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# Cathodoluminescence studies of gallium nitride nanowires with oxide layers coatings

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Nitride-based structures have found their place in many advancements, especially optoelectronic devices. This technology can be easily applied for group III nitrides. However, it doesn't come without drawbacks, as there can be a high lattice mismatch between the material and substrate. This problem can be solved by replacing 2D layers of nitride material with an array of 1D nanowires (NWs) that exhibit stress reduction due to the high surface-to- volume ratio and small surface area that has contact with a substrate[1]. To further improve device performance parameters, core-shell NW heterostructures have become significantly more popular in recent years[2]. This architecture can give more control over the structural and optical properties of NWs, including bandgap engineering, and shells provide additional protection and inhibit photoinduced degradation of the structures[3].

In this work, we studied gallium nitride (GaN) nanowires grown catalyst-free on Si (111) substrates using plasma-assisted molecular beam epitaxy. The surface of NWs was covered with shells consisting of oxides – $HfO_x$ or $Al_xO_y$ – of varying thicknesses using atomic layer deposition.

To observe local optical properties of nanowires, they were studied using scanning electron microscopy combined with cathodoluminescence (CL) spectroscopy and mapping techniques. CL allows direct correlation of optical properties and morphology of materials with spatial resolution of tens of nanometers, making it especially useful for studying nanostructures. To investigate the structural properties of samples, such as shell thickness, crystal quality and strain, a combination of various methods was used, including X-ray diffraction and transmission electron microscopy.

We present detailed analysis of the CL signal of the NWs, including its intensity and distribution, as well as its spectral characteristics, which is significantly influenced by the properties of the oxide coating, particularly its thickness, morphology, and structure. We observed in submicron scale that CL signal was increased for samples with oxide shells compared to NWs without them.

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**References**

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