

Bruce E. Cohen

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EDUCATION AND TRAINING

1989 – 1996 Ph.D., University of California Berkeley, Department of Chemistry
1996 Neurobiology Course, Marine Biological Laboratory, Woods Hole, MA
1985 – 1989 A.B., Princeton University, *cum laude*, Department of Chemistry

RESEARCH AND PROFESSIONAL EXPERIENCE

2019 – Staff Scientist, Division of Molecular Biophysics & Integrated Bioimaging, Lawrence Berkeley National Laboratory
2011 – Career Staff Scientist, Biological Nanostructures Laboratory, The Molecular Foundry, Lawrence Berkeley National Laboratory
2005 – 2011 Staff Scientist, Biological Nanostructures Laboratory, The Molecular Foundry, Lawrence Berkeley National Laboratory
1997 – 2005 Howard Hughes Medical Institute Postdoctoral fellow, University of California San Francisco. Advisor: Lily Y. Jan, Department of Physiology

SELECTED PUBLICATIONS

A Skripka, M Lee, X Qi, J-A Pan, H Yang, C Lee, PJ Schuck, **BE Cohen**, D Jaque & EM Chan. A Generalized Approach to Photon Avalanche Upconversion in Luminescent Nanocrystals. *Nano Lett.* 23, 7100–7106 (2023). DOI: 10.1021/acs.nanolett.3c01955

X Wang, C Jiang, Z Wang, **BE Cohen**, EM Chan & G Chen. Triplet-Induced Singlet Oxygen Photobleaches Near Infrared Dye-Sensitized Upconversion Nanosystem. *Nano Lett.* 23, 7001–7007 (2023). DOI: 10.1021/acs.nanolett.3c01671

C Lee, EZ Xu, KWC Kwock, A Teitelboim, Y Liu, HS Park, B Ursprung, ME Ziffer, Y Karube, N Fardian-Melamed, CCS Pedroso, J Kim, SD Pritzl, SH Nam, T Lohmueller, JS Owen, P Ercius, YD Suh*, **BE Cohen***, EM Chan* & PJ Schuck*. Indefinite and Bidirectional Near Infrared Nanocrystal Photoswitching. *Nature* 618, 951–958 (2023). DOI: 10.1038/s41586-023-06076-7

X Wu, G Bordia, R Streubel, J Hasnain, CCS Pedroso, **BE Cohen**, B Rad, PD Ashby, AK Omar, PL Geissler, D Wang, H Xue, J Wang & TP Russell. Ballistic Ejection of Microdroplets from Overpacked Interfacial Assemblies. *Advanced Functional Materials*, 2213844 (2023). DOI: 10.1002/adfm.202213844

Z Zhang, A Skripka, JC Dahl, C Dun, JJ Urban, D Jaque, PJ Schuck, **BE Cohen** & EM Chan. Tuning Phonon Energies in Lanthanide-doped Potassium Lead Halide Nanocrystals for Enhanced Nonlinearity and Upconversion. *Angewandte Chemie* 135, e202212549 (2023). DOI: 10.1002/ange.202212549

H Najafiaghdam, CCS Pedroso, NA Torquato, **BE Cohen** & MM Anwar. Fully Integrated Ultra-Thin Intraoperative Micro-Imager for Cancer Detection Using Upconverting Nanoparticles. *Molecular Imaging and Biology* 25, 168–179 (2023). DOI: 10.1007/s11307-022-01710-8

RJ Sepela, RG Stewart, LA Valencia, P Thapa, Z Wang, **BE Cohen** & JT Sack. The AMIGO1 adhesion protein activates Kv2.1 voltage sensors. *Biophysical Journal* 121, 1395–1416 (2022). DOI: 10.1016/j.bpj.2022.03.020

H Najafiaghdam, CCS Pedroso, **BE Cohen** & MM Anwar. Optics-Free Chip-Scale Intraoperative Imaging

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Using NIR-Excited Upconverting Nanoparticles. *IEEE Transactions on Biomedical Circuits and Systems*, 16, 312-323 (2022). DOI: 10.1109/TBCAS.2022.3165186.

