Hard x-ray spectroscopy of Sm-based heavy-fermion compound $SmOs_4Sb_{12}$

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Sm-based heavy-fermion compound $SmOs_4Sb_{12}$ [1,2] has been investigated by bulk-sensitive photoemission spectroscopy (PES). In order to reveal the bulk nature of Sm compounds, the bulk-sensitive PES with hard x-ray (HAX) is a very powerful tool since the Sm valence and electronic structures are often different between on the surface and in the bulk. The HAXPES clearly demonstrates that the strongly mixed valence of Sm is realized in the bulk of $SmOs_4Sb_{12}$. Furthermore, it is found that the Sm valence decreases below 100 K, indicating that the Kondo coherence develops with approaching the proposed Kondo temperature (T_K ~20 K). Our theoretical analysis suggests that the small energy difference between Sm divalent and trivalent states combined with the weak hybridization between conduction and 4*f* electrons is the origin of the coexistence of the strongly mixed valence and the heavy-fermion character in $SmOs_4Sb_{12}$.

[1] S. Sanada *et al.*, J. Phys. Soc. Jpn. **74**, 246 (2005).
[2] W. M. Yuhasz *et al.*, Phys. Rev. B **71**, 104402 (2005).