

## Polina Anikeeva

Class of 1942 Associate Professor of Materials Science and Engineering

### Work Address:

Massachusetts Institute of Technology  
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### Education

2009 – Ph.D. Materials Science and Engineering, MIT  
2003 – BS (Honors), Department of Biophysics,  
St.Petersburg State Polytechnic University (SPbSPU).

### Positions

2016-current – Associate professor,  
Department of Materials Science and Engineering, MIT  
2011-2016 – Assistant professor,  
Department of Materials Science and Engineering, MIT  
2009-2011 – Postdoctoral fellow, Optical Neural Engineering Lab (Prof. Karl Deisseroth),  
Department of Bioengineering, Stanford  
2004-2009 – Ph.D. student, Laboratory of Organic Electronics and Optics (Prof. Vladimir Bulović),  
Department of Materials Science and Engineering, MIT  
2003-2004 – Research assistant, Softmatter Nanotechnology and Advanced Spectroscopy Team,  
Chemistry Division, Los Alamos National Laboratory  
2002-2003 – Exchange research assistant, Department of Physical Chemistry,  
Swiss Federal Institute of Technology (ETH Zürich)

### Fellowships and awards

- 2015 Junior Bose Teaching Award, School of Engineering, MIT
- 2015 Bose Research Grant
- 2015 Technology Review TR35
- 2014 EMBS Brain Grand Challenges Young Investigator Award
- 2014 Outstanding Faculty Undergraduate Research (UROP) Mentor
- 2013 Speaker, US NAE Frontiers of Engineering
- 2013 Dresselhaus Fund Inaugural Award
- 2013 DARPA Young Faculty Award
- 2013 NSF CAREER Award
- 2012 Center for Materials Science and Engineering Shared Facilities Junior Faculty Award
- 2011 Sanofi Biomedical Innovation Program Award
- 2009 Deans Postdoctoral Fellowship, School of Medicine, Stanford.
- 2008 PhD thesis is chosen to conclude the Micro Technology Laboratory seminar series, MTL at MIT.
- 2008 Outstanding Thesis Research Award, Department of Materials Science and Engineering, MIT.
- 2002-2003 ETH Zurich Fellowship funded through student exchange program, Zurich, Switzerland.
- 2001-2002 Vladimir Potanin's Fellowship, SPbSPU, St.Petersburg, Russia.

### Publications

1. Romero, G., Christiansen, M.G., Stocche Barbosa, L., Garcia, F., **Anikeeva, P.** *Localized Excitation of Neural Activity via Rapid Magnetothermal Drug Release.* Adv. Funct. Mater., 2016. DOI: 10.1002/adfm.201602189

