Photoelectron measurement of extremely uniform Si nano-islands on Si(111) 7×7 substrate

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**Introduction**

Photoelectron spectroscopy (PES) has been widely used to determine the electronic states of low-dimensional structures, such as two-dimensional quantum-wells and one-dimensional chains. However, the investigation of the electronic states of zero-dimensional quantum dots such as nano-islands by PES has hardly been reported. This is because the information about nano-islands is overwhelmed by the background as a result of the very low density and irregularity in size of the nano-islands.

In this report, we show PES and STM/STS results on size-selected Si nano-islands nucleated on Si(111)[1-3], which are formed by a fine control of growth temperature, $T_g$, and annealing temperature, $T_a$.

**Experiment**

The STM measurements were performed in an ultrahigh-vacuum STM chamber (base pressure: $2 \times 10^{-8}$ Pa) equipped with reflection high-energy electron diffraction (RHEED) and an electron beam evaporation source. STM images were observed with an STM head (ULVAC Japan), controlled by Topsystem 3 (Oxford instruments). The PES measurements were performed by using synchrotron radiation on the beam line BL-7B. The experimental chamber, whose base pressure is about $6 \times 10^{-8}$ Pa, is equipped with an angle-resolved photoelectron spectrometer (ARPES), an evaporation source, a quartz crystal thickness monitor and a sample manipulator with a cryostat.

**Results and discussion**

Figure 1(a) shows a typical STM image for the fabricated surface with a $\theta = 0.07$ bilayer (BL: 1 BL corresponds to $1.57 \times 10^{15}$ atoms/cm$^2$). Almost all nano-islands have a rounded shape composed of 162 atoms (R-island), as indicated by an arrow. The enlarged image of the R-island is also shown in the inset in Fig. 1(b). The number density of R-island reaches about 65%[4].

Figure 2 displays a set of PES spectra for a clean 7×7 surface, the fabricated surface ($\theta = 0.07$ BL) and an STS spectra, $(dI/dV)/(dV)$, obtained at the adatom on the R-island[3,4]. A characteristic state $L_{5/2}$ of the R-islands in STS can be observed in the PES from the fabricated surface.

**References**


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