

Ryan Aaron Mehl

Oregon State University
Department of Biochemistry and Biophysics
2011 Agricultural and Life Sciences Building
Corvallis, OR 97331
Phone: (541) 737-4429
Email: ryan.mehl@oregonstate.edu
Webpage: <https://mehl.biochem.oregonstate.edu/>

Updated: November 18, 2022

Professional

- 2022-present **Director NIH GCE4All Center**, Oregon State University
- 2022-present **Halide Biologics, Inc. Founding Board**
- 2018-present **Professor of Biochemistry and Biophysics**, Oregon State University
- 2016-2019 **Chief Technology Officer, xBiologix Inc.**, Corvallis, Oregon
- 2011-2022 **Director of Unnatural Protein Facility**, Oregon State University
- 2011-2018 **Associate Professor of Biochemistry and Biophysics**, Oregon State University
- 2008-2011 **Associate Professor of Chemistry**, Franklin & Marshall College
- 2002-2008 **Assistant Professor of Chemistry**, Franklin & Marshall College
- 2001-2002 **Postdoctoral Fellow**, The Scripps Research Institute
Research Advisor: Professor Peter G. Schultz
Unnatural amino acid research
- 1996-2001 **PhD, Cornell University**, Chemistry and Chemical Biology.
Research Advisor: Professor Tadhg Begley
Thesis Title: "Mechanistic Studies on the Formation and Repair of a Novel DNA Lesion: The Spore Photoproduct", "Studies on the First *in vitro* Biosynthesis of Thiamin From Purine Precursors"
- 1994-1996 **Research Assistant**, National Starch & Chemical Company, Research and Development Division, Bridgewater, NJ
- 1992-1996 **Research Assistant**, Moravian College, Bethlehem, PA.
Research Advisor; Professor Dan R. Libby
Thesis Title: "Model Studies on the Mechanism of Hydride Transfer for NAD(P)H"

Education

- 2001 Cornell University, Ithaca, NY
Department of Chemistry and Chemical Biology
Ph.D. Organic Chemistry
- 1999 Cornell University, Ithaca, NY
Department of Chemistry and Chemical Biology
M. S. Chemistry
- 1996 Moravian College, Bethlehem, PA
B. S. Chemistry

Awards

- 2019 Milton Harris Award in Basic Research, Oregon State University
- 2006 Young Alumni Achievement Award, Moravian College
- 2005 NSF Career Award
- 2000 NIH Chemistry/Biology Interface Training Grant
- 1996 Louis & Ester Bader Memorial Award in Chemistry
- 1994 Omicron Delta Kappa, National Leadership Honor Society
- 1989 Eagle Scout

Funding

- 2022-2027 NIH, RM1-GM144227 (PI) \$5,536,522 (The GCE4All Center: Unleashing the Potential of Genetic Code Expansion for Biomedical Research)
- 2021-2023 Amgen, MA1-2021056675 (PI) \$1,209,543
(Engineering of therapeutic antibodies with genetic code expansion)
- 2021-2023 Amgen, MA2-2021056675 (PI) \$449,372
(Engineering of bispecific antibodies with genetic code expansion)
- 2021-2023 Abbvie, 00179930 (PI) \$379,573
(Engineering E3 ligase degradomers with genetically encoded ligands sites)
- 2021-2025 NIH, R01GM114653-6 (PI) \$1,145,088
(Defining Roles of NitroTyrosine in Disease Via Genetic Code Expansion)
- 2021-2025 NSF-MCB-2054824 (PI) \$1,209,960
(Ideal Eukaryotic Tetrazine Ligations For Imaging Protein Dynamics in Live Cells)
- 2019-2024 R01 NS102479-01A1 (PI: Franco, subcontract: Mehl) \$1,583,968
(Redox Signaling in Neurofibromatosis)
- 2018-2022 NIH R01GM131168-01 (PI) \$1,857,595
(Development of an improved core technology for efficient genetic code expansion in biomedical research)
- 2015-2020 NIH R01 GM114653 (PI) \$937,735 (\$94,656 equipment supplement)
(Defining Roles of NitroTyrosine In Disease Via Genetic Code Expansion)
- 2015-2019 NSF MCB 1518265 (PI) \$900,835
(Genetic Encoding of Tetrazine Amino Acids to Develop Ideal Bioorthogonal Ligations)

- 2014-2015 Oregon Health & Sciences University Medical Research Foundation (PI) \$40K
(Probing The Role of Tyrosine Nitration in Mammalian Disease Regulation)
- 2011-2014 NSF CHE-1112409, (Co-PI) \$216,091
(Surface Patterning of Biomaterials Using the Tetrazine Ligation)
- 2011-2012 NIH COBRE Seed Grant, (PI) \$91,800
(Development of methods for photochemically patterning surfaces)
- 2005-2011 NSF Career-MCB-0448297 (PI) \$520,846
(Developing site-specific photocrosslinkers using unnatural amino acids on *in vivo* complexes)
- 2005-2007 Cottrell Science Research Corporation (PI) \$35,000
(Generation and Evaluation of Improved Site-Specifically Incorporated 19F-Amino Acids for studying protein conformational changes in vivo and in vitro)
- 2005-2007 Petroleum Research Fund-ACS (PI) \$39,704
Manipulating protein interfaces by photocrosslinking of genetically incorporated unnatural amino acids)

Intramural funding:

- 2022-2023 Impact Studio (PI) Provost study stage 1
- 2019-2021 Revenue options from genetic code expansion plus
SciRIS Stage 2 (PI), \$75,000, Oregon State University seed funding
(Structurally functionalized nanobodies)
- 2012 RERF equipment proposal (Co-PI) \$25,000
UP Facility purchase of a high-powered hydrostatic cell disruption device.
- 2006 Faculty Enhancement Research Award (PI, F&M) \$5,000
Summer Research Supplies
- 2005 Faculty Enhancement Research Award (PI, F&M) \$5,000
Summer Research Supplies
- 2004 Faculty Enhancement Research Award (PI, F&M) \$5,000
Summer Research Supplies

Presentations at Professional Meetings and Seminars

The Limits of Labeling in Cells Using Genetic Code Expansion, University of Southern California. 10/20/22

Defining Ideal Protein Labeling and how to get there with Genetic Code Expansion, ThermoFisher 07/30/2021