2. **Anikeeva, P.**, Jasanoff, A.P. *Magnetogenetics: Problems on the back of an envelope*, eLife 5:e19569, 2016.
3. Schuerle, S., Dudani, J.S., Christiansen, M.G., **Anikeeva, P.**, Bhatia, S.N. *Magnetically Actuated Protease Sensors for In Vivo Tumor Profiling*. Nano Letters, 2016.
4. Chen, R., Christiansen, M.G., Sourakov, A., Mohr, A., Matsumoto, Y., Okada, S., Jasanoff, A., **Anikeeva, P.** *High-performance ferrite nanoparticles through nonaqueous redox phase tuning*, Nano Lett. 16, 1345, 2016.
5. Ruckh, T.T., Skipwith, C.G., Chang, W., Senko, A.W., Bulović, V., **Anikeeva, P.**, Clark, H.A. *Ion-Switchable Quantum Dot FRET Rates In Ratiometric Potassium Sensors*. ACS Nano 10, 4020, 2016.
6. **Anikeeva, P.** *Optogenetics unleashed*, Nat. Biotechnol. 34, 43, 2016.
7. Koppes, R.A., Park, S., Hood, T., Jia, X., Poorheravi, N.A., Achyuta, A.K.H., Fink, Y., **Anikeeva, P.** *Thermally Drawn Fibers as Nerve Guidance Scaffolds*. Biomaterials 81, 27, 2016.
8. Matsumoto, Y., Chen, R., **Anikeeva, P.**, Jasanoff, A.P., *Engineering intracellular biomineralization and biosensing by a magnetic protein*, Nat. Comms. 6, 8721, 2015.
9. Loynachan, C. N., Romero, G., Christiansen, M.G., Chen, R., Ellison, R., O'Malley, T.T., Froriep, U.P., Walsh, D.M., **Anikeeva, P.** *Targeted Magnetic Nanoparticles for Remote Magnetothermal Disruption of Amyloid- $\beta$  Aggregates*, Adv. Healthcare Mater. 4, 2100, 2015. Cover.
10. **Anikeeva, P.**, Koppes, R.A., *Restoring the Sense of Touch*, Science 350, 274, 2015.
11. **Anikeeva, P.**, Jia, X. *Remote-Controlled Mice*, Cell Systems 1, 104, 2015
12. Park, S., Koppes, R.A., Froriep, U.P., Jia, X., Achyuta, A.K.H., McLaughlin, B.L., **Anikeeva, P.**, *Optogenetic control of nerve growth*, Sci. Rep. 5, 9669, 2015.
13. Chen, R., Romero, G., Christiansen, M.G., Mohr, A., **Anikeeva, P.**, *Wireless magnetothermal deep brain stimulation*, Science 347, 1477, 2015. (Perspectives by Temel and Jahanshahi, Science 347, 1418, 2015.)
14. Canales,\* A., Jia,\* X., Froriep,\* U.P., Koppes,\* R.A., Tringides, C.M., Selvidge, J., Lu, C., Wei, L., Hou, C., Fink, Y., **Anikeeva, P.**, *Multifunctional fibers for optical, electrical and chemical interrogation of neural circuits in vivo*, Nat. Biotechnol. 33, 277, 2015. \* - Equal contribution. Cover. (News and Views by Herrera and Adamantidis, Nat. Biotechnol. 33, 259, 2015.)
15. Lu, C., Froriep, U.P., Canales, A., Koppes, R.A., Caggiano, V., Selvidge, J., Bizzi, E., **Anikeeva, P.**, *Polymer Fiber Probes Enable Optical Control of Spinal Cord and Muscle Function In Vivo*, Adv. Funct. Mater. 24, 6594, 2014. Back cover.
16. Guynaydin, L.A., Grosenick, L., Finkelstein, J.C., Kauvar, I.V., Fenno, L.E., Adhikari, A., Lammel, S., Mirzabekov, J.J., Airan, R.D., Tye, K.M., **Anikeeva, P.**, Malenka, R.C., Deisseroth, K. *Natural neural projection dynamics underlying social behavior modulation*. Cell, 157, 1535, 2014.
17. Pashaie, R., **Anikeeva, P.**, Lee, J.H., Prakash, R., Yizhar, O., Prigge, M., Chander, D., Richner, T., Williams, J. *Optogenetic brain interfaces*, IEEE Rev. Biomed. Eng. 7, 3-30, 2014.
18. Birmingham, K., Gradinaru, V., **Anikeeva, P.**, Grill, W.M., Pikov, V., Weber, D., McLaughlin, B., Pasricha, P., Ludwig, K., Famm, K. *A research roadmap towards bioelectronic medicines*, Nat. Rev. Drug Disc. 13, 399, 2014.
19. Christiansen, M.G., Senko, A.W., Chen, R., Romero Uribe, G., **Anikeeva, P.** *Magnetically multiplexed heating of single domain nanoparticles*. Appl. Phys. Lett. 104, 213103-8, 2014.
20. Chen, R., Christiansen, M.G., **Anikeeva, P.**, *Maximizing hysteretic losses in magnetic ferrite nanoparticles via model-driven synthesis and materials optimization*. ACS Nano, 7, 8990, 2013.
21. Liske, H., Qian, X., **Anikeeva, P.**, Deisseroth, K., Delp, S. *Optical control of neuronal excitation and inhibition using a single opsin protein, ChR2*. Sci. Rep., 3, 3110, 2013.
22. Liske, H., Towne, C., **Anikeeva, P.**, Zhao, S., Feng, G., Deisseroth, K., Delp, S. *Optical inhibition of motor neuron and muscle activity in vivo*. Muscle and Nerve, 47, 916, 2013.
23. **Anikeeva, P.**, Deisseroth, K., *Photothermal genetic engineering*. ACS Nano, 6, 7548, 2012.

