



Christina Smolke

Adjunct Professor
Bioengineering

CONTACT INFORMATION

- **Alternate Contact**

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Bio

BIO

Professor Smolke's research program focuses on developing modular genetic platforms for programming information processing and control functions in living systems, resulting in transformative technologies for engineering, manipulating, and probing biological systems. She has pioneered the design and application of a broad class of RNA molecules, called RNA devices, that process and transmit user-specified input signals to targeted protein outputs, thereby linking molecular computation to gene expression. This technology has been extended to efficiently construct multi-input devices exhibiting various higher-order information processing functions, demonstrating combinatorial assembly of many information processing, transduction, and control devices from a smaller number of components. Her laboratory is applying these technologies to addressing key challenges in cellular therapeutics, targeted molecular therapies, and green biosynthesis strategies.

ACADEMIC APPOINTMENTS

- Adjunct Professor, Bioengineering
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Associate Chair of Education, Stanford Bioengineering, (2012- present)

HONORS AND AWARDS

- TR35, Top 35 Young Innovators of the World, Technology Review (2004)
- Beckman Young Investigator Award, Arnold and Mabel Beckman Foundation (2005)
- National Science Foundation CAREER Award, National Science Foundation (2006)
- Alfred P. Sloan Foundation Fellow, Alfred P. Sloan Foundation (2008)
- World Technology Award in Biotechnology (Individual), World Technology Network (2009)
- NIH Director's Pioneer Award, National Institutes of Health (2012)

PROFESSIONAL EDUCATION

- Postdoctorate, UC Berkeley , Cell Biology (2003)

- Ph.D., UC Berkeley , Chemical Engineering (2001)
- B.S., USC , Chemical Engineering (1997)

LINKS

- Lab Website: <http://smolkelab.stanford.edu/>

Teaching

COURSES

2019-20

- Introduction to Bioengineering (Engineering Living Matter): BIOE 80, ENGR 80 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Co-Advisor (NonAC)

Peter Dykstra, Osman Jamil, Matias Kaplan

Doctoral Dissertation Reader (NonAC)

Robert Chen

Undergraduate Major Advisor

Stav Spinzi

Doctoral (Program)

John Eugenis, Alex Ferris, Callan Monette, Peter Suzuki

Publications

PUBLICATIONS

- **Engineering a microbial platform for de novo biosynthesis of diverse methylxanthines.** *Metabolic engineering*
McKeague, M., Wang, Y., Cravens, A., Win, M. N., Smolke, C. D.
2016; 38: 191-203
- **Engineering biosynthesis of the anticancer alkaloid noscapine in yeast** *NATURE COMMUNICATIONS*
Li, Y., Smolke, C. D.
2016; 7
- **Opportunities in the design and application of RNA for gene expression control** *NUCLEIC ACIDS RESEARCH*
McKeague, M., Wong, R. S., Smolke, C. D.
2016; 44 (7): 2987-2999
- **In Vitro Screening and in Silico Modeling of RNA-Based Gene Expression Control.** *ACS chemical biology*
McKeague, M., Wang, Y., Smolke, C. D.
2015; 10 (11): 2463-2467
- **Engineering dynamic cell cycle control with synthetic small molecule-responsive RNA devices** *JOURNAL OF BIOLOGICAL ENGINEERING*
Wei, K. Y., Smolke, C. D.
2015; 9
- **High-throughput cellular RNA device engineering.** *Nature methods*
Townshend, B., Kennedy, A. B., Xiang, J. S., Smolke, C. D.
2015; 12 (10): 989-994
- **Complete biosynthesis of opioids in yeast.** *Science*
Galanie, S., Thodey, K., Trenchard, I. J., Filsinger Interrante, M., Smolke, C. D.