CCS Pedroso, VR Mann, K Zuberbühler, M-F Bohn, J Yu, V Altoe, CS Craik & **BE Cohen**. Immunotargeting of Nanocrystals by SpyCatcher Conjugation of Engineered Antibodies. *ACS Nano* 15, 18374–18384 (2021). DOI: 10.1021/acsnano.1c07856

KWC Kwock, C Lee, A Teitelboim, Y Liu, K Yao, SB Alam, **BE Cohen**, EM Chan & PJ Schuck. Surface-Sensitive Photon Avalanche Behavior Revealed by Single-Avalanching-Nanoparticle Imaging. *Journal of Physical Chemistry C* 125, 23976–23982 (2021). DOI: 10.1021/acs.jpcc.1c07721

EZ Xu, C Lee, SD Pritzl, IS Chen, T Lohmueller, **BE Cohen**, E Chan & PJ Schuck. Infrared-to-ultraviolet upconverting nanoparticles for COVID-19-related disinfection applications. *Optical Materials X* 12, 100099 (2021). DOI: 10.1016/j.omx.2021.100099

P Thapa, R Stewart, RJ Sepela, O Vivas, LK Parajuli, M Lillya, S Fletcher-Taylor, **BE Cohen**, K Zito & JT Sack. EVAP: a two-photon imaging tool to study conformational changes in endogenous Kv2 channels in live tissues. *Journal of General Physiology* 153: e202012858 (2021). (front cover)
DOI: 10.1085/jgp.202012858

R Stewart, **BE Cohen*** & JT Sack*. Fluorescent toxins as ion channel activity sensors. *Methods in Enzymology* 653, 295-318 (2021). DOI: 10.1016/bs.mie.2021.02.014

VR Mann, F Manea, NJ Borys, CM Ajo-Franklin* & **BE Cohen***. Controlled and Stable Patterning of Diverse Inorganic Nanocrystals on Crystalline Two-Dimensional Protein Arrays. *Biochemistry* 60, 1063-1074 (2021). DOI: 10.1021/acs.biochem.1c00032

C Sanchez-Cano, **BE Cohen**, WJ Parak, et al. X-ray-Based Techniques to Study the Nano–Bio Interface. *ACS Nano* 15, 3754–3807 (2021). DOI: 10.1021/acsnano.0c09563

C Lee, EZ Xu, Y Liu, A Teitelboim, K Yao, A Fernandez-Bravo, AM Kotulska, SH Nam, YD Suh*, A Bednarkiewicz*, **BE Cohen***, EM Chan* & PJ Schuck*. Giant nonlinear optical responses from photon avalanching nanoparticles. *Nature* 589, 230-235 (2021). (front cover)
DOI: 10.1038/s41586-020-03092-9

S Fletcher-Taylor, P Thapa, RJ Sepela, R Kaakati, V Yarov-Yarovoy, JT Sack* & **BE Cohen***. Distinguishing Potassium Channel Resting State Conformations in Live Cells with Environment-Sensitive Fluorescence. *ACS Chemical Neuroscience* 11, 2316–2326 (2020). (front cover)
DOI: 10.1021/acchemneuro.0c00276

Y Chu, **BE Cohen** & H-h Chuang. A single TRPV1 amino acid controls species sensitivity to capsaicin. *Scientific Reports* 10, 8038 (2020). DOI: 10.1038/s41598-020-64584-2

Y Liu, A Teitelboim, A Fernandez-Bravo, K Yao, MVP Altoe, S Aloni, C Zhang, **BE Cohen**, PJ Schuck & EM Chan. Controlled Assembly of Upconverting Nanoparticles for Low-Threshold Microlasers and Their Imaging in Scattering Media. *ACS Nano* 14, 1508-1519 (2020). (front cover)
DOI: 10.1021/acsnano.9b06102

LB Thal, VR Mann, D Sprinzen, JR McBride, KR Reid, ID Tomlinson, DG McMahon, **BE Cohen*** & SJ Rosenthal*. Ligand-conjugated quantum dots for fast sub-diffraction protein tracking in acute brain

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slices. *Biomaterials Science* 8, 837-845 (2020). DOI: 10.1039/C9BM01629E

H Najafiaghdam, E Papageorgiou, NA Torquato, B Tian, **BE Cohen*** & M Anwar*. A 25 micron-thin microscope for imaging upconverting nanoparticles with NIR-I and NIR-II illumination. *Theranostics* 9, 8239-8252 (2019). DOI:10.7150/thno.37672

