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CO adsorption structure on Co/Pd(111) magnetic thin film studied by energy-scanning photoelectron diffraction

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Introduction

Appearance of surface perpendicular magnetic easy axis is a typical feature of the low-dimensional effects. Recently, we have found that CO molecular adsorption on Co/Pd(111) magnetic thin film creates the spin reorientation transition from parallel to perpendicular[1]. Besides, temperature dependent study has revealed that CO adsorption creates the spin reorientation transition only below about 200 K[2]. As the adsorption temperature affects the surface structure, we should clarify the surface structure, which might be related to the surface magnetic anisotropy. Photoelectron diffraction is a powerful tool to determine the structure of adsorbates. Especially, energy-scanning photoelectron diffraction has been used to estimate the adsorption structure with the "projection method". We have adopted this method to determine the relationship between adsorption structure and magnetic anisotropy.

Experiment

Sample preparation and measurement were performed in an ultrahigh vacuum chamber at BL-7A. 5 monolayer Co films were prepared by the electron bombardment method. CO was dosed on Co/Pd(111) at 300 K and 200 K. C 1*s* photoelectron from CO/Co/Pd(111) was monitored by hemispherical electron analyzer (SES-2002). Incident photon energy was scanned from 320 eV to 600 eV, which corresponds to 3-9 $Å^{-1}$ for the wave number of photoelectron. Photoelectron emission was monitored from 5 angles. Quantity of the photoelectron modulates because of the diffraction from neighbor atoms. Extracted modulations from different emission angles were compared with the simulated spectra calculated by the MSRD code.

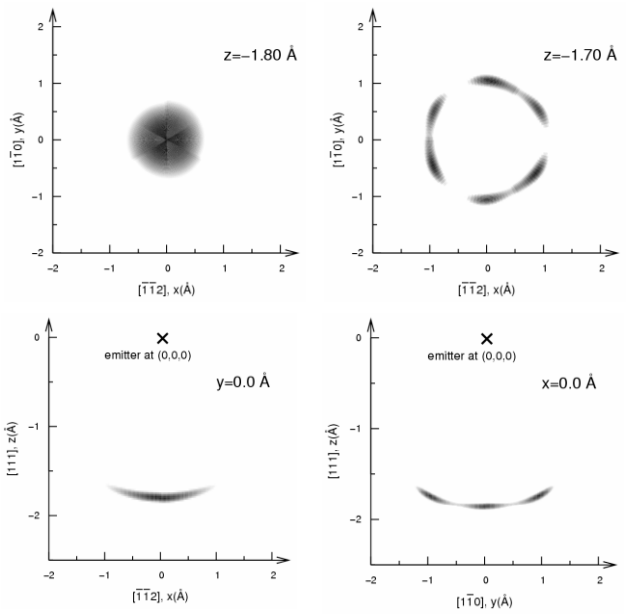

Fig. 1 Results of the projection method at 300 K (left) and 200 K (right).

Results and discussion

At this thickness of Co, CO adsorption causes the spin reorientation transition at 200 K, while it does not occur at 300 K. Fig. 1 shows the plots of the neighboring scattering atoms derived from the results of the projection method. From this figure, we found that CO is adsorbed on atop sites at 300 K and atop and bridge sites at 200 K. Because the projection method considers only single scattering, multiple scattering calculation is needed in order to obtain more reliable results. Fig. 2 shows experimental and simulated modulations of the photoelectron. Simulated spectra well reproduce the experimental spectra. Although some discrepancies still exist specially at 200 K, we have succeeded for the determination of the surface adsorption structure at 300 K and 200 K, which exhibit different behavior of the surface magnetic anisotropy by the CO adsorption.

References

[1] D. Matsumura et al., Phys. Rev. B, 66, 024402 (2002).

[2] D. Matsumura et al., Physica Scripta in press.

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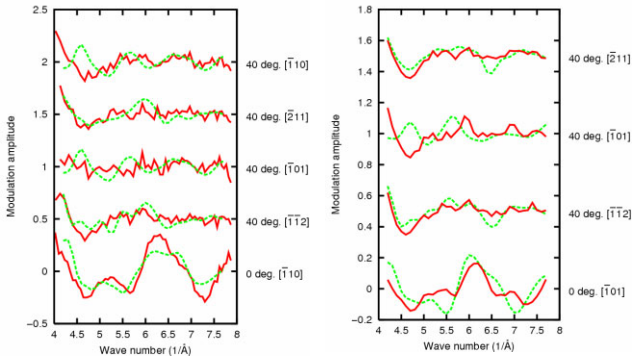

Fig. 2 Experimental (red) and simulated (green) modulations at 300 K (left) and 200 K (right).