24. **Anikeeva, P.**, Andalman, A.S., Witten, I.B., Warden, M.R., Goshen, I., Grosenick, L., Gunaydin, L.A., Frank, L., Deisseroth, K. *Optetrode: a multichannel readout for optogenetic control in freely moving mice*. Nat. Neurosci., 15, 163, 2011. \* - Equal contribution
25. Witten, I.B., Lin, S.C., Brodsky, M., Prakash, R., Diester, I., **Anikeeva, P.**, Gradinaru, V., Ramakrishnan, C., Deisseroth, K. *Cholinergic interneurons control local circuit activity and cocaine conditioning*. Science, 330, 1677, 2010.
26. Shirasaki, Y., **Anikeeva, P.O.**, Tischler, J.R., Bradley, M.S., Bulović, V. *Efficient Förster energy transfer from phosphorescent organic molecules to J-aggregate thin films*, Chem. Phys. Lett., 485, 243, 2010.
27. Panzer, M.J., Aidala, K.E., **Anikeeva, P.O.**, Halpert, J.E., Bawendi, M.G., Bulović V. *Nanoscale morphology revealed at the interface between colloidal quantum dots and organic semiconductor films*. Nano Lett., 10, 2421, 2010.
28. **Anikeeva, P.O.**, Halpert J. E., Bawendi, M.G., Bulović, V. *Quantum dot light-emitting devices with electroluminescence tunable over the entire visible spectrum*, Nano Lett., 9, 2532, 2009.
29. Hummon, M.R., Stollenwerk, A.J., Narayanamurti, V., **Anikeeva, P.O.**, Panzer, M.J., Wood, V.C., Bulović, V. *Detecting Charging Energy and Charge State of CdSe/ZnS Quantum Dots using a Scanning Tunneling Microscope*. Phys. Rev. B, 81, 115439, 2009.
30. **Anikeeva, P.O.**, Madigan, C.F., Halpert, J.E., Bawendi, M.G., Bulovic, V. *Electronic and Excitonic Processes in Hybrid Organic-Quantum Dot LEDs*, Phys. Rev. B, 78, 085434, 2008.
31. Kim, L., **Anikeeva, P. O.**, Coe-Sullivan, S. A., Steckel J. S., Bawendi, M. G., Bulović, V. *Contact Printing of Quantum Dot Light Emitting Devices*, Nano Lett., 8, 5413, 2008.
32. **Anikeeva, P.O.**, Halpert J. E., Bawendi, M.G., Bulovic, V. *Electroluminescence from a Mixed Red-Green-Blue Colloidal Quantum Dot Monolayer*, Nano Lett., 7, 2196, 2007.
33. **Anikeeva, P.O.**, Madigan C. F., Coe-Sullivan, S. A., Steckel, J.S., Bawendi, M.G., Bulovic, V. *Photoluminescence of CdSe/ZnS core/shell quantum dots enhanced by energy transfer from a phosphorescent donor*, Chem. Phys. Lett., 424, 120, 2006.
34. Steckel, J.S., Snee, P., Coe-Sullivan, S. A., Zimmer, J.P., Halpert, J. E., **Anikeeva, P.O.**, Kim, L., Bulovic, V., Bawendi, M.G. *Color-Saturated Green-Emitting QD-LEDs*, Angew. Chem. Int. Ed., 45, 5796, 2006.
35. Ivanov, S.A., Nanda, J., Piryatinski, A., Achermann, M., Balet, L.P., Bezel, I. V., **Anikeeva, P.O.**, Tretiak, S., Klimov, V. I. *Light Amplification Using Inverted Core/Shell Nanocrystals: Towards Lasing in Single-Exciton Regime*, J. Phys. Chem., 108, 10625, 2004.

