(6a2)

Sm 4f electronic state of $SmFe_4P_{12}$ probed by bulk-sensitive photoemission

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Bulk sensitive photoemission by means of high energy photons, which is now available with high resolution, already revealed the Pr $4f$ electronic states in $PrFe_4P_{12}$. Namely, a prominent structure (Kondo resonance) was found in the vicinity of the Fermi level (E_F) and its intensity showed a temperature dependence consistent with that of the resistivity. In this study, bulk sensitive photoemission is utilized for the study of the electronic states of $SmFe_4P_{12}$.

Sm $3d$ photoabsorption spectrum of $SmFe_4P_{12}$ (see Fig. 1 (a)) has a line shape which is typical of nearly trivalent Sm compounds. In the resonant photoemission spectra (see Fig. 1 (b)) in the Sm $3d$ photoabsorption region, structures near E_F corresponding to Sm^{2+} are found in addition to those for Sm^{3+}. Although contribution of surface Sm^{2+} cannot be excluded, the observed temperature dependence (see Fig. 1 (c)) might be related to the temperature dependence of the Sm valence due to the Kondo effect. Further detailed measurement will be needed in order to extract the bulk Sm $4f$ excitation spectrum.

Another promising method for the evaluation of the Sm valence is Sm 3d core-level photoemission. Preliminary measurement using photon energy of 1500 eV suggests the existence of Sm^{2+} in the bulk. Unambiguous evaluation of the Sm valence needs experiment with much higher photon energy, e. g. 8 keV.

[1] A. Yamasaki, *et al.* Phys. Rev. B **70**, 113103 (2004).

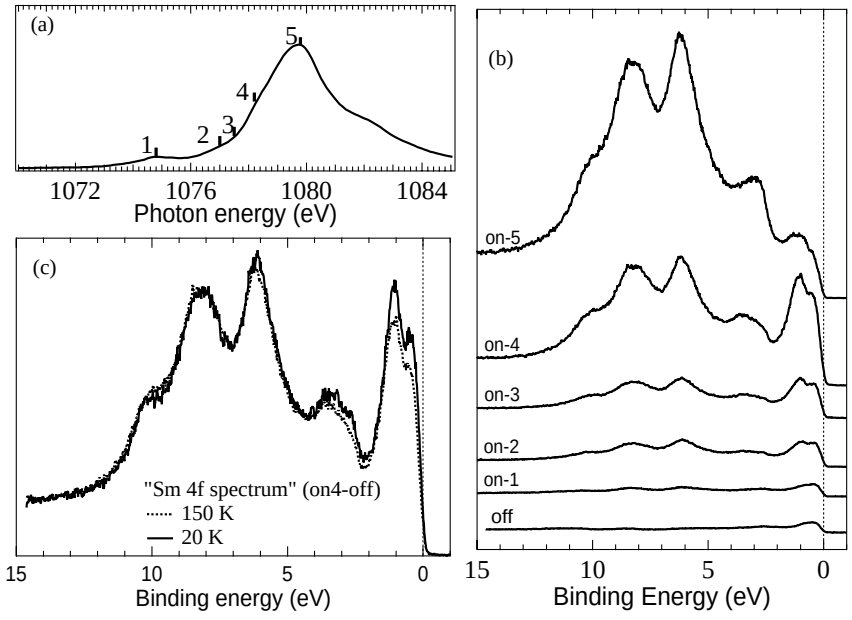

Figure 1: (a) Sm $3d \rightarrow 4f$ photoabsorption spectrum. (b) Resonant photoemission spectra taken at 150 K. Photon energies are indicated in (a) except for off resonance taken at a sufficiently low photon energy. (c) Temperature dependence of the Sm $4f$ spectrum extracted by subtracting the off-resonance spectrum from the "on 4" spectrum.