



# INTRODUCTION TO SECONDARY ELECTRON DETECTION

THE UNIVERSITY OF VICTORIA

*In Partial Fulfillment of the CAMTEC Workshop*

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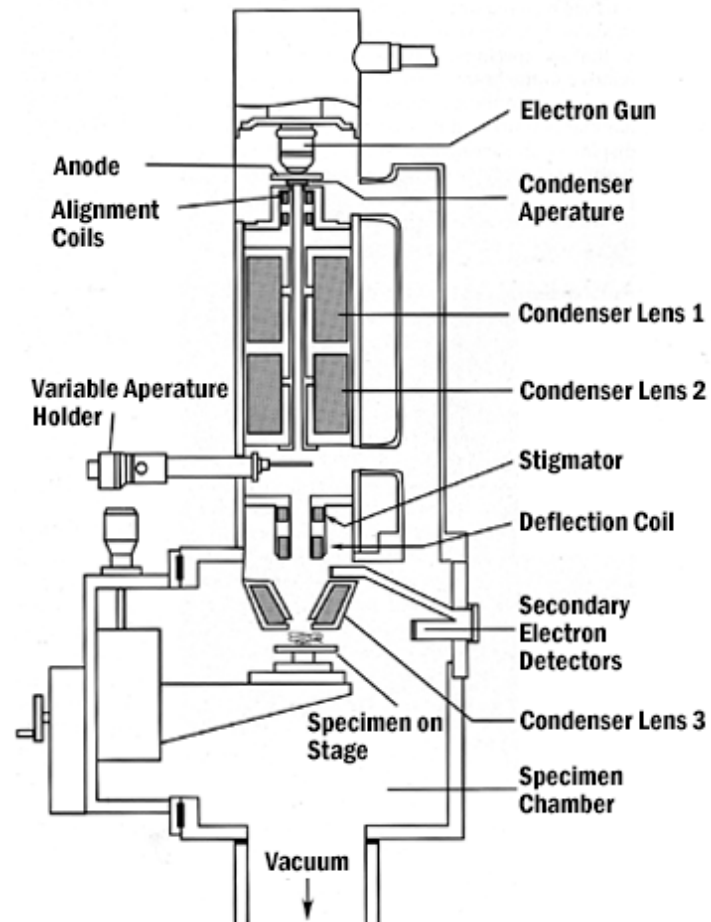
# Agenda