### Patents and patent applications

1. R. Chen, P. O. Anikeeva, A. Sourakov, "Nanoparticles and Methods of Making", provisional U.S. patent application 62/259,036.
2. Anikeeva, P.O, Christiansen, M.G., R. Chen, "Independent Magnetically-Multiplexed Heating of Portions of a Target", US and International patent application PCT/US14/67866.
3. Anikeeva, P.O., Canales, A., Jia, X., Frieep, U.P., Lu, C., Tringides, C.M., Y. Fink, "Methods and Apparatus for Stimulating and Recording Neural Activity", US patent application US13/919,594.
4. Anikeeva, P.O., Deisseroth K. "Upconversion of light for use in optogenetic methods", US and International patent application PCT/US2011/059287.
5. Halpert, J.E., Anikeeva, P.O., Bawendi, M.G., Bulović, V. "Blue Light Emitting Semiconductor Nanocrystals and Devices". US and International patent application PCT/US2007/075593.
6. Hollingsworth, J.A., Klimov, V.I., Anikeeva, P.O. "Semiconductor nanocrystal quantum dots and metallic nanocrystals as UV blockers and colorants for sunscreen and/or sunless tanning compositions", US patent application US10/857,583.
7. Chen, J., Bulović, V., Anikeeva, P.O., Bawendi, M.G. "Light Emitting Device Including Semiconductor Nanocrystals", US Patent 8941299, issued January 27, 2015.

8. Coe-Sullivan, S. A., Bulović, V., Steckel, J. S., Bawendi, M.G., Anikeeva, P.O., Halpert, J.E. “White Light Emitting Devices”, US Patent 9093657, issued July 28, 2015.

### **Synergistic activities**

**2011-present** – Undergraduate research supervisor through MIT Undergraduate Research Opportunities Program (UROP) >15 students, Center for Materials Science and Engineering Research Experiences for Undergraduates (CMSE REU) - 2 students, MIT Summer Research Program (MSRP) - 1 student.

**2012-2013** – High school research supervisor - 1 student from Swampscott High School, MA.

**2013-present** – Hosted 9-week laboratory summer internships for 6 faculty and 4 students from Roxbury and Bunker Hill Community colleges (inner city Boston area colleges).

**2013** – Co-organizer (with Shain and Kassegne) of the Center for Sensorimotor Neural Engineering Microelectrode Workshop, Seattle 01/18-01/19/2013.

**2013** – Primary organizer of the Symposium J: Materials for Neural Interfaces at the Fall Materials Research Society Annual Meeting, 1-6/12/2013.

**Member** of Materials Research Society, Society for Neuroscience, Optical Society of America

**Reviewer** for Science, Nature Publishing Group (NPG), Optical Society of America (OSA) Journals, IEEE Journals, American Chemical Society (ACS) Journals.

**Proposal reviewer** for National Science Foundation, National Institutes of Health, European Research Council, Cariplo Foundation (Italy), Human Frontiers Program, Natural Sciences and Engineering Research Council of Canada.

### **Research support**

#### **Ongoing Research Support**

**NSF CAREER Award** Anikeeva (PI) 02/15/13-12/31/18

Optoelectronic neural scaffolds:

Materials platform for investigation and control of neuronal activity and development.

The goal of this project is to engineer an integrated platform for electrophysiological recording and stimulation of growing neurons in vitro with the goal of controlling and monitoring the development of their processes.

Role: PI

**NSF ERC, Center for Sensorimotor Neural Engineering** Voldman (PI) 09/01/12-08/31/18

Microfabricated microelectrode interfaces to the mammalian nervous systems

The goal of this project is to develop neural recording microelectrodes for interfaces with the central and peripheral nervous systems for neuroprosthetic applications.

