

KMU 396 MATERIALS SCIENCE AND TECHNOLOGY I PRESENTATION

Energy Dispersive X-Ray, EDX

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OUTLINE

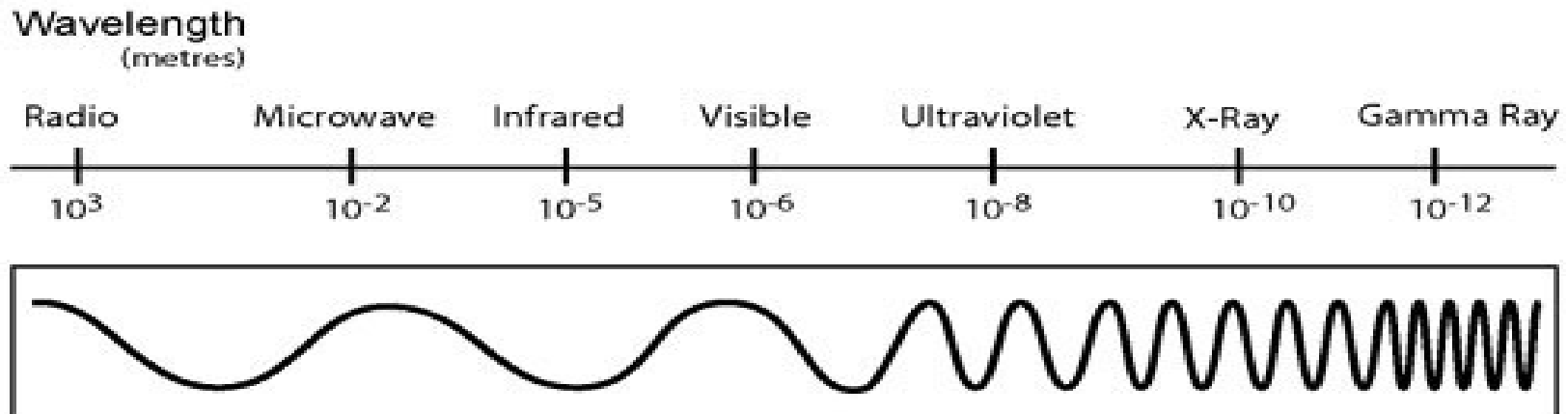
- X-Ray
- What EDX is?
- Usage Areas
- History
- Instruments
- How it works
- Material Analysis
- Advantages and Disadvantages
- Summary
- References



WHAT IS X-RAY?

- ❖ A form of electromagnetic radiation
- ❖ Have a wavelength in the range of 10 to 0.01 nanometers
- ❖ Largest use is to take images of the inside of objects in diagnostic radiography and crystallography

THE ELECTRO MAGNETIC SPECTRUM



*X-Ray Spectroscopy

- Gathering name for several spectroscopic techniques
- Determining electronic structure of materials by using X-ray excitation.

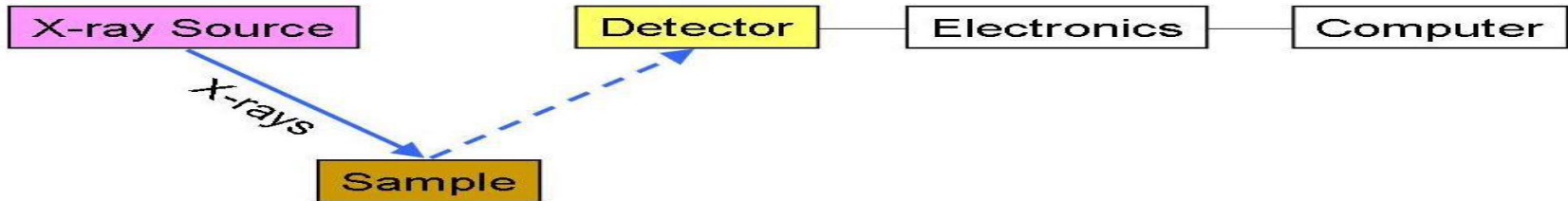


What kind of X-ray spectroscopy?

- X-ray absorption spectroscopy
- Identification and measurement of concentration of elements
- X-ray emission spectroscopy or X-ray fluorescence (XRF)
- X-ray magnetic circular dichroism
- Determining the local geometric and electronic structure of matter.