2015; 349 (6252): 1095-1100

- **SYNTHETIC BIOLOGY Complete biosynthesis of opioids in yeast** *SCIENCE*
Galanie, S., Thodey, K., Trenchard, I. J., Interrante, M. F., Smolke, C. D.
2015; 349 (6252): 1095-1100
- **Control of alphavirus-based gene expression using engineered riboswitches.** *Virology*
Bell, C. L., Yu, D., Smolke, C. D., Geall, A. J., Beard, C. W., Mason, P. W.
2015; 483: 302-311
- **De novo production of the key branch point benzylisoquinoline alkaloid reticuline in yeast.** *Metabolic engineering*
Trenchard, I. J., Siddiqui, M. S., Thodey, K., Smolke, C. D.
2015; 31: 74-83
- **Engineering strategies for the fermentative production of plant alkaloids in yeast** *METABOLIC ENGINEERING*
Trenchard, I. J., Smolke, C. D.
2015; 30: 96-104
- **Synthetic feedback control using an RNAi-based gene-regulatory device** *JOURNAL OF BIOLOGICAL ENGINEERING*
Bloom, R. J., Winkler, S. M., Smolke, C. D.
2015; 9
- **Synthetic feedback control using an RNAi-based gene-regulatory device.** *Journal of biological engineering*
Bloom, R. J., Winkler, S. M., Smolke, C. D.
2015; 9: 5-?
- **Optimization of yeast-based production of medicinal protoberberine alkaloids.** *Microbial cell factories*
Galanie, S., Smolke, C. D.
2015; 14 (1): 144-?
- **Optimization of yeast-based production of medicinal protoberberine alkaloids.** *Microbial cell factories*
Galanie, S., Smolke, C. D.
2015; 14: 144-?
- **A system for multilocus chromosomal integration and transformation-free selection marker rescue** *FEMS YEAST RESEARCH*
Siddiqui, M. S., Choksi, A., Smolke, C. D.
2014; 14 (8): 1171-1185
- **A system for multilocus chromosomal integration and transformation-free selection marker rescue.** *FEMS yeast research*
Siddiqui, M. S., Choksi, A., Smolke, C. D.
2014; 14 (8): 1171-1185
- **A quantitative framework for the forward design of synthetic miRNA circuits** *NATURE METHODS*
Bloom, R. J., Winkler, S. M., Smolke, C. D.
2014; 11 (11): 1147-1153
- **Protein-responsive ribozyme switches in eukaryotic cells.** *Nucleic acids research*
Kennedy, A. B., Vowles, J. V., D'Espaux, L., Smolke, C. D.
2014; 42 (19): 12306-12321
- **A microbial biomanufacturing platform for natural and semisynthetic opioids** *NATURE CHEMICAL BIOLOGY*
Thodey, K., Galanie, S., Smolke, C. D.
2014; 10 (10): 837-U78
- **Realizing the potential of synthetic biology.** *Nature reviews. Molecular cell biology*
Church, G. M., Elowitz, M. B., Smolke, C. D., Voigt, C. A., Weiss, R.
2014; 15 (4): 289-294
- **Kinetic and equilibrium binding characterization of aptamers to small molecules using a label-free, sensitive, and scalable platform.** *Analytical chemistry*
Chang, A. L., McKeague, M., Liang, J. C., Smolke, C. D.

2014; 86 (7): 3273-3278

- **Facile Characterization of Aptamer Kinetic and Equilibrium Binding Properties Using Surface Plasmon Resonance** *RIBOSWITCH DISCOVERY, STRUCTURE AND FUNCTION*
Chang, A. L., McKeague, M., Smolke, C. D.
2014; 549: 451-466
- **Facile characterization of aptamer kinetic and equilibrium binding properties using surface plasmon resonance.** *Methods in enzymology*
Chang, A. L., McKeague, M., Smolke, C. D.
2014; 549: 451-466
- **Molecular tools for chemical biotechnology.** *Current opinion in biotechnology*
Galanie, S., Siddiqui, M. S., Smolke, C. D.
2013; 24 (6): 1000-1009
- **Dynamically Reshaping Signaling Networks to Program Cell Fate via Genetic Controllers** *SCIENCE*
Galloway, K. E., Franco, E., Smolke, C. D.
2013; 341 (6152): 1358-?
- **A yeast-based rapid prototype platform for gene control elements in mammalian cells** *BIOTECHNOLOGY AND BIOENGINEERING*
Wei, K. Y., Chen, Y. Y., Smolke, C. D.
2013; 110 (4): 1201-1210
- **A versatile cis-blocking and trans-activation strategy for ribozyme characterization** *NUCLEIC ACIDS RESEARCH*
Kennedy, A. B., Liang, J. C., Smolke, C. D.
2013; 41 (2)
- **Synthetic Biology: Advancing the Design of Diverse Genetic Systems** *ANNUAL REVIEW OF CHEMICAL AND BIOMOLECULAR ENGINEERING, VOL 4*
Wang, Y., Wei, K. Y., Smolke, C. D.
2013; 4: 69-102
- **Identification and treatment of heme depletion attributed to overexpression of a lineage of evolved P450 monooxygenases** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Michener, J. K., Nielsen, J., Smolke, C. D.
2012; 109 (47): 19504-19509
- **A high-throughput, quantitative cell-based screen for efficient tailoring of RNA device activity** *NUCLEIC ACIDS RESEARCH*
Liang, J. C., Chang, A. L., Kennedy, A. B., Smolke, C. D.
2012; 40 (20)
- **Synthetic RNA switches as a tool for temporal and spatial control over gene expression** *CURRENT OPINION IN BIOTECHNOLOGY*
Chang, A. L., Wolf, J. J., Smolke, C. D.
2012; 23 (5): 679-688
- **High-throughput enzyme evolution in *Saccharomyces cerevisiae* using a synthetic RNA switch** *METABOLIC ENGINEERING*
Michener, J. K., Smolke, C. D.
2012; 14 (4): 306-316
- **Applications of genetically-encoded biosensors for the construction and control of biosynthetic pathways** *METABOLIC ENGINEERING*
Michener, J. K., Thodey, K., Liang, J. C., Smolke, C. D.
2012; 14 (3): 212-222
- **Synthetic biology: Emerging methodologies to catalyze the metabolic engineering design cycle** *METABOLIC ENGINEERING*
Smolke, C. D., Tyo, K. E.
2012; 14 (3): 187-188
- **Metabolic engineering of *Saccharomyces cerevisiae* for alkaloid production** *Experimental Biology Meeting 2012*
Smolke, C. D.
FEDERATION AMER SOC EXP BIOL.2012
- **Advancing secondary metabolite biosynthesis in yeast with synthetic biology tools** *FEMS YEAST RESEARCH*

