

# Xueqiao Wang

Ph.D. candidate

Cambridge, MA | xueqiaow@mit.edu | <https://sites.mit.edu/xueqiaowang/>

---

## Summary

Condensed matter physicist with strong background in materials science

## Key Competencies

- Nanofabrication
- Low temperature electrical transport
- Cryogenic capacitance measurements
- Characterization of 2D materials

---

## EDUCATION

### Massachusetts Institute of Technology, Cambridge, Massachusetts

- Ph.D. Candidate in Materials Science and Engineering expected graduation 2027
- M.Sc. in Materials Science and Engineering March 2022
- Supervisor: Pablo Jarillo-Herrero
- GPA: 5.0/5.0

### Georgia Institute of Technology, Atlanta, Georgia

December 2019

- B.Sc. in Materials Science and Engineering
  - Concentration: Structural and Functional Materials
  - Certificate: Nanomaterials
  - Certificate: Research Option, with thesis "Load Dependent Fatigue Crack Initiation in High Purity Al"
  - Capstone Design thesis and first authored paper "FTIR and Gravimetric Determination of Solvent Mass Diffusivity in 3M's Vinyl Films"
  - GPA: 4.0/4.0

---

## PROFESSIONAL EXPERIENCE

### Graduate research assistant

Sep 2020 – present

*Jarillo-Herrero Group for Quantum Nanoelectronics, Dept. of Physics, MIT, Cambridge, MA*

*Quantum transport studies on emergent phases of matter in novel 2D material systems*

- **Co-discovered unconventional ferroelectricity** in graphene-hBN moiré systems that realize continuously tunable polarizations and electronic ratchet effect [2]
- Designed a **novel 2D material device structure** and corresponding measurement scheme to realize a dual mode hybrid analog-digital ferroelectric field effect transistor (FeFET) based on combined unconventional and sliding ferroelectricity (publication in preparation)
- Fabricated the **smallest** FeFETs (50nm) made of sliding hBN layers (publication in preparation)
- Applied **nanosecond pulsing** to hybrid FeFETs to study polarization switching dynamics of two ferroelectric mechanisms (publication in preparation)
- Applied capacitance measurements with high electron mobility transistor (HEMT)-based **cryogenic on-chip amplifier** to study the microscopic mechanism of unconventional ferroelectricity
- **Lead** team of four group members to design and create **sample carrier PCB**, mechanical support and wiring of a **cryogenic** measurement probe and with copper tape **filters** for thermal noise reduction

- Fabricated high quality graphene-hBN moiré heterostructure devices with a negative differential resistance regime, enabling a **new mechanism for single photon detection** with higher operating temperature and longer wavelength range [1]
- Fabricated transport and capacitance devices from hBN-graphene moiré heterostructure that realize **room temperature neuromorphic** functionalities [3]

#### Research Intern

Jan – Aug 2020

*Materials Science Division, Physical and Life Science Directorate, Lawrence Livermore National Laboratory, Livermore, CA*

*Optimization of 2D material based aerogel for applications in 3D printable batteries and supercapacitors*

- Improved preparation recipe for rGO based electrode ink and aerogel

#### Research Assistant

Nov 2016 – Dec 2019

*Kacher Lab, Georgia Tech, Atlanta, GA*

*Study of mechanical deformation pathways in Al alloys: fatigue crack initiation, slip trace formation, grain boundary (GB) deformation and ledge formation*

- Incorporated digital image correlation strain mapping in tensile and fatigue tests
- Designed and optimized experimental procedures on annealing, fatigue testing, Ga-induced liquid metal embrittlement of high purity Al and Al alloys
- SEM, TEM, STEM imaging, and stereoscopic reconstruction of imaging data

#### Research Assistant

Aug 2017 – Dec 2019

*Microelectronic and Photonic Packaging Materials Group, Georgia Tech, Atlanta, GA*

*Synthesis and characterization of conductive polymer composites, graphene-based supercapacitors, electrically conductive adhesives*

- Developed silo-Ag isotropically conductive adhesives (ICA) with resistivity below  $10^{-4}$   $\Omega$ -cm with little hysteresis under reversed mechanical straining
- Synthesized and characterized polyurethane (PU) and polydimethylsiloxane (PDMS) with rGO and silver nanoparticle fillers with optical, thermal, and mechanical testing tools (FTIR, XPS, DSC, DMA, TGA, lap shear and tensile tests)

