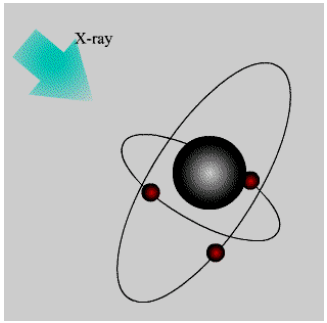
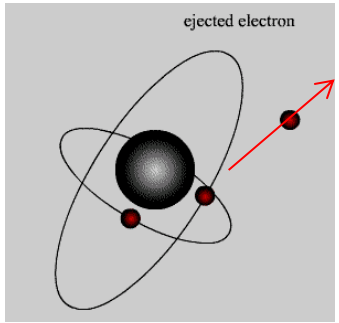
X-ray Photoelectron Spectroscopy

Electron Spectroscopy for Chemical Analysis (ESCA)





➢ XPS 란?

- 방출되는 광전자의 에너지를 통해 결합상태 및 원소를 분석하는 방법
- 스웨덴의 물리학자 K. Siegbahn에 의하여 개발됨 - 전자 분광법(ESCA) 라고도 부름

➢ XPS 원리

특정 에너지를 가진 X-ray을 시편에 조사하면 시편에서 전자들이 방출되는데, 이때 전자들의 운동에너지를 측정하면, (원자들의 Bind energy를 통해) 시편의 원소를 알 수 있음.

$$K.E = h\upsilon - B.E$$

(K.E : 운동에너지 , B.E : 결합에너지)

What is XPS ?

X-ray Photoelectron Spectroscopy (XPS)
Electron Spectroscopy for Chemical Analysis (ESCA)

XPS, also known as ESCA, is the most widely used surface analysis technique because of its relative simplicity in use and data interpretation. The sample is irradiated with mono-energetic x-rays causing photoelectrons to be emitted from the sample surface. An electron energy analyzer determines the binding energy of the photoelectrons. From the binding energy and intensity of a photoelectron peak, the elemental identity, chemical state, and quantity of an element are determined. The information XPS provides about surface layers or thin film structures is of value in many industrial applications including: polymer surface modification, catalysis, corrosion, adhesion, semiconductor and dielectric materials, electronics packaging, magnetic media, and thin film coatings used in a number of industries. Specific applications include: surface elemental and chemical characterization, thin film characterization, surface cleanliness, and surface migration of additives or impurities.

