

Thermally desorbed InN capping layers for nitride surface science

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Nitrides, including those grown by MBE, have exciting optical and electrical properties such as superconductivity¹ and magnetism² that make them important for many technological applications. It is often necessary to transfer nitride films between vacuum chambers for various processing and characterization steps, resulting in contamination that must be removed.³ Additionally, surface and interface studies are difficult due to oxygen, carbon, silicon, etc, contamination during exposure to atmosphere. In this talk we discuss the effectiveness and limitations of InN capping layers which are thermally desorbed in vacuum. To demonstrate the InN capping and decapping procedure we will discuss synchrotron X-ray characterization of high Al-content AlGaN grown with different strain states, capped, and decapped under vacuum at the Advanced Photon Source (APS). InN decomposes at temperatures above 450°C, while AlGaN does not decompose until much higher temperatures (>800°C).³ We take advantage of this difference in decomposition temperature to utilize InN as a temporary, protective capping layer that can be removed in-situ to examine the properties of the underlying film surface without exposure to atmosphere. We first demonstrate the facile removal of the InN capping layer by examining the RHEED pattern before and after InN deposition and removal. Initial InN films were not smooth and uniform across the surface of the GaN films, as indicated by the spotty RHEED pattern and the visible surface roughness shown in Fig. 1. Growth parameters were tuned systematically to optimize the crystallinity and morphology of the capping layer for maximal coverage of the underlying films. This work serves as a proof of concept for this surface protection technique and can be used on other thin films that are more sensitive to oxidation through atmospheric exposure.

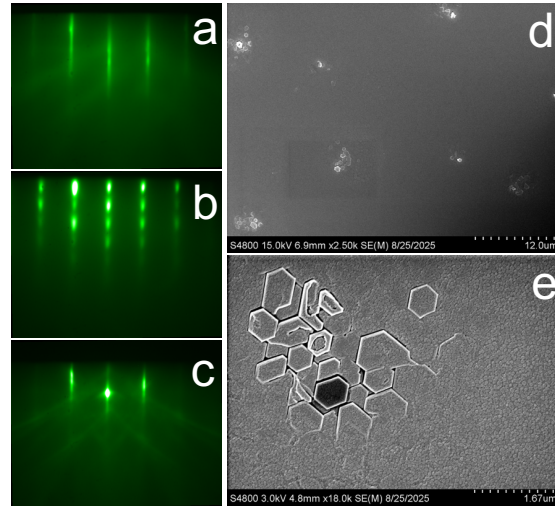


Fig. 1: RHEED images for a) as-grown GaN b) the film after InN capping layer growth c) the GaN film after removal of InN capping layer by heating above 450 °C. SEM images for d) an area of the film showing an uneven distribution of InN across the surface and e) a magnified section showing the hexagonally structured nuclei that were not incorporated

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