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Spin-resolved valence-band and core-level photoelectron spectroscopy with VLEED-type spin polarimeter

Yasuo TAKEICHI[1,*], Taichi OKUDA[1,2], Akinori NISHIDE[1], Ayumi HARASAWA[1], Akito KAKIZAKI[1]
[1]ISSP, the Univ. of Tokyo, Kashiwa, Chiba 277-8581, Japan
[2]HiSOR, Hiroshima Univ., Higashi-Hiroshima, Hiroshima 789-0046, Japan

Introduction

Spin-resolved photoelectron spectroscopy (PES) is one of the most powerful method to study the spin-dependent electronic properties of solids. In spite of the great improvement in energy and momentum resolution of spin-integrated PES, spin-resolved experiments have suffered its relatively low resolution and long time consumption originated from the low efficiency of the spin polarimeter.

Recently, we have developed a new electron-spin polarimeter utilizing very-low-energy electron diffraction (VLEED) to overcome this shortcoming [1,2]. The efficiency of the new polarimeter was realized to be two-orders-of-magnitude higher than that of the conventional Mott detectors. To serve this instrument in practical use such as the experiments in our proposal, we performed some experiments to compare with those in the literature.

Spin-resolved PES of Ni(110)

Ni(110) is one of the most well-investigated specimens by spin-resolved PES. The sample was shaped in so-called “picture frame” and measured in remanent magnetization. The cycles of Ar^+ bombardment and annealing was repeated to obtain clean and well-ordered surface, which was checked by Auger electron spectroscopy and low-energy electron diffraction. The effective Sherman function S_{eff} = 0.40 was determined by preceding measurement of the polarization of the secondary electrons from Ni(110) [1,2]. All the spectra here were obtained in the room temperature.

Figure 1 is the spin- and angle-resolved valence-band spectrum of Ni(110) measured in normal emission. The spectrum (a) and (b) were taken in 3 hours and 15 minutes, respectively. Even in such a surprisingly short data acquisition time, we can clearly see the spin-split Ni 3d bands. Furthermore, it shows a trace of another minority peak just below Fermi level, whose intensity was already suppressed in Fig. 1(a). We also performed spin- and angle-resolved PES in normal emission using photon energy from 20 to 90 eV (not shown here). The results were consistent with the literature [3].

Figure 2 shows the spin-resolved 3p core-level photoemission spectra. As the polarimeter needs very-low-energy (E_k = 6 eV) electrons, the pass energy of the energy analyzer was chosen to be relatively low, which results in the suppressed intensity of the spectra. Under this condition, the result was still fairly better than the literature [4,5]. The spin polarization shown in Fig. 2(b) reveals clear peaks and dips due to the spin-polarized sattelites corresponding to the different final state.

In conclution, we performed spin-resolved PES of Ni(110). The result was obtained in consistent with the literature and in short acquisition time. The high efficiency of the new spin polarimeter was shown in the practical experiments.

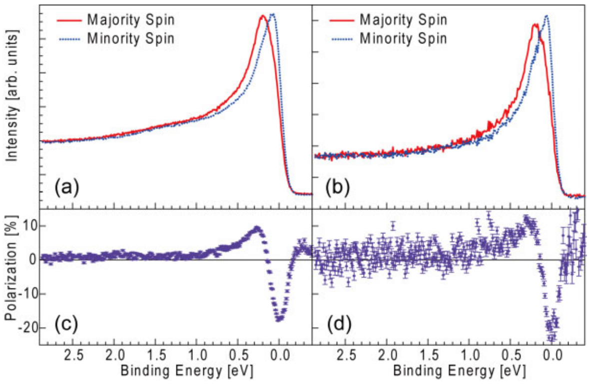

Fig. 1: Spin-resolved valence-band spectra and their spin-polar-ization of Ni(110) excited with synchrotron light $h\upsilon$ = 21.2 eV. The acquisition time was 3 hours: (a),(c) and 15 minutes: (b),(d).

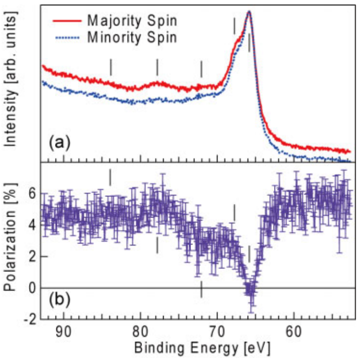

Fig. 2: Spin-resolved 3p core-level spectra (a) and its spin-polarization (b) excited with synchrotron radiation $h\upsilon$ = 160 eV. The markers indicate the 3p main peak and its sattelites [4,5].

References

[1] See an article by T. Okuda *et al.* in this report.
[2] T. Okuda *et al.*, Rev. Sci. Instrum., **79**, 123117 (2008).
[3] K. Ono *et al.*, Solid State Commun., **107**, 153 (1998).
[4] Y. Liu *et al.*, Phys. Rev. B, **52**, R8593 (1995).
[5] Y. Saitoh *et al.*, Phys. Rev. B, **52**, R11549 (1995).

[*] takeichi@issp.u-tokyo.ac.jp