What is EDX?



- Analyzing X-rays emitted by the matter
- Investigation of a sample
- Analytical technique used for the elemental analysis
- Full quantitative analysis showing the sample composition
- Technique used for chemical characterization of a sample



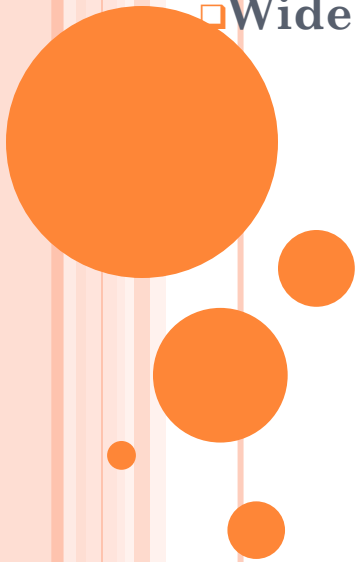
Where we can use EDX?

- Quality Control Screening
 - To correct material
 - To plate specification
- Failure Analysis
 - Unknowns identification
 - Excrement identification
- Materials Comparing and Evaluating
 - Multiple spot analysis
 - Elemental diffusion profiles
 - Contaminants



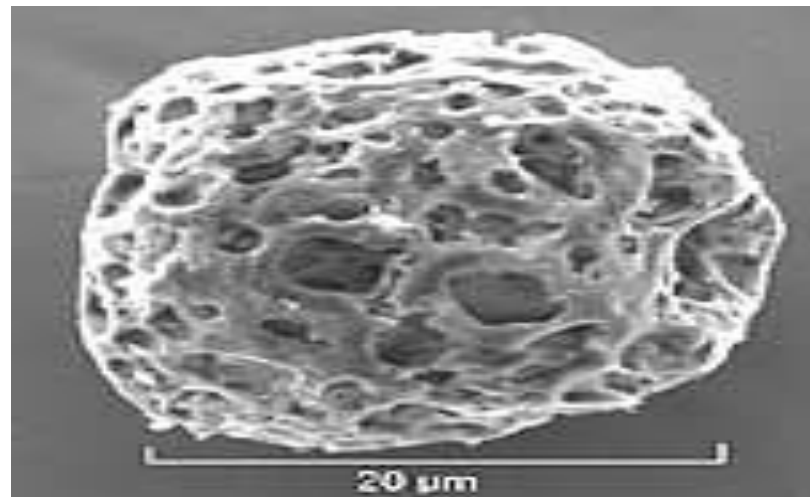
EDX APPLICATIONS

- ❑ Perform qualitative and quantitative analysis by using re-emitted X-rays characteristic from elements
- ❑ Wide variety of samples such as solids, powder, thin films



RELATIONSHIP BETWEEN SEM AND EDX

- ❑ **SEM/EDX instrument** is a powerful and flexible tool for solving a wide range of product and processing problems for a diverse range of metals and materials.
- ❑ can produce extremely high magnification images (up to 200000x)



RANGE OF MATERIALS FOR INVESTIGATION BY SEM/EDX

- Metals, Glass and Ceramics
- Semiconductors
- Composite Materials
- Fibres (Textile, fabric , man-made, natural, carbon fibres, glass fibres, kevlar)
- Plastic and polymers
- Powders and dust



