnol Prog* 2003;19(3):1029-1032.

28. **Kaar JL**, Jesionowski AM, Berberich JA, Moulton R, Russell AJ[*]. Impact of ionic liquid physical properties on lipase activity and stability. *J Am Chem Soc* 2003;125(14):4125-4131.

29. Russell AJ*, Erbeldinger M, DeFrank JJ, **Kaar J**, Drevon G. Catalytic buffers enable positive-response inhibition-based sensing of nerve agents. *Biotechnol Bioeng* 2002;77(3):352-357.

PATENTS

1. Oh H, **Kaar JL**, Russell AJ, Federspiel WJ. "Devices, systems and methods for reducing the concentration of carbon dioxide in fluids." US Patent Number 7763097.

INVITED PRESENTATIONS

1. Biostability Symposium, Army Natick Soldier Research Development and Engineering Center, 09/2015
2. Colorado Protein Stability Conference, 07/2015
3. Frontier of the Interface of Materials and Biology: Using Nanotechnology To Investigate Cellular and other Biological Systems Session, ACS Fall Meeting, 08/2014
4. Biophysical Society Summer Course, University of North Carolina, 06/2014
5. Colorado Center for Biofuels and Biorefining Semi-Annual Meeting, 04/2014
6. Seminar, Department of Chemical Engineering, University of Washington, 11/2013
7. Research Symposium, Department of Chemical & Biological Engineering, 10/2013
8. Army Research Office Reactive Chemical Systems Meeting, 10/2012
9. Seminar, Department of Chemical & Biological Engineering, Colorado School of Mines, 04/2012
10. Seminar, Department of Chemical & Biological Engineering, Colorado State University, 12/2011
11. Biophysics Supergroup, University of Colorado, 01/2011
12. Seminar, Department of Chemical & Biological Engineering, University of Colorado, 02/2010
13. Seminar, Department of Chemical and Biomolecular Engineering, Clemson University, 02/2010
14. NATO PG31 Meeting on Non-Corrosive, Biotechnology-Based Decontaminants for Chemical and Biological Weapons, 03/2004

CONTRIBUTED PRESENTATIONS

(* denotes presenter)

1. Weltz JS*, Schwartz DK, Kaar JL. Surface-mediated protein unfolding as a search process for denaturing sites. Biophysics Supergroup, University of Colorado, 2015 (talk).
2. Kastantin M*, Grover N, Marruecos DF, Schwartz DK, Kaar JL. Fibronectin conformation and integrin binding on crowded surfaces. ACS Spring Meeting, 2015 (talk).
3. Nordwald EM*, Brunecky R, Himmel ME, Beckham GT, Kaar JL. Charge engineering of cellulases improves ionic liquid tolerance and reduces lignin inhibitions. ACS Spring Meeting, 2015 (talk).
4. Nordwald EM*, Armstrong GS, Kaar JL. NMR-guided rational engineering of an ionic liquid tolerant lipase. ACS Spring Meeting, 2015 (talk).

