GUANGYU XU

(413) 577-4308 • guangyux@umass.edu • http://people.umass.edu/guangyux/

University of Massachusetts, 100 Natural Resources Road, Amherst, MA 01003

EMPLOYMENT

UNIV. OF MASSACHUSETTS, AMHERST — Amherst, MA
Assistant Professor, Electrical and Computer Engineering — *January 2016 - present*

EDUCATION

UNIV. OF CALIFORNIA, LOS ANGELES — Los Angeles, CA
Ph.D., Electrical Engineering — *2006-2011*

TSINGHUA UNIVERSITY — Beijing, China
Master of Science, Electrical Engineering — *2003-2006*

TSINGHUA UNIVERSITY — Beijing, China
Bachelor of Science, Fundamental Sciences — *2000-2003*

RESEARCH INTEREST

Bioelectronics, Nanoelectronics, Biosensing, Neuro-interface, Lab-on-Chip, Device Physics.

AWARDS

1. Best Symposium Presentation Golden Award, MRS Spring Conference, 2011
2. Chinese Government Scholarship for Outstanding Self-financed Students Studying Abroad, 2011
3. Outstanding Ph.D Student Award Finalist, UCLA Electrical Engineering, 2011
4. Outstanding Theme Poster Prize in 6th Annual FCRP FENA review, 2010
5. UCLA, Henry Samueli Electrical Engineering Graduate Student Fellowship, 2006 - 2007
6. General Electric Fellowship, 2004
7. Tsinghua University Outstanding Academic Performance Scholarship, 2002
8. First Prize in National Physics Olympiad in China, 1999
9. Second Prize in National Mathematics Olympiad in China, 1999

PROFESSIONAL EXPERIENCE

MIT MEDIA LAB, ED BOYDEN LAB — Cambridge, MA
Postdoctoral Associate — *2014 - 2016*

- **Development of spatially multiplexing for multi-signal cellular imaging.** With a synthetic biology approach, this technology expresses spatially separated fluorescent protein sensor clusters, each bound on a chromosome–specific binding site in the genome. Bioinformatics analysis has been applied to identify c.a. 20 such binding sites available in human genome and c.a. 10 in mouse genome, offering unprecedented multiplicity in single-cell fluorescence imaging. These binding sites can be employed to multiplex any genetically encoded sensors, such as ionic or kinase sensors, either based on intensiometric or FRET readouts, within a single enabling simultaneous monitoring of variety cellular signals that can report, for instance, the gene regulation activities.

HARVARD UNIVERSITY, DONHEE HAM LAB — Cambridge, MA
Postdoctoral Fellow — *2011- 2014*

- **Development of high-performance all-electrical DNA chip technologies.** Results include: **1) a graphene array chip built from graphene flakes synthesized by chemical-vapor-deposition (CVD).** A robust array yield is achieved with a 100-fM sensitivity, on par with optical DNA microarrays and 10-times higher than prior CVD-graphene FET sensors. Each graphene acts as an electrophoretic electrode for site-specific DNA immobilization, and performs subsequent site-specific detection of complementary target DNA as a FET, suggesting a path toward all-electrical multiplexed DNA arrays. **2) An ion-sensitive FET (ISFET) array chip built with tsmc-0.18um CMOS technology.** The real-time DNA charge detection signal can be enhanced by biasing the ISFET near threshold, by reducing its channel-to-sensing area ratio, and by minimizing the double layer capacitance of the sensing electrode, offering a systematic optimization strategy for CMOS-ISFET based biomolecule sensing.

UCLA, KANG WANG LAB Los Angeles, CA
Graduate Research Assistant *2006-2011*

- In close collaboration with The Molecular Foundry at Lawrence Berkeley National Laboratory (LBNL).
- **Variability effects in graphene**: 1) revealed an abnormal 1/f noise pattern in graphene devices originating from non-uniform carrier distribution; proposed a new noise model that can benefit future all-graphene circuit modeling. 2) Revealed a strong correlation between 1/f noise in graphene nanoribbon (GNR) devices with their band structures; provided a noise-based metrology to probe the quantum transport in GNRs graphene circuit modeling. **Top-down scalability in graphene electronics**: Revealed the critical role of edge effect on the scaling behavior in graphene devices; the scaling behavior can be tuned by varying the gate bias, the number of layers, or the width of graphene devices. These findings are critical in realizing top-down scalable graphene electronics.
- **Research impact:**
  1. **Research seminars** at Purdue University, Stanford University and Columbia University (2011)
  2. **Best Symposium Presentation Golden Award** at MRS Spring Meeting (2011)
  3. **Nature Conference** presentation, attendees: Nature Editors and top graphene researchers worldwide (2011)
  4. **Highlights in Research Annual reviews** in FCRP program and UCLA Electrical Engineering (2009-2011)
  5. **Media reports** highlighted in more than 30 science media (2010)
  6. **Invited talks** in Japan, China and LBNL Annual User Meeting (2009-2010)

