Synchrotron-Based ARPES Studies of Hf (0001) Single Crystal

Laxman Nagi Reddy[1,2, a)], Maria Christine Richter[1,2], Olivier Heckmann[1,2], Jean Zaraket[1,2], Mauro Fanciulli[1,2], Waly Ndiaye[1,2], Saleem Ayaz Khan[3], Laurent Nicolaï[3], Natalia Olszowska[4], Marcin Rosmus[4], Weimin Wang[5], Ján Minár[3] and Karol Hricovini [1,2]

[1]LPMS, CY Cergy Paris University, France
[2]DRF, IRAMIS, LIDYL, CEA Saclay, France
[3]NTC, University of West-Bohemia, Pilsen, Czech Republic
[4]Solaris National Synchrotron Radiation Centre, Krakow, Poland.
[5]MAX IV Laboratory, Lund, Sweden.

[a)] Corresponding author: laxman.nagi-reddy@cyu.fr

Abstract. Systematic Angle-Resolved Photoemission Spectroscopy (ARPES) experiments have been carried out to investigate the electronic structure of the Hf (0001) surface by synchrotron radiation. High-Z materials have attracted much interest because the strong spin-orbit coupling in combination with the broken inversion symmetry and an important effective electric field at the surface results in a spin-momentum locking. Spin-polarized electrons at the surface are of interest in physics and novel applications in electronics and data processing [1], [2]. Surprisingly, ARPES studies of Hf surfaces are entirely missing in literature to our best knowledge.
The hafnium surface was known to be very sensitive to oxidation. In the cleaning procedure (ion bombardment and annealing) we tuned the annealing temperature yielding a high-quality unreconstructed surface. To explore bulk electronic states, we recorded ARPES spectra as a function of photon energy from 20 eV to 100 eV at room and liquid nitrogen temperatures. In addition, we used both linear and circular polarized light to fathom the polarization dependence. Furthermore, our preliminary results reveal the presence of a surface state in Hf (0001) which is in excellent agreement with theoretical calculations.

[1] LaShell S. *et al*., Phys. Rev. Lett. 77, 3419 (1996).
[2] Varykhalov A. *et al*., Phys.Rev.Lett. 108, 066804 (2012).