



Tools of Nanoscience

■ Microscopy

- ☐ Optical
- ☐ Electron
 - SEM
 - TEM
- ☐ Scanning Probe
 - STM
 - AFM
 - NSOM

■ Spectroscopy

- ☐ Electromagnetic
- ☐ Mass
- ☐ Electron

■ Ion beams

- ☐ FIB

■ Diffraction

- ☐ X-Ray
- ☐ Electron
- ☐ RBS



Nanoscience Tools

- Optical Microscopes
- Electron Microscopes
 - Scanning Electron Microscope (SEM)
 - Transmission Electron Microscope (TEM)
- Scanning Probe Microscopes (SPM)
 - Scanning Tunneling Microscope (STM)
 - Atomic Force Microscope (AFM)
- X-Ray Analysis
 - Energy Dispersive X-ray Spectroscopy (EDS)
 - Wavelength Dispersive X-ray Spectroscopy (WDS)
 - X-ray Diffraction (XRD)
- Focused ion beam (FIB)
- Mass spectrometry/Residual gas analyzer (Mass spec/RGA)
 - Secondary ion mass spectrometry (SIMS)
 - Time of Flight SIMS (ToF SIMS)
- Fourier transform infrared spectroscopy (FTIR)
- Auger electron spectroscopy (Auger or AES)
- Atom probe microscopy
- X-ray photoelectron spectroscopy (XPS)
- X-ray fluorescence (XRF)
- Raman spectroscopy



Spectroscopy

■ Electromagnetic

- ☐ X-Ray
 - EDS
 - WDS
 - XPS/ESCA
 - XRD
- ☐ UV/Vis
 - UV/Vis
 - Ultraviolet
- ☐ Infrared
 - FTIR
 - Raman

