Structural properties of inclined GaN nanowires

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We present a structural characterization of self-assembled inclined GaN nanowires (NWs) on *r*-plane sapphire grown by plasma-assisted molecular beam epitaxy (PAMBE), under nitrogen rich conditions and excessive substrate nitridation. The size and the density of the NWs are depended in the nitridation conditions. Photoluminescence measurements of these NWs showed excellent crystal quality and strong emission even at room temperature.

The GaN NWs were grown along the *c*-axis subtending a 61^{o} angle to the *r*-plane sapphire substrate as shown in the TEM image of Figure 1. A rough and discontinuous nonpolar *a*-plane GaN thin film was formed between the NWs.

High-resolution transmission electron microscopy (HRTEM) techniques were employed for the elucidation of the grown origin of the NWs. The sapphire nitridation pre-treatment appears to enhance roughness that promotes the nucleation of both nonpolar and semipolar nanocrystals [1,2]. This is further confirmed by the Moiré fringes close to the interface that suggest interfacial areas of different materials overlap. By combining the TEM observations in cross-section and plan-view geometries, the crystallographic model of the NWs was constructed. Convergent-beam electron diffraction (CBED) was employed to identify the polarity of the NWs.

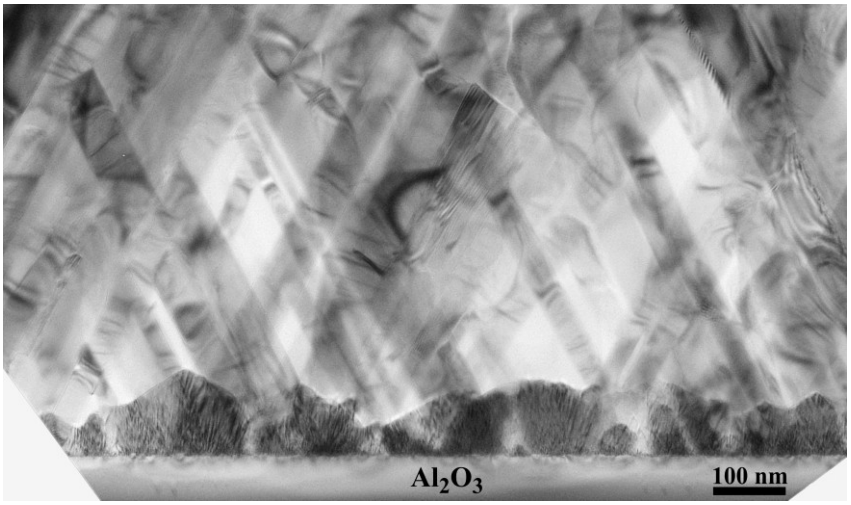

Figure 1: TEM image of the inclined GaN NWs along $[0001]_{a\text{-GaN}} \parallel [1\underline{1}0\underline{1}]_{Al2O3}$ zone axis. Between the NWs, a rough thin film of nonpolar *a*-plane GaN is formed.

References

[1] J. Smalc-Koziorowska *et al.*, Applied Physics Letters **93**, 021910 (2008).
[2] J. Smalc-Koziorowska *et al.*, Journal of Applied Physics **107**, 073525 (2010).

Acknowledgments: Research co-financed by the European Union (ESF) and Greek national funds - Research Funding Program: THALES, project NANOWIRE.

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