BIOGRAPHICAL SKETCH

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NAME: Deiters, Alexander

eRA COMMONS USER NAME (credential, e.g., agency login): alexdeiters

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
University of Münster, Münster	BS	10/1995	Chemistry
University of Münster, Münster	PhD	10/2000	Organic Chemistry
The University of Texas at Austin, Austin, TX	Postdoctoral Fellow	08/2002	Organic Chemistry
The Scripps Research Institute, La Jolla, CA	Postdoctoral Fellow	06/2004	Chemical Biology

A. Personal Statement

My lab focuses on developing innovative chemical tools that address biological problems and persisting methodology gaps, in particular in the context of conditional control of protein and nucleic acid function. While a major emphasis of our work is on the optical control of cellular processes through light-triggered removal of so called "caging groups", we also have significant experience in the hydrogen peroxide-triggered activation of small molecules and gene function in human cells. Thus, my group is perfectly situated to support Josh Wesalo's AHA Fellowship application with extensive expertise and infrastructure that we have in place. My students and postdocs routinely conduct the synthesis of complex organic molecules and have experience in a wide range of laboratory techniques required for Josh's proposed studies on the H_2O_2-triggered control of Nox function, such as mammalian cell culture, fluorescence microscopy, Western blots, qPCR, reporter assays, cell viability assays, etc.

My ability to plan, conduct, and supervise research projects at the interface of chemistry and biology is documented by over 125 peer-reviewed publications, as well as continued funding from private foundations and federal agencies. The PhD and MD/PhD students in my group have very diverse research backgrounds, ranging from synthetic organic chemistry, to chemical engineering, biochemistry, biophysics, and functional genomics, further facilitating Josh's successful completion of his project at the interface of chemistry and cardiovascular biology.

1. Brown W, Liu J, Tsang M, **Deiters A.** Cell-Lineage Tracing in Zebrafish Embryos with an Expanded Genetic Code. Chembiochem. 2018 Apr 27;PubMed PMID: 29701891.
2. Luo J, Liu Q, Morihiro K, **Deiters A.** Small-molecule control of protein function through Staudinger reduction. Nat Chem. 2016 Nov;8(11):1027-1034. PubMed PMID: 27768095; PubMed Central PMCID: PMC5119652.
3. Hanna RD, Naro Y, **Deiters A**, Floreancig PE. Alcohol, Aldehyde, and Ketone Liberation and Intracellular Cargo Release through Peroxide-Mediated α-Boryl Ether Fragmentation. J Am Chem Soc. 2016 Oct 12;138(40):13353-13360. PubMed PMID: 27636404.
4. Govan JM, McIver AL, Riggsbee C, **Deiters A**. Hydrogen peroxide induced activation of gene expression in mammalian cells using boronate estrone derivatives. Angew Chem Int Ed Engl. 2012 Sep 3;51(36):9066-70. PubMed PMID: 22855386.

B. Positions and Honors

Positions and Employment

2004 - 2009 Assistant Professor, North Carolina State University
2009 - 2012 Associate Professor, North Carolina State University
2012 - 2013 Professor, North Carolina State University
2013 - Professor, University of Pittsburgh

Other Experience and Professional Memberships

2013 - Member, University of Pittsburgh Cancer Institute
2013 - Guest Editor, Bioorganic & Medicinal Chemistry, Elsevier, Special Issue "Oligonucleotides as Drug Targets and Cellular Probes"
2014 - Member, Molecular Biophysics & Structural Biology Program, University of Pittsburgh
2014 - Member, Center for Nucleic Acids Science & Technology, Carnegie Mellon University
2015 - Member, Medical Scientist Training Program, University of Pittsburgh School of Medicine
2016 - Member, Editorial Advisory Board, ChemBioChem (Wiley-VCH)
2016 - Member, Editorial Board, Scientific Reports (Nature Publishing Group)
2017 - 2018 Guest Editor, ChemBioChem, Wiley-VCH, Special Issue "Optogenetics, Photopharmacology, and Optochemical Biology"
2018 - 2019 Guest Editor, Methods in Enzymology, Elsevier, Volume on "Optochemical Biology"

Honors

2006 Basil O'Connor Scholar Award, March of Dimes Foundation
2007 Faculty Research Award, Sigma Xi
2007 Cottrell Scholar Award, Research Corporation
2007 Beckman Young Investigator Award, Arnold and Mabel Beckman Foundation
2007 MJ Collins Award, CEM Corporation
2009 Faculty Early Career Development (CAREER) Award, National Science Foundation
2009 Teva USA Scholar Award, American Chemical Society
2010 Thieme Chemistry Journals Award, Thieme Medical Publishers
2010 Research Scholar Award, American Cancer Society
2011 Alumni Association Outstanding Research Award, North Carolina State University
2014 New Initiative Research Award, Charles E. Kaufman Foundation