TSINGHUA UNIVERSITY, NANO-OPTOELECTRONICS LAB Beijing, China
Graduate Research Assistant *2003-2006*

- **Micro-structured fiber and Bragg fiber design**: 1) photonic crystal fibers: broadband dispersion compensation design near 1.55μm window (experimentally proved); 2) Bragg fibers: low-loss single-mode transmission design at near-infrared windows from 1.34μm to 2.94μm (near infrared). Both designs are feasible for fiber fabrication.

TEACHING AND MENTORING EXPERIENCE

UMASS AMHERST Amherst, MA
Instructor, ECE 697BS*:* Introduction to Biosensors and Bioelectronics *Spring 2016*
Instructor, ECE 323, 324: Electronics I and II *Fall 2016 – Fall 2017*

MIT MEDIA LAB Cambridge, MA
Tutoring two graduate students: molecular biology and cell imaging *Spring 2015 – Fall 2015*

UCLA Los Angeles, CA
Teaching Assistant, EE121B: Principles of Semiconductor Device Design *Spring 2008*
Teaching Assistant, EE122L: Semiconductor Devices Laboratory *Spring 2008*
Teaching Assistant, EE122L: Semiconductor Devices Laboratory *Winter 2008*
Tutoring two graduate students: characterization and modeling in carbon electronics *Fall 2008 – Fall 2010*

BOOK CHAPTERS

1. D. Mao, L. Lyu, and G. Xu, "Graphene Field-Effect Transistors: The Road to Bioelectronics", **Advanced Materials Book Series, Wiley,** (accepted, 2017).
2. J. Abbott, D. Ham, and G. Xu, "All-Electrical Graphene DNA Sensor Array", **Biosensors and Biodetection: Methods and Protocols, Volume 2: Electrochemical, Bioelectronic, Piezoelectric, Cellular and Molecular Biosensors, Springer,** 169-187 (2017).

JOURNAL PAPERS

1. D. Mao, J. Morley, Z. Zhang, M. Donelley, and G. Xu. "High-yield passive Si photodiode array towards optical neural recording", (**in submission,** 2017).
2. L. Lyu, P. Jaswal, and G. Xu. "Dimensional Crossover of Graphene for Enhanced Charge Sensing", (**in submission,** 2017).
3. G. Xu, J. Abbott and D. Ham. "Optimization of CMOS-ISFET based Biomolecular Sensing: Analysis and Demonstration in DNA Detection", **IEEE Trans. Electron Devices** 63, 3249-3256 (2016).
4. G. Xu, J. Abbott, L. Qin, K. Yeung, Y. Song, H. Yoon, J. Kong and D. Ham. "Electrophoretic and Field-Effect Graphene for All-Electrical DNA Array Technology", **Nat. Commun.** 5:4866, doi: 10.1038/ncomms5866 (2014).
5. G. Xu, Y. Zhang, X. Duan, A. A. Balandin and K. L .Wang. "Variability Effects in Graphene: Challenges and Opportunities for Device Engineering and Applications", **Proc. IEEE.** 101, 1670-1688 (2013).