Ideal Protein Labeling In Cells Using Genetic Code Expansion, EMBL Germany EMBO Workshop: Chemical Biology 09/3-5/2020

Improving Genetic Code Expansion Guided By Computational Design. OHSU Chemical Biology Conference. OHSU 12/12/2019

Ideal Protein Labeling In Cells Using Genetic Code Expansion. Manchester University, 9/24/2019

Tetrazine Amino Acid Reactivity In Vivo: Surprising redox behavior and how to control it. Bioorganic Gorgon Conference 06/09/2019

Ideal Protein Materials with Genetic Code Expansion. ACS Spring Conference 04/03/2019

Directed Evolution: Controlling Evolution on the Molecular Level, Corvallis Library, 04/20/2019

Genetic Code Expansion: Reprogramming life and science and everything they contact. Pacific North West National Labs. 05/20/2018

Genetic Code Expansion: Reprogramming life and science and everything they contact. OSU College of Science Board of Directors. 04/14/2018

Ideal Protein Materials: Thinking Outside the Codon Wheel. Florida State University. 04/10/2018

Thinking Outside the Codon Wheel. OHSU Chemical Biology Conference. OHSU 12/12/2017

Genetic Code Expansion: Its Role in Advancing Protein Polymer Hybrids. Protein Polymer Center, Carnegie Mellon University 06/05/2017

Genetic Code Expansion: From Bench to Bench and Beyond. ACS Fall Conference, 08/23/2016

Ideal Protein Surfaces in Material Science. Protein Polymer Center, Carnegie Mellon University 06/13/2016

Ideal Bioorthogonal ligations: The Need For Speed. Bioorganic Gordon Conference. 06/09/2016

The Pursuit of Ideal Bioorthogonal Ligations and Their Applications. Portland State. 02/17/2016

The Pursuit of Ideal Bioorthogonal Ligations and Their Applications. UC Irvine. 02/10/2016

Ideal Protein Materials via Genetic Code Expansion. Duke. 01/21/2016

Defining Roles of NitroTyrosine in Disease via Genetic Code Expansion. OHSU. 01/14/2016

Defining Roles of NitroTyrosine in Disease via Genetic Code Expansion. Center for Genome Research and Biocomputing. Oregon State University. 09/18/2015

Advances in Protein Materials Driven By Genetic Code Expansion. Protein Polymer Center, Carnegie Mellon University 06/08/2015

Defining Roles of NitroTyrosine in Disease via Genetic Code Expansion. Bioorganic Gordon Conference, 06/10/2015

Defining Roles of NitroTyrosine in Disease via Genetic Code Expansion. Begley Symposium, Texas A&M University 04/17/2015

Defining Roles of NitroTyrosine in Disease via Genetic Code Expansion. Medical Research Council Cambridge UK. 04/02/2015

Unnatural Protein Facility: Impacts on Protein NMR. Murdock Funding application. 11/20/2014

Genetic Code Expansion: Non-Canonical Amino Acids in Your Favorite Protein. Willamette College 10/06/2014

Non-Canonical Amino Acids In Your Favorite Protein. North-West Crystallography 07/21/14

Genetically Encoding Oxidative Stress, NO Conference, 07/14/14

Synthetic Chemical Biology: Next Generation Proteins with Genetic Code Expansion.
Bioorganic Gordon Conference 06/08/2014

Genetic Code Expansion in Chemical Biology. Volcano Conference, 02/14/14

Studying the Chemical Biology of Oxidative Stress with Broadly Permissive Translation. Texas
A&M University 09/24/13

Unnatural Protein Facility at Oregon State University. National ACS Organic Regional Meeting
07/22/13

Expanding Chemical Biology with Broadly Permissive Translation. Colorado State University
04/22/13

Expanding Chemical Biology with Broadly Permissive Translation. University of Pittsburgh
10/17/12

Expanding Chemical Biology with Synthetic Biology: Non-Proteinogenic Amino Acid
Mutagenesis. Pacific Northwest National Laboratory 07/10/12

Expanding Chemical Biology with Synthetic Biology: Unnatural Amino Acid Mutagenesis.
University of Michigan 03/13/12

Fusing Chemical Biology with Synthetic Biology: Unnatural Amino Acid Mutagenesis
Applications. University of Pennsylvania 01/27/11

Fusing Chemical Biology with Synthetic Biology: Unnatural Amino Acid Mutagenesis
Applications. University of Delaware 01/13/11

Fusing Chemical Biology with Synthetic Biology: Unnatural Amino Acid Mutagenesis
Applications. Carnegie Mellon University 01/07/11

Fusing Chemical Biology with Synthetic Biology: Unnatural Amino Acid Mutagenesis
Applications. Oregon State University 08/15/10

Generating Permissivity to Increase Utility: Site-Specific Unnatural Aminoacyl-tRNA
Synthetases. The American Society for Biochemistry and Molecular Biology Annual Meeting.
04/26/10.

Career Envy: The Road to a Successful PUI Position. Myriam Cotten, Sean Decatur, Ryan
Mehl, Kathleen Parson, Joseph Provost, The American Society for Biochemistry and Molecular
Biology Annual Meeting. 04/25/10.

Generating Permissive Site-Specific Unnatural Amino Acid Synthetases. The American Society
for Biochemistry and Molecular Biology Annual Meeting. 04/27/10.

Generating Permissive Site-Specific Unnatural Amino Acid Synthetases for *In Vivo* Production
of Proteins Containing Useful Chemical Functionality. University of Notre Dame. 04/22/10.