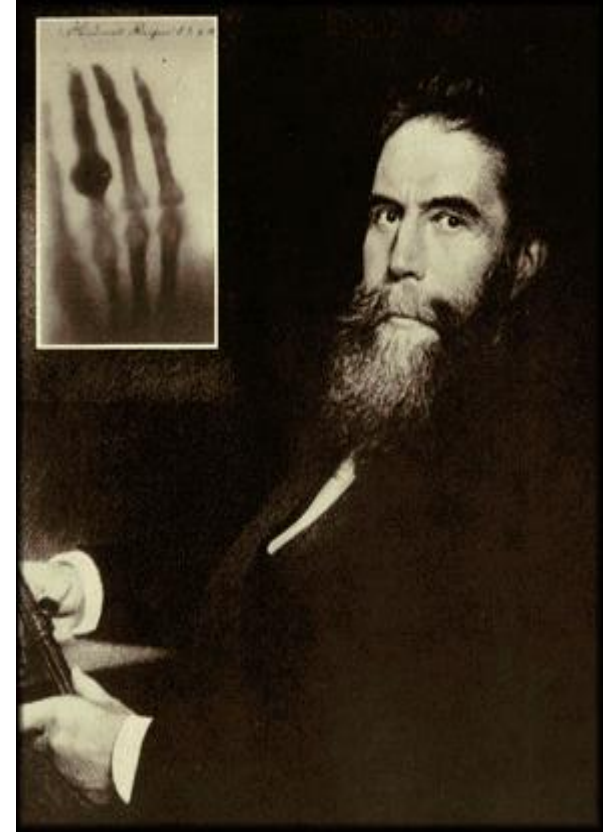
RELEVANT INDUSTRIES FOR EDX

- Aerospace
- Automotive
- Biomedical/biotechnology
- Data Storage
- Defense
- Displays
- Electronics
- Industrial Products
- Lighting
- Pharmaceutical
- Photonics
- Polymer
- Semiconductor
- Solar Photovoltaics
- Telecommunications



History of X-Ray

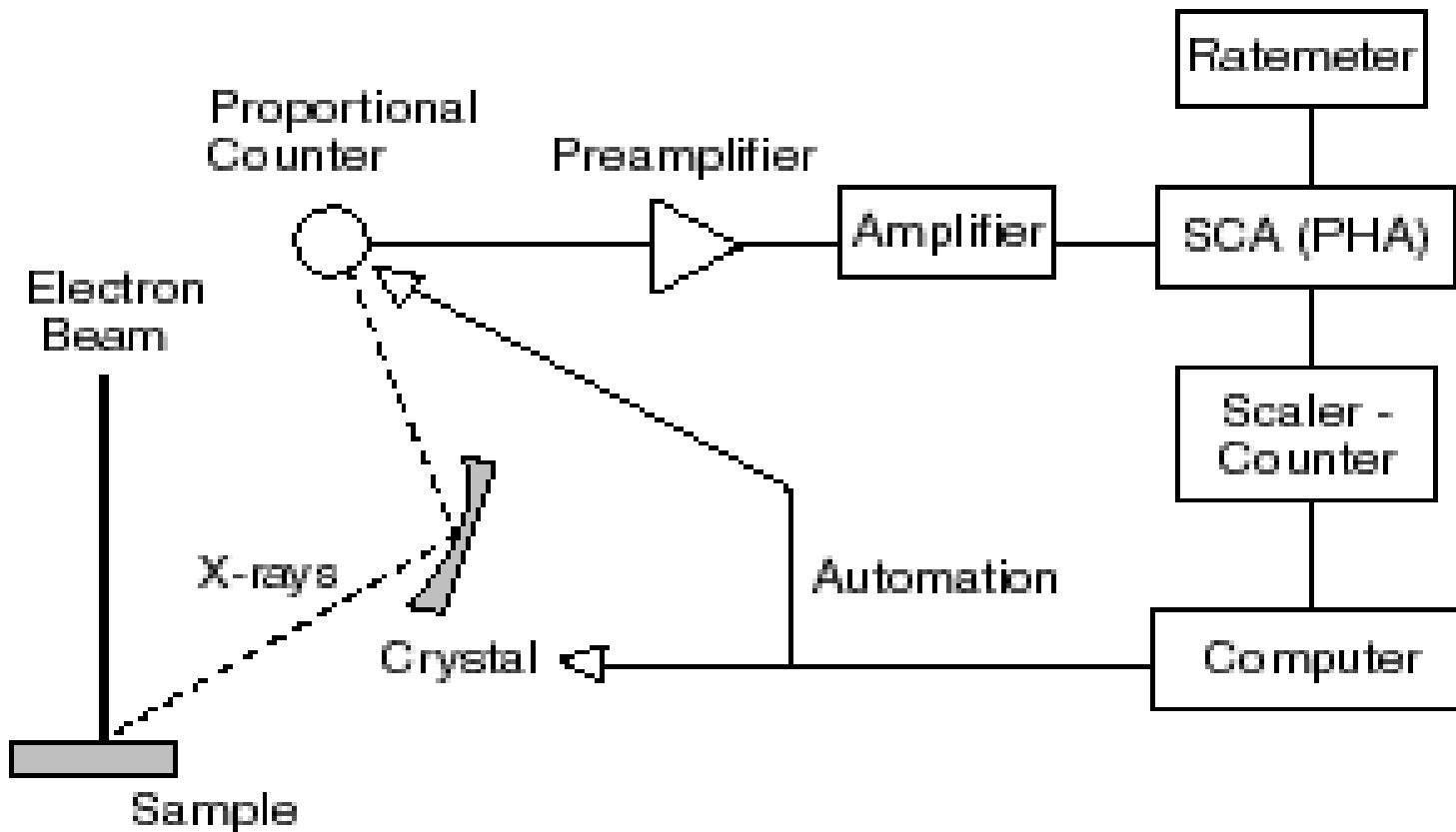
- Firstly discovered by Wilhelm Röntgen in 1870s
- Also called; Röntgen rays.
- ❖ EDX is a new technique for X-Rays
- ❖ EDX is since 1950s

