

Lecture 18

Applications of Auger spectroscopy

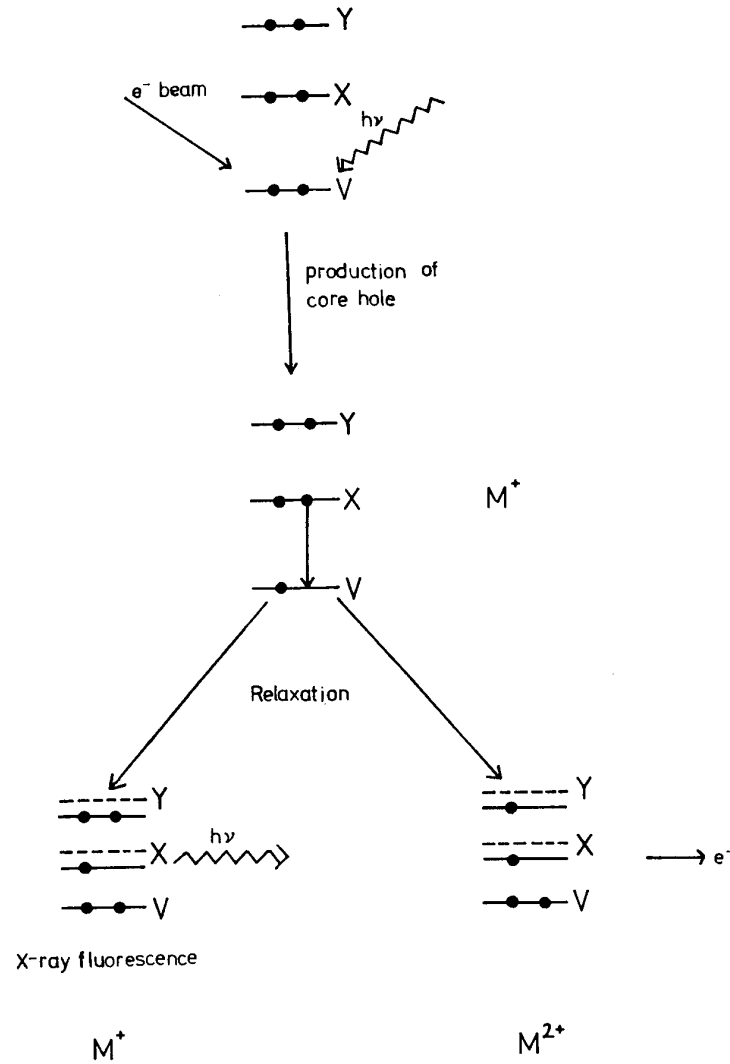
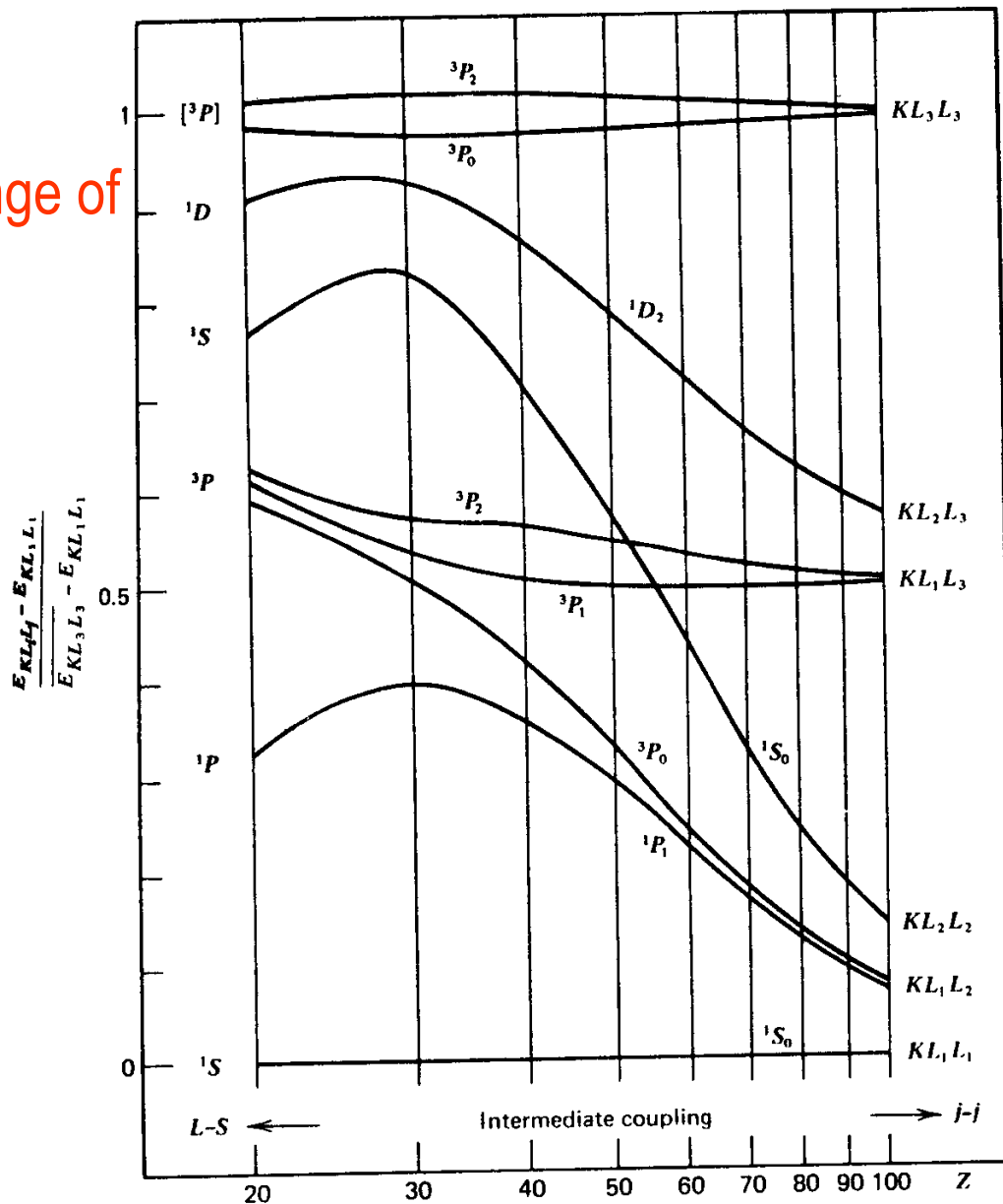