Generating Permissive Site-Specific Unnatural Amino Acid Synthetases. Carnegie Mellon University, 11/23/09

Generating Permissive Site-Specific Unnatural Amino Acid Synthetases. Worcester Polytechnic Institute, 11/18/09

Identifying and Utilizing Broad Substrate Specificity in Unnatural Amino Acid Synthetases. Proteins, *SIM-Industrial Microbiology and Biotechnology*. 07/27/09

Identifying and Utilizing Broad Substrate Specificity in Unnatural Amino Acid Synthetases. Leeds University, 03/20/09

Selecting Synthetases for Unnatural Amino Acids that don't Exist. Emory University, 10/20/08

High Yield Genetic Incorporation of Unnatural Amino Acids for Probing Protein Interactions and Dynamics. Biocatalysis Gordon Conference, 7/08

Improving Evolution Using Intelligent Design: Unnatural Amino Acids in Proteins. Ithaca College, 11/13/07

Site-specific Photocrosslinking and Fluorinated Amino Acids in vivo and in vitro. Proteins Gordon Conference, 6/07

Study of Protein Interfaces using Site-specifically Incorporated Unnatural Amino Acids. Bioorganic Gordon Conference, 6/07

Changing Biochemistry: Unnatural Amino Acids in Proteins. Bowdoin College, 12/06

Improving Evolution Using Intelligent Design: Unnatural Amino Acids in Proteins. Moravian College, 10/06

Unnatural Amino Acids at Protein Interfaces. The Scripps Research Institute, 8/06

Improving Evolution Using Intelligent Design: Unnatural Amino Acids in Proteins. Sarah Lawrence College, 2/06

How might unnatural amino acids change the way you do science? Non-Standard Amino Acids in Proteins. University of Delaware, 12/05

Non-Standard Amino Acids in Proteins. Ambrex, San Diego, CA, 7/05

Unnatural Amino Acids at Protein interfaces and Active-Sites. Gordon Conference, 6/05

Photocrosslinking Unnatural Amino Acids at Protein interfaces. Gordon Conference, 6/03

Stabilizing Proteins with Site-Specifically Incorporated Unnatural Amino Acids. Penn State College of Medicine, 5/03

Professional activities

Guest lectures at OSU and elsewhere in the US:

- "Chemical Biology" CH637, OSU, Corvallis, May 20, 2017, (Instructor: Sandra Loesgen), lecture on "Ideal Bioorthogonal Ligations"
- "Bioconjugation and Protein Modifications" BIOE49/599, OSU, Corvallis, February 28, 2016, (Instructor: Karl Schilke), lecture on "Genetic Code Expansion Bioorthogonal Ligations"
- "Bioconjugation and Protein Modifications" BIOE49/599, OSU, Corvallis, May 25, 2015, (Instructor: Karl Schilke), lecture on "Genetic Code Expansion and Bioorthogonal Ligations"

- “Chemical Biology ” CH637 OSU, Corvallis, May 11, 2014, (Instructor: Sandra Loesgen), lecture on “Bioorthogonal Ligations”
- “Bioconjugation and Protein Modifications ” BIOE49/599, OSU, Corvallis, May 20, 2014, (Instructor: Karl Schilke), lecture on “Genetic Code Expansion and Bioorthogonal Ligations”
- “Research Perspectives” MCB511, OSU, Corvallis, November 17, 2014, (Instructor: Indira Rajagopal), lecture on “Studying Oxidative Stress with Genetic Code Expansion”
- “Introduction to Biochemistry and Biophysics Research” BB111, OSU, Corvallis, October 10, 2013 (Instructor: Kevin Ahern), lecture on “Synthetic Chemical Biology”

International workshops lead:

- “Genetic Code Expansion Workshop”, August, 2018, Directed with Unnatural Protein Faculty, Oregon State University, Oregon
- “Genetic Code Expansion Workshop”, August, 2017, Directed with Unnatural Protein Faculty, Oregon State University, Oregon
- “Genetic Code Expansion Workshop”, August, 2016, Directed with Unnatural Protein Faculty, Oregon State University, Oregon
- “Genetic Code Expansion Workshop”, August, 2015, Directed with Unnatural Protein Faculty, Oregon State University, Oregon
- “Interpretation of Comparative Genomics Workshop”, January 2004, Co-Directed with the Fellowship for Interpretation of Genomes (FIG), Franklin and Marshall College, Lancaster, Pennsylvania

Founder and director of Unnatural Protein Facility (2011-2022)

- Established the world’s first Unnatural Protein (UP) Facility on the OSU campus using start-up support from OSU. The mission of the UP Facility is to give researchers full access to current GCE tools for their academic endeavors and to facilitate development of new tools desired by the research community.
- Organized/hosted International GCE workshops (2015-2018) training ~20 scientists/year.
- Supported training women and minorities in GCE as specific broader aim of NSF
- Organize/host International GCE conferences, 2016, at OSU for 94 scientists from 13 countries. 2018, at OSU for 113 scientists from 12 countries. 2020 will be in Beijing China and 2022 will be at OSU, Corvallis USA.
- At least seven OSU research labs have had a major NSF or NIH award funded where one or more aims involve GCE tools: Colin Johnson, Andy Karplus, Chong Fang, Wei Kong, Karl Schilke, Elisar Barbar, and Maria Franco.

Director of the GCE4All NIH BTDD National Center (2022-present)

- The GCE4All Center: Unleashing the Potential of Genetic Code Expansion for Biomedical Research. By optimizing, developing and broadly disseminating GCE technologies, the GCE4All Center makes the use of powerful tools and approaches standard; enabling scientific breakthroughs worldwide.

Reviews:

- Journals: *ACS Biochemistry*, *ACS Chemical Biology*, *ACS Bioconjugation Chemistry*, *ACS Organic Letters*, *Angewandte Chemie*, *Cell Chemical Biology*, *Chemistry and Biology*, *ChemComm*, *ChemBioChem*, *Chemical Communications*, *Journal of the American Chemical Society*, *Journal of Chemical Education*, *ACS Synthetic Biology*, *Journal of Biological Chemistry*, *Journal of Molecular Biology*, *Nature*, *Nature Chemistry*, *Nature Chemical Biology*, *Nucleic Acids Research*, *Science*, *Science Reports*. (Reviewed approximately 2 manuscripts per month since 2011.)

