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# Photoemission spectroscopy of Co cluster grown on S/GaAs(001)

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## Introduction

Ni valence band photoemission spectra is known to show the satellite structure at about 6eV below the Fermi level. The origin of this phenomenon is explained as an excited Ni two-hole bound state, which comes from the localized nature of the Ni valence band[1,2]. In spite of the similar electronic configuration of Co to that of Ni, the clear satellite has not been observed in valence spectra of Co. It is thought that the correlation in the Co valence band is small because Co valence band is much itinerant than that of Ni. However, in the case of Co ultra thin film, a weak satellite was observed in 2*p* photoemission spectrum[3]. It is considered that the limited scales of Co thickness or Co cluster sizes induce the localized nature of Co *d*-band. In order to investigate the effect of the electron localization, we have performed the photo-emission measurements of Co cluster grown on S/GaAs(001).

## Experimental

The spin-resolved photoemission (SRPES) and resonant photoemission measurements were carried out at the BL-19A. The Co clusters were grown on the sulfur passivated GaAs surface by an electron-beam evaporation. From AFM image of the sample, the cluster sizes were estimated to be about 40 nm in diameter, and 3, 4 nm in height. The sample was magnetized in situ by pulse current through magnetization coil for SRPES measurement. The magnetization was checked by observing the magneto-optic Kerr effect.

## Results and Discussion

The valence band photoemission spectra for photon energies between 55 and 80 eV clearly show a satellite peak at the binding energy of around 5eV in Fig. 1. Figure 2 shows the photon energy dependences of the intensities of the satellite. It shows resonance enhancement around the 3*p*-3*d* excitation threshold similar to that of Ni valence band satellite. We have fitted the intensity of satellite with Fano's formula[4] and obtained the value of the characteristic parameters as q=1.018 and Γ=1.54. In Fig.3, the constant-initial-state spin-polarization spectrum (CISSPS) of the satellite is shown, which is converted from spin-resolved photoemission spectra. The observed spin polarization around satellite is positive and the photon energy dependence is similar to the spectra for Ni(110) reported by Clauberg *et al.* [1] or Kinoshita *et al.*[2]. These results suggest that the small Co clusters have narrower *d* band structure, leading to a highly correlated *d*-*d* interaction.

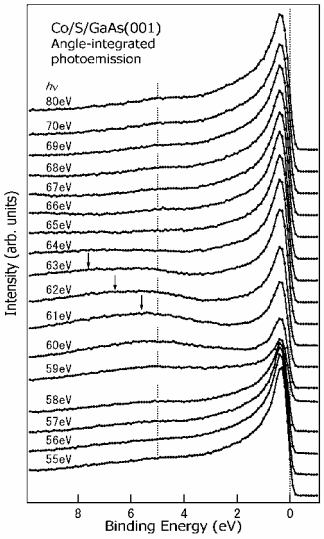


Fig.1. Valence band spectra of Co cluster on S/GaAs(001) for photon energy *hν* between 55 and 80eV. Dashed lines indicate the satellite. The arrows indicate the $M_{2,3}$ *VV* sCK Auger peaks.

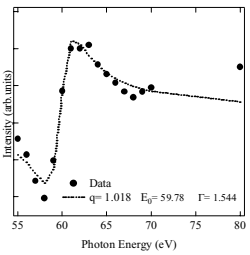


Fig.2. The photon energy dependence of the intensity of the satellite ($E_B$=5 eV). Dashed line shows the fitted curve with Fano's formula.

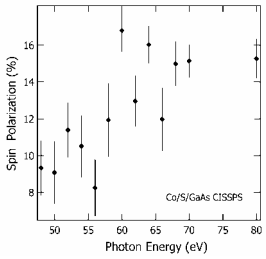


Fig.3. Constant-initial-state spin polarized photo-emission spectrum of the satellite.

## References

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