Development of scanning probe microscope and applications for study of semiconductor surfaces

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Concerning the high temperature observation by UHV-STM and the development of UHV NC-AFM with atomic resolution and that application, we have investigated and concluded following results.

1. In the observation of UHV-STM at 1×1→7×7 phase transition (860℃), the 7×7 structure of Si (111) grows from the upper side of the step as temperature decreases. When the 7×7 structure becomes predominant, the edge of step aligns in any of three different directions of 7 7 unit cell.

2. In UHV NC-AFM observation, the individual dimmer atoms on Si(100) 2×1 structure could be observed. As for the sapphire (1000) surface, 3√3√3√3 and √31 ×√31 structures could be observed, and the polypropylene chains could be clearly resolved on the polypropylene film.

3. An NC-AFM image reflected a geometrical surface topography more than an STM image, and the possibility to analyze more accurate surface structure was shown by the comparison with the STM image and the NC-AFM image. In the observation of O_2 adsorbed surface, the possibility to investigate a state of adsorption as well could be shown.

4. In the observation of surface potential on the Ag and Au evaporated Si(111) 7×7 surfaces by the development of UHV SKPM using the gradient of electrostatic force, the electric potential distribution of the atom level could be observed with a potential resolution of about 10 meV. The atomic potential difference reflects the local electron density on the surface, and the average potentials corresponding to the DC levels in potential images reflect the work function value.