5. Plaks JG*, Berberich JA, Kaar JL. Ligase-mediated biorthogonal insertion of click reactive groups for site-specific protein modification. ACS Spring Meeting, 2015 (talk).
6. MacConaghy KI*, Kaar JL, Stoykovich MP. Photonic crystal platform for biomolecular sensing. ACS Spring Meeting, 2015 (talk).
7. MacConaghy KI*, Kaar JL, Stoykovich MP. Material considerations in the design of sensitive and rapid biosensors based on optically diffracting hydrogels. ACS Spring Meeting, 2015 (poster).
8. Weltz JS*, Schwartz DK, Kaar JL. Probing protein denaturation at the solid-liquid interface with single-molecule fluorescence microscopy. ACS Spring Meeting, 2015 (talk).
9. MacConaghy KI*, Geary CI, Kaar JL, Stoykovich MP. Development of a photonic crystal biosensor for assaying kinase activity. AIChE Annual Meeting, 2014 (talk).
10. MacConaghy KI*, Kaar JL, Stoykovich MP. Characterization of the Key Properties of Optically Diffracting Hydrogels for Biosensing Applications. AIChE Annual Meeting, 2014 (poster).
11. Nordwald EM*, Kaar JL. Effect of site-specific mutations on solvent-induced inactivation of lipase in ionic liquids: Towards the rational design of ionic liquid tolerant enzymes. AIChE Annual Meeting, 2014 (poster).
12. Nordwald EM*, Kaar JL. Charge engineering of cellulases improves ionic liquid tolerance and reduces lignin inhibition. AIChE Annual Meeting, 2014 (poster).
13. Nordwald EM*, Kaar JL. Stabilization of enzymes in ionic liquids via modification of enzyme charge. AIChE Annual Meeting, 2013 (talk).
14. McLoughlin SY, Kastantin MJ, Schwartz DK, Kaar JL*. Protein engineering-enabled single molecule resolution of protein structure at biomaterial interfaces. AIChE Annual Meeting, 2013 (talk).
15. Kastantin MJ*, McLoughlin S, Kaar JL, Schwartz DK. Single molecule observations of fibronectin conformation and its interaction with model integrins. AIChE Annual Meeting, 2013 (talk).
16. Plaks J*, Kaar JL. Engineering proteins for biomaterial applications. RosettaCon, 2013 (poster).
17. McLoughlin SY, Kastantin M, Schwartz DK, Kaar JL*. Protein engineering-enabled single-molecule resolution of protein structure at biomaterial interfaces. Colorado Protein Stability Conference, 2013 (poster).
18. McLoughlin S, Kastantin M*, Schwartz DK, Kaar JL. Protein engineering-enabled single molecule resolution of protein structure at biomaterial interfaces. Biophysics Supergroup, University of Colorado, 2013 (talk).
19. Nordwald EM*, Kaar JL. Improving the tolerance of cellulosic enzymes to ionic liquids using barcoded PROSAR for sustainable biofuel production, Biophysics Supergroup, University of Colorado, 2012 (talk).
20. Nordwald EM*, Kaar JL. Enzyme structure-function-microenvironment relationships in ionic liquids. Enzyme Engineering XXI Conference, 2011 (poster).
21. Kaar JL*, Basse N, Settani G, Joerger AC, Rutherford TJ, Fersht AR. Towards the rational design of p53 stabilizing drugs: probing the surface of the oncogenic Y220C mutant. AIChE Annual Meeting, 2009 (talk).
22. Basse N*, Kaar J, Rutherford T, Fersht A. NMR and thermal shift: comparison of methods for fragment-based lead discovery. MipTec, 2009 (poster).

23. Kaar JL*, Li Y, Blair HC, Asche G, Koepsel RR, Huard J, Russell AJ. Matrix metalloproteinase-1 treatment of muscle fibrosis. TERMIS-Europe Meeting, 2008 (poster).
24. Kaar JL*, Li Y, Huard J, Koepsel RR, Russell AJ. Reversing the effects of scarring in lacerated muscle tissue using matrix metalloproteinase-1. TERMIS-North America Meeting, 2007 (poster).
25. Kaar JL, Amitai G*, DeFrank JJ, Russell AJ. Biocatalytic pH control for nerve agent detoxification in aqueous solution and fire fighting foam. Self-Detoxifying Materials for CB Defense Conference, 2007 (talk).
26. Oh H*, Kaar JL, Russell AJ, Federspiel WJ. Application of carbonic anhydrase for improved CO_2 gas exchange in artificial lungs. BMES Annual Meeting, 2006.
27. Oh H*, Kaar JL, Russell AJ, Federspiel WJ, Immobilization and assessment of carbonic anhydrase on hollow fiber membranes for enzyme-enhanced artificial lungs. ASAIO Annual Meeting 2006.
28. Kaar JL*, Koepsel RR, Li Y, Huard J, Russell AJ. Mitigation of scar tissue formation with PEGylated matrix metalloproteinase-1. TESI Annual Meeting, 2005 (poster).
29. Kaar JL*, Koepsel RR, DeFrank JJ, Russell AJ, Biocatalytic pH control for nerve agent detoxification, AIChE Annual Meeting, 2004 (talk).
30. Sharma NK*, Kaar J, Russell AJ. Potential applications of ionic liquids in enzyme-catalyzed polymer synthesis. ACS Fall Meeting, 2004 (talk).
31. Berberich JA, Mesiano AM, Kaar JL, Sharma NK*, Russell AJ. Green approach to polyester synthesis using enzymes. EPA Forum on Emerging Technologies, 2003.
32. Berberich JA*, Kaar JL, Mesiano AM, Erbeldinger M, Russell AJ, Biocatalysis and enzyme stability in ionic liquids. ACS Fall Meeting, 2002 (talk).
33. Kaar J*, Berberich JA, Drevon G, Russell AJ. Nerve agent biosensing polyurethane coating. AIChE Annual Meeting, 2001 (poster).