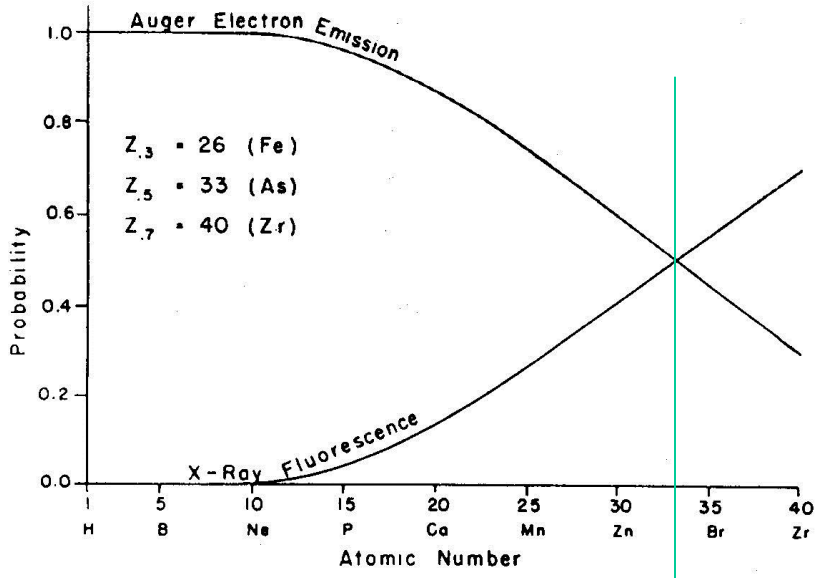
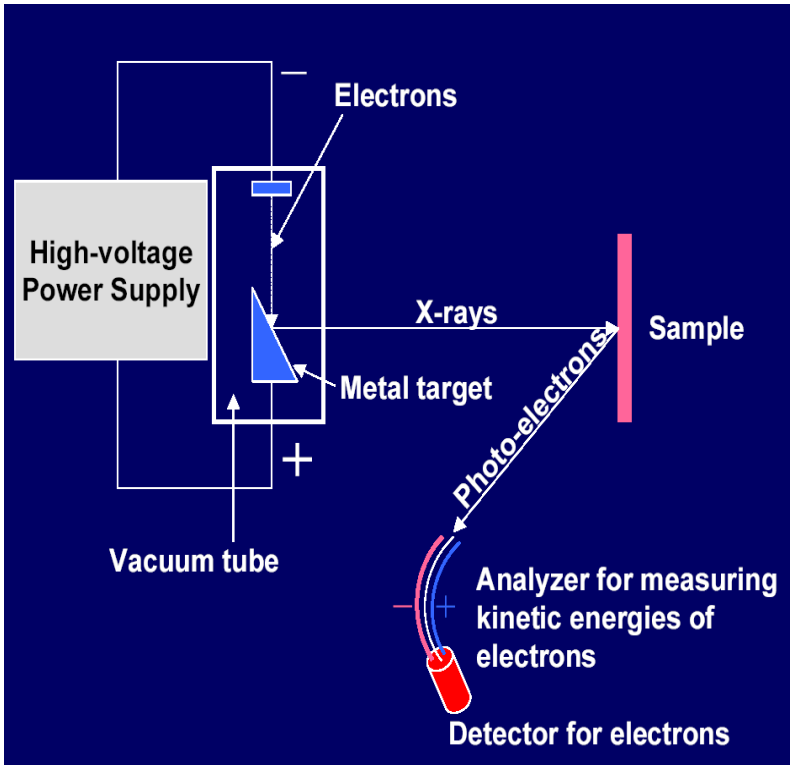
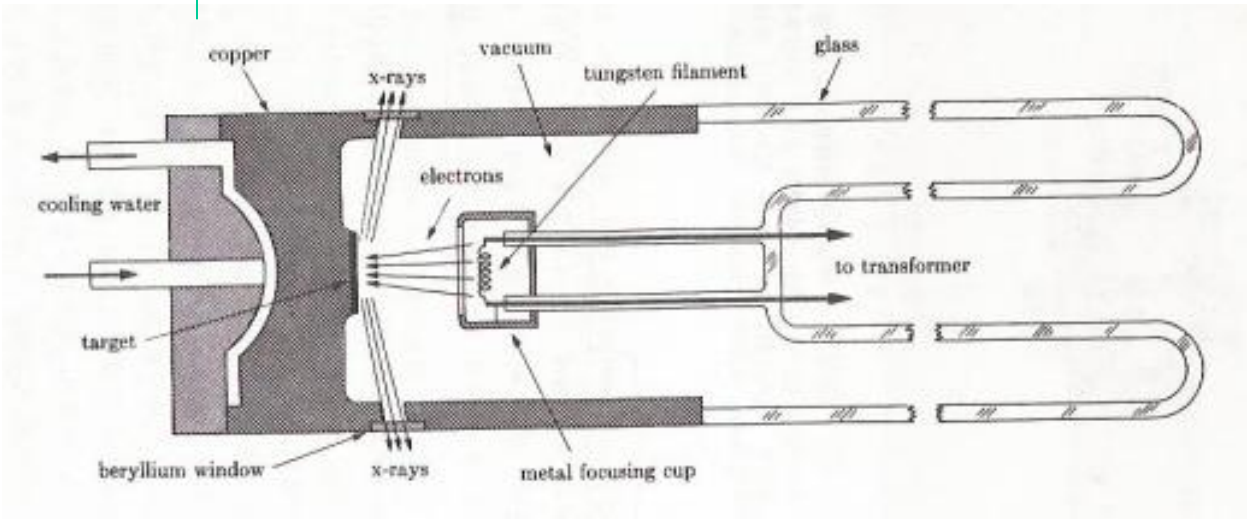
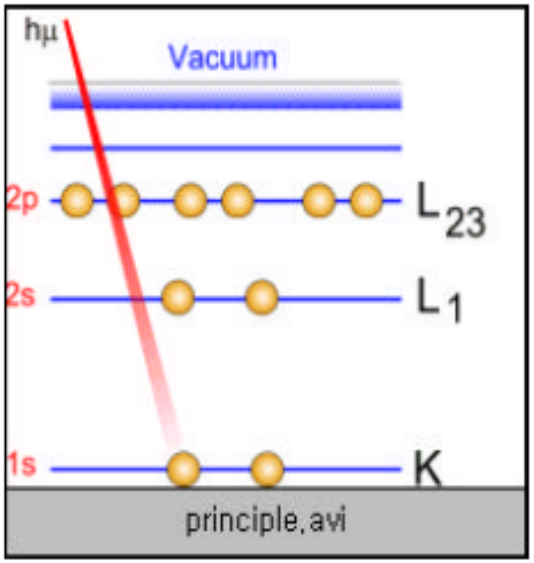