Figure 1.4. Possibilities for decay of a core vacancy.

Relaxation occurs as a result of core hole emission

The change of LS – jj coupling schemes



Configurations

$2s^02p^6$	KL_1L_1	$1s2s2s$
$2s^12p^5$	KL_1L_2	$1s2s2p_{1/2}$
	KL_1L_3	$1s2s2p_{3/2}$
$2s^22p^4$	KL_2L_2	$1s2p_{1/2}2p_{1/2}$
	KL_2L_3	$1s2p_{1/2}2p_{3/2}$
	KL_3L_3	$1s2p_{3/2}2p_{3/2}$

Figure 2.1. Coupling between final atomic vacancy states following a KLL transition for different Z . (Reprinted with permission of Wiley-Interscience, New York.)

Details of the electronic structure can be studied

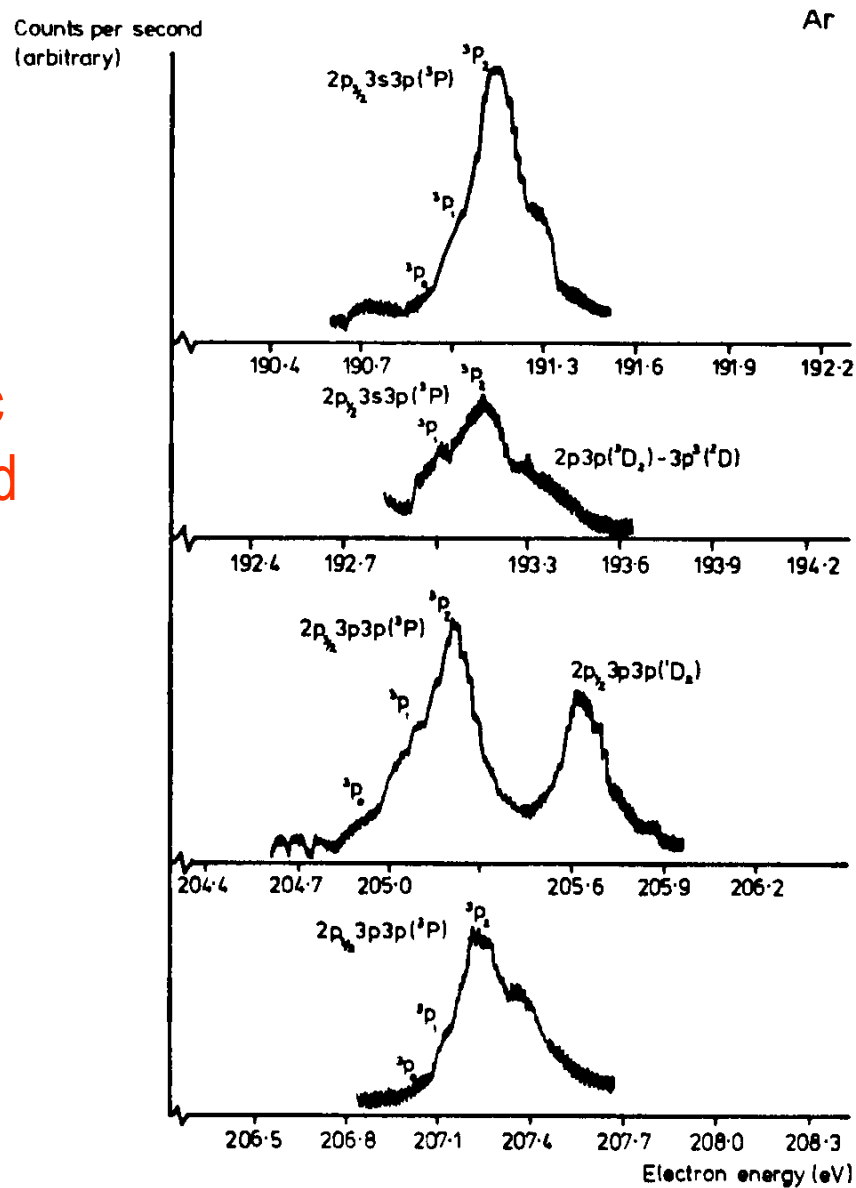


Figure 2.2. Auger 3P peaks of argon in the gas phase by electron impact.⁵ (Reprinted with permission of American Chemical Society, Washington.)