A Fernandez-Bravo, D Wang, ES Barnard, A Teitelboim, CA Tajon, J Guan, GC Schatz, **BE Cohen**, EM Chan, PJ Schuck & TW Odom. Ultralow-threshold, Continuous-wave upconverting lasing from sub-wavelength plasmons. *Nature Materials* 18, 1172-1176 (2019). DOI: 10.1038/s41563-019-0482-5

MB Prigozhin, PC Maurer, AM Curtis, N Liu, MD Wisser, C Siefe, B Tian, EM Chan, G Song, S Fischer, S Aloni, DF Ogletree, ES Barnard, L-M Joubert, J Rao, AP Alivisatos, RM Macfarlane, **BE Cohen**, Y Cui, JA Dionne & S Chu. Bright sub-20 nm cathodoluminescent nanoprobe for electron microscopy. *Nature Nanotechnology* 14, 420-425 (2019).

A Teitelboim, B Tian, D Garfield, A Fernandez-Bravo, A Gotlin, PJ Schuck*, **BE Cohen*** & EM Chan*. Energy Transfer Networks Within Upconverting Nanoparticles are Complex Systems with Collective, Robust, and History-dependent Dynamics. *J. Phys. Chem. C* 123, 2678-2689 (2019).

M Charrier, D Li, VR Mann, L Yun, S Jani, B Rad, **BE Cohen**, PD Ashby, K Ryan, CM Ajo-Franklin. Engineering the S-layer of *Caulobacter crescentus* as a Foundation for Stable, High-Density, 2D Living Materials. *ACS Synthetic Biology* 8, 181-190 (2019).

B Tian, A Fernandez-Bravo, H Najafiaghdam, NA Torquato, MVP Altoe, A Teitelboim, CA Tajon, Y Tian, NJ Borys, ES Barnard, M Anwar, EM Chan*, PJ Schuck* & **BE Cohen***. Low irradiance multiphoton imaging with alloyed lanthanide nanocrystals. *Nature Communications* 9, 3082 (2018). DOI: 10.1038/s41467-018-05577-8

H Najafiaghdam, EP Papageorgiou, NA Torquato, CA Tajon, H Zhang, C Park, B Boser, **BE Cohen** & M Anwar. A Molecular Imaging "Skin": Time-resolving Intraoperative Imager for Microscopic Residual Cancer Detection Using Enhanced Upconverting Nanoparticles. *Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 1-4 (2018).

CA Tajon, H Yang, B Tian, Y Tian, P Ercius, PJ Schuck, EM Chan & **BE Cohen**. Photostable and efficient upconverting nanocrystal-based chemical sensors. *Optical Materials* 84, 345-353 (2018).

M Chamanzar, DJ Garfield, J Iafrati, EM Chan, V Sohal, **BE Cohen**, PJ Schuck & MM Maharbiz. Upconverting nanoparticle micro-lightbulbs designed for deep tissue optical stimulation and imaging. *Biomedical Optics Express* 9, 4359-4371 (2018).

A. Fernandez-Bravo, K. Yao, ES Barnard, NJ. Borys, ES Levy, B Tian, CA Tajon, L Moretti, MVP Altoe, S Aloni, K Beketayev, F Scotognella, **BE Cohen***, EM Chan* & PJ Schuck*. Continuous-wave upconverting nanoparticle microlasers. *Nature Nanotechnology* 13, 572-577 (2018).

DJ Garfield, NJ Borys, SM Hamed, NA Torquato, CA Tajon, B Tian, B Shevitski, ES Barnard, YD Suh, S Aloni, JB Neaton, EM Chan*, **BE Cohen*** & PJ Schuck*. Enrichment of molecular antenna triplets amplifies upconverting nanoparticle emission. *Nature Photonics* 12, 402-407 (2018).

VR Mann, AS Powers, DC Tilley, JT Sack & **BE Cohen**. Azide-Alkyne Click Conjugation on Quantum Dots by Selective Copper Coordination. *ACS Nano* 12, 4469-4477 (2018).

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N Sugiyam, AY Sonay, R Tussiwand, **BE Cohen** & P Pantazis. Effective Labeling of Primary Somatic Stem Cells with BaTiO₃ Nanocrystals for Second Harmonic Generation Imaging. *Small* 14: 1870036 (2018).

SM Wichner, VR Mann, AS Powers, MA Segal, M Mir, JN Bandaria, MA DeWitt, X Darzacq, A Yildiz* & **BE Cohen***. Covalent Protein Labeling and Improved Single Molecule Optical Properties of Aqueous CdSe/CdS Quantum Dots. *ACS Nano* 11, 6773 (2017).