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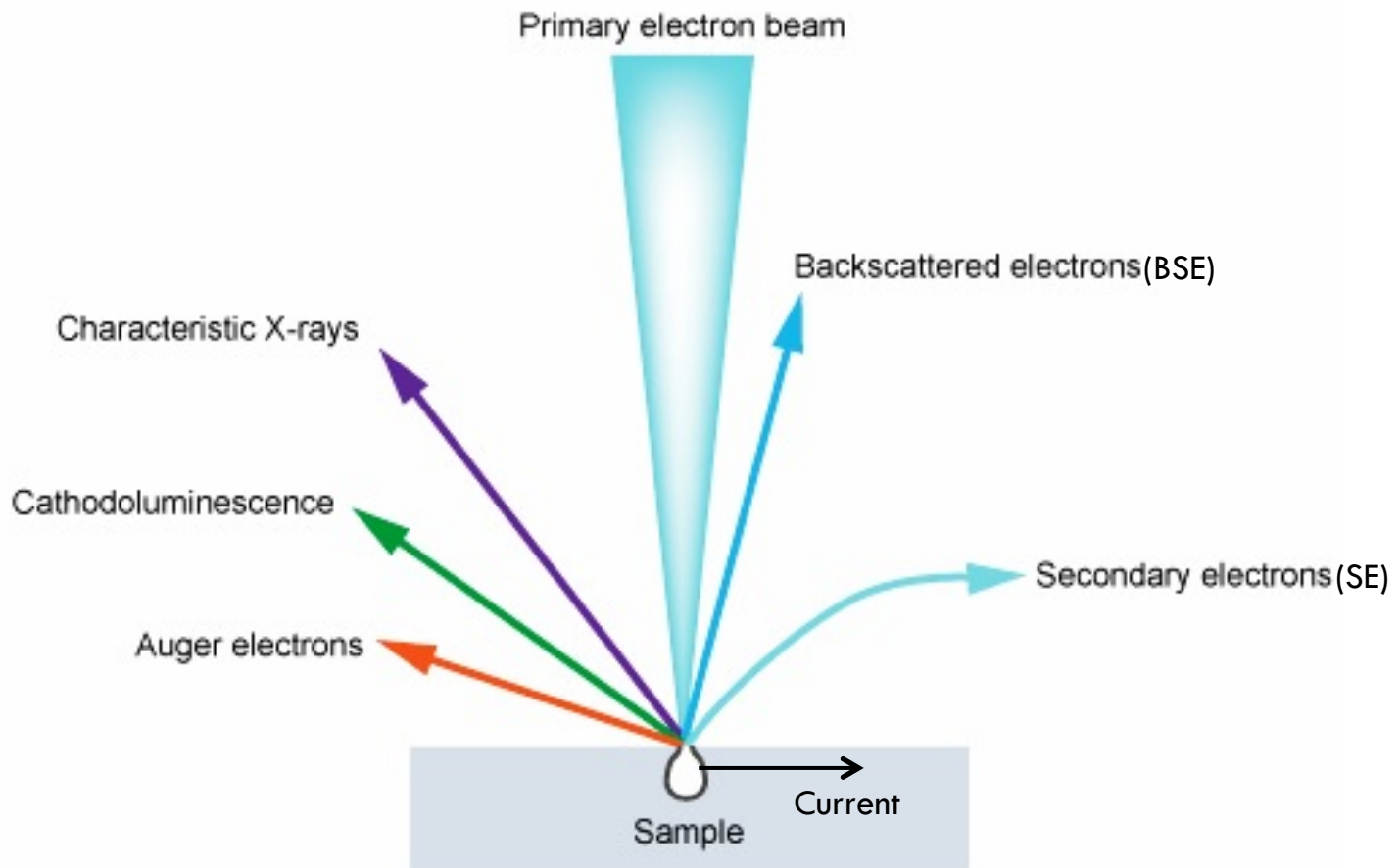
- Introduction
- Beam-Sample Interaction
- Secondary Electron
  - ▣ Imaging Features
  - ▣ Energy Range
  - ▣ Types
  - ▣ Yield
  - ▣ Detection

