Diagnostic Medical instruments

E-Content

by

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X-Rays

- We can define X-Rays or X-radiation as a *form of electromagnetic radiation*. They are powerful waves of electromagnetic energy. **Most of them have a wavelength ranging from 0.01 to 10 nanometres, corresponding to frequencies in the range 3 × 10^{19} Hz to 3×10^{16} Hz and energies in the range 100 eV to 100 keV.**

Who invented the X-Ray?

- German physicist Wilhelm Röntgen is typically credited for the discovery of X-Rays in 1895 because he was the first to comprehensively study them, though he is not thought to be the first to have seen and perceived their effects.

Production of X-rays

- **Filament current** applied through tungsten filament at cathode.
- Heats up filament to produce enough energy to overcome binding energy of electrons (**thermionic emission**).
- Electrons released from filament.
- Tube voltage is applied across the x-ray tube.
- Electrons, therefore, are accelerated towards positively charged anode, which gives them a certain **energy**.
- The electrons strike the anode and the energy released via interaction with the anode atoms produces **x-ray photons**.
- These x-ray photons leave the x-ray tube through the window in an x-ray beam towards the patient.
- They pass through the patient to the detector to produce the x-ray image (this section is covered in the next chapter “Interaction with matter”).

Production of X-rays

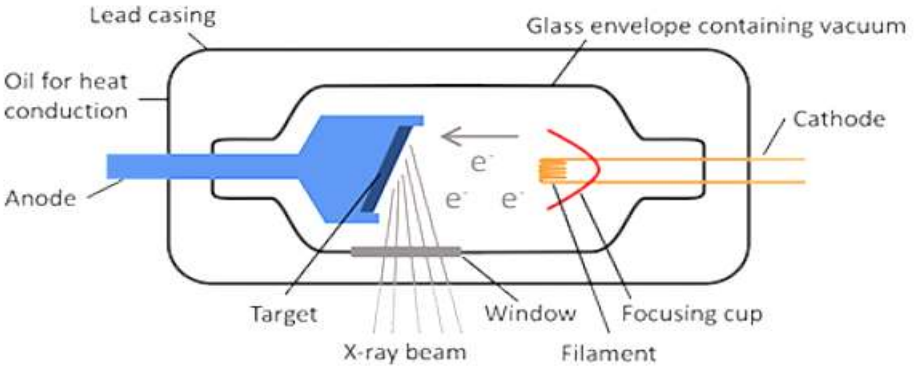
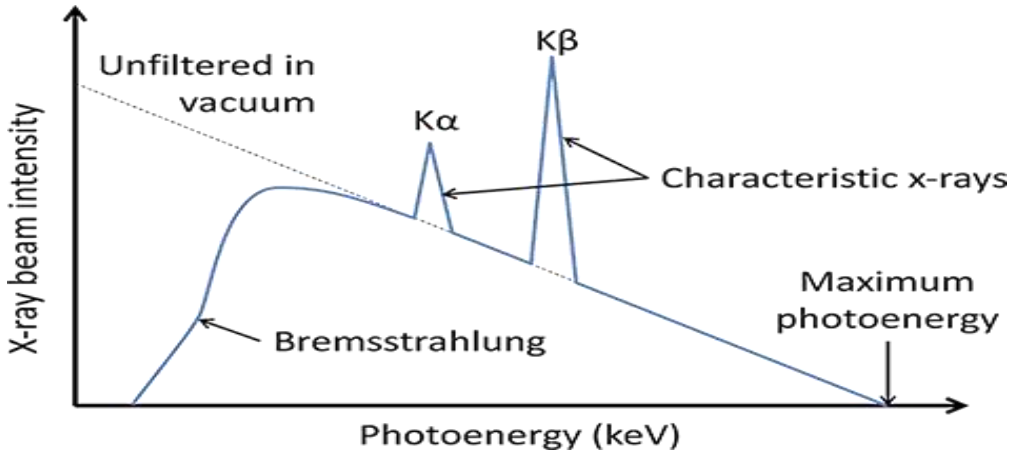


Diagram of an x-ray tube

Spectrum of x-ray



The resulting spectrum of x-ray photon energies released is shown in the graph. At a specific photo energy there are peaks where more x-rays are released. These are at the **characteristic radiation** energies and are different for different materials. The rest of the graph is mainly Bremsstrahlung, in which photons with a range of energies are produced. Bremsstrahlung accounts for the majority of x-ray photon production.

Applications of X-ray

- **Medical Use:** They are used for medical purposes to detect the breakage in human bones.
- **Security:** They are used as a scanner to scan the luggage of passengers in airports, rail terminals, and other places.
- **Astronomy:** It is emitted by celestial objects and are studied to understand the environment.
- **Industrial Purpose:It** is widely used to detect the defects in the welds.
- Restoration:They are used to restoring old paintings.

Thank You!