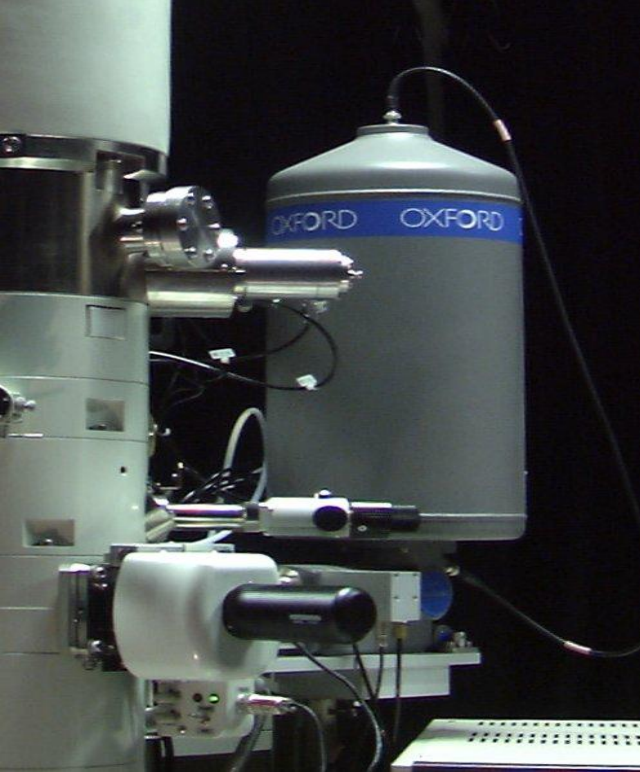


Wilhelm Röntgen, German Scientist(1845-1923)