PERSONNEL SUPERVISED (Fall 2010 – present)

Erik Nordwald, PhD student, 2011 – 2015
Kelsey (Childress) MacConaghy, PhD student, 2012 – present
Joseph Plaks, PhD student, 2013 – present
Nuria Codina, PhD student, 2013 – present
James Weltz, PhD student, 2014 – 2015
David Faulon Marruecos, PhD student, 2015 – present
Samantha Summers, PhD student, 2015 – present
Alaksh Choudhury, PhD student, 2015 – present
Garrett Chado, PhD student, 2015 – present
Katerina Voigt, PhD student, 2011
Navdeep Grover, Postdoc, 2014 – present
Sean Yu McLoughlin, Postdoc, 2012 – 2013
Michael Mckenna, undergraduate researcher, 2015 – present
Clare Wise, undergraduate researcher, 2015 – present
Melissa Rabin, undergraduate researcher, 2015
Vanessa Witte, undergraduate researcher, 2014
Caine Leuschner, undergraduate researcher, 2014
Chloe Anderson, undergraduate researcher 2013
David Faulon Marruecos, visiting undergraduate researcher, 2013
Karine Hoff, undergraduate researcher, 2012 – 2013
Cuining Liu, undergraduate researcher, 2012

Gregory Nierode, undergraduate researcher (completed senior thesis), 2011 – 2012
Cassie Dymecki, undergraduate researcher, 2011 – 2012
Joseph Gardener, undergraduate researcher, 2011 – 2012

TEACHING

- **Fall 2015** Applied Data Analysis CHEN 3010 (105 students), 3 credits
- **Spring 2015** Biokinetics CHEN 4830 (67 students), 3 credits
- **Fall 2014** Pharmaceutical Biotechnology CHEN 4801 (49 students), 3 credits
- **Fall 2013** Applied Data Analysis CHEN 3010 (60 students), 3 credits
- **Spring 2013** Pharmaceutical Biotechnology CHEN 4801 (65 students), 3 credits
- **Fall 2012** Applied Data Analysis CHEN 3010 (51 students), 3 credits
- **Fall 2011** Applied Data Analysis CHEN 3010 (55 students), 3 credits
- **Spring 2011** Pharmaceutical Biotechnology CHEN 4801 (co-taught, 77 students), 3 credits
- **Fall 2010** Applied Data Analysis CHEN 3010 (co-taught, 109 students), 3 credits

SERVICE ACTIVITIES

Review for journals

ACS Catalysis, ACS Chemical Biology, Acta Biomaterialia, Biochemical Engineering Journal, Biomacromolecules, Bioprocess and Biosystems Engineering, Biotechnology Advances, Biotechnology Progress, Biotechnology and Bioengineering, Cell and Molecular Bioengineering, ChemBioChem, Chemical Communications, Enzyme and Microbial Technology, Encyclopaedia of Catalysis, FEBS Letters, Langmuir, Journal of the American Chemical Society, Journal of Molecular Catalysis B: Enzymatic, Nucleic Acids Research, Organic Letters, Protein Engineering, Design, and Selection, Tissue Engineering, Topics in Catalysis