ME Materia, MP Leal, M Scotto, PB Balakrishnan, SA Kumar, ML García-Martín, **BE Cohen**, EM Chan & T Pellegrino. Multifunctional Magnetic and Upconverting Nanobeads as Dual Modal Imaging Tools. *Bioconjugate Chemistry* 28, 2707–27 (2017).

ES Levy, CA Tajon, TS Bischof, J Iafrati, A Fernandez-Bravo, DJ Garfield, M Chamanzar, MM Maharbiz, VS Sohal, PJ Schuck, **BE Cohen** & EM Chan. Energy-Looping Nanoparticles: Harnessing Excited-State Absorption for Deep-Tissue Imaging. *ACS Nano* 10, 8423–8433 (2016).

EM Chan, ES Levy & **BE Cohen**. Rationally designed energy transfer in upconverting nanoparticles. *Advanced Materials* 27, 5753-5761 (2015).

EL Rosen, K Gilmore, AM Sawvel, AT Hammack, SE Doris, S Aloni, V Altoe, D Nordlund, T Weng, D Sokaras, **BE Cohen**, JJ Urban, DF Ogletree, DJ Milliron, D Prendergast & BA Helms. Chemically directing *d*-block heterometallics to nanocrystal surfaces as molecular beacons of surface structure. *Chemical Science* 6, 6295-6304 (2015).

DC Tilley, KE Eum, S Fletcher-Taylor, DC Austin, C Dupré, LA Patrón, RL Garcia, K Lam, V Yarov-Yarovoy, **BE Cohen** & JT Sack. Chemoselective tarantula toxins report voltage activation of wild-type ion channels in live cells. *Proc. Natl. Acad. Sci.* 111, E4789-E4796 (2014).

DJ Gargas, EM Chan, AD Ostrowski, S Aloni, V Altoe, ES Barnard, B Sanii, JJ Urban, DJ Milliron, **BE Cohen*** & PJ Schuck*. Engineering bright sub-10-nm upconverting nanocrystals for single-molecule imaging. *Nature Nanotechnology* 9, 300-305 (2014).

EM Chan, G Han, JD Goldberg, DJ Gargas, AD Ostrowski, PJ Schuck, **BE Cohen** & DJ Milliron. Combinatorial discovery of lanthanide-doped nanocrystals with spectrally pure upconverted emission. *Nano Lett.* 12, 3839-3845 (2012).

AE Albers, EM Chan, PM McBride, CM Ajo-Franklin, **BE Cohen*** & BA Helms*. Dual-emitting quantum dot/quantum rod-based nanothermometers with enhanced response and sensitivity in live cells. *J. Am. Chem. Soc.* 134, 9565–9568 (2012).

AD Ostrowski, EM Chan, DJ Gargas, EM Katz, G Han, PJ Schuck, DJ Milliron & **BE Cohen**. Controlled synthesis and single-particle imaging of bright, sub-10 nm lanthanide-doped upconverting nanocrystals. *ACS Nano* 6, 2686–2692 (2012).

SB Lowe, JAB Dick, **BE Cohen** & MM Stevens. Multiplex sensing of protease and kinase enzyme activity *via* orthogonal coupling of quantum dot-peptide conjugates. *ACS Nano* 6, 851–857 (2012).

H Lia, S Wanga, AY Chuang, **BE Cohen** & H-H Chuang. Activity-dependent targeting of TRPV1 with a pore-permeating capsaicin analog. *Proc. Natl. Acad. Sci.* 108, 8497-8500 (2011).

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MA Caldwell, AE Albers, SC Levy, TE Pick, **BE Cohen**, BA Helms & DJ Milliron. Driving oxygen coordinated ligand exchange at nanocrystal surfaces using trialkylsilylated Chalcogenides. *Chem. Comm.* 47, 556-558 (2011).

BE Cohen. Biological Imaging: Beyond fluorescence. *Nature* 467, 407-408 (2010).

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JE Ghadiali, **BE Cohen*** & MM Stevens*. Protein kinase-actuated resonance energy transfer in quantum dot-peptide conjugates. *ACS Nano* 4, 4915-4919 (2010).