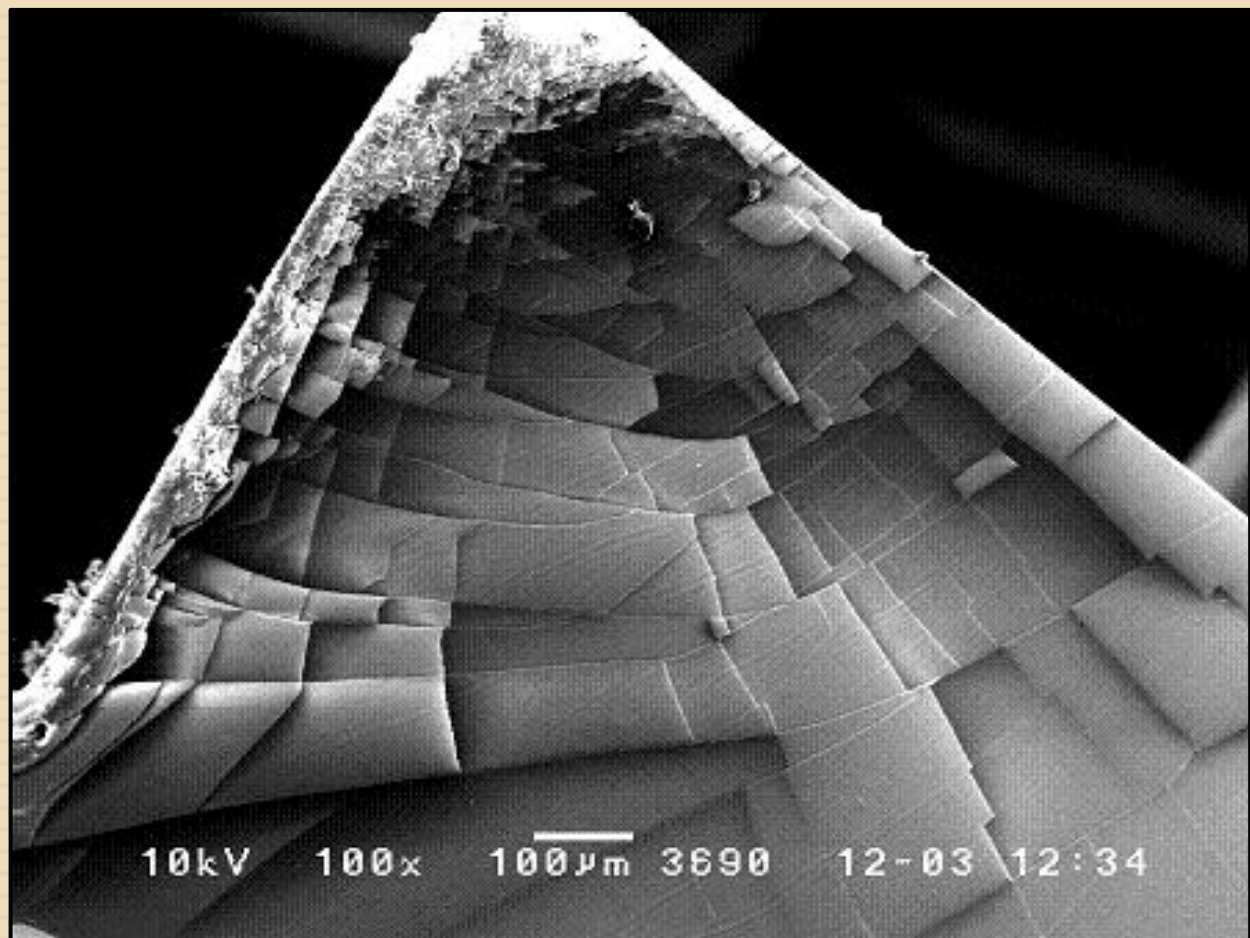
# Introduction

## Scanning Electron Microscope



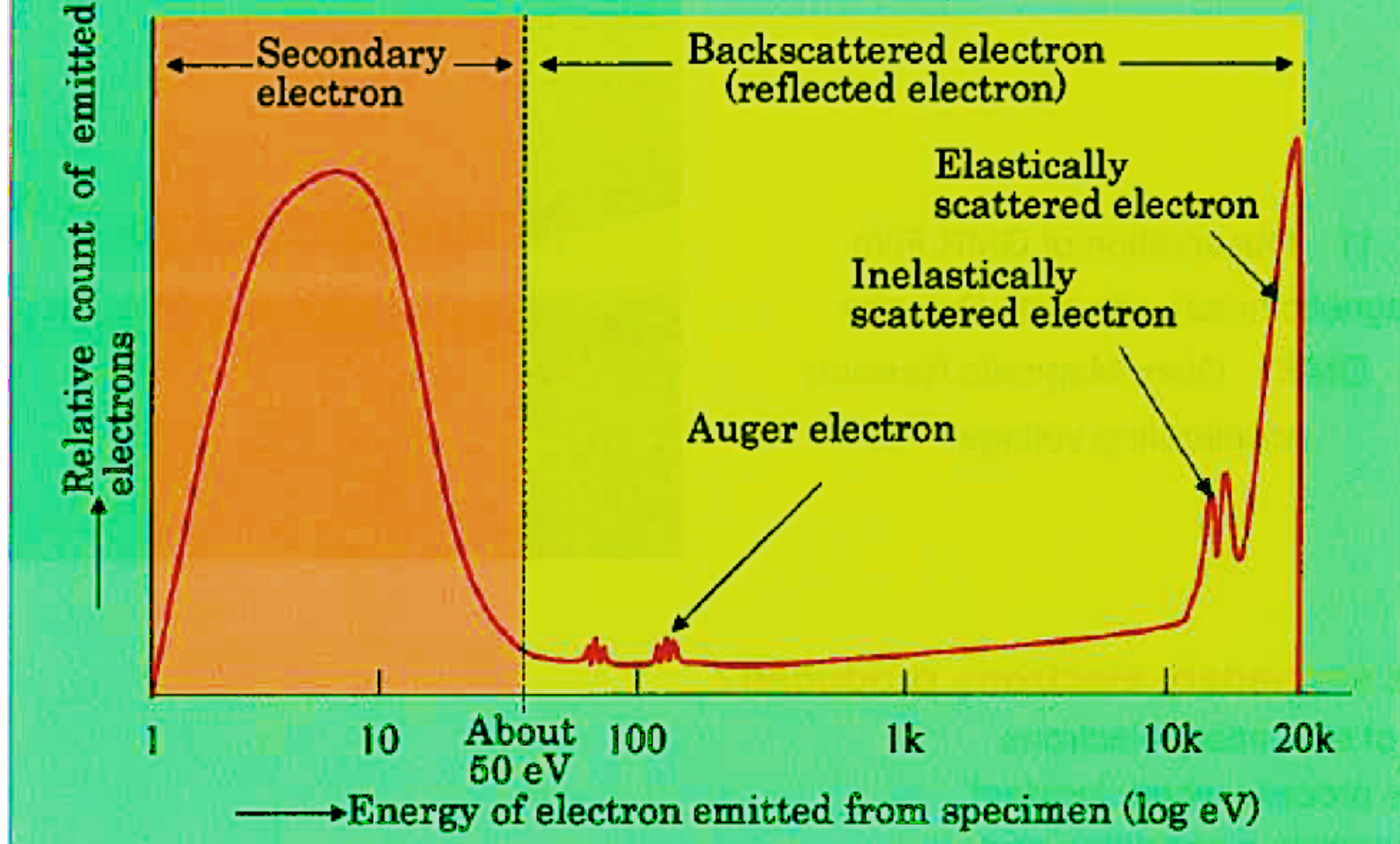
# Beam-Sample Interaction





## Secondary Electron: Imaging Features

- Produces High Field of Depth Image
- Intricate Topographical Imaging



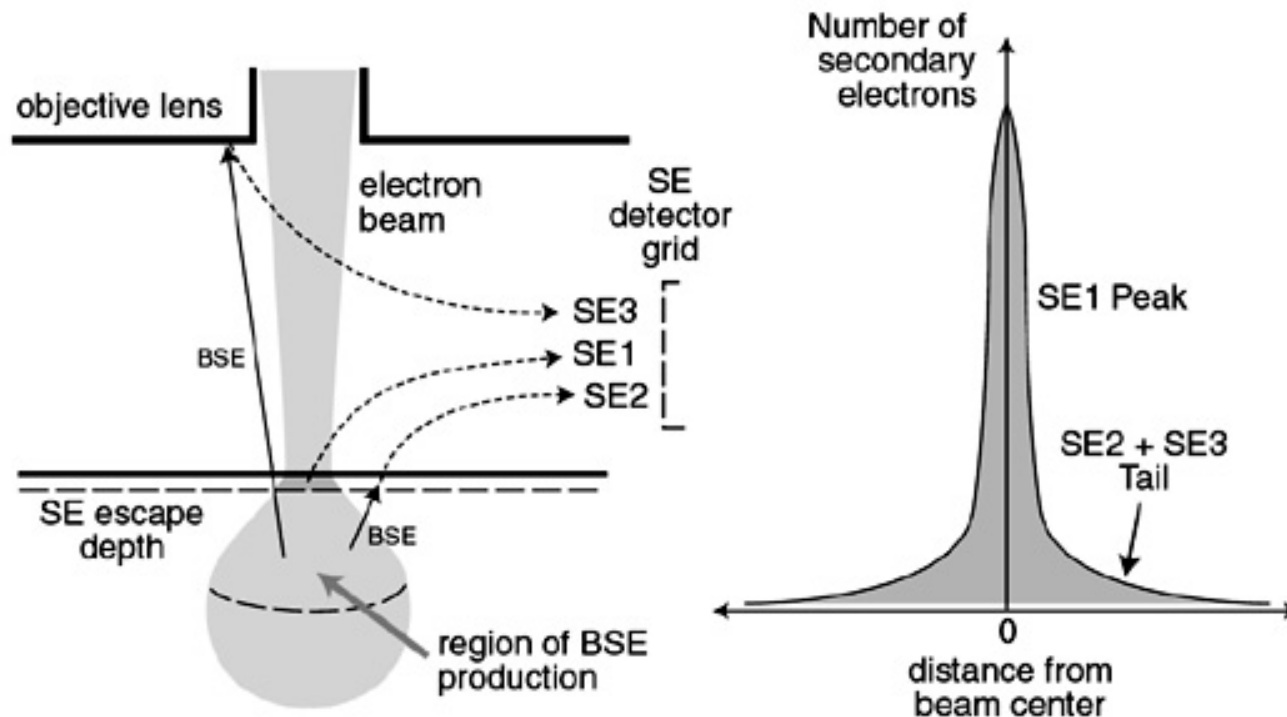
## Secondary Electron: Energy Range

Secondary Electrons are given off at around 50eV.

However, Back Scattered Electrons require high electron energy.

# Secondary Electron: Types

- SE1: Electron release from Incident Beam
- SE2: Electron release from Backscattered Output
- SE3: Electron release from BSE and chamber strike





