Curriculum Vitae

Girish Shrinivas Kulkarni, Ph.D.

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Current Positions

Research Fellow, University of Michigan, Ann Arbor — Jan 2015-
(*T3N Fellowship: State of Michigan and University of Michigan*)

President and ***Co-Founder***, Arborsense, Inc. Ann Arbor Michigan, U.S.A. — Feb 2015-

Education

Ph.D. - Electrical Engineering, University of Michigan, Ann Arbor, MI — 2014
Dissertation: 'Carbon nanoelectronic heterodyne sensors: A new paradigm for chemical and biological detection.' *Advisor*: Prof. Zhaohui Zhong
GPA: 4.0/4.0

M.S. - Electrical Engineering, University of Michigan, Ann Arbor, MI — 2010
GPA: 4.0/4.0

B.E. - Electronics and Electrical Communication, Punjab Engineering College, India — 2008
University Gold Medal (82.79%)

Research Interests

1.) Fundamental Science
   a. Nano-electrophysiology and Diagnostics
   b. Nanoelectronic Heterodyne Spectroscopy
   c. Nano-Surface and Interface properties
   d. Low dimensional materials (carbon nanomaterials, TMDCs).
2.) Technology Application
   a. Wearables
   b. Chemical and Biological Sensors and Systems

Grants/Funding Experience

1.) NSF IIP-1548317: Phase I SBIR and Phase IB SBIR Supplemental — **$ 164,954**
Role: **Principal Investigator** — Jan 2016 - Dec 2016
Title: Wearable nanoelectronic vapor sensors for transdermal alcohol monitoring.

2.) Michigan Emerging Technologies Funds (ETF) — **$ 25,000**
Role: **Principal Investigator** — Apr 2016 - Dec 2018
Title: Wearable nanoelectronic vapor sensors for transdermal alcohol monitoring.

3.) NIH 1 R41 AA 024694 - 01 STTR Phase I (*Declined*) — **$ 225,000**
Role: **Principal Investigator** — Jan 2017 - July 2017
Title: Wearable nanoelectronic vapor sensors for transdermal alcohol monitoring.

Grant Writing/Participation:

NSF SBIR Phase II (PI; *Under Review*), M-Kickstart (Internal Funds, Funded - $ 25,000, Co-drafted R&D activity and technical milestones); UM-MTRAC (Internal Funds, Co-drafted R&D activity).

Research Experience

T3N Research Fellow 2015-
Biomedical Engineering, University of Michigan
Mentor: Prof. Xudong Fan

- Investigated fundamental chemical interaction between charge neutral molecules and pristine graphene nano-surface.
- Developed universal, broad-spectrum pristine graphene vapor sensors based for rapid and sensitive detection of polar and non-polar analytes.

Key Contributions:

1.) First demonstration of electrical probing and tuning of non-covalent molecular physisorption on graphene.
2.) First demonstration of detection of non-polar analytes on pristine graphene exploiting the incomplete screening associated with semi-metallic nature of graphene.

Chief Technological Officer 2015-
Arborsense, Inc.

- Explored applicability of graphene vapor sensors for wearable health monitoring.

Key Contributions:

1.) Developed wearable nanoelectronic graphene sensors which monitor transdermal vapors continuously and in real-time.
2.) Implemented circuitry to collect and transmit data from wearable graphene sensors to a smartphone via Bluetooth.

Research Assistant 2009-2014
Electrical Engineering, University of Michigan
Advisor: Prof. Zhaohui Zhong

- Developed carbon nanotube and graphene nanoelectronic heterodyne sensors to address the shortcomings of conventional charge-detection based sensing technologies.

Key Contributions:

1.) Invented and patented a new electronic sensing paradigm: heterodyne sensors.
2.) First demonstration of simultaneous rapid (~0.1s) and sensitive (<1ppb) vapor detection addressing speed-sensitivity trade-off of conventional sensors.
3.) First demonstration of biomolecular detection in physiologically relevant ions strength solutions (~100mM) by mitigating the fundamental Debye screening effect.

Undergraduate Intern
Centre Scientific Instruments Organisation (CSIO) 2007
Chandigarh, India

- Evaluated charge transport in DNA nanowires.

