New Approach in TEM-EDS Quantitative Analysis, Used for Auger Calibration in Order to Set an Advanced Back Metal Control

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In Silicon Devices fabrication the Front-End/Back-End compatibility it is always a big issue, considering the *high electrical performances* of devices and the continuous shrinkage of packages. It is common, in particular in Power Device technologies context, to use the *bulk* of the wafer as common drain terminal. For this reason, to ensure a good electrical contact, stable in terms of temperature and strain, a multilayer of metal stack is deposited in the backside of the wafer that is connected to the frame of the package through a process called die attach. Often these stacks are composed of Ti/Ni/Au or more commonly Ti/NiV/Ag. The last layer, Au or Ag, must be clean and there must be no Nickel on the surface, to ensure the proper operation of electrical contact and die attach. But due to the high mobility of the Nickel, it is possible that, in some conditions (for example process deviation, bad storage, uncontrolled thermal budget, etc), there is a segregation through the last layer and the Nickel reach the surface reacting with the atmosphere and creating a very stable layer of nickel oxide that cannot be removed. The corresponding devices must be discharged.

We promote the use of Auger Electron Spectroscopy (AES) to control the stack but, in this specific case, it give results just qualitative. The reason is related to the absence of a standard sample for calibration of spectra with Ni peaks in Ag matrix. Moreover the usage of tabulated Relative Sensitivity Factors (RSFs) give results with an error of about 20% that are not enough for our needs.

An alternative technique, is Energy Dispersive X-ray Spectrometry (EDS) in cross section using Transmission Electron Microscopy (TEM). On this technique, quantitative results could be extrapolated if the specimen satisfy the Thin Foil Criterion condition (in order to semplify *ZAF* corrections) and if the Cliff and Lorimer coefficient (k_{AB}) is known (using one time again e referring sample that is unavailable). Recently we have demonstrated the possibility to extrapolate the Cliff and Lorimer coefficient in a binary alloy starting from a multilayer of pure elements.

In this study first we have prepared two set of samples for k_{AB} extrapolation. Then we have prepared a wafer with a standard back metal thermally over stressed, in order to promote the nickel migration. This wafer has been analysed by both AES and TEM-EDS and we have used the quantitative results find with TEM-EDS, using the k_{AB} previously calculated, for AES-RSF (of Ni in Ag matrix) calculation.

Finally the Ni concentration results were compared with that ones obtained on the same sample with X-ray Photoelectron Spectroscopy (XPS), which is a third complementary techniques, obtaining a perfect agreement