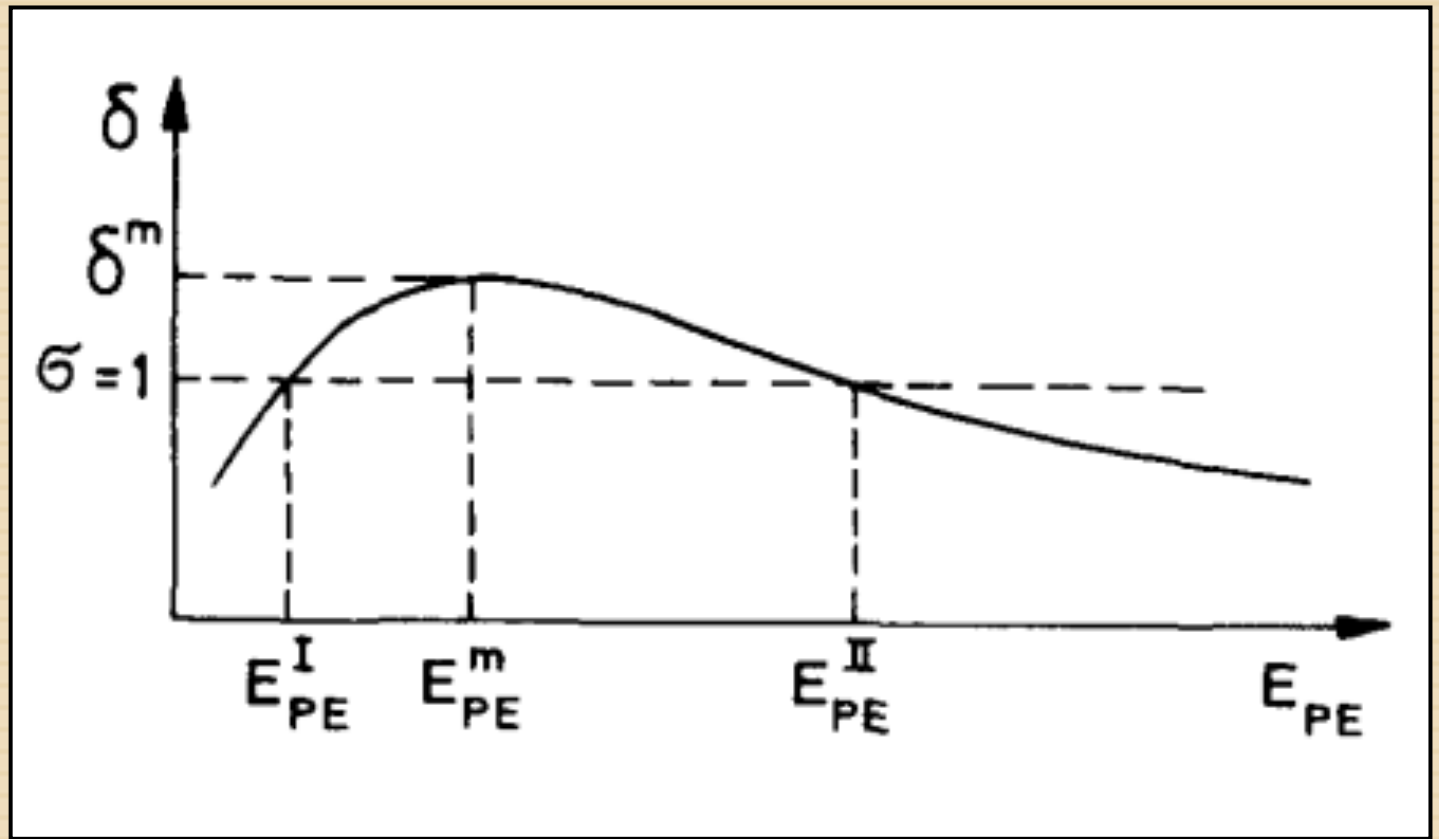
# Secondary Electron: Yield

## Definition

- The amount of Secondary Electrons produced in relation to the amount of Primary Electron induced to a specimen.