Variation in intensity with change in excitation

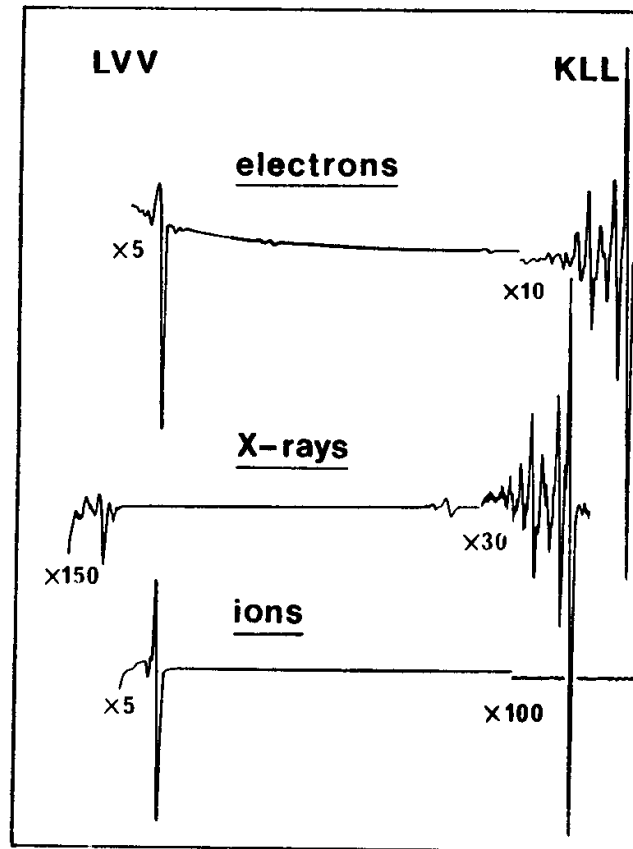


Figure 6.6. Aluminum *LVV* and *KLL* first-derivative Auger spectra under electron (5 keV), x-ray (1254 eV), and ion (5 keV argon) irradiation. The x-ray-induced spectrum is displaced slightly on the energy axis to avoid confusion. The main features to note are: (i) Relatively weak x-ray-induced Auger emission. The *KLL* features are excited, not by the 1254-eV radiation, but by the background bremsstrahlung component of the x-ray spectrum. The *LVV* features are very weak due to the low photoionization cross section of the aluminum *L* levels at 1254 eV. (ii) The absence of *KLL* Auger features in the ion-induced spectrum. The ion-induced *LVV* feature, however, is very intense and different in structure to the corresponding electron-induced feature.

Manifestation of change in electronic structure

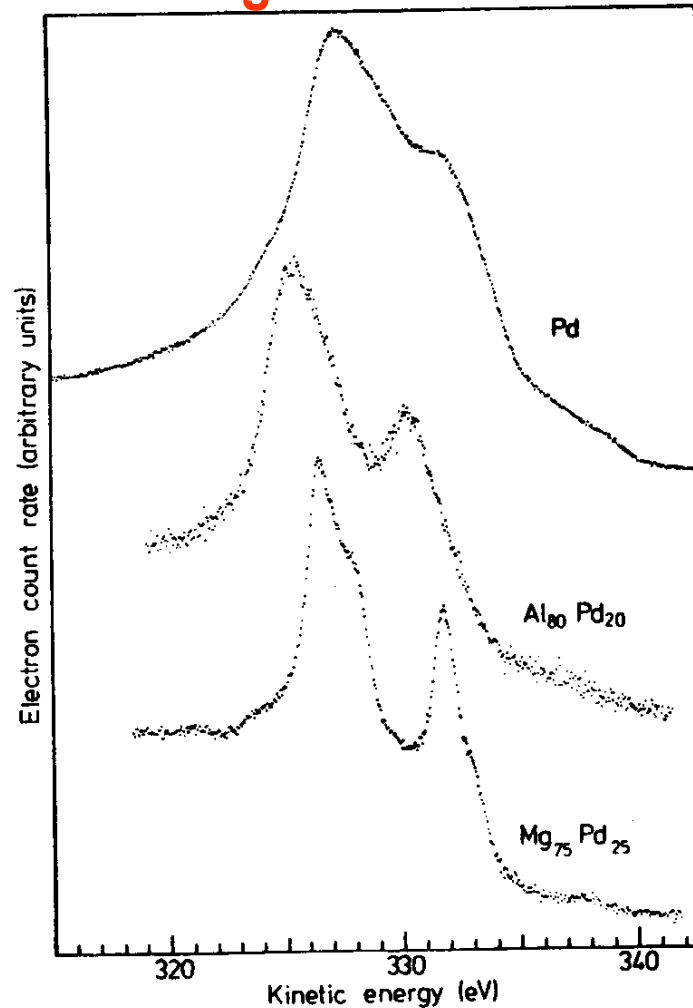


Figure 6.7. Pd $M_{4,5} N_{4,5} N_{4,5}$ Auger spectra from Pd, Al_{0.8}Pd_{0.2}, and Mg_{0.75}Pd_{0.25}, showing bandlike structure in the element, and atomic-like structure in the alloys. (Reproduced with permission from Reference 140, © Institute of Physics.)