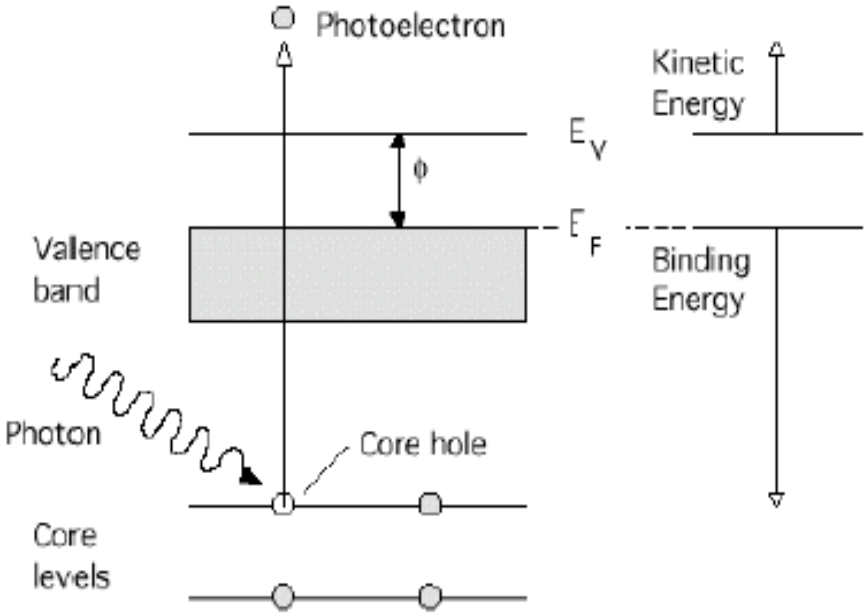
Figure 3.5 Relative probabilities of relaxation by emission of an Auger electron and by emission of an X-ray photon of characteristic energy, following creation of a core hole in the *K* shell