- Siddiqui, M. S., Thodey, K., Trenchard, I., Smolke, C. D.
2012; 12 (2): 144-170
- **Synthetic biology: advancing biological frontiers by building synthetic systems** *GENOME BIOLOGY*
Chen, Y. Y., Galloway, K. E., Smolke, C. D.
2012; 13 (2)
 - **From DNA to Targeted Therapeutics: Bringing Synthetic Biology to the Clinic** *SCIENCE TRANSLATIONAL MEDICINE*
Chen, Y. Y., Smolke, C. D.
2011; 3 (106)
 - **Synthetic RNA modules for fine-tuning gene expression levels in yeast by modulating RNase III activity** *NUCLEIC ACIDS RESEARCH*
Babiskin, A. H., Smolke, C. D.
2011; 39 (19): 8651-8664
 - **Engineering Biological Systems with Synthetic RNA Molecules** *MOLECULAR CELL*
Liang, J. C., Bloom, R. J., Smolke, C. D.
2011; 43 (6): 915-926
 - **Cell biology. Bringing it together with RNA.** *Science*
Thodey, K., Smolke, C. D.
2011; 333 (6041): 412-413
 - **Engineering ligand-responsive RNA controllers in yeast through the assembly of RNase III tuning modules** *NUCLEIC ACIDS RESEARCH*
Babiskin, A. H., Smolke, C. D.
2011; 39 (12): 5299-5311
 - **Design of small molecule-responsive microRNAs based on structural requirements for Drosha processing** *NUCLEIC ACIDS RESEARCH*
Beisel, C. L., Chen, Y. Y., Culler, S. J., Hoff, K. G., Smolke, C. D.
2011; 39 (7): 2981-2994
 - **Informing Biological Design by Integration of Systems and Synthetic Biology** *CELL*
Smolke, C. D., Silver, P. A.
2011; 144 (6): 855-859
 - **A synthetic library of RNA control modules for predictable tuning of gene expression in yeast** *MOLECULAR SYSTEMS BIOLOGY*
Babiskin, A. H., Smolke, C. D.
2011; 7
 - **Reprogramming Cellular Behavior with RNA Controllers Responsive to Endogenous Proteins** *SCIENCE*
Culler, S. J., Hoff, K. G., Smolke, C. D.
2010; 330 (6008): 1251-1255
 - **Functional selection and systematic analysis of intronic splicing elements identify active sequence motifs and associated splicing factors** *NUCLEIC ACIDS RESEARCH*
Culler, S. J., Hoff, K. G., Voelker, R. B., Berglund, J. A., Smolke, C. D.
2010; 38 (15): 5152-5165
 - **Engineering RNA controllers for programming cellular behavior** *35th Congress of the Federation-of-European-Biochemical-Societies*
Smolke, C.
WILEY-BLACKWELL.2010: 30-30
 - **Genetic control of mammalian T-cell proliferation with synthetic RNA regulatory systems** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Chen, Y. Y., Jensen, M. C., Smolke, C. D.
2010; 107 (19): 8531-8536
 - **In Vivo Fluorescent Detection of Fe-S Clusters Coordinated by Human GRX2** *CHEMISTRY & BIOLOGY*
Hoff, K. G., Culler, S. J., Nguyen, P. Q., McGuire, R. M., Silberg, J. J., Smolke, C. D.
2009; 16 (12): 1299-1308

- **Building outside of the box: iGEM and the BioBricks Foundation** *NATURE BIOTECHNOLOGY*
Smolke, C. D.
2009; 27 (12): 1099-1102
- **Cell biology. It's the DNA that counts.** *Science*
Smolke, C. D.
2009; 324 (5931): 1156-1157
- **Design Principles for Riboswitch Function** *PLOS COMPUTATIONAL BIOLOGY*
Beisel, C. L., Smolke, C. D.
2009; 5 (4)
- **Frameworks for Programming Biological Function through RNA Parts and Devices** *CHEMISTRY & BIOLOGY*
Win, M. N., Liang, J. C., Smolke, C. D.
2009; 16 (3): 298-310
- **Synthetic control of a fitness tradeoff in yeast nitrogen metabolism.** *Journal of biological engineering*
Bayer, T. S., Hoff, K. G., Beisel, C. L., Lee, J. J., Smolke, C. D.
2009; 3: 1-?
- **Model-guided design of ligand-regulated RNAi for programmable control of gene expression** *MOLECULAR SYSTEMS BIOLOGY*
Beisel, C. L., Bayer, T. S., Hoff, K. G., Smolke, C. D.
2008; 4