Segregation

Cr enrichment

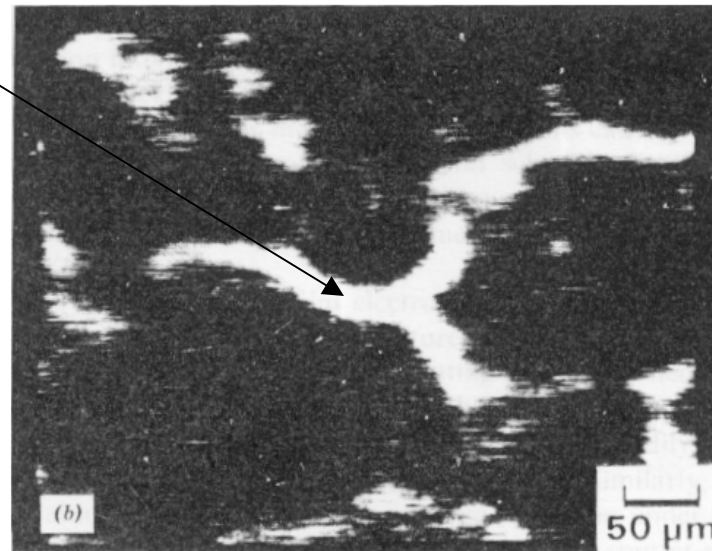
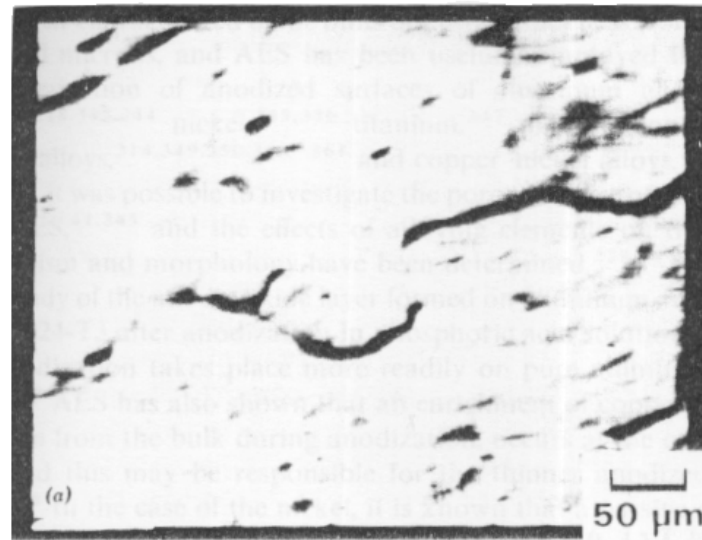