Key Contributions:

1.) Identified effect of base pair sequence on charge hopping in DNA nanowires.

Publications

In preparation

1. W. Zang, **G.S. Kulkarni**, H. Zhu, K. Lee, X. Fan and Z. Zhong, 'A universal graphene nanoelectronic detector for polar and non-polar analyte sensing', *to be submitted*.

Submitted

1. **G.S. Kulkarni**, W. Zang and Z. Zhong, 'Nanoelectronic Heterodyne Sensor: A New Electronic Sensing Paradigm', *Accounts of Chemical Research, **Invited Article**, submitted*, 2016.

Published

1. K. Lee, **G.S. Kulkarni** and Z. Zhong, 'Coulomb blockade in monolayer MoS2 single electron transistor', *Nanoscale*, DOI: 10.1039/c5nr08954a (2016).
2. **G.S. Kulkarni**, K. Reddy, W. Zang, K. Lee, X. Fan and Z. Zhong, 'Electrical probing and tuning of molecular physisorption on graphene', *Nano Letters*, 2016, 16, pp. 695−700.
3. **G.S. Kulkarni**, K. Reddy, X. Fan and Z. Zhong, 'Graphene nanoelectronic heterodyne sensor for rapid and sensitive vapour detection.' *Nature Communications*, 5:4376 doi: 10.1038/ncomms5376 (2014)
   - Work highlighted in IEEE spectrum, Michigan Radio, Nanowerk, Wearable Tech, World Journal, Science Journal, Phys.org, Health and Environment, Controlled Environment.
4. **G.S. Kulkarni**, Z. Zhong, 'Fabrication of Carbon Nanotube High-Frequency Nanoelectronic Biosensor for Sensing in High Ionic Strength Solutions.' *J. Vis. Exp.* (77), e50438, doi: 10.3791/50438 (2013)
5. L. David, R. Bhandavat, **G. Kulkarni**, S. Pahwa, Z. Zhong and G. Singh, 'Synthesis of Graphene Films by Rapid Heating and Quenching at Ambient Pressures and Their Electrochemical Characterization.' *Applied Materials & Interfaces* 5, 546 (2013)
6. S. Lee, K. Lee, C. H. Liu, **G.S. Kulkarni** and Z. Zhong, 'Flexible and transparent all-graphene circuits for quaternary digital modulations.' *Nature Communications* 3, 1018 (2012)
7. **Girish S. Kulkarni** and Zhaohui Zhong, 'Detection beyond the Debye screening length in a high frequency nanoelectronic biosensor.' *Nano Letters* - 2012, 12 (2), pp. 719-723
8. Inderpreet Kaur, **Girish S. Kulkarni**, Ram Ajore, Bhanu Prakash Kotamarthi, Nimal Singh, Lalit M. Bharadwaj, 'Role of Adenine and Guanine Sites in Hole Hopping in DNA Nanowire', Journal of Theoretical and Computational Chemistry Vol. 08, 529 (2009)

Patents

1. Zhaohui Zhong, **Girish Kulkarni**, Karthik Reddy and Xudong Fan, 'Graphene Nanoelectronic Heterodyne Sensor for Rapid and Sensitive Vapor Detection', PCT/US2014/068578, US patent filed - 05/19/2016

Invited Talks

1. 'Graphene Heterodyne Vapor Sensors'- Agilent Technologies, Ann Arbor, 2014

Conference Presentations And Talks

1. **Girish Kulkarni**, Karthik Reddy, Wenzhe Zang, Xudong Fan and Zhaohui Zhong - 'Probing molecule-graphene binding affinity with graphene nanoelectronic heterodyne sensor.' *Materials Research Society*, Boston, 2014. (Oral presentation)

