UC San Diego
JACOBS SCHOOL OF ENGINEERING
NanoEngineering

UCSD NANO & CHEMICAL ENGINEERING

# SPECIAL SEMINAR

**March 22nd 2023**

**Seminar Presentation: 9:30AM-10:30AM**

**SME Room 248**

***"Boundless Boundary: Quantum transport through heterojunctions and superlattices"***


## Dr. Qi Qian

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**Abstract:** Quantum materials, having a rich variety of quantum states and phases, are primary workhorse in the emerging second quantum evolution. It is critical to discover and understand functional phases of quantum matter and translate them into technological advances. In this talk, I will focus on the development and investigation of high-quality heterojunctions and superlattices, and the exploration of the unique quantum transport properties of these novel material platforms. I will first show how quantum nematic to smectic phase transition in conventional GaAs/AlGaAs interface is triggered with minimized disorder and low electronic temperature. I will then show several unique methods using the novel van der Waals (vdW) integration approach, where atomically flat interfaces can be achieved between various systems through vdW interaction and can be extended to multiple layers forming high-order superlattice structures. They enable a series of quantum transport studies, including the observation of weak localization effect and ferroelectric large polaron formation in lead halide perovskite, as well as robust spin tunneling in chiral molecule intercalation superlattice. Inspired by these findings, I will also discuss the exciting opportunities of vdW integration for creating new artificial quantum solids with designable chemical compositions, dimensionality, interlayer distances and structure motifs, which opens up brand new platforms for both the fundamental studies and quantum technologies.


**Educational Development and Training:** The quest for searching new material systems for quantum science and technology has motivated the speaker's career development efforts. This presentation shares how nano engineering and physics can be beautifully combined together to build up new quantum materials. It will illustrate how to design experiments and use problem solving skills, and how to build up mentorship between PI's, students, and postdocs. It will also explain that collaborations among different labs have been a critical part in today's research projects.

**Biosketch:** Dr. Qi Qian is currently a postdoctoral research scholar at UCLA in the Department of Chemistry and Biochemistry with Prof. Xiangfeng Duan. She received her Ph.D. degree in condensed matter physics from Purdue University in 2018 with Prof. Michael Manfra. Her research interest includes quantum materials engineering, nanoscale devices development and low temperature quantum transport properties investigation. Her research works are published in top peer-reviewed journals and conferences, including Nature, Nature Materials, Nature Nanotechnology, Nature Communications, Advanced Materials and Physical Review B. She has received 2023 Material Research Society (MRS) Postdoctoral Award, the nomination of 2022 Chancellor's Award for Postdoctoral Research at UCLA, 2018 the Lark-Horovitz Prize in Physics at Purdue University, 2018 Lijuan Wang Memorial Award at Purdue University.