6. G. Xu, C. M. Torres, Jr., J. Tang, J. Bai, E. B. Song, Y. Huang, X. Duan, Y. Zhang and K. L. Wang. "Edge Effect on Resistance Scaling Rules in Graphene Nanostructures", **Nano Lett.** 11, 1082-1086 (2011).
7. G. Xu, C. M. Torres, Jr., J. Bai, J. Tang, T. Yu, Y. Huang, X. Duan, Y. Zhang and K. L. Wang. "Line-width Roughness in Nanowire-Mask Based Graphene Nanoribbons", **Appl. Phys. Lett.** 98, 243118 (2011).
8. M. Wang, E. B. Song, S. Lee , J. Tang, M. Lang, C. Zeng , G. Xu, Y. Zhou and K. L. Wang. "Quantum Dot Behavior in Bilayer Graphene Nanoribbons", **ACS Nano.** 5, 8769-8773 (2011).
9. E. B. Song, B. Lian , S. M. Kim , S. Lee , T-K. Chung , M. Wang , C. Zeng , G. Xu, K. Wong , Y. Zhou , H. I. Rasool , D. H. Seo , H.-J Chung , J. Heo , S. Seo and K. L. Wang. "Robust Bi-stable Memory Operation in Single-Layer Graphene Ferroelectric Memory", **Appl. Phys. Lett.** 99, 042109 (2011).
10. G. Xu, C. M. Torres, Jr., Y. Zhang, F. Liu, E. B. Song, M. Wang, Y. Zhou, C. Zeng and K. L. Wang. "Effect of Spatial Charge Inhomogeneity on 1/f Noise Behavior in Graphene", **Nano Lett.** 10, 3312-3317 (2010).
11. G. Xu, C. M. Torres, Jr., E. B. Song, J. Tang, J. Bai, X. Duan, Y. Zhang and K. L. Wang. "Enhanced Conductance Fluctuation by Quantum Confinement Effect in Graphene Nanoribbons", **Nano Lett.** 10, 4590-4594 (2010).
12. G. Xu, J. Bai, C. M. Torres, Jr., E. B. Song, J. Tang, Y. Zhou, X. Duan, Y. Zhang and K. L. Wang. "Low-Noise Submicron Channel Graphene Nanoribbons", **Appl. Phys. Lett.** 97, 019034 (2010).
13. E. B. Song, B. Lian, G. Xu, B. Yuan, C. Zeng, A. Chen, M. Wang, S. Kim, M. Lang, Y. Zhou and K. L. Wang. "Visibility and Raman Spectroscopy of Mono and Bilayer Graphene on Crystalline Silicon", **Appl. Phys. Lett.** 96, 081911 (2010).
14. C. Zeng, M. Wang, Y. Zhou, M. Lang, B. Lian, E. B. Song, G. Xu, J. Tang, C. M.Torres, Jr., and K. L. Wang, "Tunneling Spectroscopy of Metal-Oxide-Graphene Structure", **Appl. Phys. Lett.** 97, 032104 (2010).
15. G. Xu, F. Liu, S. Han, K. Ryu, A. Badmaev, B. Lei, C. Zhou and K. L. Wang. "Low-Frequency Noise in Top- Gated Ambipolar Carbon Nanotube Field Effect Transistors", **Appl. Phys. Lett.** 92, 223114 (2008).
16. G. Xu, W. Zhang, Y. Huang and J. Peng. "Loss Characteristics of Single-HE_{11}-Mode Bragg Fiber", **IEEE J. Lightwave Technol.** 25, 359-366 (2007).
17. G. Xu, W. Zhang, Y. Huang and J. Peng. "Large Dispersion Properties and Nonlinear Effects in Up/Down Doping Honeycomb Photonic Crystal Fiber", **Opt. Eng.** 45, 125004, (2006).

CONFERENCE PAPERS/TALKS

1. D. Mao, J. Morley, Z. Zhang, M. Donelley, and G. Xu. "High-yield passive Si photodiode array towards optical neural recording", **63th IEEE International Electron Devices Meeting** (**accepted**, 2017).
2. G. Xu, C. Linghu, K. Piatkevich, K. Adamala, and E. Boyden. "Simultaneous Imaging of Multiple Signaling Pathways in a Living Cell through Spatial Scaffolding", **MIT Department of Brain and Cognitive Sciences Interview Day Poster Session,** Cambridge (2016).
3. K. Piatkevich, E. Jung, G. Xu, F. Chen, and E. Boyden. "Engineering Tools for Mapping Brain Computations", **Junior Scientist Workshop on Protein Engineering: Making and Using Tools for Neuroscience and Other Biological Problems**, Janelia Research campus, Ashburn (2016).
4. G. Xu, K. Piatkevich, K. Adamala, and E. Boyden. "Spatial Multiplexing for Simultaneous Imaging of Multiple Signaling Pathways in a Living Cell", 734.11/DD27, **Society for Neuroscience**, Chicago (2015).
5. N. Sun, Y. Liu. L. Qin, G. Xu and D. Ham. "Solid-State and Biological Systems Interface", **38th ESSCIRC Meeting,** pp. 14-17, Boareaux, France, **invited paper and plenary talk** (2012).
6. G. Xu, C. M. Torres Jr., J. Bai, J. Tang, X. Duan, Y. Zhang and K. L. Wang. "Effect of Edge Disorders on the Scaling Behaviors of Graphene Nanostructures", AA11.4, **MRS Fall Meeting**, Boston (2011).
7. G. Xu, Y. Zhang, F. Liu, X. Duan, Y. Huang and K. L. Wang. "Electronic Transport in Graphene and Graphene Nanoribbons", P21, **DOE BES E-Beam Microcharacterization Centers and Nanoscale Science Research Centers Contractors' Meeting**, The Westin Annapolis (2011).
8. G. Xu, C. M. Torres, Jr., X. Duan, Y. Zhang and K. L. Wang. "Variability Effects in Graphene: Probing its Charge Distribution, Band Structure and Scaling Behavior", P36, **Nature Conference - Graphene: The Road to Applications**, Boston (2011).
9. G. Xu, C. M. Torres, Jr., E. B. Song, J. Tang, J. Bai, X. Duan, Y. Zhang and K. L. Wang. "Low-Frequency Noise of Graphene Nanostructures for Device and Material Characterizations", Y6.7, **MRS Spring Meeting**, San Francisco (2011).
10. G. Xu, C. M. Torres, Jr., E. B. Song, J. Tang, J. Bai, X. Duan, Y. Zhang and K. L. Wang."Enhanced Conductance Fluctuation by Quantum Confinement Effect in Graphene Nanoribbons", T37.00008, **APS March Meeting**, Dallas (2011).
11. G. Xu, J. Bai, C. M. Torres Jr., E. B. Song, J. Tang, Y. Zhou, X. Duan, Y. Zhang, Y. Huang and K. L. Wang.