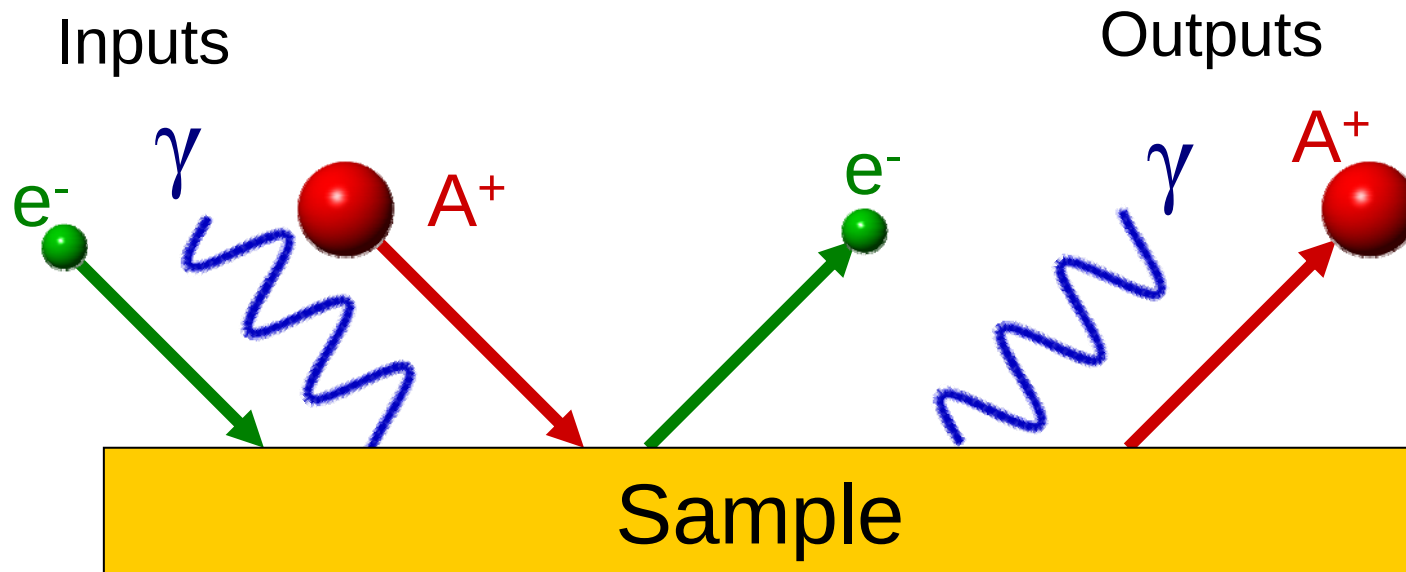
■ Mass

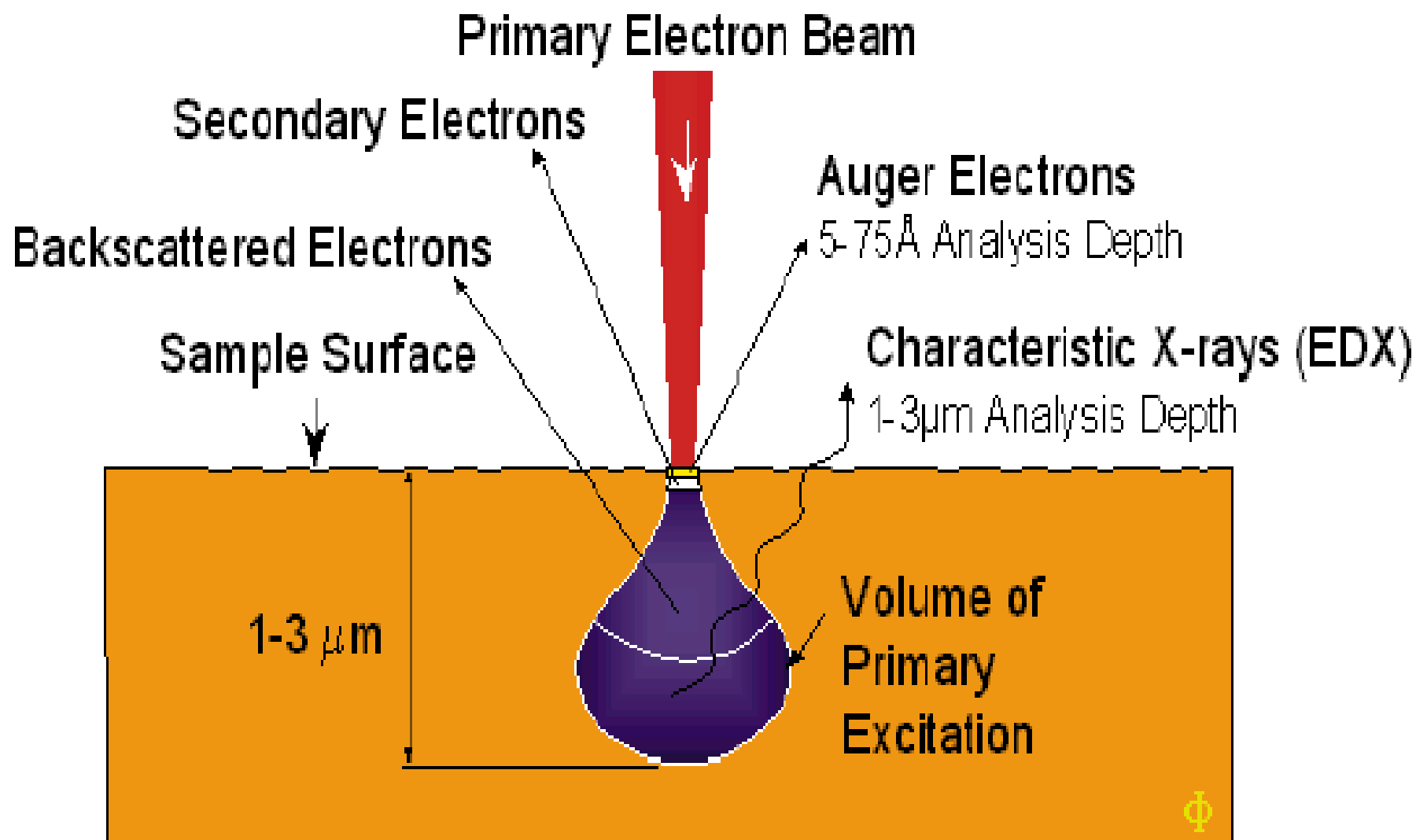
- ☐ RGA
- ☐ GC/MS
- ☐ SIMS
- ☐ ToF SIMS
- ☐ ICP MS
- ☐ Atom Probe

