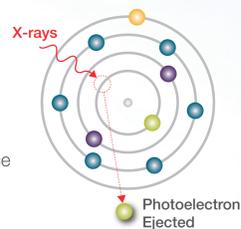


# X-ray Photoelectron Spectroscopy

## Explore the surface—and beyond

### Why explore the surface?

- The surface is the part of a material that interacts with its environment and other materials
- Knowledge of electronic, chemical and physical surface properties is crucial in many applications



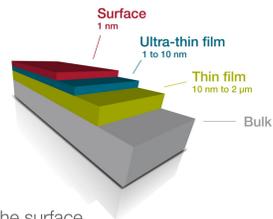
### How does it work

- Surface is irradiated with X-rays from a photon source
- X-rays cause electrons to be ejected (photoelectrons)
- Kinetic energy (KE) of photoelectrons is measured by an analyzer
- The binding energy (BE) of the electrons is deduced from the kinetic energy and photon energy

$$\text{Photon Energy (Known)} - \text{Kinetic Energy (Measured)} = \text{Binding Energy (Calculated)}$$

### Binding energy depends upon:

- Element
- Orbital from which electron was ejected
- Chemical state of the element
- As photoelectrons interact strongly with matter, the signal comes from the top ~10 nm of the surface
  - Thin films and interfaces can be investigated by depth profiling: cycles of removing material with an ion source and analyzing



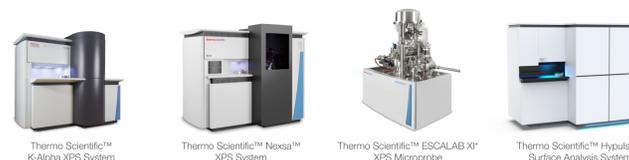
### XPS Applications

Metals, bio-materials, oxides, glass, fibers, carbon, ceramics, nano-materials, powders, plastics and polymers

Electrical Properties	Physical Interactions	Biological	Magnetic Properties	Appearance	Chemical Activity
Transistor gates	Non-stick	Implant acceptance	Hard disks	Light transmittance	Catalysis
Memory	Scratch resistance	Anti-bacterial	Magnetic media	Painting	Anti-corrosion
Photovoltaics	Waterproofing	Anti-fouling		Coating	Adhesion
Contact resistance	Composite materials	Cell promotion			
Multilayer superconductors	Flame retardants				



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