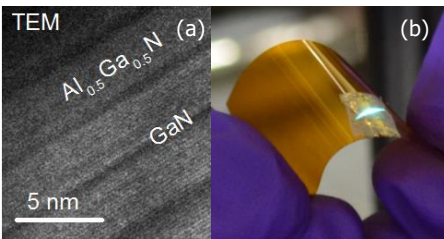
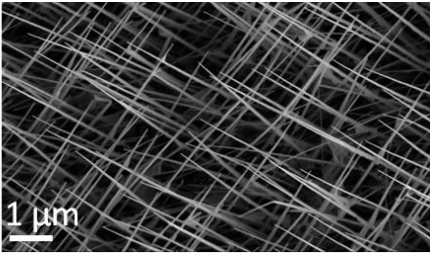


Semiconductor Optoelectronics and Nanostructures



(a) TEM cross section of GaN QWs grown on graphene, (b) Luminescence from a GaN QW transferred to a flexible substrate.



MOVPE grown GaN nanowires

Tools & Techniques

We use metalorganic vapour phase epitaxy (MOVPE) for the synthesis of compound semiconductors. We have two MOVPE systems, a horizontal reactor for As/P materials and a 3x2" closed-coupled showerhead system for III-Nitrides, with in-situ optical sensors for growth monitoring. We also use the extensive structural, optical and electrical characterization tools across the department to analyze and understand our materials.

CURRENT MEMBERS:

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Compound semiconductors and devices

Optoelectronic devices – lasers, LEDs, transistors etc. – that drive today's technological world depend on combining various semiconductors, typically of different bandgaps. These devices have many layers, ranging from few atoms to a few μm in thickness. Semiconductor quantum structures – ultra-thin film, wire, or dot-like configurations of nm size are at the heart of most devices. The growth of compound semiconductor heterojunctions is the first step for devices. Our lab specializes in the epitaxial growth and characterization of bulk and low-dimensional (quantum wells/wires/dots) III-V semiconductors, particularly III-nitrides, and their use in different heterostructures and devices.

Ongoing research

MOVPE grown III-Nitrides

- Synthesis of semi-polar and non-polar oriented nitrides. HRXRD techniques to characterize epilayers with anisotropic biaxial strain, polarization resolved measurements of optical properties.
- Novel substrates for III-nitrides: MOVPE growth on graphene, MoS₂ WS₂
- Heterostructures for devices – 2D electron gas layers for HEMTs, InGaN/GaN and AlGaIn/GaN QWs for LEDs, etc.
- Growth of nanowires and quantum dots in III-nitrides

Other III-V and 2D materials

- VLS grown nanowires of InAs, InP and core-shell structures
- Study of the 2D-3D transition and the effects of growth kinetics quantum dots (InAs/GaAs, InAs/InP)
- Heterostructures for QW lasers, QW infrared photodetectors
- Synthesis and characterization of bulk and thin-films of transition metal dichalcogenides like ReS₂, ReSe₂, MoS₂, WS₂ etc.



Showerhead MOVPE system for the synthesis of III-nitride materials. The system can handle 3 2-inch wafers, and is equipped with an in-situ real-time optical sensors for measuring surface temperature, growth rate, and sample curvature.