- Funding: National Science Foundation, National Institute of Health, Cottrell Research Fund, American Chemical Society Petroleum Research Fund, European Research Council, UKRI Biotechnology and Biological Sciences Research Council, UKRI Engineering Physical Sciences Research Council, Oregon State University College of Science

Service

- OSU P&T Committee, 2017-2019, 2022-present
- OHSU Chemical Biology and Physiology Conference Committee, 2018-present
- OSU Chair of Hiring committee 2021-2022
- OSU Graduate Committee Chair, 2015-2016, 2020-2021
- OSU COS innovation Council, 2019-2021
- BB COS awards Committee, 2016-2018
- Center for Genome Research and Biocomputing (CGRB) conference committee, 2017-18
- Curriculum Committee, 2017
- COS Chemical Safety committee, 2015-present
- Graduate Committee Chair, 2015
- Seminar Program Chair, 2013-2016
- College of Science, Dept. of Chemistry faculty search committee 2012
- School of Life Sciences Faculty Awards committee, 2016-present
- Graduate Committee, 2011-2015
- Committee member for developing the new Biochemistry and Molecular Biology major.
- Discussion leader, Bioorganic Gordon Conference, July 2006
- Oregon State University's STEM Academy camp, hosted by my research lab and the Unnatural Protein Facility. The Camp is a one-week summer camp for 14-18 middle school students with four-five graduate students. (2016-2018)

Publications and Patents

a. Refereed Journal Articles (patents below)

(total of 87, 6599 citation, h-index of 42, i10 index of 79; Source: google scholar)

https://scholar.google.com/citations?hl=en&user=IZ6kMj4AAAAJ&view_op=list_works&sortby=pubdate

- (87) Gottfried-Lee I, Perona JJ, Karplus PA, Mehl RA, Cooley RB. Structures of *Methanomethylophilus alvus* Pyrrolysine tRNA-Synthetases Support the Need for De Novo Selections When Altering the Substrate Specificity. *ACS Chem Biol.* **2022** Nov 17. Epub ahead of print.
- (86) Avila-Crump S, Hemshorn ML, Jones CM, Mbengi L, Meyer K, Griffis JA, Jana S, Petrina GE, Pagar VV, Karplus PA, Petersson EJ, Perona JJ, Mehl RA, Cooley RB. Generating Efficient *Methanomethylophilus alvus* Pyrrolysyl-tRNA Synthetases for Structurally Diverse Non-Canonical Amino Acids. *ACS Chem Biol.* **2022** Nov 16. Epub ahead of print.
- (85) Vesely CH, Reardon PN, Yu Z, Barbar E, Mehl RA, Cooley RB. Accessing isotopically labeled proteins containing genetically encoded phosphoserine for NMR with optimized expression conditions. *J Biol Chem.* **2022** Oct 17:102613. Epub ahead of print.

- (84) Van Fossen EM, Bednar RM, Jana S, Franklin R, Beckman J, Karplus PA, Mehl RA. Nanobody assemblies with fully flexible topology enabled by genetically encoded tetrazine amino acids. *Sci Adv.* **2022** May 6;8(18):eabm6909.
- (83) Jandy M, Noor A, Nelson P, Dennys CN, Karabinas IM, Pestoni JC, Singh GD, Luc L, Devyldere R, Perdomo N, Mitchell CE, Adams L, Fuse MA, Mendoza FA, Marean-Reardon CL, Mehl RA, Estevez AG, Franco MC. Peroxynitrite nitration of Tyr 56 in Hsp90 induces PC12 cell death through P2X7R-dependent PTEN activation. *Redox Biol.* **2022** Apr;50:102247.
- (82) Van Fossen EM, Grutzius S, Ruby CE, Mourich DV, Cebra C, Bracha S, Karplus PA, Cooley RB, Mehl RA. Creating a Selective Nanobody Against 3-Nitrotyrosine Containing Proteins. *Front Chem.* **2022** Feb 21;10:835229.
- (81) Zhu P, Franklin R, Vogel A, Stanisheuski S, Reardon P, Sluchanko NN, Beckman JS, Karplus PA, Mehl RA, Cooley RB. PermaPhos^{Ser} : autonomous synthesis of functional, permanently phosphorylated proteins. *bioRxiv* [Preprint]. **2021** Dec 14:2021.10.22.465468
- (80) Bednar RM, Jana S, Kuppa S, Franklin R, Beckman J, Antony E, Cooley RB, Mehl RA. Genetic Incorporation of Two Mutually Orthogonal Bioorthogonal Amino Acids That Enable Efficient Protein Dual-Labeling in Cells. *ACS Chem Biol.* **2021** Nov 19;16(11):2612-2622.
- (79) Zagotta WN, Sim BS, Nhim AK, Raza MM, Evans EG, Venkatesh Y, Jones CM, Mehl RA, Petersson EJ, Gordon SE. An improved fluorescent noncanonical amino acid for measuring conformational distributions using time-resolved transition metal ion FRET. *Elife.* **2021** Oct 8;10:e70236.
- (77) Jones CM, Robkis DM, Blizzard RJ, Munari M, Venkatesh Y, Mihaila TS, Eddins AJ, Mehl RA, Zagotta WN, Gordon SE, Petersson EJ. Genetic encoding of a highly photostable, long lifetime fluorescent amino acid for imaging in mammalian cells. *Chem Sci.* **2021** Aug 3;12(36):11955-11964.
- (77) Chaparro Sosa AF, Bednar RM, Mehl RA, Schwartz DK, Kaar JL. Faster Surface Ligation Reactions Improve Immobilized Enzyme Structure and Activity. *J Am Chem Soc.* **2021** May 12;143(18):7154-7163.
- (76) Galles GD, Infield DT, Mehl RA, Ahern CA. Selection and validation of orthogonal tRNA/synthetase pairs for the encoding of unnatural amino acids across kingdoms. *Methods Enzymol.* **2021**;654:3-18.
- (75) Yang B, Kwon K, Jana S, Kim S, Avila-Crump S, Tae G, Mehl RA, Kwon I. Temporal Control of Efficient *In Vivo* Bioconjugation Using a Genetically Encoded Tetrazine-Mediated Inverse-Electron-Demand Diels-Alder Reaction. *Bioconjug Chem.* **2020** Oct 21;31(10):2456-2464.
- (74) Beyer JN, Hosseinzadeh P, Gottfried-Lee I, Van Fossen EM, Zhu P, Bednar RM, Karplus PA, Mehl RA, Cooley RB. Overcoming Near-Cognate Suppression in a Release Factor 1-Deficient Host with an Improved Nitro-Tyrosine tRNA Synthetase. *J Mol Biol.* **2020** Jul 24;432(16):4690-4704.