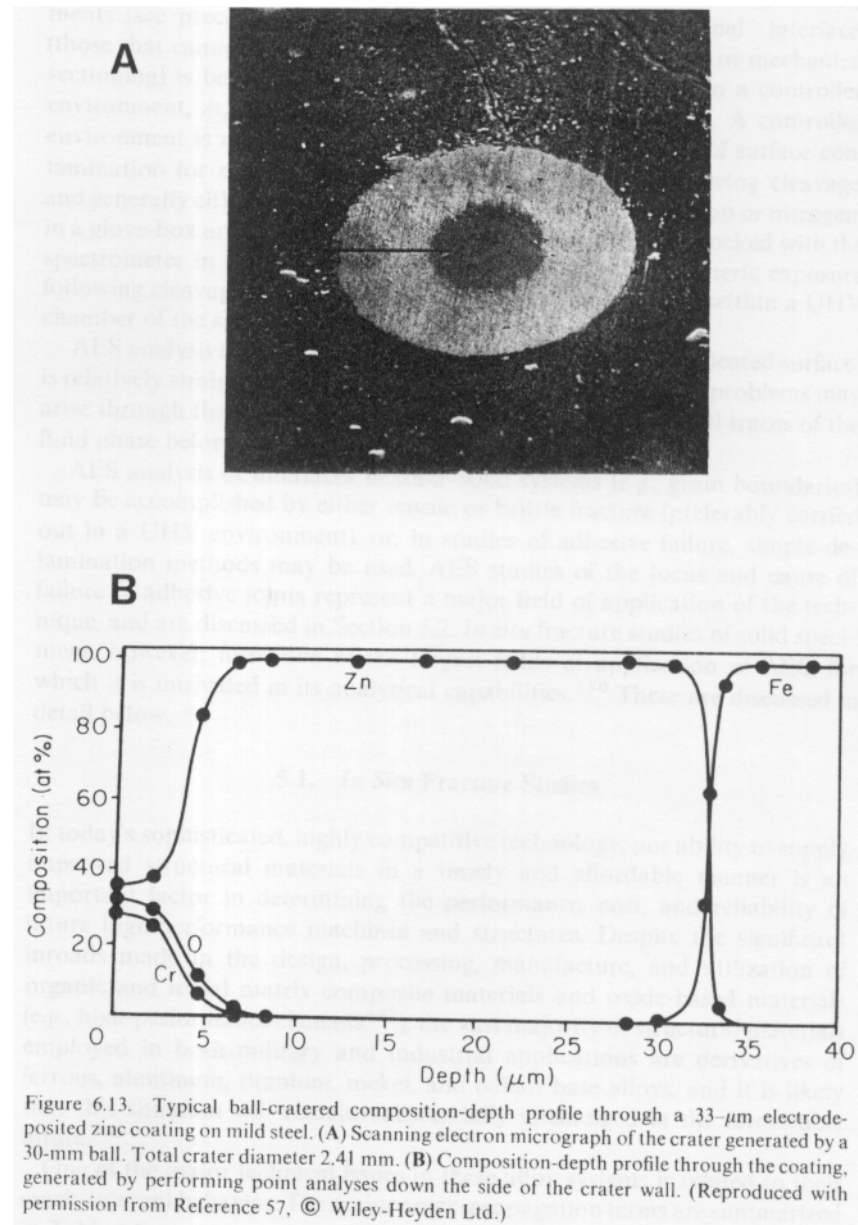
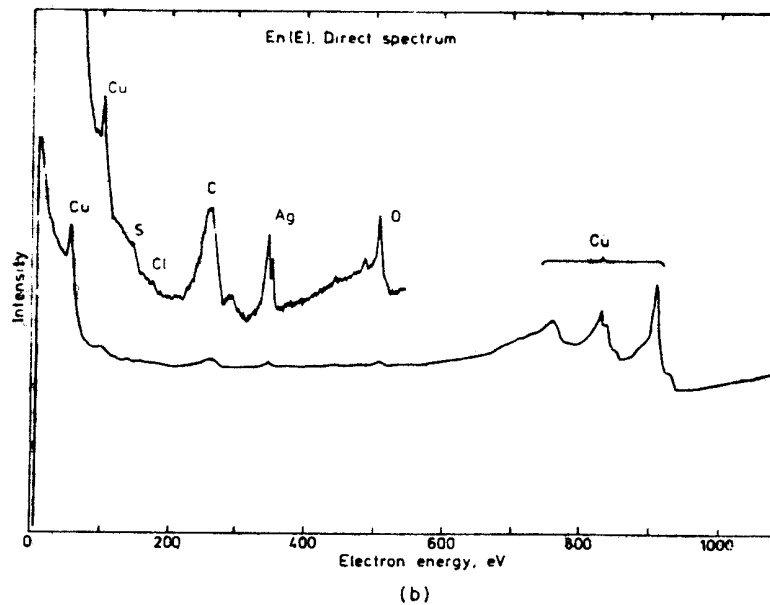
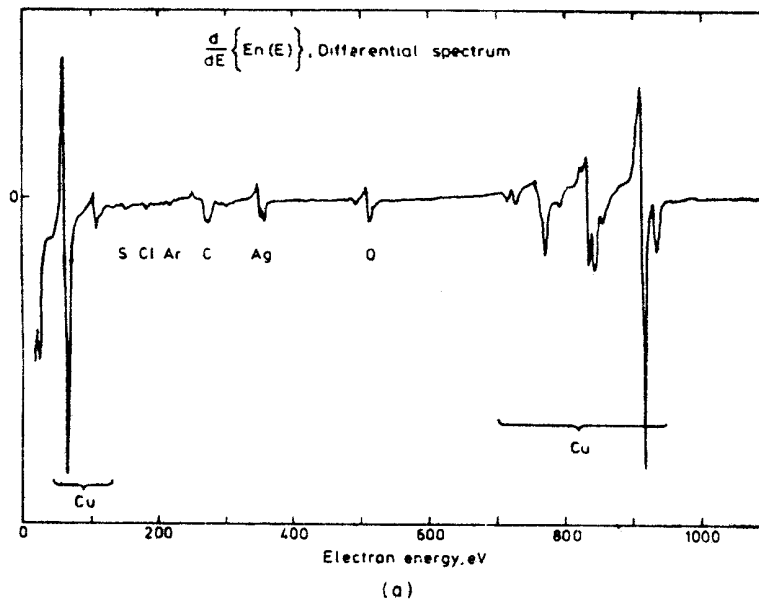