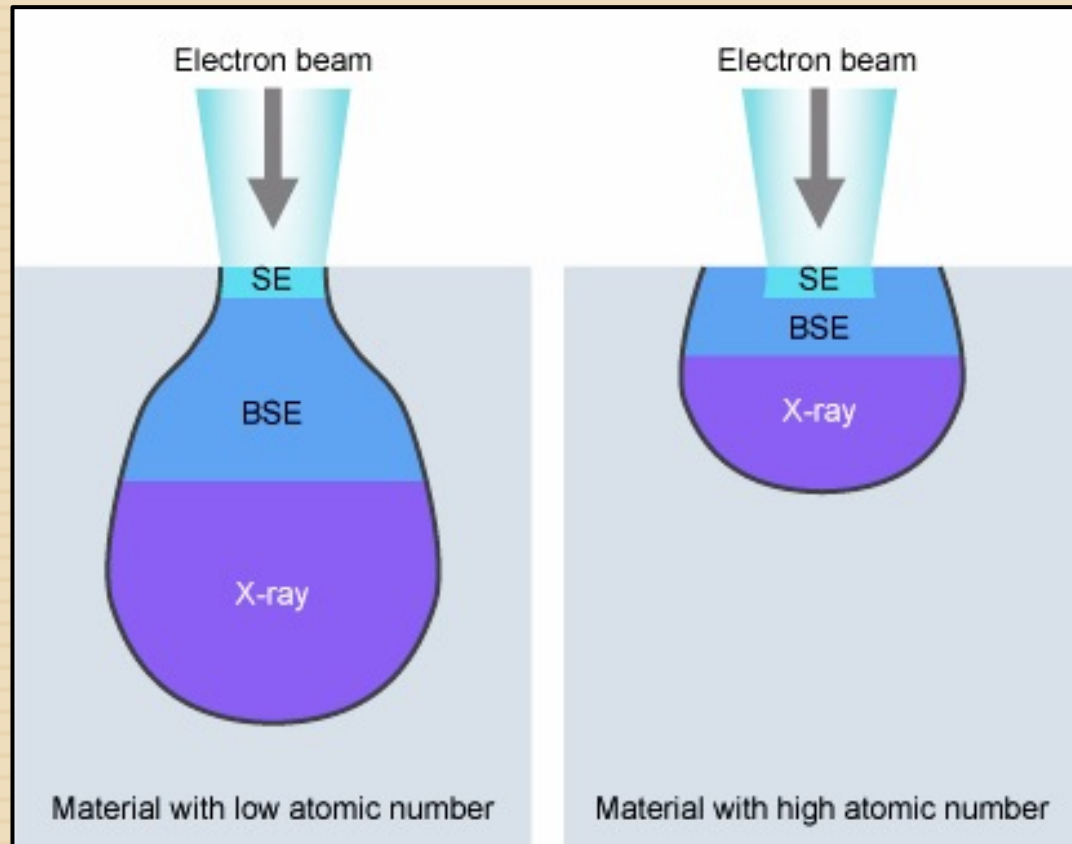
## Subject To

- Surface Morphology
- Specimen Tilt:  $(1 / \cos \theta)$
- Material Atomic Number:  $Z$