E Chan, C Xu, A Mao, G Han, J Owen, **BE Cohen** & DJ Milliron. Reproducible, high-throughput synthesis of colloidal nanocrystals for optimization in multidimensional parameter space. *Nano Lett.* 10, 1874-1885 (2010).

S Wu, G Han, DJ Milliron, S Aloni, V Altoe, DV Talapin, **BE Cohen*** & PJ Schuck*. Non-blinking and photostable upconverted luminescence from single lanthanide-doped nanocrystals. *Proc. Natl. Acad. Sci.* 106, 10917-10921 (2009).

G Han, T Mokari, C Ajo-Franklin & **BE Cohen**. Caged quantum dots. *J. Am. Chem. Soc.* 130, 15811-15813 (2008).

JS Salafsky & **BE Cohen**. A second-harmonic-active unnatural amino acid as a structural probe of biomolecules on surfaces. *J. Phys. Chem. B* 112, 15103-15107 (2008).

P Abbyad, X Shi, W Childs, TB McAnaney, **BE Cohen** & SG. Boxer. Measurement of solvation responses at multiple sites in a globular protein. *J. Phys. Chem. B* 111, 8269-8276 (2007).

BE Cohen*, A Pralle, X Yao, G Swaminath, C Gandhi, YN Jan, BK Kobilka, EY Isacoff & LY Jan. A fluorescent probe designed for studying protein conformational change. *Proc. Natl. Acad. Sci.* 102, 965-970 (2005).

BE Cohen*, TB McAnaney, ES Park, YN Jan, SG Boxer & LY Jan. Probing protein electrostatics with a synthetic fluorescent amino acid. *Science* 296, 1700-1703 (2002).

(*denotes corresponding authors)

SELECTED PRESENTATIONS (PREVIOUS 3 YEARS)

The Evolution of Inorganic Nanocrystals for Bioimaging, Upconverting Nanoparticles Gordon Research Conference, Waterville Valley, NH, June 18-23, 2023.

Unlimited Photons from Avalanching Nanoparticles for INPALM Superresolution Imaging. Berkeley Advanced Imaging Methods Workshop, Berkeley, CA, January 24-26, 2023.

The Evolution of Inorganic Nanocrystals for Bioimaging, 242nd Electrochemical Society Meeting, Atlanta, October 9-13, 2022.

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Immunotargeting of Nanocrystals by SpyCatcher Conjugation of Engineered Antibodies, American Chemical Society Fall 2022 National Meeting, Chicago, August 20-25, 2022.

Innate Deeply Subwavelength Imaging with Photon Avalanching Nanoparticles, American Chemical Society Fall 2022 National Meeting, Chicago, August 20-25, 2022.

Upconversion and Avalanching in Lanthanide-based Nanocrystals for Imaging, 29th Rare Earth Research Conference, University of Pennsylvania, Philadelphia, June 27-30, 2022.

The Evolution of Nanoparticles for Bioimaging, 66th Annual Biophysical Society Meeting, San Francisco, February 19-23, 2022.

Quantitative NIR Imaging with Upconverting Nanoparticles. Berkeley Advanced Imaging Methods Workshop, virtual presentation, January 18-20, 2022.

Upconverting Nanoparticles for Quantitative Bioimaging, Pacifichem: The International Chemical Congress of Pacific Basin Societies, virtual presentation, December 16-21, 2021.

To the ends of the periodic table and back in search of imaging probes, Vanderbilt Institute of Nanoscale Science and Engineering Seminar, Vanderbilt University, September 22, 2021.

Bringing Abbe into the 21st century: real-time 70-nm resolution confocal imaging with photon avalanching nanoparticles, UPConline2021, virtual presentation, April 6-9, 2021.

To the ends of the periodic table and back in search of neuroimaging probes. UCSF Kavli Neuroscience Seminar, virtual presentation, February 22, 2021.

Super-resolution deep brain imaging and sensing with photon avalanching nanoparticles for understanding compound brain injury. DTRA Tech Watch Seminar, virtual presentation, October 22, 2020.

PATENTS AND DISCLOSURES

PJ Schuck, C Lee, E Xu, K Yao, EM Chan, **BE Cohen**, YD Suh, SH Nam. System and method for providing and/or facilitating giant nonlinear optical responses from photon avalanching nanoparticles. US Application number 17531266 (2021).

