Novel Trends in Synchrotron and FEL-Based Analysis Focus Topic

Room Central Hall - Session SA-TuP

Synchrotron and FEL-Based Analysis Poster Session

SA-TuP-2 Inelastic Background Analysis using a Reference on Technologically Relevant Samples: Determination of Input Parameters*,* ***Charlotte Zborowski****, O Renault,* CEA/LETI-University Grenoble Alpes, France*; A Torres,* CEA/LETI-University Grenoble Alpes, Francee, France*; Y Yamashita,* NIMS, Japan*; G Grenet,* Inl, Ecl, France*; S Tougaard,* SDU, Denmark

Abstract: Recently, the advent of Hard X-ray Photoelectron Spectroscopy (HAXPES) has enabled to study deeply buried interfaces [1,2]. It was shown that by combining HAXPES with inelastic background analysis [3], structures at a depth >50 nm can be studied. This study was performed on technologically relevant High Electron Mobility Transistors presenting different thicknesses of the Ta/Al electrode on an $Al_{0.25}Ga_{0.75}N$/AlN/GaN heterostructure. HAXPES was performed at the Spring-8 synchrotron using 8 keV photons. Here, we present a non-destructive solution to get information on deeply buried layers and interfaces. This is a refined analytical method, based on the use of a reference spectrum, for determining the required input parameters, i.e. the inelastic mean free path calculated using the TPP-2M formula and the inelastic scattering cross-section. As the spectra present marked plasmons, after the elastic peaks, we used an average of individual inelastic scattering cross-sections [4], K, which can be determined from Reflection Electron Energy-Loss Spectra. The use of a reference sample gives extra constraints which make the analysis faster to converge towards a more accurate result. The results were determined with the best Ta $3p_{3/2}$ corrected spectra calculated with different cross-sections and the resulting in-depth distribution was found with an accuracy better than 5% and in good agreement with the TEM results. We have also successfully used this technique to study structures at a depth >70 nm.

References

[1] P. Risteruci et al., Applied Physics Letters, 104, (2014).

[2] C. Zborowski et al., Applied Surface Science, (Submitted).

[3] S. Tougaard, Journal of Electron Spectroscopy and Related Phenomena, 178–179 (2010).

[4] P. Risterucci et al., Applied Surface Science, 402, (2017).

Part of this work was performed at the Nanocharacterization Platform of CEA-MINATEC. NIMS and Spring-8 are acknowledged for providing beamtime and the staff of the BL15-XU beamline for their assistance during the experiment.

SA-TuP-3 Hard X-ray Photoelectron Spectroscopy in the Home Laboratory: A Commercially Available System*,* ***Susanna Eriksson****, P Palmgren, M Patt, M Heiss, P Baumann, P Zeigermann, T Wiell, K Backlund, C Liljenberg, M Lundqvist,* Scienta Omicron

During the past decade, increased attention has been shown to hard X-rays in the photoelectron spectroscopy field. This is mainly due to the increased information depth enabled by the higher photon energies. Such bulk sensitive measurements could previously only be performed at dedicated synchrotron radiation facilities. The beam lines providing this type of radiation are heavily booked, so access to the experimental setups is thus limited.

We now present a novel product featuring a monochromized X-ray source giving out Ga Ka radiation at 9.25 keV and a wide acceptance angle hemispherical electron analyzer, both combined on a simple to use vacuum system. The base system can easily be customized by adding separate modules such as a MBE- or preparation chamber or a glove box. With this novel base system, a new set of possible experiments opens up in the home laboratory: investigations of buried interfaces, in operando devices, real world samples, etc. Such samples or conditions have previously been unattainable with the limited information depth of traditional XPS.

At the heart of the system is a liquid jet of a molten Ga-rich alloy. Electrons which are accelerated into this jet generate an intense Ga Ka radiation. These X-rays are monochromized and refocused using an ellipsoidal mirror in a Rowland geometry. The small spot size of 20 µm provided by the liquid jet source is maintained throughout the passing of the monochromator and only slightly broadened to about 50 µm. The photon energy width is targeted at 0.5 eV, suitable for the typical intrinsic core level width at the relatively high photon energy. In order to allow for easy adjustment of the X-ray focal point relative to the electron analyzer, the entire assembly of monochromator and source can be moved down to a precision of a few micrometers. The hemispherical electron analyzer is configured for high kinetic energies allowing for detection of the full energy range the source provides, a large acceptance angle of +/- 30 degrees

We present prototype data taken from polycrystalline gold and silicon wafers with a surface layer of silicon dioxide with a controlled thickness.

SA-TuP-4 Vacuum System of the ESS Cold Linac, Update on Design and Status*,* ***Fabio Ravelli****, S Scolari, M Ferreira,* European Spallation Source ERIC, Sweden

The European Spallation Source, under construction in Lund (Sweden), is a neutron source based on a 5 MWatt super-conducting linear accelerator. The ultimate goal of ESS is to be the brightest neutron scattering facility and to enable novel science in many fields, such as biology research, environmental technologies and fundamental physics.

After a brief description of the superconducting Linac, the talk focuses on the vacuum design of the Warm Units that give continuity to the beam line environment between adjoining cryomodules [1]. As the use of N on-Evapoarble Getter and Sputter Ion P ump comb ination pumps is under evaluation, a campaign of measurements on particles generated during operation (activation - regeneration - pumping) by two different models of combination pump has been performed; the results of these tests are discussed. Finally, some insights about particle free installation tooling [2] are presented.

[1] ESS Vacuum System Status, Dr. Marcelo J. Ferreira, ESS Vacuum System Section Leader, IVC-20, August 21-26, 2016, Busan, Korea

[2] Particle Free Installation of Warm Linac Units at ESS F. Ravelli and M. J. Ferreira, 2016 CAS Accelerator School, October 2-14, 2016, Budapest, Hungary

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