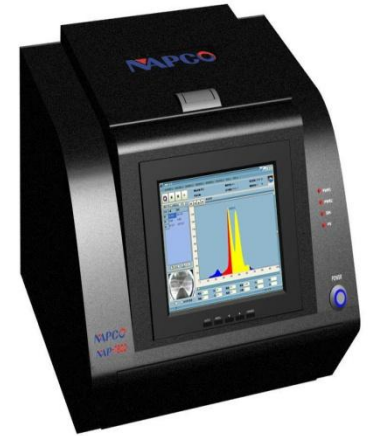


Energy Dispersive X-Ray Spectrophotometer (EDX) System Schematic





Pulse Processor
Measures energy of
the incoming X-ray

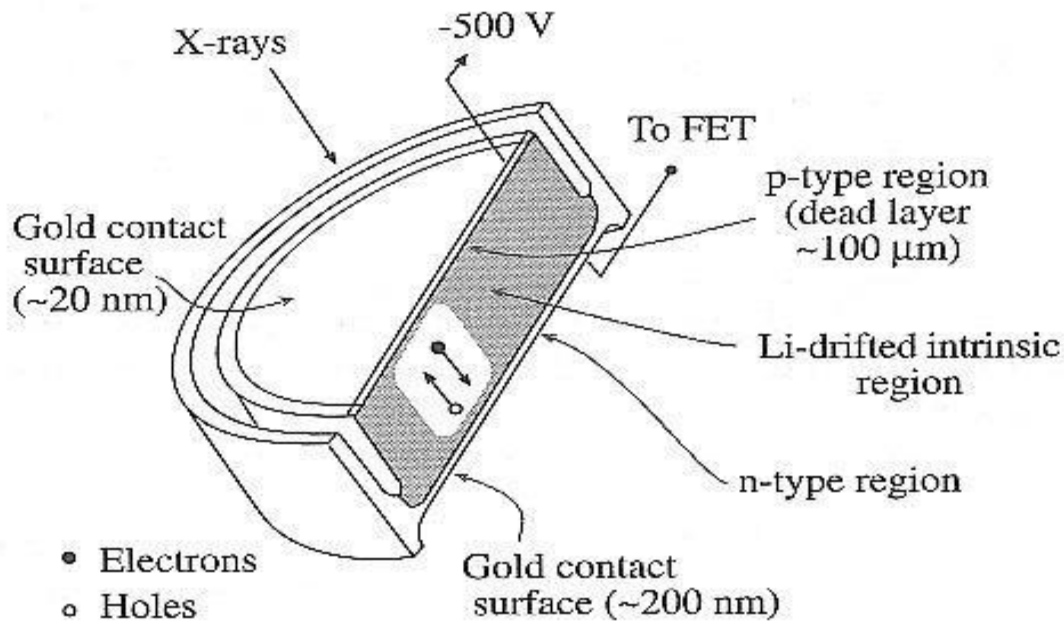


X-Ray Detectors
Detects and converts
X-rays into electronic
signals



Analyzer
Displays the X-rays
data



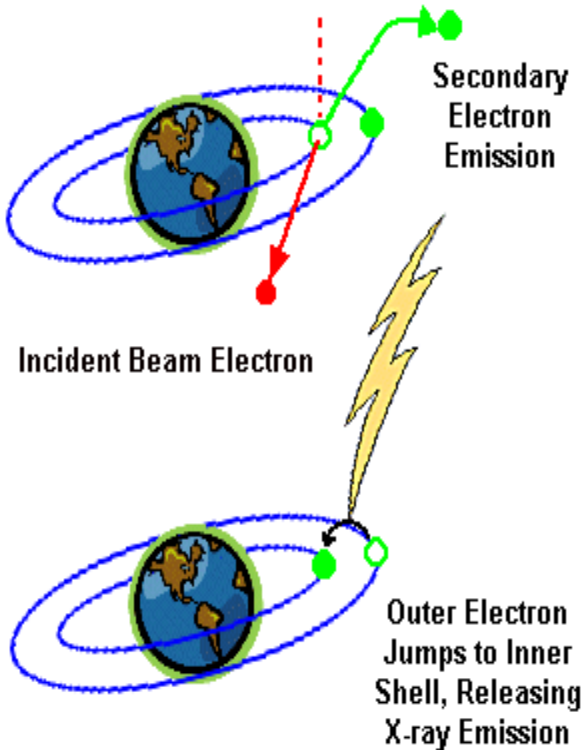


Detectors are so important

***Because they act as semiconductors like
Lithium and Silicon***



X-ray Emission



- A high-energy beam of charged particles is focused into the sample
- Ground state (unexcited) electrons in sample are stimulated
- Electrons are excited from lower energy shells to higher energy shell
- The difference in energy between the shells may be released in the form of an X-ray
- The number and energy of the X-rays emitted from a specimen can be measured by an energy dispersive spectrometer





Figure 1: Elements in an EDX spectrum are identified based on the energy content of the X-rays emitted by their electrons as these electrons transfer from a higher-energy shell to a lower-energy one



Which materials couldn't be analysis?

As Disadvantages of EDX

- Small atomic mass elements like H, He, Be or Li
- Isotopes of same element.



Advantages of EDX

- Quick way to analyze materials.
- A cheap technique.
- Commonly available.
- Having versatility.



SUMMARY

- Definitions of x-ray and x-ray spectroscopy
- A brief information about edx
- Definitions of edx and application areas
- History of edx and how edx works
- Advantages and disadvantages of edx



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Thank You

For

Listening