Figure 6.11. (a) Secondary-electron image and (b) chromium Auger map of 304 stainless steel oxidized in 0.05 torr O_2 at 800 C, showing chromium enrichment at grain boundaries. (Reproduced with permission from Reference 316, © North-Holland Publishing Company.)

Depth profiling





Auger spectra can be collected in the normal mode as well.

Figure 5.11 Differential and direct electron spectra from contaminated copper

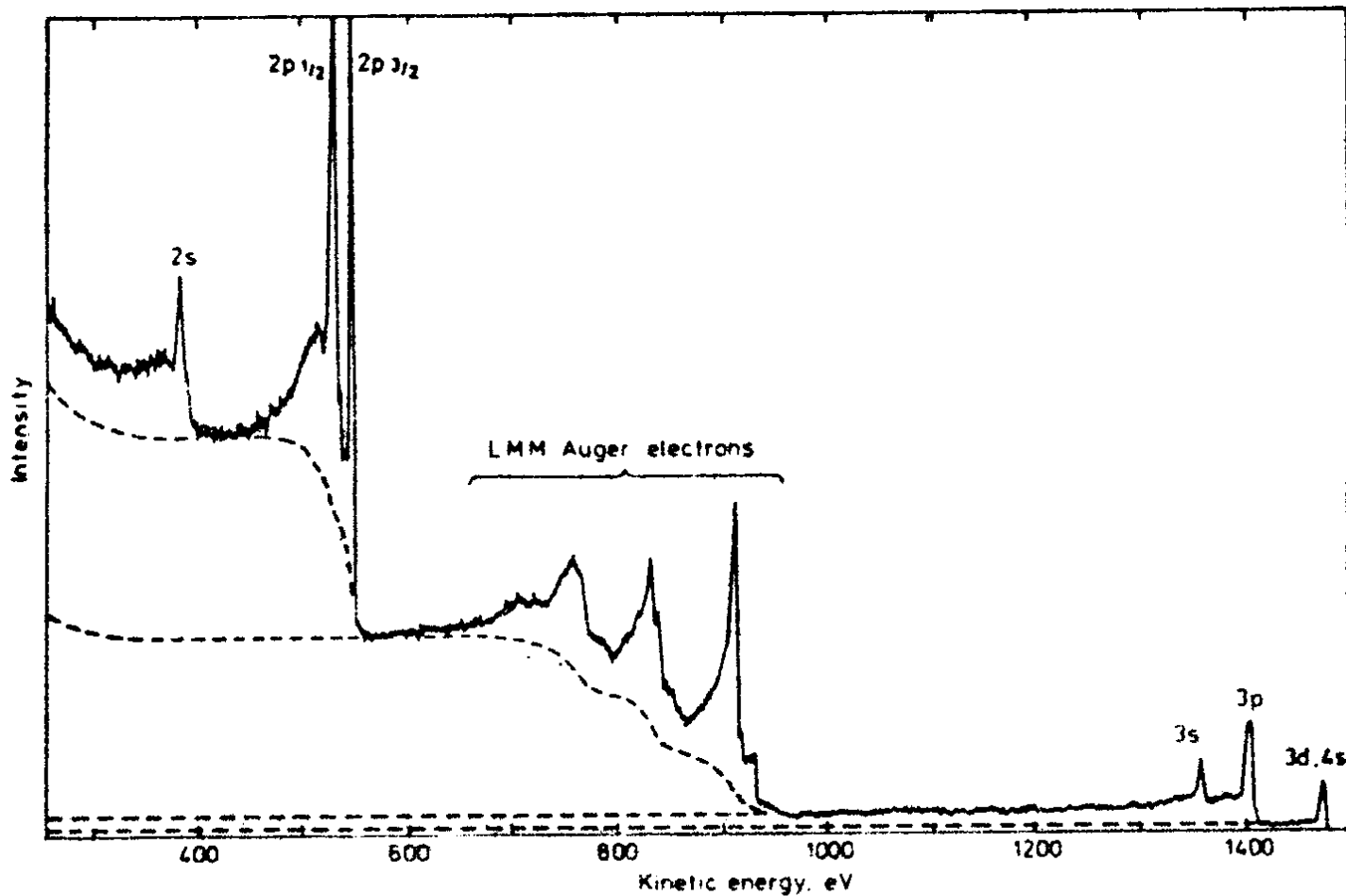
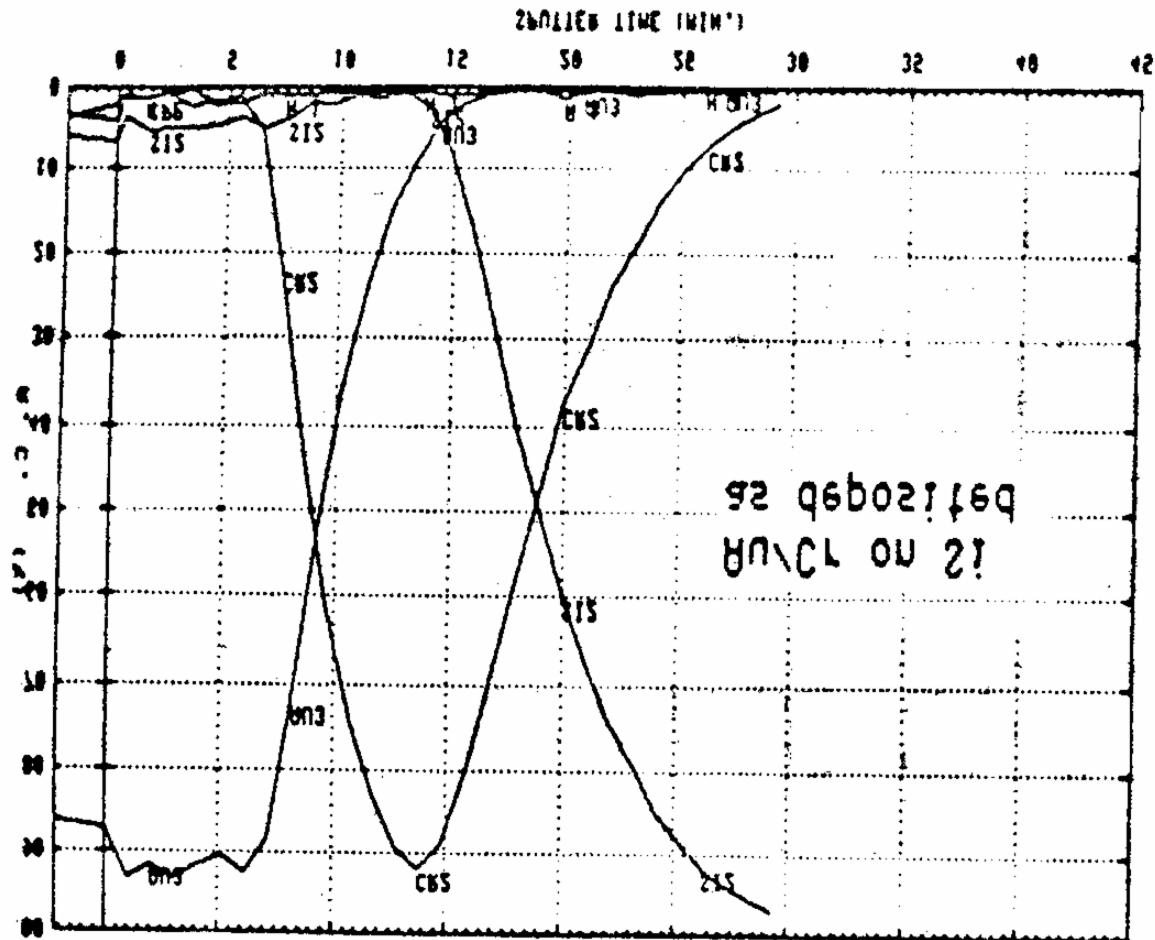


Figure 5.12 XPS spectrum from copper showing the stepped background and Auger electron peaks. (After Seah²¹)

In order to do quantitative analysis, one needs to correct the background.

Figure 8.1 LEA depth profile of a gold film on chromium on silicon, as deposited



Depth profiling is an important aspect of Auger spectroscopy. The depth resolution can be as high as 50 nm.