BE Cohen, A Ostrowski, EM Chan, D Gargas, E Katz, PJ Schuck, DJ Milliron, Controlled Synthesis of Bright and Compatible Lanthanide-Doped Upconverting Nanocrystals. U.S. Patent No. 9556379 (2017).

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RESEARCH SUPPORT

Current

The Molecular Foundry
ongoing Persson (PI)
Department of Energy
DE-AC02-05CH11231

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This block grant is the core budget for the Molecular Foundry, covering certain internal research and User program expenses for all Principal Investigators throughout the institute.

Role: Co-Investigator

Chip-Scale Intraoperative Optical Navigation with Immunotargeted Upconverting Nanoparticles

7/1/2023 – 6/30/2027 Cohen, Anwar (co-PIs)

NIH National Cancer Institute

R01 CA278672-01A1

This project combines upconverting nanoparticle technology with advanced chip design to create micron-sized intraoperative imagers with heightened sensitivity, for detecting small populations of cancerous cells in real time.

Efficient infrared-to-visible conversion with an upconverting nanoparticle microlaser

10/1/21 – 9/30/24 Crozier (PI)

Department of Defense

DARPA - Enhanced Night Vision in eyeglass form factors (ENVision)

This project combines advances in nanophotonics and in upconverting nanoparticle (UCNP) engineering to realize a device that converts infrared nightglow to visible wavelengths.

Role: Co-Investigator

Deeply subwavelength imaging of living and complex nanomaterials

10/1/19-9/30/23 Cohen (PI)

Department of Energy

Molecular Foundry TCDP

This grant is to develop correlated superresolution/AFM imaging to understand hybrid protein-nanocrystal nanostructures at low nm resolution.

Role: Principal Investigator

Completed

Visualizing endogenous ion channel activation

9/1/16-6/30/21 Cohen, Sack (co-PIs)

National Institutes of Health

NINDS R01

A project to develop probes able to record the activities of specific ion channels during neuronal activity by conjugating novel state-dependent toxins to fluorophores and nanocrystals.

Role: co-Principal Investigator

Multiscale Self-Assembly for Strong and Tough Living Materials

4/1/17–3/31/21 Ajo-Franklin (PI)

Department of Defense

DARPA - Engineered Living Materials (ELM)

The goal of this project is to design, synthesize, assemble, and characterize nanoparticle-bacterial composites that resemble 'brick-and-mortar' structure of nacre, but that can switch between being porous and flexible to impermeable, stiff, and strong in response to environmental cues.

Role: co- Investigator

Fluorescent sensors of SARS-CoV-2 contamination on masks

5/3/20 – 12/31/20 Tandore (PI)

Department of Energy

Basic Energy Sciences

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This National Virtual Biotechnology Laboratory project is a rapid response effort to develop simple, instant colorimetric assays for SARS-CoV-2 on masks and other surfaces.

Role: Co-Investigator, Lead of viral sensors thrust

Fiberless Deep-Brain Optical Imaging

10/1/14–9/30/16 Cohen (PI)

Department of Energy

Laboratory-Directed Research and Development (LDRD)

A multi-disciplinary and multi-institution (LBNL, UC Berkeley, UCSF) project that combines expertise in optogenetics, optical probe design, nanoscience, and neuronal biochemistry, which will extend the reach of imaging and manipulation deep into the brain.

Role: Principal Investigator

Nano-optogenetic control of neuronal firing with targeted nanocrystals

10/1/15-9/30/16 Cohen (PI)

State of California

Cal-BRAIN Award

Part of a statewide program to support and integrate new technologies capable of monitoring wide-scale activity in the brain. The goal of this proposal is to develop nanocrystals that efficiently convert near infrared light to wavelengths that cause neurons to fire, and to test these for optogenetic activity.

Role: Principal Investigator

Neuro/Nano Technology for Brain Mapping

10/1/13 – 9/30/14 Denes (PI)

Department of Energy

Laboratory-Directed Research and Development (LDRD)

The goal of this project was to integrate efforts related to the Presidential BRAIN initiative and begin to systematically address the technical challenges associated with high-resolution and large-scale neural technologies.

Role: Co-Investigator

Integrated Imaging of Microbial Community Response to External Threats

10/1/12 – 9/30/14 Auer (PI)

Department of Energy

Laboratory-Directed Research and Development (LDRD)

An effort to gain fundamental insight into inter-species conflicts in microbial communities by integrating multiple imaging modalities.

Role: Co-Investigator