"Nanowire-Mask Based Fabrication of High Mobility and Low Noise Graphene Nanoribbon Short-Channel Field-Effect Transistors", **68th IEEE Device Research Conference (DRC)**, III-11, 71-72, Notre Dame (2010).

12. G. Xu, C. M. Torres, Jr., Y. Zhang, F. Liu, E. B. Song, M. Wang, Y. Zhou, C. Zeng and K. L. Wang. "Electron-Hole Puddle Induced Scattering and 1/f Noise Behavior in Graphene", **APS March Meeting**, BAPS.2010.MAR.L21.9, Portland (2010).
13. G. Xu, C. M. Torres, Jr., Y. Zhang, F. Liu, E. B. Song, M. Wang, Y. Zhou, C. Zeng, and K. L. Wang. "Effect of Spatial Charge Inhomogeneity on 1/f Noise Behavior in Graphene", **8th International Workshop on Future Information Processing Technologies**, Kyoto, Japan, **invited** (2010).
14. G. Xu, Y. Zhang and K. L. Wang. "Effect of Spatial Charge Inhomogeneity on 1/f Noise Behavior in Graphene", **16th International Conference on Superlattices, Nanostructures and Nanodevices**, IT-27, Beijing, China, **invited** (2010).
15. K. L. Wang, G. Xu and C. M. Torres. "Random Telegraph Signal and Flicker Noise in Carbon Electronics: Carbon Nanotube and Graphene", **LBNL ALS/TMF User Meeting**, Berkeley, **invited** (2009).
16. G. Xu, C. M. Torres, Jr., Y. Zhang, F. Liu, E. B. Song, M. Wang, Y. Zhou, C. Zeng and K. L. Wang. "Electron-Hole Puddle Related Scattering in Graphene", **LBNL ALS/TMF User Meeting**, TMF-34D-CARB, Berkeley (2009).
17. E. Song, B. Lian, C. Zeng, G. Xu, Y. Zhou, C. M. Torres, M. Wang and K. Wang. "Fundamental Studies of Graphene on Crystalline Silicon", **Nano-DDS Conference**, IV (S1) Graphene #3, Fort Lauderdale (2009).
18. G. Xu, F. Liu, S. Han, K. Ryu, A. Badmaev, C. Zhou and K. L. Wang. "Low-Frequency Noise in Top-Gated Ambipolar Carbon Nanotube Field-Effect Transistors", **APS March Meeting**, BAPS.2008.MAR.B35.3, New Orleans (2008).
19. G. Xu, W. Zhang, Y. Huang, and J. Peng. "Optical Properties of Solid Core Honeycomb Photonic Crystal Fiber with Different Doping Levels", **20th International Optics Conference**, Proc. SPIE, 6025, 602505, Changchun, China (2006).

INVITED SEMINARS

1. University of Massachusetts Medical School, MA, April 2016.
2. Worcester Polytechnic Institute, MA, March 2016.
3. Washington University in St. Louis, MO, May 2015.
4. Ohio State University, Columbus, OH, November 2014.

PROFESSIONAL SERVICE

NSF Panelist: ECCS-EPMD Bioelectronics and Sensors (unsolicited), February 2017

Samsung Electronics Panelist: Information and Communications Technology-based Convergence Grant Program (unsolicited), August 2017.

Reviewer: Proceedings of the IEEE, Nano Letters, ACS Nano, Scientific Reports, Journal of American Chemistry Society, Chemical Society Reviews, Applied Physics Letters, IEEE Transactions on Biomedical Circuits and Systems, IEEE Transactions on Electronic Devices, IEEE Electron Device Letters, Nanotechnology, among others.