

Electronic Supplementary Information (ESI);

Interface Phonon Modes in the $[\text{AlN}/\text{GaN}]_{20}$ and $[\text{Al}_{0.35}\text{Ga}_{0.65}\text{N}/\text{Al}_{0.55}\text{Ga}_{0.45}\text{N}]_{20}$

2D Multi Quantum Well Structures

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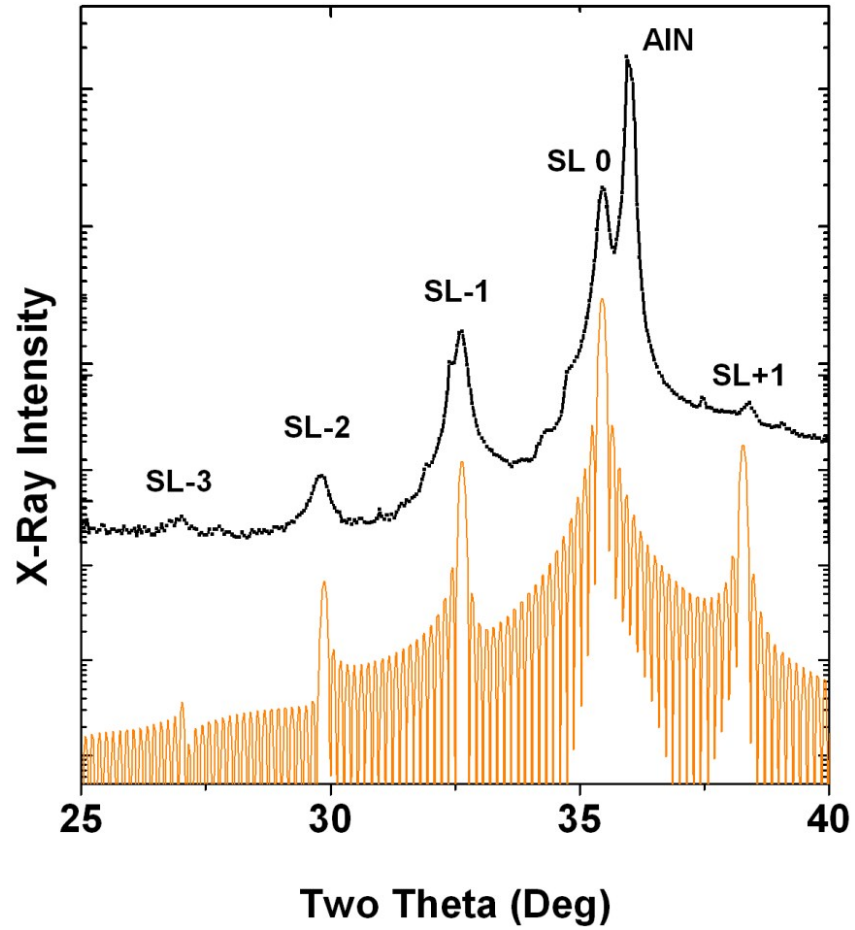


Fig. S1. High resolution x-ray diffraction data of $[\text{AlN}/\text{GaN}]_{20}$ MQWs showing the AlN layer and several superlattice peaks. Simulation using the X-ray Kinematic model [1] shows that the periodicity of the repeating bi-layer of QW structures is about 3.25 nm.