## Secondary Electron: Yield

- Highest Secondary Electron Yield at Optimal Primary Beam Energy



## Secondary Electron: Yield

- Atomic Number (Z) effect on Secondary Electron Yield

# Secondary Electron: Detection

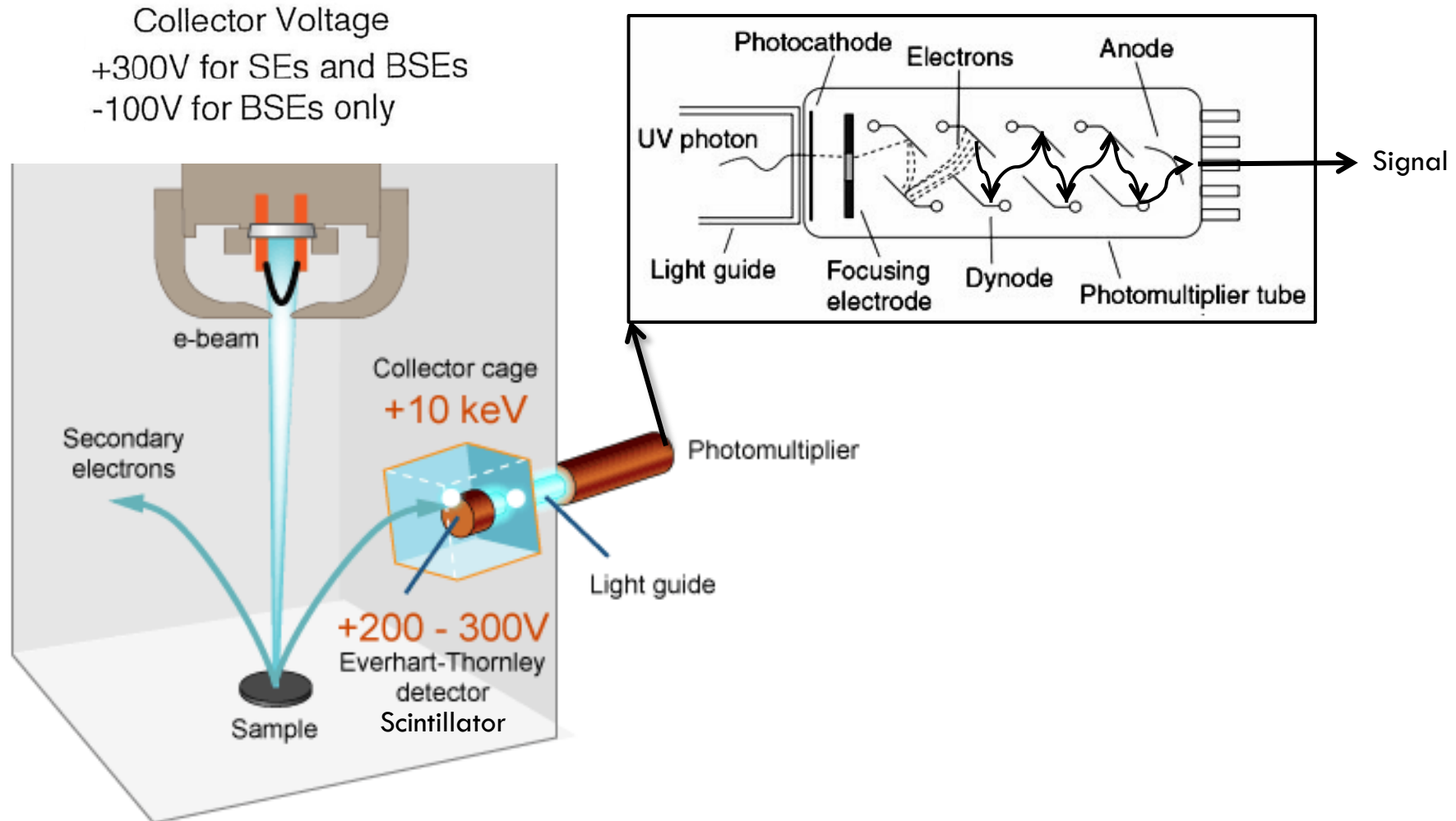
## Instrument

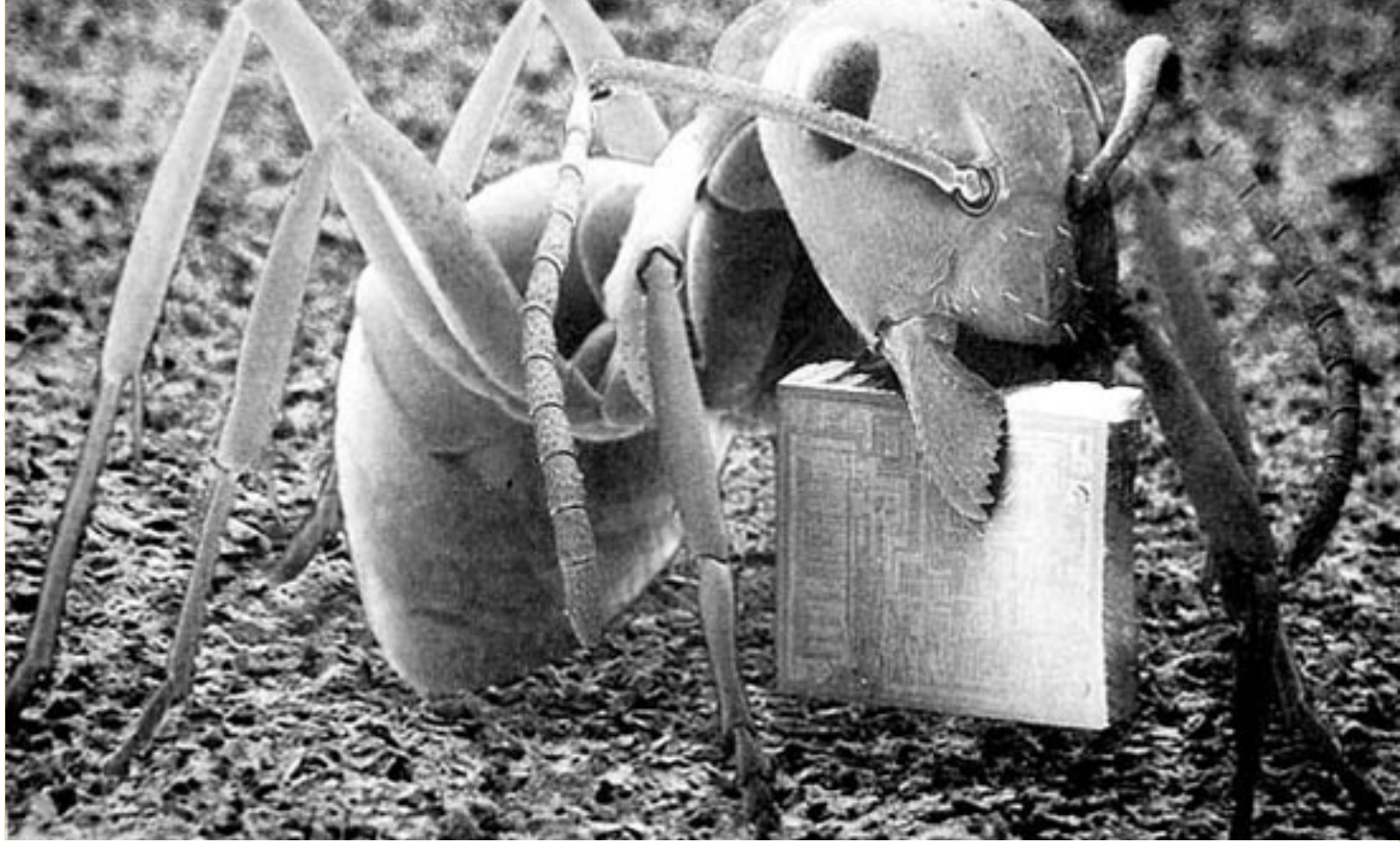
- Everhart-Thornley Detector (1960)

## Purpose

- To increase the efficiency of detecting Secondary Electrons by:
  - ▣ Adding a light guided Scintillator to carry the photon signal
  - ▣ Using Photomultiplier to accelerate photons
- To improve Signal-Noise Ratio (SNR) for better imaging

# Secondary Electron: Detection





Picture Mania: Ant (2mm) and Microchip



Thank You



# References

- Hitachi: Let's Familiarize Ourselves with the SEM
- Everhart, TE and RFM Thornley (1960).  
"Wide-band detector for micro-microampere low-energy electron currents"
- <http://www.ammrf.org.au/myscope/sem>