

Hard X-ray Photoemission Spectra of $\text{Yb}_{0.88}\text{Lu}_{0.12}\text{B}_{12}$

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ABSTRACT

Temperature-dependence of the Yb $3d$ and valence band photoemission spectra of a Lu substituted Kondo semiconductor $\text{Yb}_{0.88}\text{Lu}_{0.12}\text{B}_{12}$ was measured by means of hard X-ray photoemission spectroscopy (HAXPES) at $h\nu \sim 8$ keV. HAXPES enables one to study the intrinsic bulk Yb $4f$ states and the Yb valence, because the photoelectrons have longer inelastic mean free paths (IMFPs) than previous low- $h\nu$ PES studies.

In the valence band, the whole peaks of the $\text{Yb}^{3+} 4f^{12}$ multiplets was found to shift by ~ 30 meV toward higher binding energies with decreasing the temperature from 200 to 20 K. On the other hand, the peak energy position of the $\text{Yb}^{2+} 4f^{13}$ spectra was almost temperature independent. The temperature-dependence of the Yb $4f$ photoemission spectra is discussed in comparison with the non-crossing approximation (NCA) calculation based on the single impurity Anderson model (SIAM).