

NIKHIL TILAK

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PROFESSIONAL EXPERIENCE

Postdoctoral Associate, Rutgers University, New Jersey, USA.
Physics Faculty, Bakliwal Tutorials, Pune, India.

07/2023 - present
06/2014 - 05/2015

EDUCATION

Ph.D. in Physics, Rutgers University, New Jersey, USA.
B.Tech. in Engineering Physics, Indian Institute of Technology Guwahati, Assam, India.

09/2015 - 06/2023
08/2010 - 05/2014

RESEARCH PROJECTS

1. Structure and electronic properties of marginally twisted MoS₂.

Studied lattice-relaxation, moire potentials and interfacial ferroelectricity in marginally twisted MoS₂ bilayers using scanning tunneling microscopy (STM) and piezoresponse force microscopy (PFM).

2. Carrier confinement in magic-angle twisted bilayer graphene.

Investigated the effects of substrate potential disorder on magic-angle twisted bilayer graphene using STM/STS.

3. Proximity-induced charge density wave in graphene/1T-TaS₂.

Investigated the incommensurate and commensurate CDW phases in 1T-TaS₂. Used graphene as a cover to protect TaS₂ surface from degradation.

4. Design and construction of a low temperature scanning tunneling microscope.

Designed and constructed a dip-stick style STM and a scanner head capable of operating from 300 K to 4.2 K. System was optimized to reduce heat-load to reduce cryogen consumption.

5. Effect of strain on CVD graphene microdrums.

Optimized the growth of monolayer graphene on copper foils. Transferred the graphene to holey silicon nitride substrates to make suspended graphene devices for strain measurements.

SKILLS

1. Device fabrication.

Expertise in making van der Waals heterostructures. Electrical contact fabrication using e-beam lithography and photolithography, thermal metal deposition, reactive ion etching, wet etching etc. Experienced in working with air-sensitive materials inside an inert gas filled glovebox.

2. Characterization techniques.

Scanning tunneling microscopy (STM), scanning probe microscopy (AFM, KPFM, EFM, PFM, force-distance spectroscopy), electronic transport, Raman spectroscopy, optical microscopy.

3. Vacuum and cryogenic techniques.

Expert at design, construction and maintenance of ultra/high vacuum chambers and cryogenic temperature measurement apparatus. Highly experienced in helium leak detection.

4. Mechanical and electronics.

Soldering, Brazing, CAD, Machining (Drilling, Lathe, Milling), Arduino based circuits.

5. Data analysis and programming.

Python, Origin, LabVIEW, Mathematica, C/C++. Experienced in machine learning and deep learning using scikit-learn, TensorFlow etc.

PUBLICATIONS

- ¹N. Tilak, G. Li, T. Taniguchi, K. Watanabe, and E. Y. Andrei, “Moiré potential, lattice relaxation, and layer polarization in marginally twisted mos2 bilayers”, Nano Letters (2022).
- ²N. Tilak, X. Lai, S. Wu, Z. Zhang, M. Xu, R. d. A. Ribeiro, P. C. Canfield, and E. Y. Andrei, “Flat band carrier confinement in magic-angle twisted bilayer graphene”, Nature communications **12**, 4180 (2021).
- ³M. A. Altvater, N. Tilak, S. Rao, G. Li, C.-J. Won, S.-W. Cheong, and E. Y. Andrei, “Charge density wave vortex lattice observed in graphene-passivated 1t-tas2 by ambient scanning tunneling microscopy”, Nano Letters **21**, 6132–6138 (2021).
- ⁴M. A. Altvater, N. Tilak, S. Rao, G. Li, C.-J. Won, S.-W. Cheong, and E. Y. Andrei, “Observation of a topological defect lattice in the charge density wave of 1t-tas2”, Applied Physics Letters **119**, 121601 (2021).
- ⁵R. K. Biroju, N. Tilak, G. Rajender, S. Dhara, and P. Giri, “Catalyst free growth of zno nanowires on graphene and graphene oxide and its enhanced photoluminescence and photoresponse”, Nanotechnology **26**, 145601 (2015).

CONFERENCE TALKS AND POSTERS

1. STM studies of marginally twisted MoS₂ bilayers [poster] Rutgers Center for Materials Theory symposium, 2022
2. Moiré bands in twisted MoS₂ homobilayers [talk] APS March Meeting 2022, Chicago
3. Observation of charging peaks near the flat band in magic-angle twisted bilayer Graphene [talk] APS March Meeting 2021, Virtual
4. A method for controllably inducing ultra-high strain in suspended 2D materials [talk] APS March Meeting 2018, Los Angeles

RECENT HONORS

- David C. Langreth Graduate Development Award 2017
“Presented annually to an especially promising early-stage graduate student by the Department of Physics and Astronomy at Rutgers.”
- MITACS Globalink Research Internship 2013
Was selected for a 12-week research internship at the *Institut national de la recherche scientifique*, Varennes, Quebec, Canada.

REVIEWER FOR

ACS Nano, ACS Nano Letters, NPJ Quantum materials

TEACHING EXPERIENCE

1. Teaching Assistant, Rutgers University, NJ, USA. (Sept 2015- May 2018)
TA for extended analytical physics (115), analytical physics (123 & 124), intro solid state physics (406), graduate quantum mechanics 1 (501), electromagnetism (385) and classical physics lab (276).
2. Taught calculus-based physics for the highly selective Indian institutes of technology joint entrance exam (IIT-JEE).
1200+ hours of teaching experience to over 550 high school students (11th and 12th grade).

LEADERSHIP AND MENTORSHIP

1. Directly mentored five undergraduate students leading to successful transitions to Graduate school and industry.
2. Student representative on the Graduate Studies and Life Committee (AY 2018-19)
3. Vice President of the Physics and Astronomy Graduate Student Organization. (AY 2016-17)