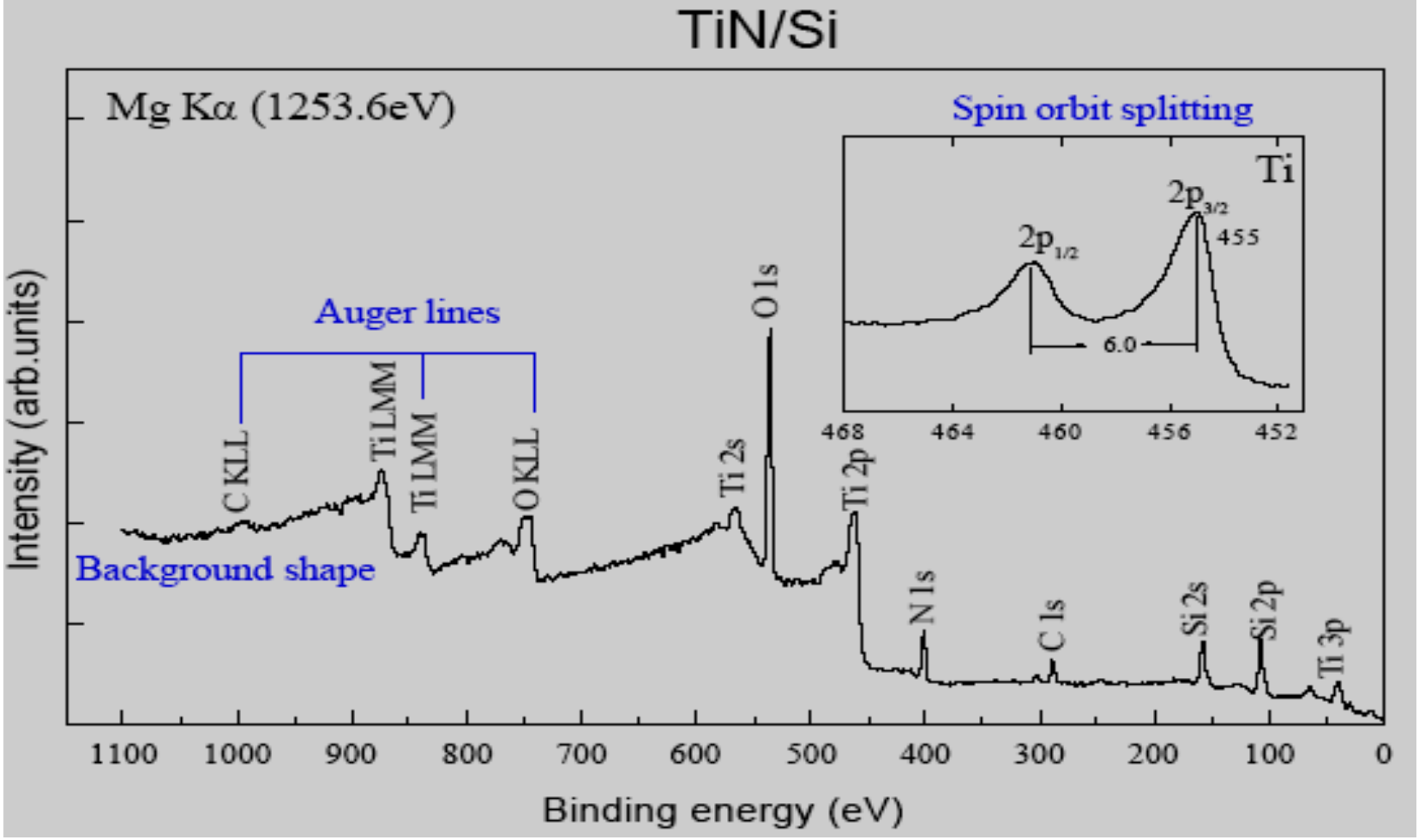
Principle





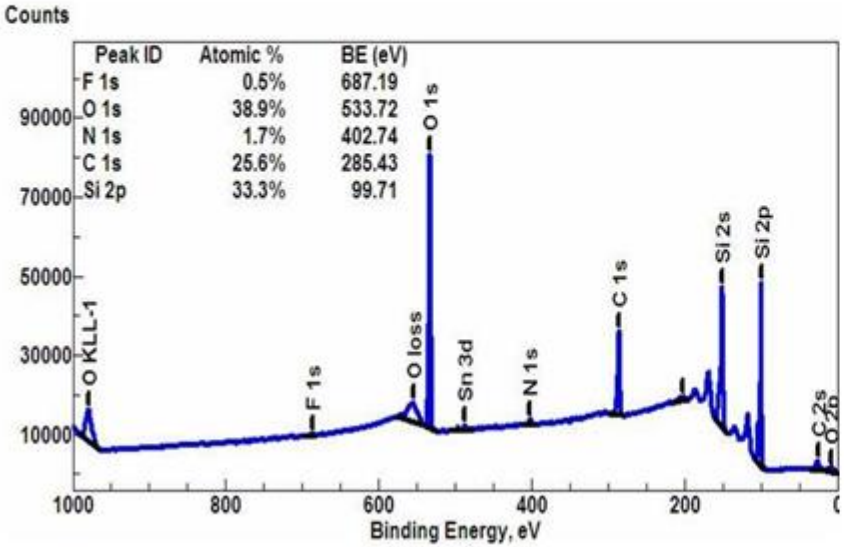
- **KE=hν-BE-ϕ**
- Absorption very fast - 10^{-16}s
- KE of photoelectron increases as BE decreases

