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

E.S. Cho¹, J.Y. Baik¹,², Y.K. Kim¹, N.H. Kim¹, K.S An¹,², T.Okuda³, T.Kinoshiba³, and C.Y. Park¹
¹ BK2physics research division and institute of Basic Science and CNNC, SungKyunKwan University, Suwon 440–746, Korea
² Thin Film Materials Laboratory, Korea Research Institute of Chemical Technology, Yuseong P.O. Box 107, Daejon 305–600, Korea
³ Synchrotron Radiation Laboratory, Institute for Solid State Physics (SRL-ISSP), The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa 277–8581, Japan

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 photoemission 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 [110] direction.

Figure 2 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 ([110] 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


* cypark@yurim.skku.ac.kr