C. Contribution to Science

1. **Optical control of protein function.** Genetically encoded light-regulation of protein function has led to "optogenetics" as an emerging new research area. I have been engineering proteins containing photocaged amino acids through genetic code expansion methodologies since my postdoctoral work in the Schultz lab. My lab has applied genetically encoded caged amino acids to the optical control of cell signaling, protein translocation, gene editing, gene expression, gene silencing, and other biological processes. The installation of light-removable protecting groups with exquisite residue-specificity into proteins enables spatial and temporal control over a wide range of cellular functions. We are now advancing this methodology to reversible optical control of protein activity.

    a. Hemphill J, Chou C, Chin JW, **Deiters A.** Genetically encoded light-activated transcription for spatiotemporal control of gene expression and gene silencing in mammalian cells. J Am Chem Soc. 2013 Sep 11;135(36):13433-9. PubMed PMID: 23931657; PubMed Central PMCID: PMC4188981.

    b. Engelke H, Chou C, Uprety R, Jess P, **Deiters A.** Control of protein function through optochemical translocation. ACS Synth Biol. 2014 Oct 17;3(10):731-6. PubMed PMID: 24933258; PubMed Central PMCID: PMC4210160.

c. Luo J, Uprety R, Naro Y, Chou C, Nguyen DP, Chin JW, **Deiters A.** Genetically encoded optochemical probes for simultaneous fluorescence reporting and light activation of protein function with two-photon excitation. J Am Chem Soc. 2014 Nov 5;136(44):15551-8. PubMed PMID: 25341086; PubMed Central PMCID: PMC4333581.

d. Hemphill J, Borchardt EK, Brown K, Asokan A, **Deiters A.** Optical Control of CRISPR/Cas9 Gene Editing. J Am Chem Soc. 2015 May 6;137(17):5642-5. PubMed PMID: 25905628; PubMed Central PMCID: PMC4919123.

2. **Optical control of oligonucleotide function.** My group has developed a generally applicable approach to the optical control of morpholino, DNA, and RNA molecules and has applied them in the regulation of gene expression in cells and aquatic embryos. Using light as an external trigger enables the activation and deactivation of oligonucleotide function with high spatial and temporal resolution. The nucleobase-caging approach has been patented by us (Publication No. US2010099159) and our caged thymidine phosphoramidite is commercially available from Glen Research and Berry & Associates.

   a. Hemphill J, Liu Q, Uprety R, Samanta S, Tsang M, Juliano RL, **Deiters A.** Conditional control of alternative splicing through light-triggered splice-switching oligonucleotides. J Am Chem Soc. 2015 Mar 18;137(10):3656-62. PubMed PMID: 25734836; PubMed Central PMCID: PMC5545098.

   b. Yamazoe S, Liu Q, McQuade LE, Deiters A, Chen JK. Sequential gene silencing using wavelength-selective caged morpholino oligonucleotides. Angew Chem Int Ed Engl. 2014 Sep 15;53(38):10114-8. PubMed PMID: 25130695; PubMed Central PMCID: PMC4206551.

   c. Hemphill J, Govan J, Uprety R, Tsang M, **Deiters A.** Site-specific promoter caging enables optochemical gene activation in cells and animals. J Am Chem Soc. 2014 May 14;136(19):7152-8. PubMed PMID: 24802207; PubMed Central PMCID: PMC4333597.

   d. Govan JM, Young DD, Lusic H, Liu Q, Lively MO, **Deiters A.** Optochemical control of RNA interference in mammalian cells. Nucleic Acids Res. 2013 Dec;41(22):10518-28. PubMed PMID: 24021631; PubMed Central PMCID: PMC3905849.

3. **DNA computation.** Cells and computers have in common that both process diverse patterns of input signals in order to create defined responses. The emerging field of DNA computation uses oligonucleotide-based logic gates for the assembly of complex computation circuits. My group reported the first examples of interfacing DNA computation with optical inputs and the first examples of triggering DNA logic gates with endogenous inputs in live cells. These developments will expand the utility of DNA computation within biological systems to new diagnostic and therapeutic applications. In addition, we are currently developing DNA logic gates that activate and release small molecules through proximity-enabled Staudinger reductions.

   a. Morihiro K, Ankenbruck N, Lukasak B, **Deiters A.** Small Molecule Release and Activation through DNA Computing. J Am Chem Soc. 2017 Oct 4;139(39):13909-13915. PubMed PMID: 28945369.

   b. Prokup A, **Deiters A.** Interfacing synthetic DNA logic operations with protein outputs. Angew Chem Int Ed Engl. 2014 Nov 24;53(48):13192-5. PubMed PMID: 25283524.

   c. Hemphill J, **Deiters A.** DNA computation in mammalian cells: microRNA logic operations. J Am Chem Soc. 2013 Jul 17;135(28):10512-8. PubMed PMID: 23795550.

   d. Prokup A, Hemphill J, **Deiters A.** DNA computation: a photochemically controlled AND gate. J Am Chem Soc. 2012 Feb 29;134(8):3810-5. PubMed PMID: 22239155.