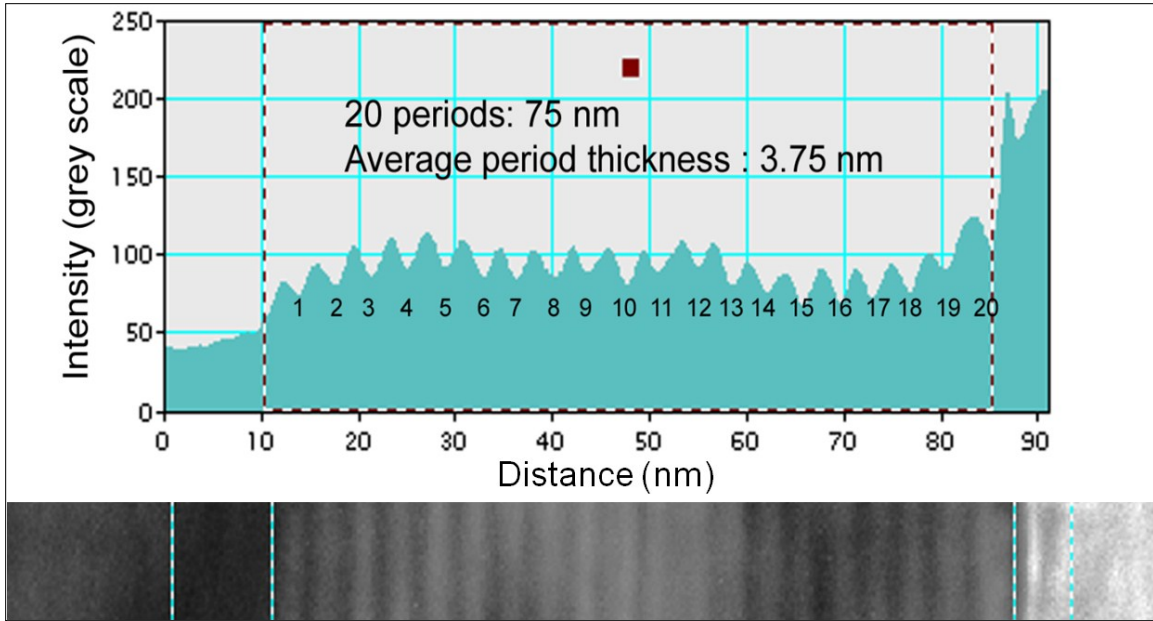


Fig. S2. Transmission electron microscopic image and corresponding intensity plot of $[\text{Al}_{0.35}\text{Ga}_{0.65}\text{N}/\text{Al}_{0.55}\text{Ga}_{0.45}\text{N}]_{20}$ MQW showing 20 periods of repeating bi-layer of QWs with 3.75 nm.

