Nikhil Tilak, Ph.D.

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SUMMARY

I'm a Postdoctoral associate in Physics at Rutgers University with 8+ years of experience in nanofabrication of devices and their characterization via electronic tunneling and transport measurements. I'm a quick-learner who thrives in a collaborative environment. I'm highly skilled at designing experiments, collecting and analyzing data, and presenting findings as evidenced by my 6 peer-reviewed journal publications and conference talks. Additionally, I am experienced in numerical and machine learning techniques using Python and am always working to expand my skill set. I'm currently seeking process/yield engineering roles in the semiconductor industry and data scientist/analyst positions.

SKILLS

- **Device fabrication:** Silicon wafer cleaning (RCA), Nanofabrication using e-beam lithography (FEI Sirion, Hitachi S-5500), thermal metal deposition (Gold, Chromium, Titanium), reactive ion/Plasma etching (O_2, CHF_3), HF wet etching of silicon dioxide, wire bonding (West Bond).
- **Characterization:** Scanning tunneling microscopy (built my own system), atomic force microscopy (NT-MDT, Asylum Cypher), Kelvin probe force microscopy, Electrostatic force microscopy, Piezoresponse microscopy, force-distance spectroscopy, electronic transport, Raman spectroscopy (Renishaw), optical microscopy.
- **Vacuum & cryogenics:** Expert at design, construction and maintenance of HV/UHV chambers and cryogenic temperature measurement apparatus. Helium leak detection (Agilent).
- **Mechanical and electronics:** Soldering, Brazing, CAD (Fusion 360), Machining (Drilling, Lathe, Milling), Arduino circuits.
- **Data analysis & programming:**
  - **Languages & platforms**: Python, C, SQL, HTML, CSS, Git/Github.
  - **Python packages**: NumPy, SciPy, Pandas, Scikit-Learn, OpenCV, NLTK, TensorFlow.
  - **Machine learning**: Linear/Logistic regression, KNN, SVM, PCA, Random Forests, XGBoost, NLP.
  - **Certificates**:Erdos institute data science bootcamp   05/2020 - 07/2020
                    Applied data science with Python.(Univ. of Michigan on Coursera)   01/2020 - 06/2020

PROFESSIONAL EXPERIENCE

- **Postdoctoral Associate** | Rutgers University, Piscataway, New Jersey   07/2023 - present
  Studying correlated phases in two-dimensional heterostructures and moire materials with tunneling and electrical transport measurements.
- **Graduate Research Assistant** | Rutgers University, Piscataway, New Jersey   05/2018 - 06/2023
  Conducted Scanning tunneling microscopy experiments on twisted two-dimensional materials leading to 6 high impact journal publications.
- **Teaching Assistant** | Rutgers University, Piscataway, New Jersey   09/2015 - 05/2018
  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).
- **Physics Faculty** | Bakliwal Tutorials, Pune, India.   06/2014 - 05/2015
  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 juniors and seniors.
- **Research Intern** | INRS, Montreal, Canada   05/2013 - 07/2013
  Won the prestigious MITACS Globalink summer internship award. Worked on lead-sulfide quantum dots.

RESEARCH PROJECTS

- **Structure and electronic properties of marginally twisted MoS_2.**
  Studied lattice-relaxation, moire potentials and interfacial ferroelectricity in marginally twisted MoS2 bilayers using scanning tunneling microscopy (STM) and piezoresponse force microscopy (PFM).
- **Carrier confinement in magic-angle twisted bilayer graphene.**
  Investigated the effects of substrate potential disorder on magic-angle twisted bilayer graphene using STM/STS.
- **Proximity-induced charge density wave in graphene/1T-TaS_2.**
  Investigated the incommensurate and commensurate CDW phases in 1T-TaS_2. Used graphene as a cover to protect TaS2 surface from degradation.
- **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.
- **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.

SELECTED DATA PROJECTS

Bookend : predict author from text snippet | repo, video   05/2020 - 07/2020

Won 1st place in the final project competition of Erdos data bootcamp.

- Trained an ensemble classifier model on books scraped from project Gutenberg to predict the authorship of a snippet of text with 93% accuracy.
- Led a team of four and was responsible for dividing tasks and establishing a GitHub-based workflow to maximize productivity.
- Implemented a bag-of-words model which gave the highest prediction accuracy score 85% among the models in the ensemble.

Sudoku-Solver: solve a Sudoku puzzle given its picture | repo, webapp   11/2022 - 01/2023

- Wrote a custom pipeline which processes the image, identifies the filled digits and produces a solution.
- Deployed a Docker containerized Dash/Plotly app to Google Cloud (GCP).

BreweryXplorer: explore 3000+ breweries in the US | repo, webapp   05/2021 - 08/2021

- Scraped and cleaned unstructured brewery data from Wikipedia and other open sources.
- Designed an interactive Dashboard using Dash/Plotly which was deployed to Heroku.

EDUCATION

- **Ph.D. in Physics** | Rutgers University, Piscataway, New Jersey   09/2015 - 06/2023
  Dissertation: *Scanning tunneling microscopy studies of twisted van der Waals heterostructures.*
- **B.Tech. in Engineering Physics** | Indian Institute of Technology, Guwahati, Assam, India.   08/2010 - 05/2014
  Placed 2nd in my cohort with a GPA of 9.04/10.

SELECTED PUBLICATIONS (google scholar)

[1] N. Tilak, M. A. Altvater, S.-H. Hung, *et al.*, "Revealing the charge density wave proximity effect in graphene 1t-TaS_2.," *(under review at Nature materials)*, 2023.

[2] N. Tilak, G. Li, T. Taniguchi, K. Watanabe, and E. Y. Andrei, "Moiré potential, lattice relaxation, and layer polarization in marginally twisted MoS_2 bilayers," *Nano Letters*, 2022.

[3] N. Tilak, X. Lai, S. Wu, *et al.*, "Flat band carrier confinement in magic-angle twisted bilayer graphene," *Nature communications*, vol. 12, no. 1, p. 4180, 2021.

[4] M. A. Altvater, N. Tilak, S. Rao, *et al.*, "Charge density wave vortex lattice observed in graphene-passivated 1t-tas2 by ambient scanning tunneling microscopy," *Nano Letters*, vol. 21, no. 14, pp. 6132–6138, 2021.

[5] M. A. Altvater, N. Tilak, S. Rao, *et al.*, "Observation of a topological defect lattice in the charge density wave of 1t-tas2," *Applied Physics Letters*, vol. 119, no. 12, p. 121 601, 2021.

[6] R. S. Bisht, J. Park, H. Yu, *et al.*, "Spatial interactions in hydrogenated perovskite nickelate synaptic networks," *Nano Letters*, Jul. 2023.

[7] R. 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*, vol. 26, no. 14, p. 145 601, 2015.

CONFERENCE TALKS & POSTERS

- STM studies of marginally twisted MoS_2 bilayers [poster]   Rutgers Center for Materials Theory symposium, 2022
- Moiré bands in twisted MoS2 homobilayers [talk]   APS March Meeting 2022, Chicago
- Observation of charging peaks near the flat band in magic-angle twisted bilayer Graphene [talk]   APS March Meeting 2021, Virtual
- 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"

REVIEWER FOR

ACS Nano, ACS Nano Letters, NPJ Quantum materials

LEADERSHIP AND MENTORSHIP

- Directly mentored five undergraduate students leading to successful transitions to graduate school and industry.
- Student representative on the graduate studies and life committee (AY 2018-19)
- Vice President of the Physics and Astronomy Graduate Student Organization. (AY 2016-17)