- (73) Oscar BG, Zhu L, Wolfendeen H, Rozanov ND, Chang A, Stout KT, Sandwisch JW, Porter JJ, Mehl RA, Fang C. Dissecting Optical Response and Molecular Structure of Fluorescent Proteins With Non-canonical Chromophores. *Front Mol Biosci.* **2020** Jul 7;7:131.
- (72) Jang HS, Jana S, Blizzard RJ, Meeuwsen JC, Mehl RA. Access to Faster Eukaryotic Cell Labeling with Encoded Tetrazine Amino Acids. *J Am Chem Soc.* **2020** Apr 22;142(16):7245-7249.
- (71) Jang HS, Gu X, Cooley RB, Porter JJ, Henson RL, Willi T, DiDonato JA, Hazen SL, Mehl RA. Efficient Site-Specific Prokaryotic and Eukaryotic Incorporation of Halotyrosine Amino Acids into Proteins. *ACS Chem Biol.* **2020** Feb 21;15(2):562-574.
- (70) Porter JJ, Jang HS, Haque MM, Stuehr DJ, Mehl RA. Tyrosine nitration on calmodulin enhances calcium-dependent association and activation of nitric-oxide synthase. *J Biol Chem.* **2020** Feb 21;295(8):2203-2211.
- (69) Bednar RM, Golbek TW, Kean KM, Brown WJ, Jana S, Baio JE, Karplus PA, Mehl RA. Immobilization of Proteins with Controlled Load and Orientation. *ACS Appl Mater Interfaces.* **2019** Oct 9;11(40):36391-36398.
- (68) Randall LM, Dalla Rizza J, Parsonage D, Santos J, Mehl RA, Lowther WT, Poole LB, Denicola A. Unraveling the effects of peroxiredoxin 2 nitration; role of C-terminal tyrosine 193. *Free Radic Biol Med.* **2019** Sep;141:492-501.
- (67) Van Fossen EM, Bednar RM, Mehl RA. Engineering Spatial Orthogonality into Protein Translation. *Biochemistry.* **2019** Aug 6;58(31):3325-3327.
- (66) Zhu P, Gafken PR, Mehl RA, Cooley RB. A Highly Versatile Expression System for the Production of Multiply Phosphorylated Proteins. *ACS Chem Biol.* **2019** Jul 19;14(7):1564-1572.
- (65) Porter, J.J.; Jang, Hyo Sang.; Van Fossen, E.M.; Nguyen, Duy; Willi, T. Cooley, R.B.; Mehl, R.A., Genetically encoded protein tyrosine nitration in mammalian cells. *ACS Chem Biol.* **2019** Jun 21;14(6):1328-1336.
- (64) Petersson, E.J.; Mehl, R.A.; Ahern, C.A. Expanding Genetic Code Expansion Through Resource Facilities, Workshops, and Conferences. *Int J Mol Sci.* **2019** Apr 29;20(9).
- (63) Fick, R.J.; Horowitz, S.; McDole, B.G.; Clay, M.C.; Mehl, R.A.; Al-Hashimi, H.M.; Scheiner, S.; Trievel, R.C. Structural and Functional Characterization of Sulfonium Caron-Oxygen Hydrogen Bonding in the Deoxyamino Sugar Methyltransferase TylM1. *Biochemistry.* **2019**, 58(16):2152-2159.
- (62) Kean, K.M.; Van Zee, K.; Mehl, R.A. Unnatural Chemical Biology: Research-Based Laboratory Course Utilizing Genetic Code Expansion. *J.Chem. Educ.* **2019**, 96(1), 66-74.

- (61) Muzika, M.; Muskat NH.; Sarid, S.; Ben-David, O.; Mehl, R. A.; Arbely, E., Chemically-Defined Lactose-Based Autoinduction Medium for Site-Specific Incorporation of Non-Canonical Amino Acids Into Proteins. **2018** *RSC Advances* 8 (45), 25558-25567.
- (60) Carlsson, A.C., Scholfield, M.R., Rowe, R.K., Ford, M.C., Alexander, A.T., Mehl, R.A., Ho, P.S. Increasing Enzyme Stability and Activity through Hydrogen Bond-Enhanced Halogen Bonds. *Biochemistry*. **2018**, 57(28):4135-4147.
- (59) Popchock, A.; Jana, S.*; Mehl, R.A.; Qiu, W. Engineering heterodimeric kinesins through genetic incorporation of noncanonical amino acids. *ACS Chemical Biology*. **2018**. 13(8) 2229-2236.
- (58) Porter, J.J.; Mehl R.A. Genetic Code Expansion: A powerful tool for understanding the physiological consequences of oxidative stress protein modifications *Oxid. Med. Cell Longev*. **2018**, 2018:7607463
- (57) Blizzard, R.J.*; Gibson, T.E.*; and Mehl, R.A. Site Specific Protein Labeling with Tetrazine Amino Acids. *Methods Mol. Biol.* **2018**, 1728:201-217
- (56) Kean, K.M., Porter, J.J., Mehl R.A., Karplus P.A. 2018. Structural insights into thermostable variant of carbonic anhydrase II. *Protein Sci.* 27(2) 573-577.
- (55) Sungwienwong, I.; Hostetler, Z. M.; Blizzard, R. J.*; Porter, J. J.*; Driggers, C. M.; Mbengi, L. Z.; Villegas, J. A.; Speight, L. C.; Saven, J. G.; Perona, J. J.; Kohli, R. M.; Mehl, R. A.; Petersson, E. J., Improving target amino acid selectivity in a permissive aminoacyl tRNA synthetase through counter-selection. *Organic & Biomolecular Chemistry* **2017**, 15 (17), 3603-3610.
- (54) Scholfield, M. R.; Ford, M. C.; Carlsson, A.-C. C.; Butta, H.; Mehl, R. A.; Ho, P. S., Structure–Energy Relationships of Halogen Bonds in Proteins. *Biochemistry* **2017**.
- (53) Row, R. D.; Shih, H.-W.; Alexander, A. T*.; Mehl, R. A.; Prescher, J. A., Cyclopropanones for metabolic targeting and sequential bioorthogonal labeling. *Journal of the American Chemical Society* **2017**.
- (52) Pokhrel, N.; Origanti, S.; Davenport, E. P.; Gandhi, D.; Kaniecki, K.; Mehl, R. A.; Greene, E. C.; Dockendorff, C.; Antony, E., Monitoring Replication Protein A (RPA) dynamics in homologous recombination through site-specific incorporation of non-canonical amino acids. *Nucleic Acids Research* **2017**, 45 (16), 9413-9426.
- (51) Lambert, W. D.; Scinto, S. L.; Dmitrenko, O.; Boyd, S. J.; Magboo, R.; Mehl, R. A.; Chin, J. W.; Fox, J. M.; Wallace, S., Computationally guided discovery of a reactive, hydrophilic trans-5-oxocene dienophile for bioorthogonal labeling. *Organic & Biomolecular Chemistry* **2017**, 15 (31), 6640-6644.
- (50) Alghamdi, M.; Zhang, J.; Oswald, A.; Porter, J. J.*; Mehl, R. A.; Kong, W., Doping of Green Fluorescent Protein into Superfluid Helium Droplets: Size and Velocity of Doped Droplets. *The Journal of Physical Chemistry A* **2017**.