2. **Girish Kulkarni**, Karthik Reddy, Xudong Fan and Zhaohui Zhong - 'Graphene heterodyne vapor sensors for rapid and sensitive vapor detection.' *56th Electronic Materials Conference*, Santa Barbara, 2014. (Oral Presentation)
3. **Girish Kulkarni**, Karthik Reddy, Xudong Fan and Zhaohui Zhong - 'A high speed high sensitivity graphene nanoelectronic vapor sensor.' *Materials Research Society*, Boston, 2013. (Oral presentation)
4. **Girish Kulkarni** and Zhaohui Zhong - 'High speed high sensitivity carbon nanomaterial based chemical and biological sensors.' *Engineering Graduate Symposium*, Ann Arbor, 2013. (Poster presentation)
5. **Girish Kulkarni** and Zhaohui Zhong - 'A High Frequency Nanoelectronic Biosensor.' *Materials Research Society*, San Francisco, 2011. (Poster presentation)
6. **Girish Kulkarni**, Kaiboon Ee and Zhaohui Zhong - 'Carbon Nanotube Based High Frequency Biosensors.' *American Physical Society*, Portland, 2010. (Oral presentation)

Honors And Awards

1. Tech Transfer Talent Network Postdoctoral Fellowship 2015-2016
2. University of Michigan Rackham Predoctoral Fellowship 2014
3. Engineering Graduate Symposium Award (2nd position), UM 2013
4. Rackham Graduate Student Research Grant, UM 2010,2014
5. Bharat Petroleum Corporation Ltd. Scholarship for Higher Studies (India) 2008
6. Gold Medal, Punjab Engineering College (Ranked 1st to Department) 2008
7. Silver Medal, Punjab Engineering College (1st in senior year project) 2008
8. Academic Tuition Freeship for Undergraduate studies 2005-2008
9. PECOSA Sydney Scholarship, Punjab Engineering College 2005,2008

Teaching Experience

Certifications

1. Preparing Future Faculty 2015
   Center for Research on Learning and Teaching (CRLT) certification
   University of Michigan
2. *Next*Prof Workshop 2015
   University of Michigan

Mentoring

1. Mentored one graduate student in Lurie Nanofabrication Laboratory and Zhong Lab at University of Michigan.
2. Trained and guided two research technicians for development of wearable graphene sensors at Arborsense, Inc.

Guest Lectures

1. Course: EE-215 Introduction to Electronic Circuits (4 one-hour lectures) Fall 2010
Instructor: Prof. Fawwaz Ulaby

Teaching Assistance

1. Course: EE-215 Introduction to Electronic Circuits Fall 2013
   University of Michigan, Instructor: Profs. Fred Terry & Heath Hofmann
   (Undergraduate course; class strength - 180)

2. Course: EE-215 Introduction to Electronic Circuits — Fall 2010
   University of Michigan, Instructor: Prof. Fawwaz Ulaby
   (Undergraduate course; class strength - 190)

Grader

1. Course: EE-520 Solid State Physics — Fall 2014
   University of Michigan, Instructor: Prof. Zhaohui Zhong
   (Graduate course, class strength - 50)

Professional Service

External

Reviewer for Nature scientific reports, IEEE Transactions on Nanotechnology, Optics Express

Internal

1. Speaker, Undergraduate Research Opportunity Program (UROP) — 2015
   Wearable Technology Interdisciplinary Seminar, University of Michigan
2. Treasurer, Nanoelectronics and Integrated Microsystems Students Association — 2012
   University of Michigan
3. Member, *Les Amis* (A registered non-profit student's organization) — 2004-2008
   Punjab Engineering College, Chandigarh India
   Events:
   a.) Annual Recruitment Drive, *Head - Arrangements and Venue* — 2005
   b.) Zèle, *Head - Printing* — 2005
   c.) Scintilla, *Head - Marketing* — 2004
   d.) Panorama, *Organizing committee member* — 2004-2007

Selected Media Coverage

1. 'Wearable technologies from Michigan', Michigan Radio
2. 'Graphene-based Sensor Brings New Wrinkle to Wearables', IEEE Spectrum
3. 'U-M developing wearable tech for disease monitoring', UM EECS News
4. 'Wolverines Working on Next Level Wearable Tech', Wearable Tech
5. 'New wearable vapour sensor for disease monitoring', Times of India
6. 'Team developing wearable tech for disease monitoring', Phys.org
7. 'U-M researchers develop graphene-based wearable vapor sensors', Graphene-info.com
8. 'Disease Monitoring Comes to Wearables', www.wearables.com
9. 'Graphene for Wearable Sensors', www.thegraphenecouncil.org
10. 'Graphene Nanoelectronic Sensors Could Help Monitor Diseases', Azonano.com

References

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