

Aspects of X-ray tube design and operation

- ◆ The electron beam produced and controlled by the current that is passed through the filament.
- ◆ Stable high voltage and filament current power supplies are needed (old-style transformers → high frequency supplies).
- ◆ Power rating: applied potential \times electron beam current (example: 50 kV and 40 mA → 2 kW).
- ◆ Maximum power determined by the rate of heat removal (without water, a tube can be destroyed in **seconds** → flow interlocks).
- ◆ The anode is electrically grounded, while the filament is kept at negative kV's (the water-cooled anode won't short out, and the filament is protected by glass insulation).

Detection of x-ray

1) Photographic film: is affected by x-ray in much the same way as by visible light, and film is the most widely used means of recording diffracted x-rays beams. However, the emulsion on ordinary film is too thin to absorb much of the incident x-radiation, and only absorbed x-rays can be effective with rather thick layers of emulsion on both sides in order to increase the total absorption. The grain size is also made large for the same purpose. This has the unfortunate consequence that x-ray films are grainy, do not resolve fine detail, and cannot stand much enlargement.

2) Fluorescent screen: are made of a thin layer of Zinc sulfide containing a trace of (Ni) mounted on cardboard backing. Under the action of x-rays, this compound fluoresces in the visible region, i.e. emits visible light, in this case yellow light.

3) Ionization devices: measure the intensity of x-ray beams by the amount of ionization they produce in a gas. x-ray quanta can cause ionization

just as high –speed electrons can namely , by knocking an electron out of gas molecule and leaving behind a positive ion this phenomenon can be made this basis of intensity measurements by passing the x-ray beam through a chamber containing a suitable gas and two electrodes having a constant potential difference between them.

The electrons are attracted to the anode and the positive ions to the cathode and a current is thus produced in an external circuit . in the ionization chamber, this current is constant for constant x-ray intensity , and the magnitude of the current is a measure of the x-ray intensity.