- (49) Rauch, B. J.; Porter, J. J. *; Mehl, R. A.; Perona, J. J., Improved Incorporation of Noncanonical Amino Acids by an Engineered tRNATyr Suppressor. *Biochemistry* **2016**, *55* (3), 618-628.
- (48) Gu, X.; Wu, Z.; Huang, Y.; Wagner, M. A.; Baleanu-Gogonea, C.; Mehl, R. A.; Buffa, J. A.; DiDonato, A. J.; Hazen, L. B.; Fox, P. L., A Systematic Investigation of Structure/Function Requirements for the Apolipoprotein AI/Lecithin Cholesterol Acyltransferase Interaction Loop of High-density Lipoprotein. *Journal of Biological Chemistry* **2016**, *291* (12), 6386-6395.
- (47) Leisle, L.; Valiyaveetil, F.; Mehl, R. A.; Ahern, C. A., Incorporation of non-canonical amino acids. In *Novel Chemical Tools to Study Ion Channel Biology*, Springer: 2015; pp 119-151.
- (46) Kamber, D. N.; Liang, Y.; Blizzard, R. J. *; Liu, F.; Mehl, R. A.; Houk, K.; Prescher, J. A., 1, 2, 4-triazines are versatile bioorthogonal reagents. *Journal of the American Chemical Society* **2015**, *137* (26), 8388-8391.
- (45) Franco, M. C.; Ricart, K. C.; Gonzalez, A. S.; Dennys, C. N.; Nelson, P. A.; Janes, M. S.; Mehl, R. A.; Landar, A.; Estévez, A. G., Nitration of Hsp90 on tyrosine 33 regulates mitochondrial metabolism. *Journal of Biological Chemistry* **2015**, *290* (31), 19055-19066.
- (44) Blizzard, R. J. *; Backus, D. R. *; Brown, W. *; Bazewicz, C. G. *; Li, Y.; Mehl, R. A., Ideal bioorthogonal reactions using a site-specifically encoded tetrazine amino acid. *Journal of the American Chemical Society* **2015**, *137* (32), 10044-10047.
- (43) Averick, S.; Mehl, R. A.; Das, S. R.; Matyjaszewski, K., Well-defined biohybrids using reversible-deactivation radical polymerization procedures. *Journal of Controlled Release* **2015**, *205*, 45-57.
- (42) Wang, K.; Sachdeva, A.; Cox, D. J.; Wilf, N. M.; Lang, K.; Wallace, S.; Mehl, R. A.; Chin, J. W., Optimized orthogonal translation of unnatural amino acids enables spontaneous protein double-labelling and FRET. *Nature chemistry* **2014**, *6* (5), 393-403.
- (41) Padmanarayana, M.; Hams, N.; Speight, L. C.; Petersson, E. J.; Mehl, R. A.; Johnson, C. P., Characterization of the lipid binding properties of Otoferlin reveals specific interactions between PI (4, 5) P2 and the C2C and C2F domains. *Biochemistry* **2014**, *53* (30), 5023-5033.
- (40) Horowitz, S.; Adhikari, U.; Dirk, L. M.; Del Rizzo, P. A.; Mehl, R. A.; Houtz, R. L.; Al-Hashimi, H. M.; Scheiner, S.; Trievel, R. C., Manipulating unconventional CH-based hydrogen bonding in a methyltransferase via noncanonical amino acid mutagenesis. *ACS chemical biology* **2014**, *9* (8), 1692-1697.
- (39) DiDonato, J. A.; Aulak, K.; Huang, Y.; Wagner, M.; Gerstenecker, G.; Topbas, C.; Gogonea, V.; DiDonato, A. J.; Tang, W. W.; Mehl, R. A.; Fox, P. L.; Plow, E. F.; Smith, J. D.; Fisher, E. A.; Hazen, S. L., Site-specific nitration of apolipoprotein AI at tyrosine 166 is both abundant within human atherosclerotic plaque and dysfunctional. *Journal of Biological Chemistry* **2014**, *289* (15), 10276-10292.

