$3d \rightarrow 4f$ Resonant Photoemission Spectroscopy of CeNi

[1,2]Jung Ran-Ju (3552), [1]Yang See-Hun(4207), *[1]Oh Se-Jung(4206)

1, Seoul National University, Korea 2, Japan Synchrotron Research Institute

The valence-band photoemission spectroscopy (PES) of Ce metal and its compounds has played an important role in understanding their electronic structures. In order to understand the PES spectra, we need to extract only the $4f$-electron contribution to the valence band. For this purpose, $4d \rightarrow 4f$ resonant PES has been widely used, however, which has a serious drawback that the photoelectrons from surface considerably contribute to the spectrum. This has been challenged by intensive efforts, especially, $3d \rightarrow 4f$ threshold edge, by which we can obtain much more bulk-dominant spectra leading to extraction of pure bulk contributions. However, these endeavors has been baffled by poor resolutions (0.8 eV). CeNi has Laves phase cubic crystal structure and strong hybridization between the localized f-level and the conduction band, which makes us to expect a large enhancement of spectral weight in the very near Fermi level.

In this report, we present the $3d \rightarrow 4f$ resonant photoemission spectroscopy (PES) spectra of CeNi with high energy resolution(0.2 eV) compared with the previously reported ones. Poly-crystal of CeNi was prepared by argon melting of high-purity metals, and resonant PES was performed in Spring-8. The poly-crystals were scraped *in situ* by a diamond file just before photoemission measurements to obtain clean and fresh surface. In order to find the exact position of on-and off-resonance photon energies, total-yield absorption experiments were carried out.

Off-resonant spectrum($h\nu$ = 868.1 eV) shows almost structureless shape, which is very different from $4d \rightarrow 4f$ edge case and is due to the differences of cross sections. This claims the strong point of $3d \rightarrow 4f$ resonant PES (figure 1 and 2).

It is found from total-yield spectrum that there are two on-resonant peaks which are located at 881.4 eV and 882.3 eV, respectively. So both on-resonant spectra are obtained and showed quite different results from each other. We can see huge overall enhancements in on-resonant spectra, especially, near the Fermi level. The striking enhancements should be derived from the bulk contributions of Ce $4f$, and a very sharp peak near the Fermi level is ascribed to "Kondo Resonance". At about 2.5 eV binding energy, a broad hump is observed and due to f^0 peak.

We observed a shoulder around 0.5 eV which has never discovered in former $3d \rightarrow 4f$ edge experiments. Here it can be witnessed that there is a remarkable difference between 881.4 eV and 882.3 eV photon energies, which should be ascribable to the difference of channel for Auger decay. It is required to calculate the absorption spectra with atomic model considering multiplets.

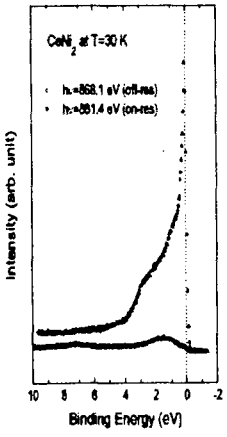

Figure 1

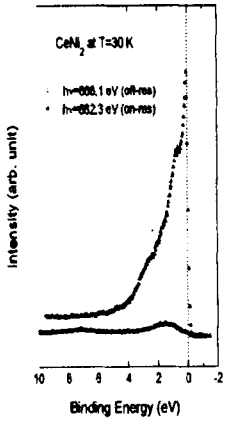

Figure 2

FIG. 1. Valence RESPES spectra of CeNi measured at 30K with photon energy of 868.1eV, where off- and on-resonances occur, respectively. Each spectrum has been normalized with respect to the photon flux.