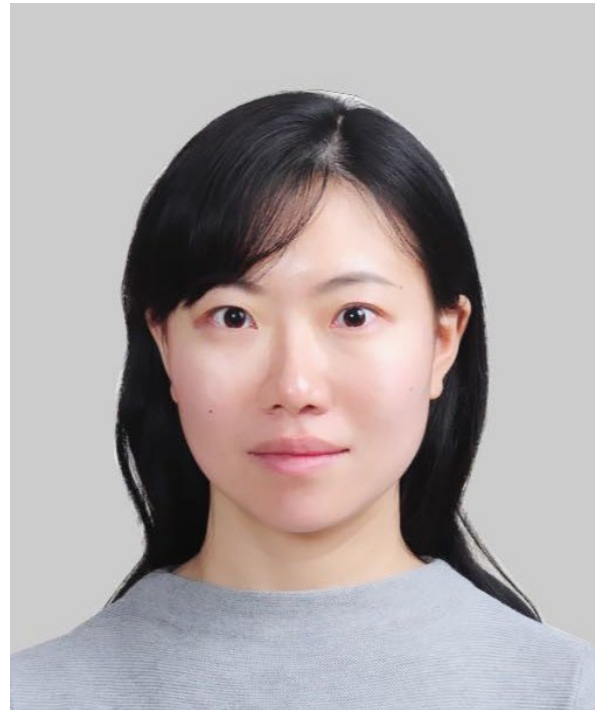


# DOCTORAL DEFENSE

## Reconfigurable Graphene Complex Oxide Nanostructures

### Qing Guo



**Abstract:** Graphene and complex-oxide heterostructures collectively exhibit nearly all of the known major properties in solid-state materials. Our goal is to integrate these two materials to create new emergent properties and functionalities. A new wet graphene transfer method is developed and used to integrate graphene with the complex-oxide system  $\text{LaAlO}_3/\text{SrTiO}_3$ . Interactions between the graphene and  $\text{LaAlO}_3/\text{SrTiO}_3$  interface are controlled at nanoscale dimensions using a conductive atomic force microscopy technique developed previously for the complex-oxide interface. The resulting hybrid structures exhibit novel and useful electronic and optical properties, many of which depend critically on controlling the chemical potential of graphene relative to the charge-neutrality point. The local density of states can be altered in graphene by programmable changes of the conductance of the complex oxide interface. In one experiment, an edge-mixed quantum hall effect is observed in sketched graphene/complex-oxide p-n junction devices. Magnetotransport measurements of superlattice structures show characteristic interference features that can be associated with the periodically patterned interface. Frictional drag measurements between single-layer graphene and a conductive  $\text{LaAlO}_3/\text{SrTiO}_3$  interface is also performed in these hybrid devices. The metallic behavior and high transparency of graphene make it an ideal top electrode for controlling magnetic properties at the  $\text{LaAlO}_3/\text{SrTiO}_3$  interface. We discuss possible new directions based on this highly versatile hybrid material platform.

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Zoom ID: 916 880 2489

Non-department members:

Contact Graduate Administrator  
at [pagrad@pitt.edu](mailto:pagrad@pitt.edu) for access

Research Advisor:

Dr. Jeremy Levy