Primary structures in XPS

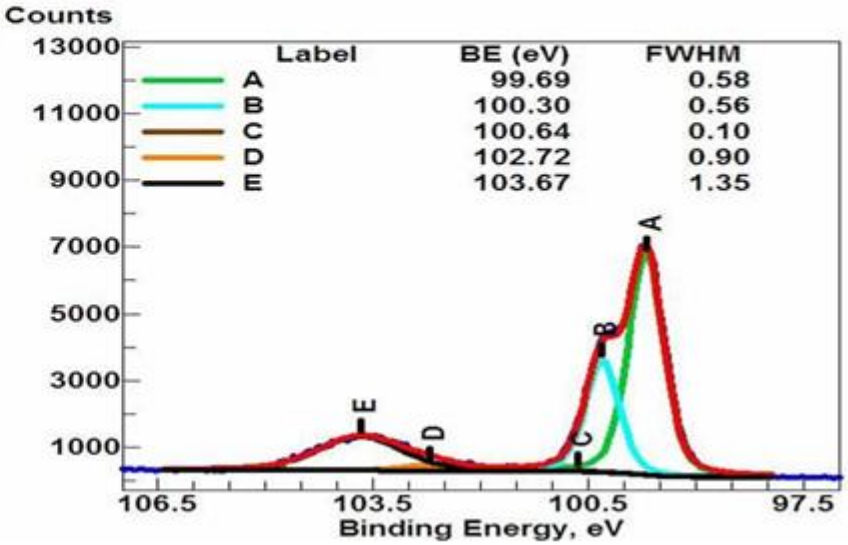


분석 예시

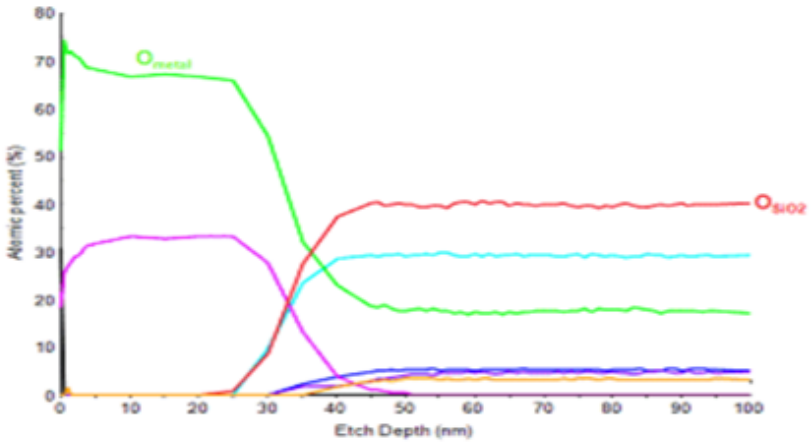
1) Wide Scan (정성 분석)
: 오염된 실리콘 웨이퍼



2) Narrow Scan
: 실리콘 2P신호의 에너지 범위에서 산화된 실리콘 웨이퍼

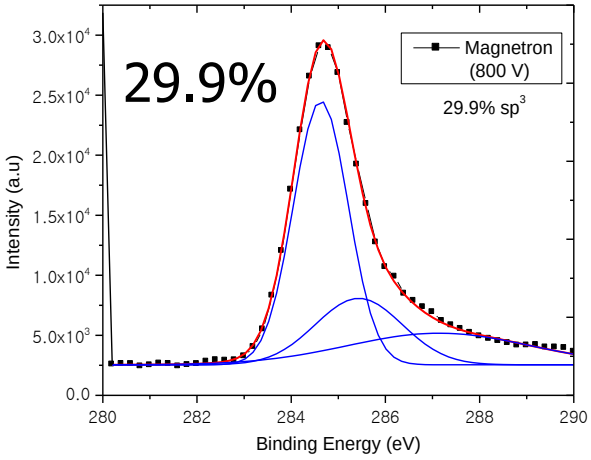


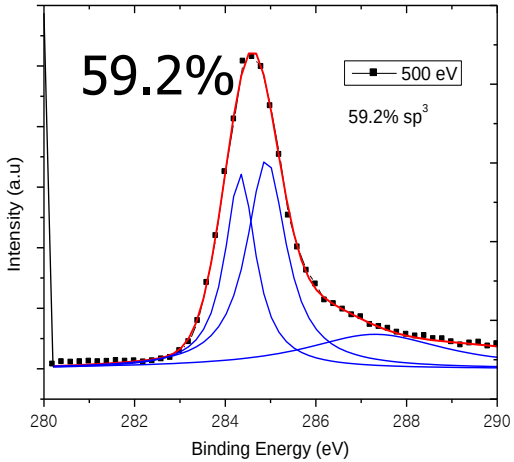
3) Depth Profiling
: Ar+을 충돌시켜 분당 수 Å을 깎아내면서 조성변화 분석

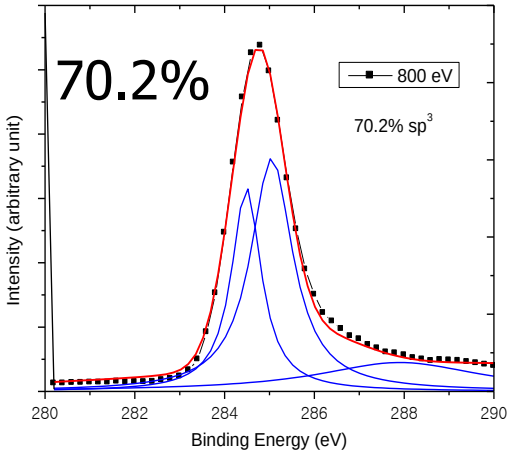


DLC, XPS 분석 – SP3 분율

The deconvolution of C 1s peak







XPS 분석 – Chemical Shift analysis