EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** Low Z number materials measurements of IMFP of electrons at keV energies using HAXPES	**Experiment number**: SI 2468
Beamline: BM25	**Date of experiment**: from: 30-May-2012 to: 2-Jun-2012	**Date of report**:
Shifts: 9	**Local contact(s)**: RUBIO-ZUAZO Juan	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

We report the results from HAXPES experimant at the spanish beamline (spline) BM25. Three Carbon film sampels of 19.2, 34.4 and 74.7 nm were diposeted onto a one sided polished copper substrat. Three photon energies of 17, 18, and 19 keV were used to generate photoelectrons from the Cu (1s) shell. Data was aquaierd for the three phton energies at each carbon film. The spectra emitted from the pure cooper substrate and from the 19.2, 34.4 and 74.7 nm carbon over-layer is depicted in Fig 1 for the photon energies of 19, 18 and 17 keV. Each spectrum was first normalized according to the storage ring electron current during the measurement, the Tougaard algorithm [1] was used for background correction and finally the intensity of each spectrum was normalized to one.

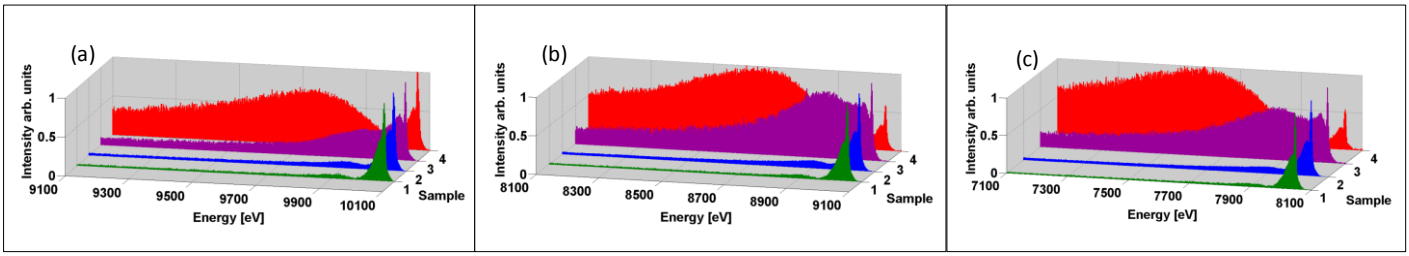

Figure 1: Measured spectra of the cooper substrate (sample 1), the 19.2 nm carbon over-layer (sample 2), the 34.4 nm Carbon over-layer (sample 3) and the 74.7 nm carbon over-layer (sample 4). The peak observed at the right side of the spectra is originated from the cooper (1s) contribution. The photon energy is 19, 18 and 17 keV in figures (a), (b) and (c), respectively.

As the electrons projection length is extended from zero to 74.7 nm, a buildup of electrons that have experienced multiple energy losses is observed. The electrons average energy, measured as a function of carbon over-layer thickens using the wide energy spectrum shown in Fig 1, is plotted in Fig 2 for photons energy of 17, 18 and 19 keV. A linear fit calculated for each photon energy and shown in Fig. 2, demonstrates the proportionality of the electron inelastic interaction characteristics. This proportionality arises from the electron inelastic interaction characteristics. As an impending electron interacts with the field of the material electrons, the approaching electron energy loss probability is almost independent of its initial energy[2].

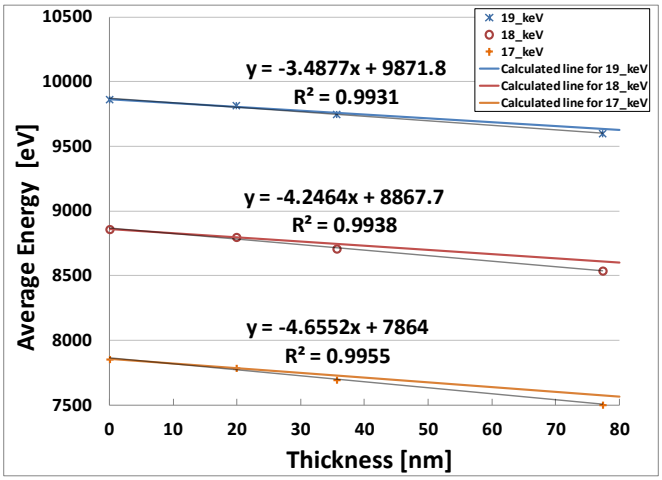

Figure 2: The average electron spectrum energy measured for the 19 keV (asterisks), the 18 keV (circles) and the 17 keV (pluses) photon energy. The equation written above each data series represents a linear fit (shown by the gray line). The thick lines are calculated for each data series using the model described in ref [3].

The thick line plotted on top of each set of measurements in Fig. 2, is the calculated results for the three different energies, using pure cupper as the reference energy according to our calculations published in ref. [3]. The small discrepancy between the measurements and the model results observed for the thicker samples are caused from the difference between the projection length and the electron path length. While the sample thickness represents the projection length, the electron path length is elongated due to elastic interactions. This effect intensifies as the photon energy decrease from 19 to 17 keV.

Reference

[1] S. Tougaard, W. Braun, E. Holub-Krappe, and H. Saalfeld, Surf. Interface Anal. 13 (1988) 225-227

[2] Werner W.S.M., Electron transport in solids for quantitative surface Analysis, Surf. Inter. Anal. 31 (2001) 141-176

[3] A. Givon, E. Tiferet and I. Orion, Nucl. Instr. Meth. B (2012), http://dx.doi.org/10.1016/j.nimb.2012.07.025