MAR06-2005-004134

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Hard x-ray photoelectron spectroscopy and x-ray standing waves

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Using the brilliant undulator radiation available from the third generation synchrotron sources, hard x-ray photoelectron spectroscopy (HAXPES) has become an emerging field in the recent years. With the excitation energy used in HAXPES one can benefits from the large mean free path of fast electrons ($\sim$ 5 nm for electrons of 6 keV kinetic energy) in probing the bulk electronic properties of materials. For high-resolution studies, photon energy bandwidth narrower than 100 meV is also readily achievable in the hard x-ray range with crystal monochromators. In addition, working with hard x-ray offers the possibility for combining photoelectron spectroscopy with x-ray standing wave (XSW) method. With the high spatial resolution from XSWs, this unique combination can provide site-specific, chemical and electronic information for studying surfaces, buried interfaces, thin films and bulk crystals. In this talk, I will briefly mention some HAXPES experiments detecting electrons up to 14.5 keV [1,2]. I will then sketch the principle of combining XSWs with HAXPES and present results from some recent applications using this combination: (1) chemical state-specific surface structure determination with core-level photoemission, (2) site-specific valence x-ray photoelectron spectroscopy and (3) XSW imaging with core-level photoemission. [1] S. Thiess, C. Kunz, B.C.C. Cowie, T.-L. Lee, M. Renier, and J. Zegenhagen. Solid State Communications 132, 589 (2004) [2] C. Kunz, S. Thiess, B.C.C. Cowie, T.-L. Lee, and J. Zegenhagen, Nuclear Instruments and Methods A 547, 73 (2005).