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Photoemission study of Ag/Si(110)1×2 surface

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Introduction

Low-dimensional systems exhibits a variety of exotic physical phenomena such as charge density wave[1], Peierls instability[2], and Luttinger liquid[3]. Self-assembled adsorbate-induced modification of semiconductor is a powerful technique for fabricating such low-dimensional nanoscale structure. Ag/Si(110)1×2 surface consist of the well-aligned Ag wires with about 1.1nm spacing in [001] direction from analysis of the LEED and AES results[4]. Here we introduce 1D metallic system composed of self-assembled Ag chains on Si(110) surface [Ag/Si(110)1×2 surface] and presents phtoemission studies.

Experimental

The PES measurements were performed at the beam line BL-18A at Photon factory in Tsukuba, Japan. The silicon sample, before putting into the chamber, was cleaned chemically by Shiraki`s method. Careful attention was paid to avoid nickel contamination during the sample preparation. In an ultrahigh vacuum, the Si(110) wafer was thoroughly outgassed at 600 °C for about 6 hours and then flashed at 1200 °C for several times. Ag rod put into a tungsten filament coil and sufficient current pass through the tungsten filament in UHV. Then, the "Ag-coated tungsten filament" was used as the evaporating source. The LEED patterns of the 1×2 was obtained after Ag deposition on the Si(110) surface at 450°C. The substrate temperature was monitored by optical pyrometer.

Results and Discussion

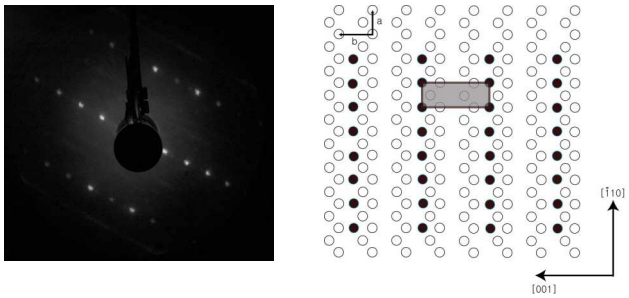

Figure 1 LEED pattern of Ag/Si(110)1×2 surface and Structural model of Ag/Si(110)1×2 surface. Open, filled and shaded circles represent Si, Ag atoms, respectively. The shaded rectangular represent the unit cell of Ag/Si(110)1×2 surface.

Figure 1 shows the LEED pattern of Ag/Si(110)1×2 surface and structural model with unit cell. From the structural model of Ag/Si(110)1×2 surface, self-aligned Ag wires are placed in [$\bar{1}$10] direction.

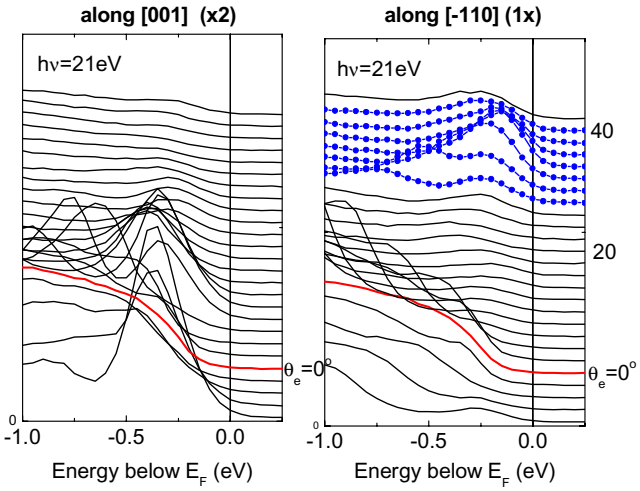

Figure2 Angle-resolved photoemission spectra of Ag/Si(110)1×2 surface. The spectra were taken along the both direction. The dotted lines indicate that the surface electronic states cross the Fermi level.

Figure 2 show the angle-resolved photoemission spectra of the Ag/Si(110)1×2 surface. The surface electronic states cross the Fermi level with parabolic dispersions along the linear chains ([$\bar{1}$10] direction) but have rather flat sinusoidal dispersions along the perpendicular direction to the chains ([001] direction). The surface electronic states are not originated from Si(110) substrate. The results suggest that the Ag/Si(110)1×2 surface is another candidate of 1D metallic system.

References

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