

Abstract

This thesis aims at improving the inelastic background analysis method in order to apply it to technologically relevant samples. Actually, these improvements are utterly needed as they concern criteria of accuracy and time saving particularly for analysis of devices presenting deeply buried layers with different materials. For this purpose, the interest of the inelastic background analysis method is at its best when combined with hard X-ray photoelectron spectroscopy (HAXPES) because HAXPES allows to probe deeper in the sample than with conventional X-ray photoelectron spectroscopy (XPS).

The present work deals with technologically relevant samples, mainly the high-electron mobility transistor (**HEMT**), at some crucial steps of their fabrication process as annealing. Actually, it is very important that these analyses shall be performed non-destructively in order to preserve the buried interfaces. These are often the location of complex phenomena that are critical for device performances and a better understanding is often a prerequisite for any improvement.

In this thesis, the in-depth diffusion phenomena are studied with the inelastic background analysis technique (using the QUASES software) combined with HAXPES for depth up to 60 nm. The depth distribution results are determined with deviations from TEM measurements smaller than a typical value of 5%. The choice of the input parameters of the method is discussed over a large range of samples and simple rules are derived which make the actual analysis easier and faster to perform.

Finally, it was shown that spectromicroscopy obtained with the HAXPEEM technique can provide spectra at each pixel usable for inelastic background analysis. This is a proof of principle that it can provide a 3D mapping of the elemental depth distribution with a non-destructive method.