

Measurement of Electronic Structure of Al₂O₃(0001) Surface

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Al₂O₃ has been widely used as a substrate for GaN thin film. When the GaN film is deposited, the substrate temperature should be raised above 1000 °C. Therefore, the detailed investigation of the Al₂O₃ surface at high temperature is key to improve the quality of GaN and other semiconductor films. The stable surface structure of Al₂O₃(0001) is the 1×1 structure. However the surface structure is reconstructed to the $\sqrt{31}\times\sqrt{31}\pm R9^\circ$ structure (hereafter $\sqrt{31}$ structure) by annealing at about 1000 °C in the vacuum [1-3]. It is theoretically predicted that the $\sqrt{31}$ reconstruction occurs by removing oxygen layers from the surface and forming Al layers[4]. Therefore the change of the electronic structure from the 1×1 structure to the $\sqrt{31}$ structure is very interesting.

We use well-oriented Al₂O₃ (0001) samples, which were supplied by Namiki Precision Jewel Co. Ltd. The samples were cut parallel to the (0001) plane with off angle being $0.15^\circ \pm 0.02^\circ$ off for <10T0> direction and annealed at 1000°C or 1400°C annealing in air. The air-annealed surface shows a clear 1×1 Reflection High Energy Electron Diffraction (RHEED) pattern without any treatment in the vacuum.

We tried to measure the photoelectron spectra (PES) from the Al₂O₃ (0001) surface. Figure 1 shows a typical example of the PES, where the photo-electrons emitted to the normal direction are measured at photon energies (E_p) from 22 eV to 35 eV. The PES at E_p below 25 eV show two clear states originate from the Al-O bonding state and the O-2p state [5]. On the other hand, the PES at E_p over 28 eV become noisy and each peak is shifted to unsystematic directions. The random shifts will be caused by a charging up on the insulator surface.

Therefore, PES have measured at E_p below 25 eV. From the PES from 1×1 and $\sqrt{31}$ structures, we have obtained some experimental evidences that the $\sqrt{31}$ structure is formed by Al layers by leaving O layer on top of the

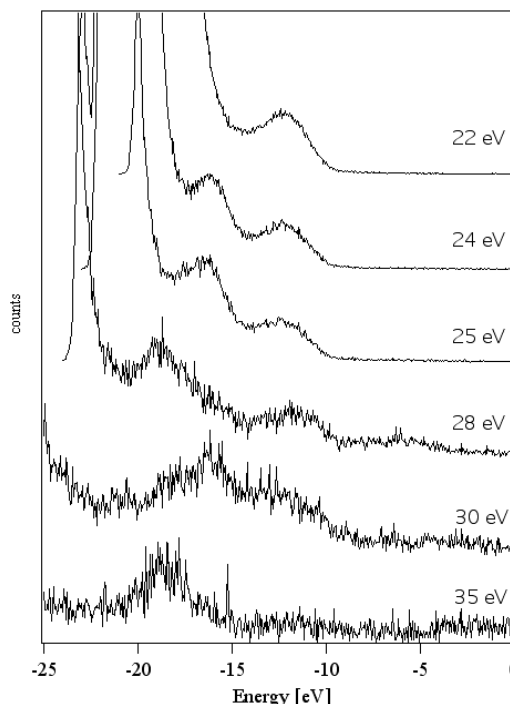


Fig. 1. PES from Al₂O₃ (0001) surface at photon energies (E_p) from 22 eV to 35 eV

Al₂O₃ (0001) surface from the results of the PES and RHEED. Detailed structure model will be published in elsewhere in the near future.

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