#### Research Intern

May – Aug 2019

*Laboratory for Multiscale Materials Experiments, Paul Scherrer Institute, Switzerland, and*

*Laboratory of Mesoscopic Systems, Department of Materials, ETH Zurich, Switzerland*

*MFM and MOKE study of energetics of chirally coupled nanomagnet systems, exchange bias modeling, and kagome Ising lattice ground state characterization [4, 5]*

- Designed sample geometry, characterized magnetization configuration of magnetic nanoislands with magnetic force microscopy (MFM) and magneto optical Kerr effect (MOKE) microscope
- Designed and tested field-based demagnetization and thermal based activation protocols to obtain ground and excited state configurations
- Developed MATLAB program for MFM image recognition, magnetization analysis, domain wall recognition, correlation length and magnetic structure factor calculation and demagnetization result simulation

## Research Intern

Jun – Aug 2018

*Lab of Technical Electrochemistry, Dept. of Chemistry, Technical University of Munich, Germany*  
*Research on the effect of binder migration and C65 gradient on tortuosity of Nickel-Manganese-Cobalt (NMC) cathode and electrochemical performance of Li ion batteries*

- Designed sample preparation and testing procedure of slurry preparation and coating of NMC cathode and graphite anode
- Performed electrochemical impedance spectroscopy, energy dispersive X-ray spectroscopy mapping, electrical resistance modeling and tortuosity analysis

## SKILLS

---

|                         |                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Experimental techniques | Electrical transport, capacitance, photocurrent, Raman and FTIR spectroscopy, atomic force microscopy (multiple variants), scanning and transmission electron microscopy |
| Instrumentation         | Sub-Kelvin cryogenics, nanofabrication                                                                                                                                   |
| Programming Languages   | Python (numpy, matplotlib), MATLAB                                                                                                                                       |

## FELLOWSHIPS AND AWARDS

---

|                                                                               |             |
|-------------------------------------------------------------------------------|-------------|
| MIT Provost Women and Minority Fellowship                                     | 2020 – 2021 |
| - 5 recipients among all MIT graduate students                                |             |
| Davidson Family Tau Beta Pi Senior Engineering Award                          | 2020        |
| - one recipient per class year in the School of Engineering at Georgia Tech   |             |
| The Outstanding Scholar Award, <i>ASM materials Education Foundation</i>      | 2019        |
| First Place winner of student presentation contest, <i>ASTM International</i> | 2017        |

## PUBLICATIONS

- 
- [1] K. Nowakowski, H. Agarwal, S. Slizovskiy, R. Smeyers, **X. Wang**, ..., P. Jarillo-Herrero, R. K. Kumar, F. H. L. Koppens, "Single-photon detection enabled by negative differential conductivity in moiré superlattices". *Science* **389**,644-649 (2025).
  - [2] Z. Zheng, **X. Wang**, ... P. Jarillo-Herrero, Q. Ma, "Electronic ratchet effect in a moiré system: signatures of excitonic ferroelectricity". arXiv:2306.03922.
  - [3] X. Yan, Z. Zheng, V.K. Sanguwan, J.H. Qian, **X. Wang**, ..., P. Jarillo-Herrero, Q. Ma, M.C. Hersam, "Moiré synaptic transistor with room-temperature neuromorphic functionality". *Nature* 624, 551–556 (2023).
  - [4] **X. Wang**, J. Yeager, C. Stanek, S. Pennell, A. Muñoz, S. Stewart, S. Gregory, and B. Brettmann, "Effects of molecular structure on liquid- and vapor-phase diffusion through poly(vinyl chloride) films," *ACS Appl. Polym. Mater.* 2020, 2, 11, 4697–4708.
  - [5] K. Hofhuis, **X. Wang**, A. Hrabec, Z. Luo, Z. Liu, P. Gambardella, P. M. Derlet, and L. J. Heyderman, "Geometrical control of disorder-induced magnetic domains in planar synthetic antiferromagnets," *Physical Review Materials*, vol. 6, no. 3, 2022.
  - [6] J. Colbois, K. Hofhuis, Z. Luo, **X. Wang**, A. Hrabec, L.J. Heyderman, and F. Mila, "Artificial out-of-plane Ising antiferromagnet on the kagome lattice with very small farther-neighbor couplings," *Phys. Rev. B* 104, 024418 (2021).