- (38) Darko, A.; Wallace, S.; Dmitrenko, O.; Machovina, M. M. *; Mehl, R. A.; Chin, J. W.; Fox, J. M., Conformationally strained trans-cyclooctene with improved stability and excellent reactivity in tetrazine ligation. *Chemical science* **2014**, *5* (10), 3770-3776.
- (37) Cooley, R. B. *; Karplus, P. A.; Mehl, R. A., Gleaning Unexpected Fruits from Hard-Won Synthetases: Probing Principles of Permissivity in Non-canonical Amino Acid-tRNA Synthetases. *ChemBioChem* **2014**, *15* (12), 1810-1819.
- (36) Cooley, R. B. *; Feldman, J. L. *; Driggers, C. M.; Bundy, T. A. *; Stokes, A. L. *; Karplus, P. A.; Mehl, R. A., Structural basis of improved second-generation 3-nitro-tyrosine tRNA synthetases. *Biochemistry* **2014**, *53* (12), 1916-1924.
- (35) Chatterjee, D.; Cooley, R. B.; Boyd, C. D.; Mehl, R. A.; O'Toole, G. A.; Sondermann, H., Mechanistic insight into the conserved allosteric regulation of periplasmic proteolysis by the signaling molecule cyclic-di-GMP. *Elife* **2014**, *3*, e03650.
- (34) Averick, S.; Karácsony, O.; Mohin, J.; Yong, X.; Moellers, N. M.; Woodman, B. F. *; Zhu, W.; Mehl, R. A.; Balazs, A. C.; Kowalewski, T.; Matyjaszewski, K., Cooperative, Reversible Self-Assembly of Covalently Pre-Linked Proteins into Giant Fibrous Structures. *Angewandte Chemie International Edition* **2014**, *53* (31), 8050-8055.
- (33) Wu, I. L.; Patterson, M. A.; Carpenter Desai, H. E.; Mehl, R. A.; Giorgi, G.; Conticello, V. P., Multiple Site-Selective Insertions of Noncanonical Amino Acids into Sequence-Repetitive Polypeptides. *ChemBioChem* **2013**, *14* (8), 968-978.
- (32) Speight, L. C.; Muthusamy, A. K.; Goldberg, J. M.; Warner, J. B.; Wissner, R. F.; Willi, T. * S.; Woodman, B. F. *; Mehl, R. A.; Petersson, E. J., Efficient synthesis and in vivo incorporation of acridon-2-ylalanine, a fluorescent amino acid for lifetime and Forster resonance energy transfer/luminescence resonance energy transfer studies. *Journal of the American Chemical Society* **2013**, *135* (50), 18806-18814.
- (31) Horowitz, S.; Dirk, L. M.; Yesselman, J. D.; Nimtz, J. S.; Adhikari, U.; Mehl, R. A.; Scheiner, S.; Houtz, R. L.; Al-Hashimi, H. M.; Trievel, R. C., Conservation and Functional Importance of Carbon-Oxygen Hydrogen Bonding in AdoMet-Dependent Methyltransferases. *Journal of the American Chemical Society* **2013**, *135* (41), 15536-15548.
- (30) Franco, M. C.; Ye, Y.; Refakis, C. A. *; Feldman, J. L. *; Stokes, A. L. *; Basso, M.; de Mera, R. M. M. F.; Sparrow, N. A.; Calingasan, N. Y.; Kiaei, M.; Rhoads, T. W.; Thong, C. M.; Grumet, M.; Barnes, S.; Beal, M. F.; Beckman, J. S.; Mehl, R. A.; Estévez, A. G., Nitration of Hsp90 induces cell death. *Proceedings of the National Academy of Sciences* **2013**, *110* (12), E1102-E1111.
- (29) Averick, S. E.; Bazewicz, C. G. *; Woodman, B. F. *; Simakova, A.; Mehl, R. A.; Matyjaszewski, K., Protein-polymer hybrids: conducting ARGET ATRP from a genetically encoded cleavable ATRP initiator. *European Polymer Journal* **2013**, *49* (10), 2919-2924.
- (28) Seitchik, J. L. *; Peeler, J. C. *; Taylor, M. T. *; Blackman, M. L. *; Rhoads, T. W.; Cooley, R. B.; Refakis, C. *; Fox, J. M.; Mehl, R. A., Genetically encoded tetrazine

- amino acid directs rapid site-specific in vivo bioorthogonal ligation with trans-cyclooctenes. *Journal of the American Chemical Society* **2012**, *134* (6), 2898-2901.
- (27) Peeler, J. C. *; Mehl, R. A., Site-specific incorporation of unnatural amino acids as probes for protein conformational changes. *Unnatural Amino Acids: Methods and Protocols* **2012**, 125-134.
- (26) Mehl, R. A., Engineered Unnatural Animals: Tools for Multicellular Biochemistry. *ChemBioChem* **2012**, *13* (2), 186-188.
- (25) Libby, R. D.; Mehl, R. A., Characterization of covalent Ene adduct intermediates in "hydride equivalent" transfers in a dihydropyridine model for NADH reduction reactions. *Bioorganic chemistry* **2012**, *40*, 57-66.
- (24) Averick, S. E.; Paredes, E.; Grahacharya, D.; Woodman, B. F. *; Miyake-Stoner, S. J.; Mehl, R. A.; Matyjaszewski, K.; Das, S. R., A protein-polymer hybrid mediated by DNA. *Langmuir* **2012**, *28* (4), 1954-1958.
- (23) Averick, S. E.; Magenau, A. J.; Simakova, A.; Woodman, B. F.*; Seong, A.; Mehl, R. A.; Matyjaszewski, K., Covalently incorporated protein-nanogels using AGET ATRP in an inverse miniemulsion. *Polymer Chemistry* **2011**, *2* (7), 1476-1478.
- (22) Averick, S.; Simakova, A.; Park, S.; Konkolewicz, D.; Magenau, A. J.; Mehl, R. A.; Matyjaszewski, K., ATRP under biologically relevant conditions: grafting from a protein. *ACS Macro Letters* **2011**, *1* (1), 6-10.
- (21) Rowe, L.; Ensor, M.; Mehl, R.; Daunert, S., Modulating the bioluminescence emission of photoproteins by in vivo site-directed incorporation of non-natural amino acids. *ACS chemical biology* **2010**, *5* (5), 455-460.
- (20) Peeler, J. C.; Woodman, B. F.; Averick, S.; Miyake-Stoner, S. J.; Stokes, A. L.; Hess, K. R.; Matyjaszewski, K.; Mehl, R. A., Genetically encoded initiator for polymer growth from proteins. *Journal of the American Chemical Society* **2010**, *132* (39), 13575-13577.
- (19) Miyake-Stoner, S. J.; Refakis, C. A.; Hammill, J. T.; Lusic, H.; Hazen, J. L.; Deiters, A.; Mehl, R. A., Generating permissive site-specific unnatural aminoacyl-tRNA synthetases. *Biochemistry* **2010**, *49* (8), 1667-1677.
- (18) Taskent-Sezgin, H.; Chung, J.; Patsalo, V.; Miyake-Stoner, S. J.; Miller, A. M.; Brewer, S. H.; Mehl, R. A.; Green, D. F.; Raleigh, D. P.; Carrico, I., Interpretation of p-cyanophenylalanine fluorescence in proteins in terms of solvent exposure and contribution of side-chain quenchers: a combined fluorescence, IR and molecular dynamics study. *Biochemistry* **2009**, *48* (38), 9040-9046.
- (17) Taskent, H.; Chung, J.; Brewer, S. H.; Mehl, R. A.; Raleigh, D. P.; Carrico, I., Interpretation of p-cyanophenylalanine Protein Fluorescence in Terms of Solvent Exposure and Contributions from Side Chain Quenching. *Protein Science* **2009**, *18*, 112.

