

Chemical State Analysis by High Resolution AES

B. Vincent Crist, Ph.D.

Fisons Instruments (VG Scientific)
3-6 Minamisuna 3-chome
Koto-ku, Tokyo 136 Japan

High energy resolution AES (HR-AES) has been available for identifying chemical states for more than 15 years, but only recently has there been a strong demand for using HR-AES to identify different chemical states in chemically similar materials which is the normal realm of XPS. To demonstrate the practical utility of HR-AES, this talk will present a series of high energy resolution Auger spectra from chemically similar materials which were obtained by using the VG MicroLab 310F. The 310F is a field emission type of AES instrument (FE-AES), which uses a hemi-spherical analyser (HSA) that provides continuous energy resolution ranging from 2.0% to 0.02%.

The 0.02% level of energy resolution is 12X better than the best resolution (0.25%) and 30X better than the 0.6% energy resolution provided by conventional cylindrical mirror analyzers (CMA). The turning point for assigning chemical states occurs for many Auger signals in the higher kinetic energy region after the analyzer surpasses 0.15% energy resolution.

High resolution AES has been used to observe the chemical state differences between three types of silicon (i.e., n-type, p-type, and un-doped Si). The kinetic energy difference between n-type and p-type silicon ($\Delta KE = 0.7$ eV) is very similar to binding energy difference observed by XPS ($\Delta BE = 0.8$ eV). HR-AES has also been used to observe very small KE differences ($\Delta KE = 0.6$ eV between GaAs and GaSb).

The VG 310F can also be used to perform High Resolution Reflected Electron Energy Loss Spectroscopy (HR-REELS) which has been used to generate a high spatial resolution map of the chemical and physical differences between diamond and graphite which is not possible to do by using high resolution AES or XPS.

