LOCALIZED AND ITINERANT 5*f* STATES IN ACTINIDE MATERIALS AS SEEN BY PHOTOEMISSION SPECTROSCOPY

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Keywords: actinides, synchrotron radiation, photoemission, angle resolved photoemission sepctroscopy

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Photoemission spectroscopy (PES) is a direct and powerful probe of the occupied electronic structure, chemical properties of surfaces, and bonding in solids. The angle-resolved version of the technique (ARPES) gives unique information concerning $E(k)$ relation in the solid. ARPES studies of uranium compounds provides extensive insight into the electronic structure and are crucial for comprehension of the wide range of ground state properties found in actinide materials such as magnetism or enhanced mass. PES techniques are capable of providing information regarding the binding energy of the 5*f* band, as well as the dispersion and hybridization with the conduction band and are a valuable tool for evaluation of the various theoretical models that forms the foundation for a comprehensive understanding of complex solids.

We present photoemission results of layered tetragonal compounds: antiferromagnet UAsSe and ferromagnet USb_2 that present an intriguing electronic structure in which both relatively dispersive and narrow 5*f* bands are found. ARPES studies reveal a very sharp photoemission peak in the vicinity of the Fermi edge we found, which is a fingerprint of the 5*f* density of states. Dispersion of this peak along the Γ to Z direction of the Brillouin zone (20 meV for UAsSe and 10 meV for USb_2) proves that neither UAsSe nor USb_2 have purely two-dimensional electronic structure and these compounds are indeed quasi-2D. We have also found a broader, hybridized *f*-character bands with a dispersion of several hundred meV along the Γ to X direction in the Brillouin zone. Narrow and dispersive bands in these U-based magnetic materials are reminiscent of band magnetism previously found in Cr and Fe, but for these uranium compounds the band widths and dispersions are two orders of magnitude smaller.

Photoemission studies also provide an evidence of a very close relationship between the electronic structure and magnetic properties in actinide compounds. The results obtained for cubic uranium, neptunium and plutonium compounds and layered uranium materials show that ordered magnetic moments and/or magnetization is closely correlated with binding energy of valence band photoemission features. For ferromagnetic UTe a Stoner-like mechanism and simple mean-field explanation is proposed.

Acknowledgements: The author (E.G.) was supported by the Polish grant of Ministry of Science and Higher Education No. N202 140 32/3877.

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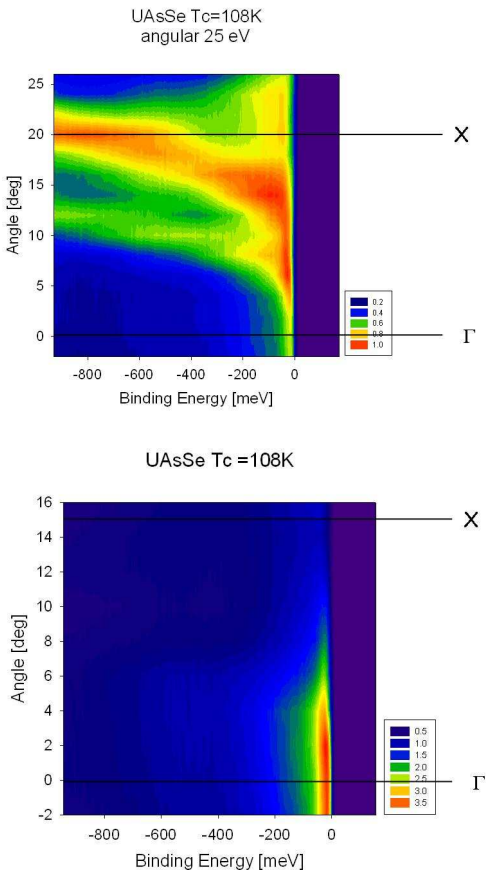

Figure 1. Angle-resolved PES spectra of UAsSe taken for $h\nu$ = 25 eV (a) and 44 eV (b). Both data are taken along the Γ to X direction of the Brillouin zone.