A study of GaN(0001) surfaces under ambient conditions by NAP-XPS, LEED and AFM techniques

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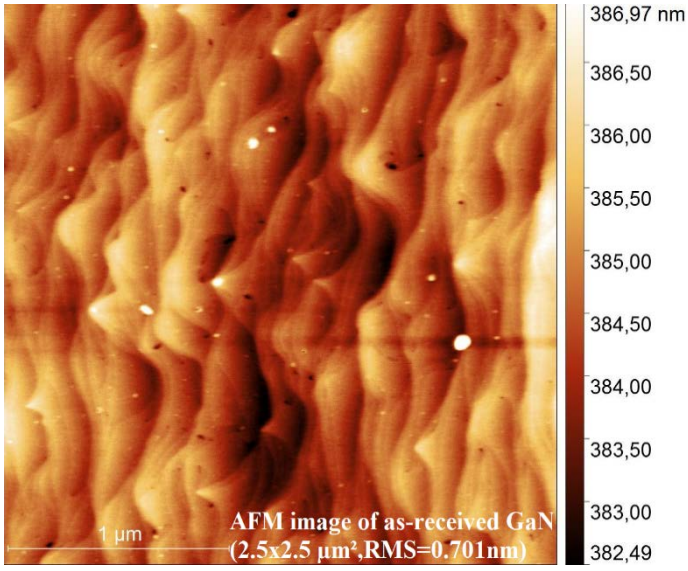
Gallium nitride (GaN) semiconductor has numerous featured physical and chemical properties that make it a promising candidate for use in biomolecular-based microelectronic devices and biosensors because of its natural living-cell biocompatibility and potentiality to convert biological information directly into electrical signal [1]; however, evaluation and assessment of GaN surfaces performance in such devices can be achieved via studying the chemical structure. In this study, the chemical structure and morphology of undoped HVPE-GaN(0001) surfaces on sapphire substrates were investigated for different treatment procedures and in dry/wet-water conditions using a variety of surface sensitive techniques.



Atomic force microscopy (AFM) and low energy electron diffraction (LEED) were used to explore the roughness and atomic structure of as-received GaN(0001) surfaces, as well as after exposing them to nitrogen (N^+-)-ion sputtering followed with thermal annealing at temperatures up to 500°C. Improvement in the atomic structure of surfaces were achieved for N^+-ion sputtered GaN(0001) surfaces in good agreement with other literature findings [2].

Chemical structure of clean GaN(0001) surfaces were also studied after exposing them to different low-pressure (< 5 mbar) in water (H_2O) vapor atmospheres using near ambient pressure (NAP)-XPS with the samples being kept at various temperatures up to 300 °C to explore surface modification and bonding mechanisms taking place via H_2O molecules [3]. Some changes occurred in the O1s photoemissions, besides a photoelectron peak due to water-gas molecules and mild changes in the XPS spectra of Ga core-levels [3]. Preliminary study of NAP-XPS spectra of clean GaN(0001) surface functionalized with few monolayers of cysteine molecules revealed that such sulfur-containing amino acid would yield further insight about the nature of bio-physical-chemical interactions and bonding processes operative at functionalized organic/GaN(0001) interface [4]

References

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