Strain and compositional fluctuations in $Al_{0.81}In_{0.19}N$/GaN heterostructures

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The strain and compositional fluctuations of nearly lattice-matched $Al_{0.81}In_{0.19}N$/GaN heterostructures [cf. Fig. 1 a-d] are investigated by cross-sectional scanning tunneling (XSTM) microscopy and selected area electron diffraction (SAED) measurements in scanning electron transmission microscopy (STEM). The presence of strain induces height modulations governed by different roughness components at the cleavage surfaces. The surface height modulations, indicated by arrows in Fig. 1a, are compatible with a relaxation of alternatingly compressive and tensile strained domains, indicating compositional fluctuations. Changes of the *a* lattice constant [cf. Fig 1e] are traced to interface misfit edge dislocations.

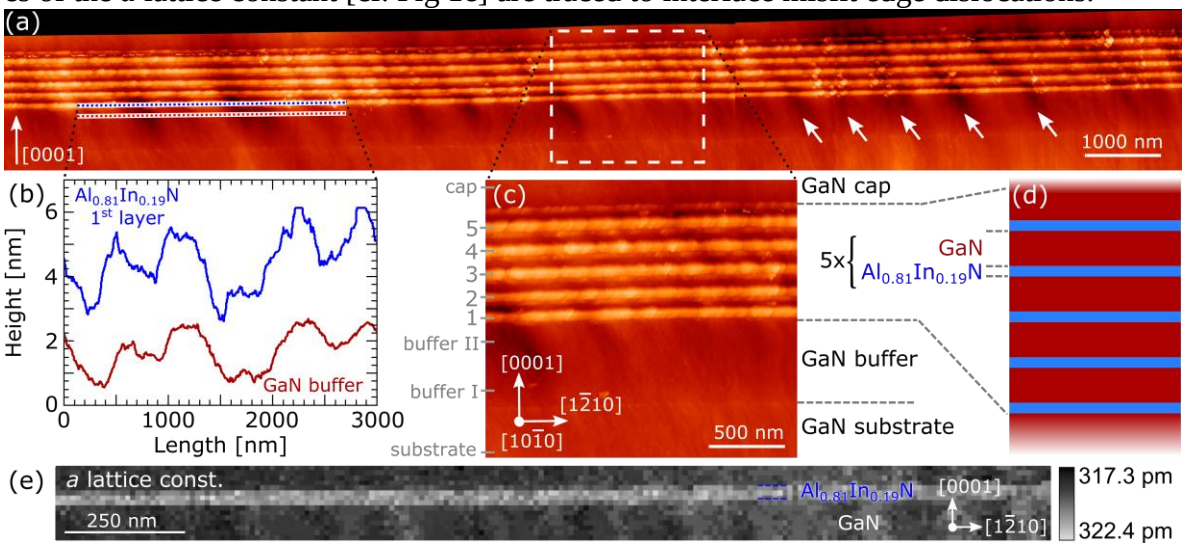

Figure 1 a) XSTM image of the $Al_{0.81}In_{0.19}N$/GaN heterostructure (-4V, 100pA). Note the presence of long range contrast fluctuations. b) Height profiles measured along the first $Al_{0.81}In_{0.19}N$ layer and the GaN buffer c) Magnification of the area in the rectangle in (a), showing the whole structure of the sample [GaN substrate, GaN buffer, 5×(31 nm $Al_{0.81}In_{0.19}N$/105 nm GaN]. d) Schematic of the heterostructure. e) Spatial distribution of the *a* lattice constants of the first $Al_{0.81}In_{0.19}N$ layer and the surrounding GaN determined from SAED patterns measured by STEM in cross-sectional geometry. The $Al_{0.81}In_{0.19}N$ layer exhibits a clear contrast with a higher *a* lattice constant with respect to GaN. In addition, a spatial modulation is visible.

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