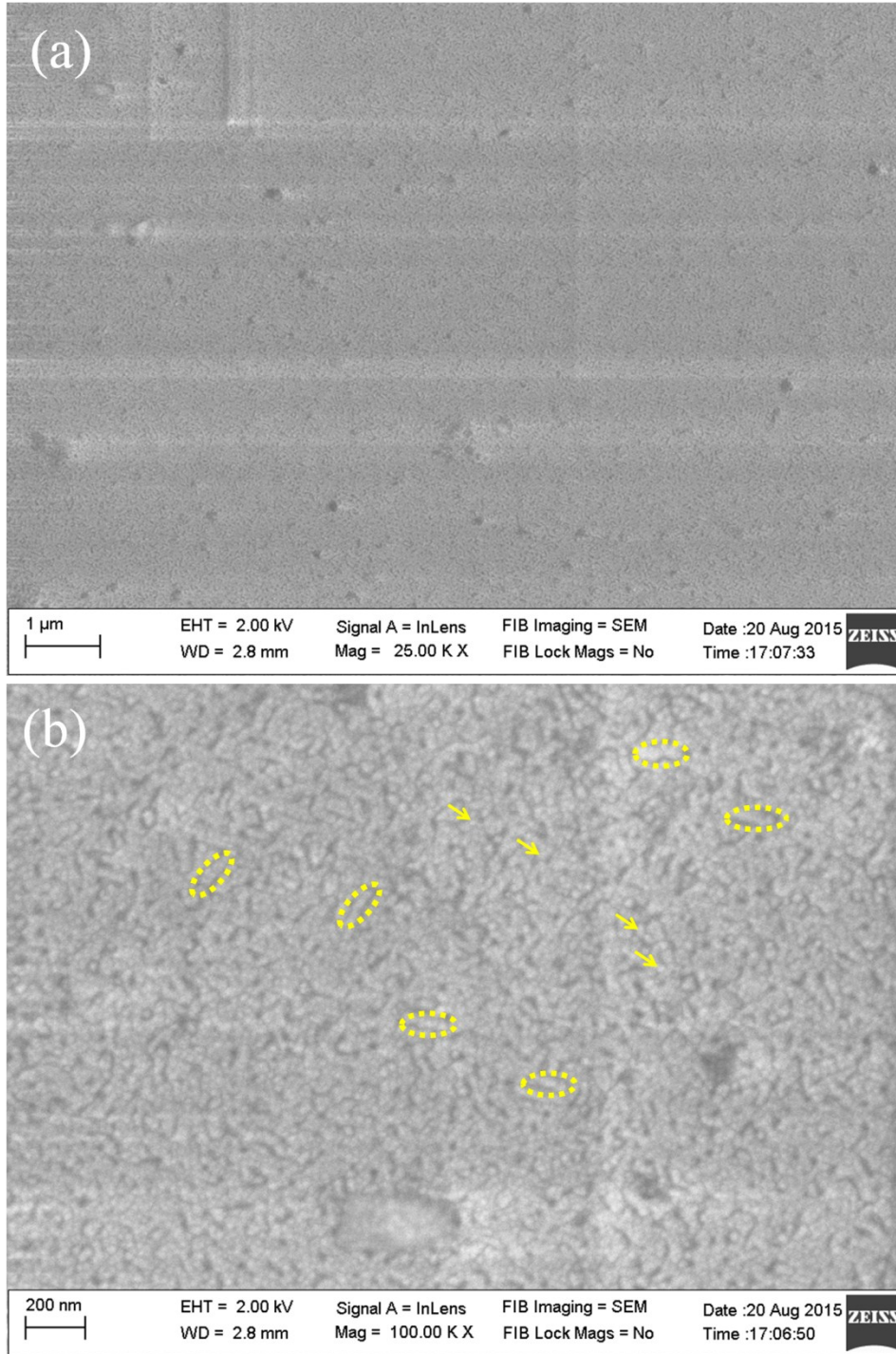


Fig. S3. (a) Typical FESEM image showing morphology of MQWs containing the nanometer sized platelets uniformly distributed all over the surface ($\sim 10 \times 10 \mu\text{m}$). (b) The high magnification image for the surface protrusions in the order of 10s (arrow head) to 100s (encircled portions) of nm. The integral multiples of nanometer sized protrusions also can act as a micron sized platelets ($\sim 2 \mu\text{m}$).

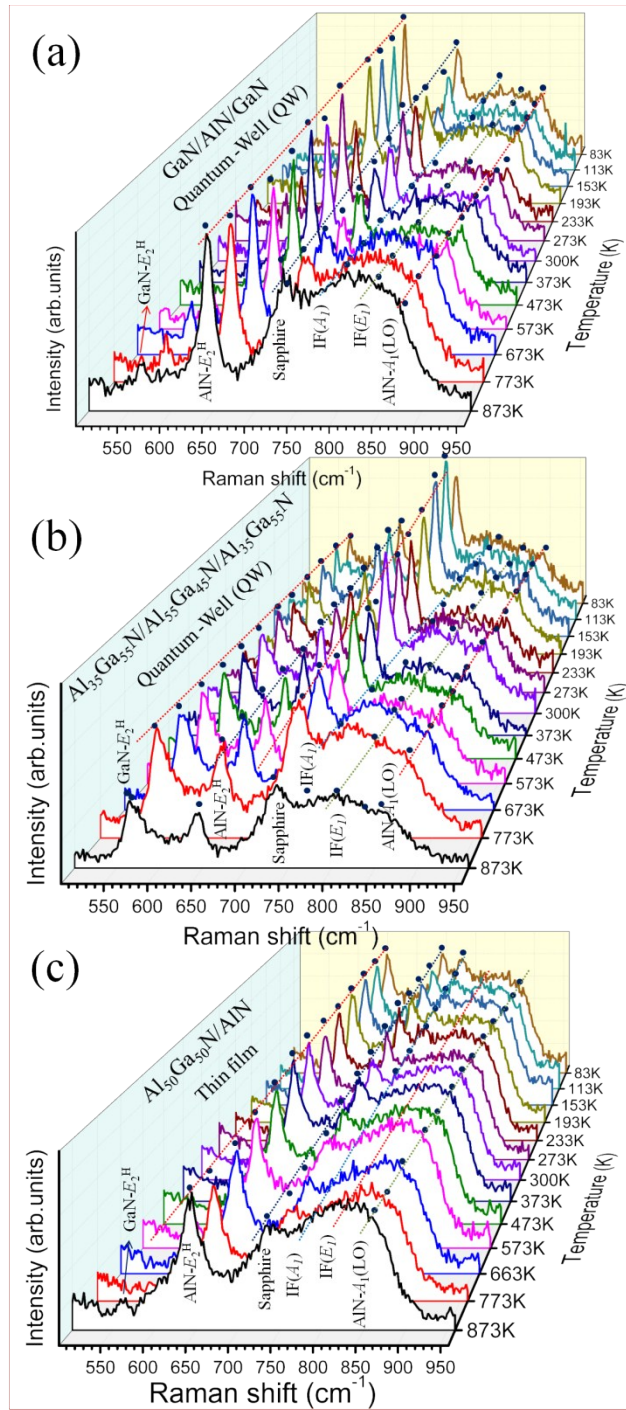


Fig. S4 The temperature dependent evolution of IF phonon modes along with allowed Raman modes of (a) [GaN/AlN]₂₀ MQWs (b) [Al_{0.35}Ga_{0.65}N/Al_{0.55}Ga_{0.45}N]₂₀ MQWs and (c) Al_{0.50}Ga_{0.50}N/AlN thin film.

References

- [1] D. Korakakis, K. F. Ludwig, Jr. and T. D. Moustakas, X-ray characterization of GaN/AlGaN multiple quantum wells for ultraviolet laser diodes, *Appl. Phys. Lett.* **1998**, *72*, 1004-1006.