Nanoscale Chemical Characterization by Auger Electron Spectroscopy*

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ABSTRACT

State of the art Auger nano-probes are more and more competitive to characterize the devices developed for nanotechnologies. Auger Electron Spectroscopy (AES) and Scanning Auger Microscopy (SAM) are gaining interest to investigate the surface chemical composition with high lateral resolution (< 10 nm). We will present the new capabilities of these techniques by the analysis of innovative nanostructures. In particular, the potential of the Auger nano-probe from Physical Electronics recently installed at the Minatec NanoCharacterization Platform will be illustrated.

The potential of SAM will be shown in terms of high lateral resolution, stability over time and sensitivity. From one hand, we investigate the chemical composition of nanodots (~10nm in height) formed during Si anneal at 900°C under UHV. These impurities, formed from surface contamination, are identified as SiC dots by Auger analyses. From the other hand, the interest of SAM is also demonstrated by the analysis of Si nanowires. The coaxial geometry prevents shadowing effects and enables uniform chemical mapping of these structures. Location of the Copper catalyst and investigation of the oxidation states are performed with high lateral and energy resolution.

In-depth chemical analysis is another interesting aspect of the technique. Results obtained by cross-section analysis and depth profiling will be compared. From one hand, tests performed on cross-sections of CdTe/CdS based solar-cells devices will be shown. These results also evidence the efficiency of charge neutralization for measurements on glass substrates. From the other hand, Auger depth profiles measured for high-k/metal gate stacks allow to clearly identify thin LaO layers (<1nm).

Auger microscopy can also bring information complementary to TEM based techniques. SAM is performed on Focused Ion Beam (FIB) cross-sections to obtain the surface chemical composition. A direct comparison between high resolution TEM images and Auger mapping will be presented. The advantages and specificity of each technique will be discussed.

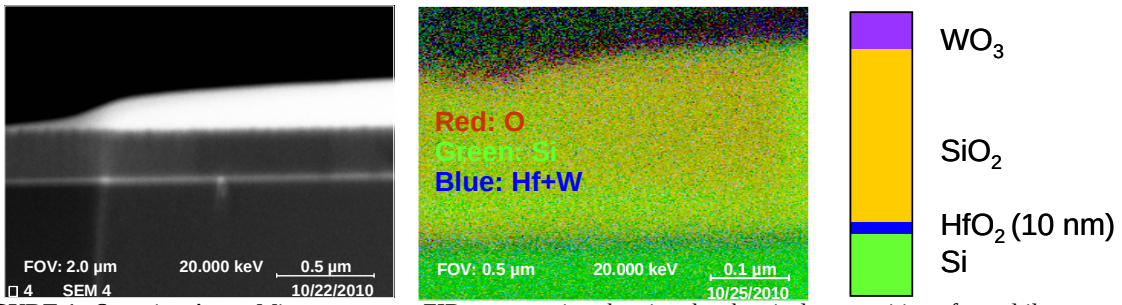

FIGURE 1. Scanning Auger Microscopy on a FIB cross-section showing the chemical composition of a multilayer stack. The thin (10 nm) HfO_2 layer is clearly identified.

Keywords: AES, SAM, Auger mapping, depth profiling, Si nanowires, SiC formation, TEM, cross-section

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