

## **THE PROGRESS OF QUANTITATIVE ANALYSIS BY ELECTRON SPECTROSCOPY**

M. P. Seah

Centre for Materials Measurement and Technology  
National Physical Laboratory  
Teddington  
Middlesex TW11 0LW,UK

### **ABSTRACT**

The physical bases of most of the concepts for the quantitative analysis of solid surfaces by Auger and X-ray photoelectron spectroscopies was clearly established in the late 1960s and the 1970s. For Auger electron spectroscopy (AES) the basic theory involving the ionisation cross sections, backscattering etc was clearly established by Bishop and Rivier in 1969 and the effects of attenuation of the electrons by matter by Palmberg and Rhodin in 1968. The use of the differential method and for studying adsorbed sub-monolayer quantities was already established by Harris in his founding publication in 1968. With X-ray photoelectron spectroscopy (XPS) the cross sections and anisotropy were established by 1976 and, for both techniques, data banks involving intensities for quantification

were available by a similar date. Over the next 20 years the theory developed, improving our understanding of many of the parameters, and calculations provided the essential parameters for quantification. The calculations became steadily more sophisticated and developed sub-fields with their own momentum. Underlying all this development has been a general weakness of good supporting experimental data since, as has been the case since surface analysis started, it is still very easy to observe what has happened but it is still very difficult to devise fully controlled experiments. This review will show how far progress has been achieved in these respects. In particular, in an analysis of a new digital Auger database we show how basic terms may be evaluated with full traceability to the SI system.