Role: Co-PI

**NSF MRSEC, DMR-1419807** Fink & Soljačić (PIs) 12/01/14-10/31/20

IRG-I: Harnessing In-fiber Fluid Instabilities: A Scalable and Universal Approach to Multidimensional Nanosphere Design, Manufacturing, and Applications

The goal of this project is to investigate fluid instabilities in multi-material fibers and apply them to scalable nanoscale optoelectronic device design.

Role: Co-PI

**NIH R01-NS086804-01A1** Anikeeva (PI) 02/15/15-01/31/20

Fiber Inspired Neural Probes for the Multifunctional Dynamic Brain Mapping

This project is dedicated to the development of multifunctional fiber probes with recording, optogenetics and drug delivery capabilities, and application of these devices to study of fear extinction in medial prefrontal cortex (mPFC) and basolateral amygdala (BLA) circuit.

Role: PI

**DARPA ElectRx HR0011-15-C-0155** Anikeeva (PI) 09/28/15-09/30/19  
Magnetic Neural Excitation (MAGNEX)  
This project aims to develop a wireless approach to modulation of adrenal function using magnetic nanomaterials and alternating magnetic fields.  
Role: PI

**Bose Research Grant** Anikeeva (PI) 11/15/15-11/14/18  
Identifying Molecular Mechanisms of Biological Magnetosensation  
Within the scope of this project we aim to identify and characterize protein candidates necessary and sufficient for enabling magnetic transduction in vertebrates.  
Role: PI

### **Completed Research Support**

**Center for Materials Science and Engineering Shared Facilities Award for Junior Faculty** Anikeeva (PI) 01/12/12-02/01/13  
Award allows junior faculty and their student to use shared experimental facilities available at the Center for Materials Science and Engineering supported by NSF under DMR-0819762  
Role:PI

**Sanofi Biomedical Innovation Award** Anikeeva (PI) 12/01/11-11/30/13  
Minimally Invasive Neural Stimulation for Treatment of Major Depressive Disorder  
The goal of this project is to develop a minimally invasive approach to neural stimulation for excitatory neurons in medial prefrontal cortex using alternating electromagnetic field and nanostructured antennae  
Role: PI

**NSF MRSEC, DMR-0819762** Fink & Soljačić (PIs) 09/01/12-05/31/14  
IRG-III: Multimaterial Multifunctional Nano-Structured Fibers  
The goal of this project is to fabricate and investigate multi-functional optical and opto-electronic fibers.  
Role: Co-PI

**McGovern Institute Neurotechnology (MINT) grant** Anikeeva (PI) 09/01/12-08/31/14  
Optoelectronic Devices for Electrophysiological Characterization and Optogenetic Stimulation of Motor Circuits in the Mouse Spinal Cord  
The goal of this project is to develop a flexible device for chronic neural recording and optical stimulation in the spinal cord of freely-moving mice.  
Role: Lead PI (Co-PI – Emilio Bizzi)

**McGovern Institute Neurotechnology (MINT) grant** Anikeeva (PI) 09/01/13-08/31/14  
Multifunctional Platform for Electrophysiological Characterization of Cortical Circuits in Mouse Models of Autism Spectrum Disorders  
The goal of this projects is to develop a multifunctional neural probe for single-neuron recording, optogenetics and drug delivery in cortico-striatal circuits in a Shank3 transgenic mouse model of social deficit.  
Role: Lead PI (co-PI – Guoping Feng)

**Draper Laboratory UR&D Grant** Anikeeva (PI) 07/01/13-06/23/15  
Optoelectronic Scaffolds For Neural Tissue Engineering  
This project aims to develop microstructured scaffolds that promote tissue regeneration via optogenetic stimulation while enabling electrophysiological readout.  
Role: PI

**DARPA YFA** Anikeeva (PI) 08/01/13-07/31/15  
Nanoparticle-Enabled Sensitivity of Specific Neurons to Alternating Magnetic Fields for Targeted Transcranial Magnetic Stimulation  
The goal of this project is to develop targeting schemes for magnetic nanoparticles to neurons and employ them as antennae for transcranial magnetic stimulation.

Role: PI