4. **Discovery of small molecule modifiers of microRNA function.** miRNAs are very important regulators of gene function and have been linked to a wide range of diseases, most importantly cancer. My group was the first to report small molecule inhibitors of specific miRNAs (miR-21 and miR-122). Since then, several other labs have adapted our discovery approach and have identified additional new miRNA inhibitors. We are optimizing our molecules through SAR studies and are applying them to probe miRNA biology and to study their therapeutic utility against cancer and HCV infection in pre-clinical models.

a. Naro Y, Thomas M, Stephens MD, Connelly CM, **Deiters A.** Aryl amide small-molecule inhibitors of microRNA miR-21 function. Bioorg Med Chem Lett. 2015 Nov 1;25(21):4793-4796. PubMed PMID: 26220158.

b. Connelly CM, Thomas M, **Deiters A.** High-throughput luciferase reporter assay for small-molecule inhibitors of microRNA function. J Biomol Screen. 2012 Jul;17(6):822-8. PubMed PMID: 22412086; PubMed Central PMCID: PMC3758890.

c. Young DD, Connelly CM, Grohmann C, **Deiters A.** Small molecule modifiers of microRNA miR-122 function for the treatment of hepatitis C virus infection and hepatocellular carcinoma. J Am Chem Soc. 2010 Jun 16;132(23):7976-81. PubMed PMID: 20527935.

d. Gumireddy K, Young DD, Xiong X, Hogenesch JB, Huang Q, **Deiters A.** Small-molecule inhibitors of microrna miR-21 function. Angew Chem Int Ed Engl. 2008;47(39):7482-4. PubMed PMID: 18712719; PubMed Central PMCID: PMC3428715.

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

R01 GM112728-01A1
DEITERS, ALEXANDER (PI)
09/01/15-07/31/19
Chemically Triggered Morpholino Antisense Oligonucleotides
Role: PI

CBET-1603930, National Science Foundation
DEITERS, ALEXANDER (PI)
08/01/16-07/31/19
Near-natural Amino Acid Mutagenesis for the Engineering and Study of Protein Function
Role: PI

CCF-1617041, National Science Foundation
DEITERS, ALEXANDER (PI)
07/01/16-06/30/19
DNA Computation in Cells
Role: PI

R21 HD085206, National Institutes of Health (NICHD)
DEITERS, ALEXANDER (PI)
09/23/16-08/31/18
Optical Control of Translation and Gene Editing in Zebrafish Embryos
Role: PI

CHE-1404836, National Science Foundation (NCE)
DEITERS, ALEXANDER (PI)
07/01/14-07/31/18
Control of Protein Dimerization Through Light-Regulated Rapamycin
Role: PI

R24 OD023046, National Institutes of Health (OD)
ETTENSOHN, CHARLES (PI)

09/01/17-05/30/21
A Resource for Developmental Regulatory Genomics
Role: Co-Investigator

R43 GM121129, National Institutes of Health (NIGMS)
Yu, Marvin (MS2 Array, LLC) (PI)
09/01/17-08/31/18
High Throughput RNA and DNA Analysis and Detection by MALDI-MS
Role: Co-Investigator

R21 AI130815, National Institutes of Health (NIAID)
DEITERS, ALEXANDER (PI)
09/01/17-08/31/19
Programmed Oligonucleotides for Targeted Viral Capsid Protein Destruction
Role: PI

Completed Research Support

120130RSG1106601RMC, American Cancer Society
DEITERS, ALEXANDER (PI)
11/01/13-12/31/15
Small Molecule Regulation of microRNAs to Understand and Treat Cancer
Role: PI

KA2014-73921, Kaufman Foundation
DEITERS, ALEXANDER (PI)
09/01/14-08/31/17
Expanding the Genetic Code of Zebrafish
Role: PI

MCB-1330746 , National Science Foundation
DEITERS, ALEXANDER (PI)
09/01/13-08/31/17
Optogenetic Dissection of Protein Kinase Networks
Role: PI