

Photomultiplier Tubes

Photomultiplier Tubes' invention is based upon two primary discoveries:

- The Photoelectric Effect
- The Secondary Emission

Basic Introduction

Photomultiplier tubes are types of photo-detectors and they are highly sensitive device towards light especially whose wavelength lies in the range of UV, Visible and IR region of the electromagnetic spectrum. Their basic use is to amplify the signal input signal. Photomultiplier tubes are widely used in Spectroscopy as a detector.

Construction and Working

The photomultiplier tubes are just similar in construction to phototubes. A phototube consists of a semi-cylindrical photocathode and an anode wire fixed inside an evacuated glass tube.

When a voltage is applied across the two electrodes and when light electromagnetic waves falls on the photocathode, the emission of electrons takes place and these electrons tend to move towards anode and hence the photocurrent is observed.

Photomultiplier tubes are similar to that of phototube that gives electrical signal on exposure of electromagnetic waves.

The electrons emitted from photocathode start drifting towards anode (dynode) which is maintained at up to 100 volt more positive with respect to cathode.

Primary Electrons

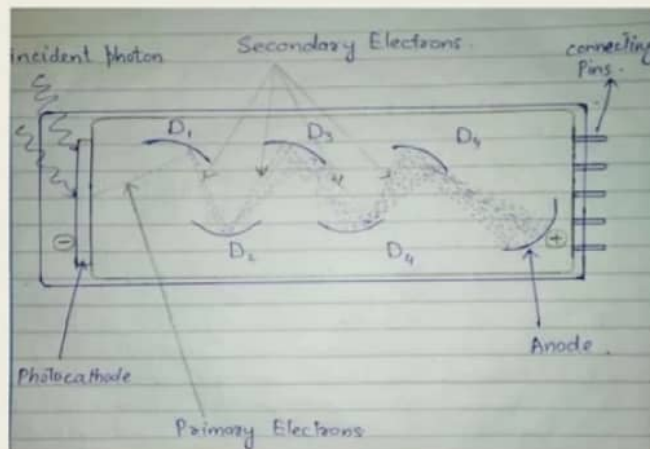
The electrons emitted after the strike of photons to photocathodes are called 'primary electrons'.

Secondary Electrons

The electrons ejected from dynode D_1 by the fall of primary electrons on it are called 'secondary electrons' and similarly when these electrons fall on the surface of dynode D_2 , more electrons are emitted than earlier. These are all called secondary electrons.

In this way by the successive striking of electrons on dynodes surface yield a large number of electrons which are easily detectable as represented by the output current.

Look at the diagram below:



Note that in the above diagram, dynode D_1 is ~100 volt more positive with respect to photocathode, D_2 is 100 volt more positive than D_1 , D_3 is at 100 volt more positive than D_2 and so on. In this way amplification of electrons which is our gain takes place we can imagine this multiplication process by an estimation that each Photon results in the emission of about 10^7 electrons.