Modification of Electronic Structure of GaN(0001) Surface by N-ion Bombardment

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Gallium nitride (GaN) is a semiconductor which has unique physical properties such as the wide and direct band gap, high chemical resistance, a relatively high melting point, good thermal conductivity. This feature has opened up the door to widespread applications in modern electronic devices. The semiconductor has been used as a base for fabrication of visible and UV lasers, light-emitting diodes, high temperature and frequency detectors, and transistors.

In all these devices the electronic structure of GaN has impact on their properties. The devices become smaller, and the surface effects as band bending i.e. the electronic structure play an increasingly large role due to their influence on conductivity, recombination velocity and photochemistry, also the electron affinity in semiconductor may vary considerably with the existence of surface dipoles. Because the band bending can arise from the surface atomic arrangement or adsorbates or the surface termination and purity, hence the preparation stage is crucial to the electronic structure of the surface. One of the most popular fabrication processes of GaN surfaces in ultrahigh vacuum (UHV) systems is thermal treatment, however, the surface stoichiometry is altered during annealing and it comes to enrich the gallium as the nitrogen escapes to the vacuum. In order to prevent this phenomenon the nitrogen ion bombardment method can be used.

Herein we present the results of a study of the influence of N^+ ion bombardment of GaN(0001) on the surface stoichiometry and electronic structure. Nitrification of the surface was done using an ion gun at the energy of 200 eV with a current of I=6 μA. The composition of residual gases in the chamber during experiments was monitored by a quadrupole mass spectrometer. The experiments were carried out *in situ* in the UHV chamber at room temperature. The setup was equipped with the surface science techniques ultraviolet photoelectron spectroscopy (UPS), X-ray photoelectron spectroscopy (XPS), and low-energy electron diffraction (LEED).