

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.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion 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 group is developing innovative chemical tools to address biological problems and close persisting methodology gaps. We have a particular focus on developing conditional control over pharmacological inhibitors, oligonucleotides, and proteins. 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 H₂O₂-triggered control of Nox function, such as mammalian cell culture, fluorescence microscopy, Western blots, qPCR, reporter assays, cell viability assays, etc.

My ability to advise and support an interdisciplinary research group working in chemistry and biology is documented by over 100 peer-reviewed publications and by external funding from public and private agencies. Currently, I am supervising a group of 17 graduate and 2 undergraduate students who come from very diverse research backgrounds, ranging from synthetic organic chemistry, to chemical engineering, biochemistry, biophysics, and functional genomics. This diversity creates synergistic effects that further facilitate Josh's successful completion of his project at the interface of chemistry and cardiovascular biology.

- Liu J, Hemphill J, Samanta S, Tsang M, **Deiters A**. Genetic Code Expansion in Zebrafish Embryos and its Application to Optical Control of Cell Signaling. J Am Chem Soc. 2017 Jul 12;139(27):9100-9103. PubMed PMID: [28657738](#).
- Luo J, Liu Q, Morihiko 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](#).
- 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](#).
- 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
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)

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

- Optical control of oligonucleotide function.** My group has developed a synthetic, generally applicable approach to the optical control of morpholino, DNA, and RNA molecules and has applied these reagents 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. Our nucleobase-caging approach has been patented (Publication No. US2010099159) and our caged thymidine phosphoramidite is commercially available from Glen Research and Berry & Associates. Caged oligonucleotides based on this methodology can be synthesized by any RNA/DNA facility.
 - 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](#).
 - 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](#).
 - 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](#).
 - Govan JM, Uprety R, Hemphill J, Lively MO, **Deiters A**. Regulation of transcription through light-activation and light-deactivation of triplex-forming oligonucleotides in mammalian cells. *ACS Chem Biol*. 2012 Jul 20;7(7):1247-56. PubMed PMID: [22540192](#); PubMed Central PMCID: [PMC3401312](#).

2. **Optical control of protein function.** Genetically encoded light-regulation of protein function has led to "optogenetics" as an emerging new research area. My group, based on fundamental work by the Schultz lab, has developed genetic code expansion methodologies for the site-specific incorporation of photocaged amino acids into proteins. We have 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, which we are currently applying to the dissection of cell signaling networks.
 - 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](#).
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. 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](#).
 - b. 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](#).
 - c. 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](#).
 - d. Prokup A, Hemphill J, Liu Q, **Deiters A.** Optically Controlled Signal Amplification for DNA Computation. *ACS Synth Biol.* 2015 Oct 16;4(10):1064-9. PubMed PMID: [25621535](#).
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 using our molecules 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):4793-6. 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 GM108952, National Institute of General Medical Sciences (NIGMS)

CHEN, JAMES (PI)

08/01/14-07/31/18

Development of Lariat-Shaped Caged Morpholinos for Optochemical Gene Regulation

Role: Co-Investigator

CHE-1404836, National Science Foundation

DEITERS, ALEXANDER (PI)

07/01/14-06/30/18 (NCE)

Control of Protein Dimerization Through Light-Regulated Rapamycin

Role: PI

R01 GM112728-01A1

DEITERS, ALEXANDER (PI)

09/01/15-07/31/19

Chemically Triggered Morpholino Antisense Oligonucleotides

Role: PI

CCF-1617041, National Science Foundation

DEITERS, ALEXANDER (PI)

07/01/16-06/30/19

DNA Computation in Cells

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

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

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

Completed Research Support

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

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

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