- (16) Stokes, A. L.; Miyake-Stoner, S. J.; Peeler, J. C.; Nguyen, D. P.; Hammer, R. P.; Mehl, R. A., Enhancing the utility of unnatural amino acid synthetases by manipulating broad substrate specificity. *Molecular BioSystems* **2009**, *5* (9), 1032-1038.
- (15) Miyake-Stoner, S. J.; Miller, A. M.; Hammill, J. T.; Peeler, J. C.; Hess, K. R.; Mehl, R. A.; Brewer, S. H., Probing protein folding using site-specifically encoded unnatural amino acids as FRET donors with tryptophan. *Biochemistry* **2009**, *48* (25), 5953-5962.
- (14) Li, C.; Wang, G.-F.; Wang, Y.; Creager-Allen, R.; Lutz, E. A.; Scronce, H.; Slade, K. M.; Ruf, R. A.; Mehl, R. A.; Pielak, G. J., Protein 19F NMR in Escherichia coli. *Journal of the American Chemical Society* **2009**, *132* (1), 321-327.
- (13) Neumann, H.; Hazen, J. L.; Weinstein, J.; Mehl, R. A.; Chin, J. W., Genetically encoding protein oxidative damage. *Journal of the American Chemical Society* **2008**, *130* (12), 4028-4033.
- (12) Carrico, Z. M.; Romanini, D. W.; Mehl, R. A.; Francis, M. B., Oxidative coupling of peptides to a virus capsid containing unnatural amino acids. *Chemical Communications* **2008**, (10), 1205-1207.
- (11) Jackson, J. C.; Hammill, J. T.; Mehl, R. A., Site-specific incorporation of a 19F-amino acid into proteins as an NMR probe for characterizing protein structure and reactivity. *Journal of the American Chemical Society* **2007**, *129* (5), 1160-1166.
- (10) Hammill, J. T.; Miyake-Stoner, S.; Hazen, J. L.; Jackson, J. C.; Mehl, R. A., Preparation of site-specifically labeled fluorinated proteins for 19F-NMR structural characterization. *Nature protocols* **2007**, *2* (10), 2601-2607.
- (9) Jackson, J. C.; Duffy, S. P.; Hess, K. R.; Mehl, R. A., Improving nature's enzyme active site with genetically encoded unnatural amino acids. *Journal of the American Chemical Society* **2006**, *128* (34), 11124-11127.
- (8) Farrell, I. S.; Toroney, R.; Hazen, J. L.; Mehl, R. A.; Chin, J. W., Photo-cross-linking interacting proteins with a genetically encoded benzophenone. *Nature methods* **2005**, *2* (5), 377-384.
- (7) Lawhorn, B. G.; Mehl, R. A.; Begley, T. P., Biosynthesis of the thiamin pyrimidine: the reconstitution of a remarkable rearrangement reaction. *Organic & biomolecular chemistry* **2004**, *2* (17), 2538-2546.
- (6) Mehl, R. A.; Anderson, J. C.; Santoro, S. W.; Wang, L.; Martin, A. B.; King, D. S.; Horn, D. M.; Schultz, P. G., Generation of a bacterium with a 21 amino acid genetic code. *Journal of the American Chemical Society* **2003**, *125* (4), 935-939.
- (5) Mehl, R. A.; Begley, T. P., Synthesis of 32P-labeled intermediates on the purine biosynthetic pathway. *Journal of Labelled Compounds and Radiopharmaceuticals* **2002**, *45* (13), 1097-1102.
- (4) Mehl, R. A., Mechanistic studies on the formation and repair of a novel DNA lesion: The spore photoproduct. Studies on the first in vitro biosynthesis of thiamin from purine precursors. **2002**.

- (3) Begley, T. P.; Kinsland, C.; Mehl, R. A.; Osterman, A.; Dorrestein, P., The biosynthesis of nicotinamide adenine dinucleotides in bacteria. *Vitamins & Hormones* **2001**, *61*, 103-119.
- (2) Mehl, R. A.; Kinsland, C.; Begley, T. P., Identification of the Escherichia colinicotinic acid mononucleotide adenylyltransferase gene. *Journal of bacteriology* **2000**, *182* (15), 4372-4374.
- (1) Mehl, R. A.; Begley, T. P., Mechanistic studies on the repair of a novel DNA photolesion: the spore photoproduct. *Organic letters* **1999**, *1* (7), 1065-1066.

b. Patents and Inventions

8. Mehl, RA; Bednar M.B., 2020, Immobilization of Proteins with Controlled Orientation and Load. Provisional US 20210072238.
7. Ho PS, Carlsson, AC., Scholfied, MR., Rowe RK, Ford MC, Mehl RA, Alexader TA, 2017, HeX-Bond for molecular engineering, medicinal chemistry applications, materials chemistry, and biological or chemical engineering. Provisional US 62520860.
6. Mehl, RA, Blizzard R., 2016, Reagents and methods for bioorthogonal labeling of biomolecules in living cells., Application WO2016176689A1
5. Mehl, RA, Matyjaszewski, K. Averick, S.,; 2013, Site-specifically incorporated initiator for growth of polymers from proteins. Application *US20160251467A9*.
4. Mehl, RA, Matyjaszewski, K. Averick, S.,; 2016, Genetically encoded initiator for polymer growth from proteins. *PCT US 8816001B2*
3. Mehl, RA. 2010. Site-specific incorporation of fluorinated amino acids into proteins *US20070218483*.
2. Schultz, P.; Wang, L.; Anderson, J. C.; Chin, J. W.; Liu, D. R.; Magliery, T. J.; Meggers, E. L.; Mehl, R. A.; Pastrnak, M.; Santoro, S. W.; Zhang, Z. 2002. Engineering of mutant orthogonal tRNA - aminoacyl tRNA synthetase pairs from *Methanococcus jannaschii* for incorporation of unnatural amino acids into proteins in vivo. *PCT Int*.
1. Schultz, P.; Wang, L.; Anderson, J. C.; Chin, J. W.; Liu, D. R.; Magliery, T. J.; Meggers, E. L.; Mehl, R. A.; Pastrnak, M.; Santoro, S. W.; Zhang, Z. 2002. Use of non-native tRNAs and amino acyl tRNA synthetases with relaxed substrate specificity in the in vivo incorporation of unnatural amino acids. *PCT Int*.