Review for grant agencies

National Science Foundation, US Army Research Office, American Chemical Society Petroleum Research Fund, University of Colorado Innovative Seed Grant Program

Professional meetings, workshops, and conferences

- Area Coordinator, Biomolecular and Biophysical Processes Symposium, ACS BIOT Meeting, 2016
- Co-chain, Biocatalysis and Biosynthesis II: Applications, AIChE Annual Meeting, 2015
- Co-chair, Protein Engineering II: Rational and Computation Techniques, AIChE Annual Meeting, 2015
- Co-chair, Protein Characterization Technologies, ACS Spring Meeting, 2015
- Co-chair, Protein Engineering session, SBE International Conference on Biomolecular Engineering, 2013
- Chair, Protein Structure, Function, and Stability II session, AIChE Annual Meeting, 2012
- Co-chair, Protein Engineering I session, AIChE Annual Meeting, 2011
- Organizer and Chair, Pathway and Genome Engineering for Biofuels and Biochemicals, Enzyme Engineering XXI Conference, 2011

Professional affiliations (member of)
American Chemical Society, American Institute of Chemical Engineers, Participating member of University of Colorado Molecular Biophysics Program, Affiliate of University of Colorado Renewable and Sustainable Energy Institute (RASEI), Participating member of University of Colorado Interdisciplinary Quantitative Biology Program, Tau Beta Pi Engineering Honor Society, Omega Chi Epsilon Chemical Engineering Honor Society

University Service
- Member of NIH/CU Molecular Biophysics Training Program Steering Committee, 2014 – present
- Member of CU Boulder campus Institutional Animal Care and Usage Committee (IACUC), 2012 – 2013
- Member of CU RASEI Faculty Search Committee, 2013

Department Service
- Member of Department Leadership Committee, 2013 – present
- Organizer for Department Seminar Series, 2012 – present
- Member of Department Strategic Planning Committee, 2011
- Member of Department Chair Search Committee, 2011
- Member of Department Graduate Committee, 2010 – present, involved in graduate admissions and recruiting, new graduate student orientation, and review of course variances
- Member of Department Faculty Search Committee, 2010
- Member of Department Academic Review and Planning Committee, 2010
- Undergraduate Advisor, 2010 – 2011
- Member of Doctoral Thesis Committee (31 total):
  Lea Sorrett (2015 – present), Anna Corts (2015 – present), Lauren Andrews (2010-2012), Amanda Cordes (2010-2011), Maliheh Shomali (2010-2013), Nicholas Sandoval (2010-2011), Navakanth Gandavarapu (2010-2013), Josh McCall (2010-2012), Mohamed Seyam (2010-2011), Alana Gerhardt (2010-2014), Joost Groot (2010-2014), Mark Tidbitt (2011-2012), Chris Koehler (2011-2012), Carolyn Schoenbaum (2011-2014), Rhea Williams (2011-2014), Blake Langdon (2011-2014), Patrick Noonan (2011-2013), Kimberly Hassett (2011-2014), Carly Fleagle (2011-2015), Mark Swartzlander (2011-2014), Stacey Skaalure (2011-2014), Emi Tokuda (2011-2014), Samir Singh (2011-2014), Aaron McUmber (2011-2015), Sarah Gould (2012-2013), Luke Amer (2012-present), Yemin Xu (2012-2014), Josh Mabry (2012-2015), Libby Beneski (2012-2015), Daniel McKinnon (2012-2014), Isaac Godfroy (2013-2015), Sophie Weiss (2013-2015), Katie Lewis (2013-2015)
- Member of Master Thesis Committee (2 total):
  Alexander VanFosson (2013), Keith Britt (2011)
- Department Representative, College of Engineering Outstanding Dissertation Award Committee, 2012
- Volunteered to speak at undergraduate senior seminar on entering academia, 2012, 2013
- Volunteered to speak at CU AIChE student chapter meeting on the benefits of Co-Op education, 2012

Community Outreach

- Mentor to three Boulder Valley High School seniors (Taylor Andrews, Richard Noack, Michael Loesel) as part of the Boulder Valley Science Research Seminar Program