■ Electron

- ☐ Auger, AES

Spectroscopy





Probe: Electrons

Electrons In

Electrons Out

Auger electrons

Secondary electron
imaging

Backscattered
electron imaging

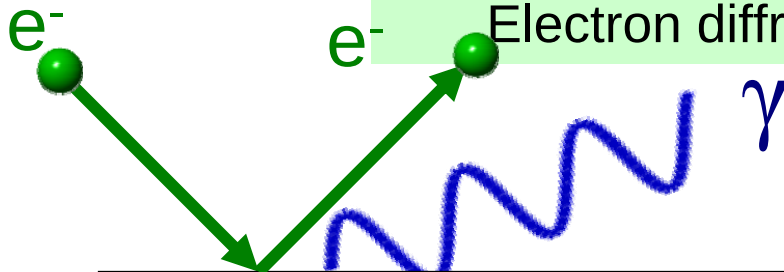
Transmitted
electrons

Electron diffraction

Photons out

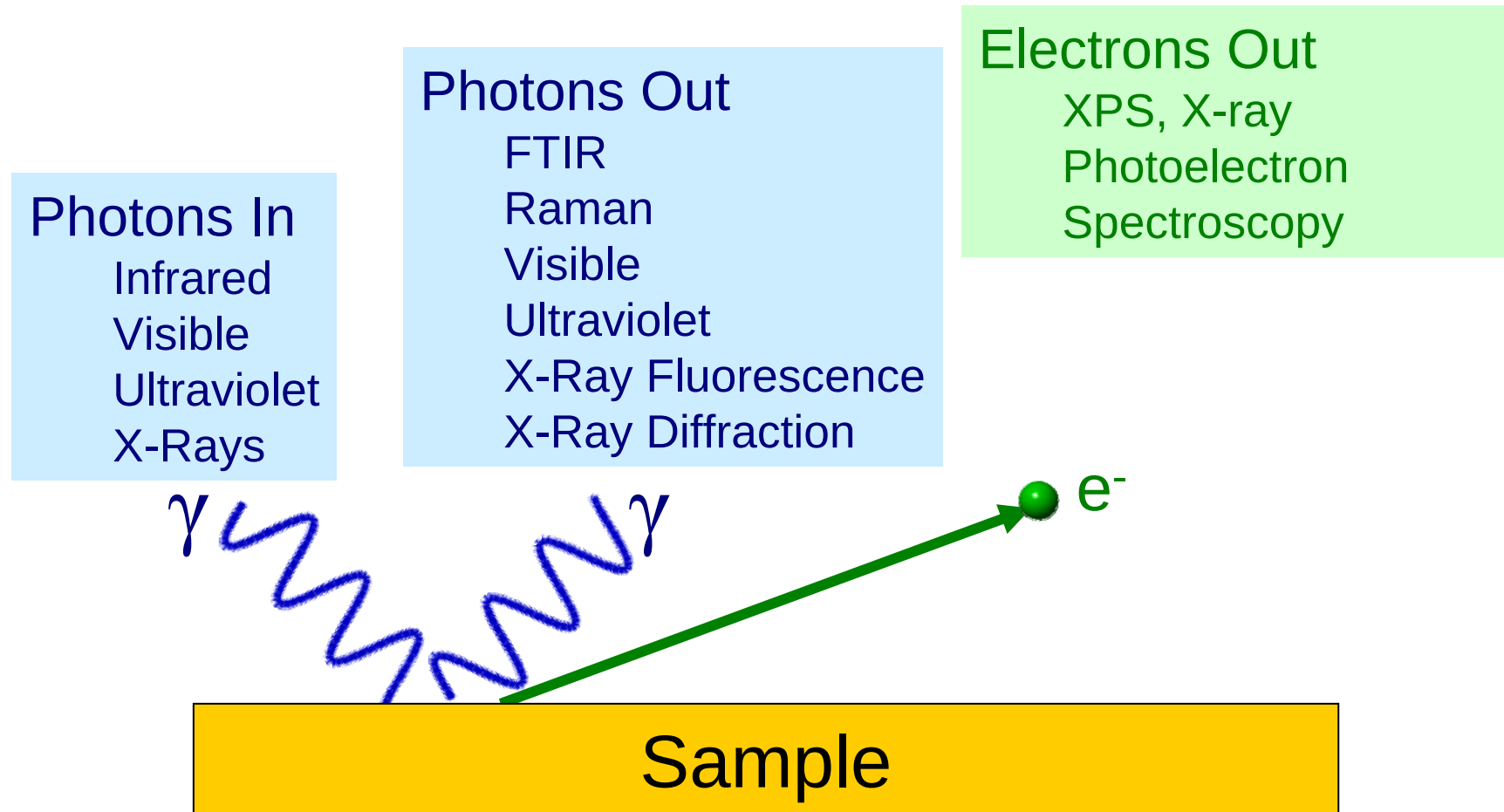
Energy Dispersive
Spectroscopy

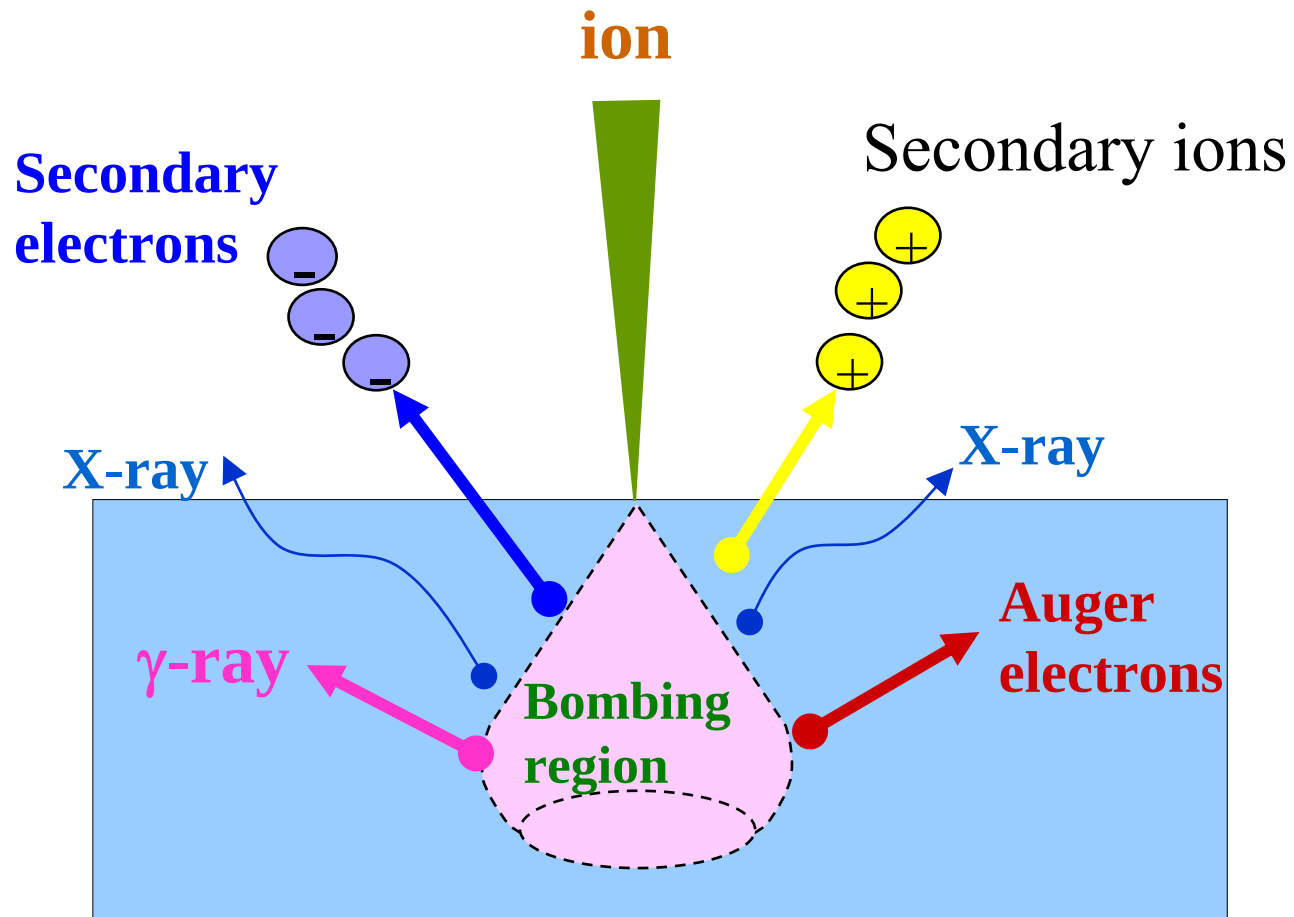
Wavelength
Dispersive
Spectroscopy



Sample

Probe: Photons





Schematic diagram for secondary effects during sputtering

Probe: Ions

