Canadian Centre for Electron Microscopy provides world-class microscopy capabilities and expertise. We are the go-to provider of electron, ion, and X-ray microscopy services and consultation to Canadian industry and researchers working in a broad range of fields. Located at McMaster University, CCEM features state-of-the-art instrumentation and experienced, dedicated staff who are happy to work with you to find solutions to your research and development questions.

Electronics

The designing, processing, and analysis of electronic devices, sensors and structures at the nanometer length scale is facing unprecedented challenges as the pursuit for smaller and faster devices continues. The CCEM provides crucial insights into key characteristics of nanoelectronics and optical devices. Through electron microscopy, device structure, elemental composition and bonding can be understood and examined from the micron- to the atomic-scale, allowing for detailed analysis of many different device types and associated physical properties.

We can provide

- structural and composition data, elemental maps, data on chemical bonding in electronics, photonics, and other functional devices
- high resolution imaging and spectroscopy of critical material interfaces, such as gate oxide/channels and metallic contacts/devices
- bandgap/structure measurements
- characterization of optical materials including plasmons, phonons and other metamaterial geometries
- Novel device architecture analysis including nanowires, two-dimensional materials, superlattices, etc.

> “The CCEM has been a trusted partner to TechInsights for over ten years. They have provided cutting edge technical capabilities, access to advanced research and are a pleasure to work with!”
>
> **Chris Pawlowicz**
> Director, R&D, TechInsights

1280 Main Street West, Hamilton, ON CANADA L8S 4M1
For inquiries and project requests contact the Facilities Manager
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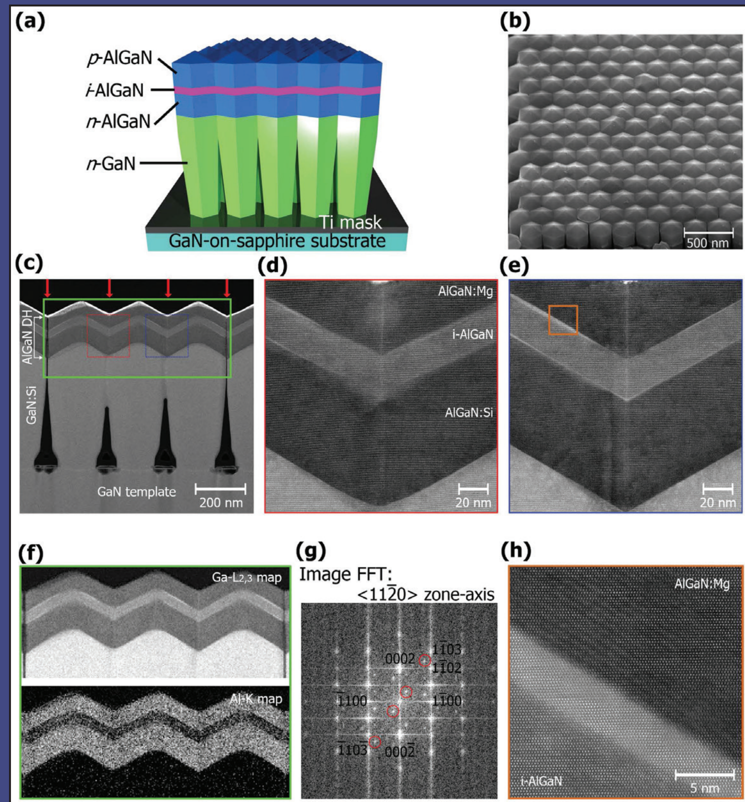
McMaster University

Investigating the Growth of AlGaN/GaN Ultraviolet Light Emitting Diodes

The miniaturization of semiconductor devices for the past 50 years pushed for the understanding of electronic and optical properties of materials to the atomic scale. The atomic arrangement, chemical species, atomic bonding, and plasmonic resonances, are all examples of properties that are now reachable with state-of-the-art electron microscopes. In this study the structural and chemical properties of AlGaN/GaN ultraviolet (UV) light emitting diodes (LEDs) were investigated at the nanometer length scale, revealing direct links with their optical properties. The LEDs were grown by molecular beam epitaxy as isolated nanowires that coalesce at the top of the structure. Using the high resolution microscopes, it was determined that the growth mechanism coupled with the chemical ordering observed in the AlGaN quantum well are the origins of the successful light emission of the LEDs in the UV regime.

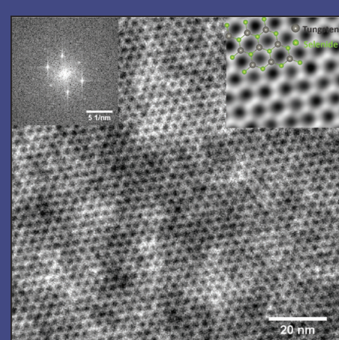


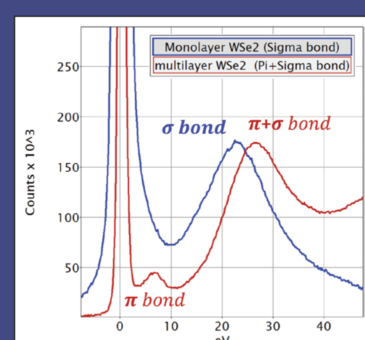
Coalesced nanowire AlGaN LED structure. SEM and STEM HAADF images, and elemental maps from STEM-EELS showthe variations in Ga and Al elemental distributions within the layers and at the interface.

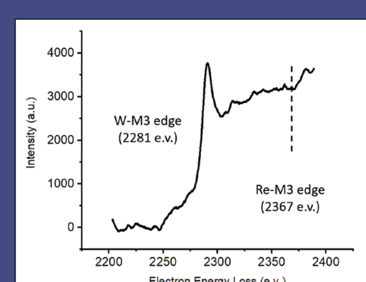
REFERENCE Controlled Coalescence of AlGaN Nanowire Arrays: An Architecture for Nearly Dislocation-Free Planar Ultraviolet Photonic Device Applications, Binh H. Le, Songrui Zhao, Xianhe Liu, Steffi Y. Woo, Gianluigi A. Botton, Zetian Mi, Advanced Materials 28 (2016) 8446–8454.

Characterization of 2D Tungsten Diselenide (WSe_2) Doped with 1% Rhenium (Re).

Achieving a scalable fabrication method with high-quality two-dimensional (2D) semiconducting materials is a main challenge for the large-scale production of many 2D materials. Tungsten diselenide (WSe_2) is a new material of interest for its potential in low-power electronics. Advanced microscopy techniques are necessary to characterize the chemical and structural details of these mono and bi-layer sheets. High resolution STEM reveals the characteristic hexagonal honeycomb structure of the WSe_2 sheets, wherein lattice strain/distortion caused by 1% Re doping can be observed. Using the state-of-the-art EELS spectrometer, the Re core-loss edges are detected, thus proving the existence of the low concentration dopant. This study shows the capabilities and necessity of high resolution TEMs to perform characterization of these 2D materials with the ability to determine structural and chemical quality of newly synthesized structures.







Structural and chemical analysis of WSe_2 doped with 1% Re.