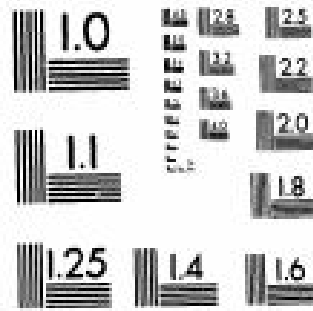
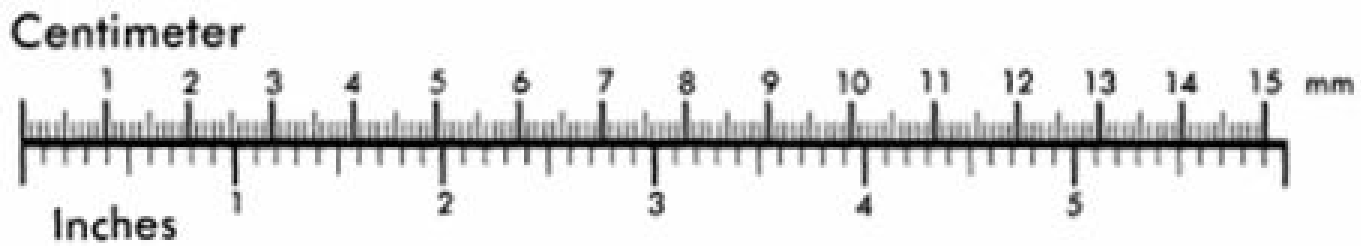


# TECHNICAL TIP.

## VOLTAGE CONTRAST EFFECT



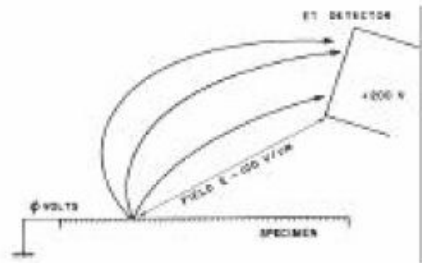
Technical sales Team  
**Seron Technologies Inc.**

## Voltage Contrast

- In SE image, **different surface potential** gives different brightness
  - affect **collection field** of E-T detector
  - affect **trajectory of SE** (can not observed with BSE or SC)
- permits to visualize the **potentials distribution** on the surface of an operating semiconductor device

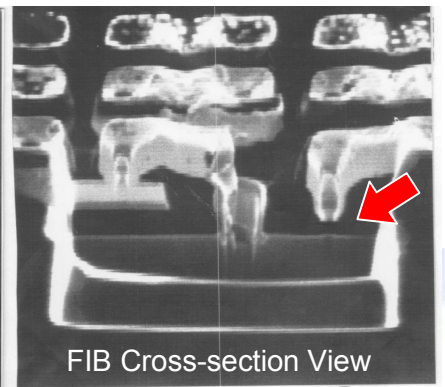
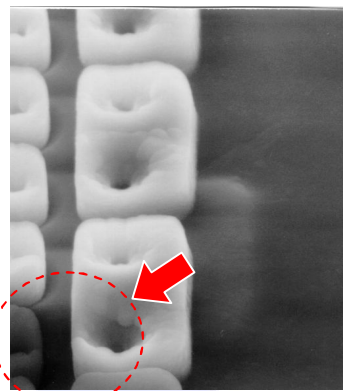
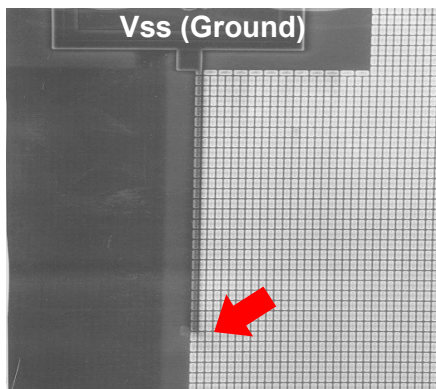
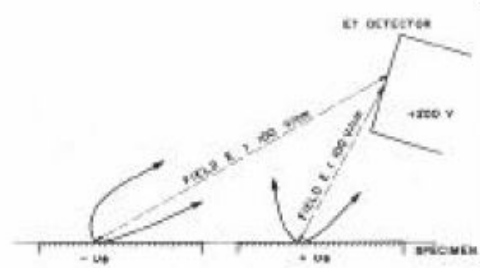
### Normal SE imaging

- +200V bias → electric field  $\approx 100\text{V/cm}$

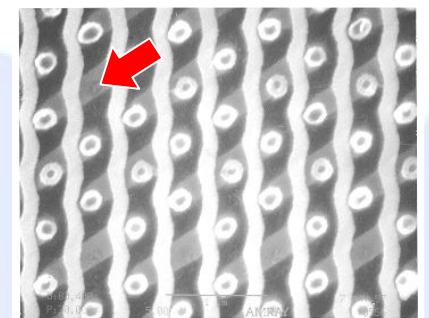
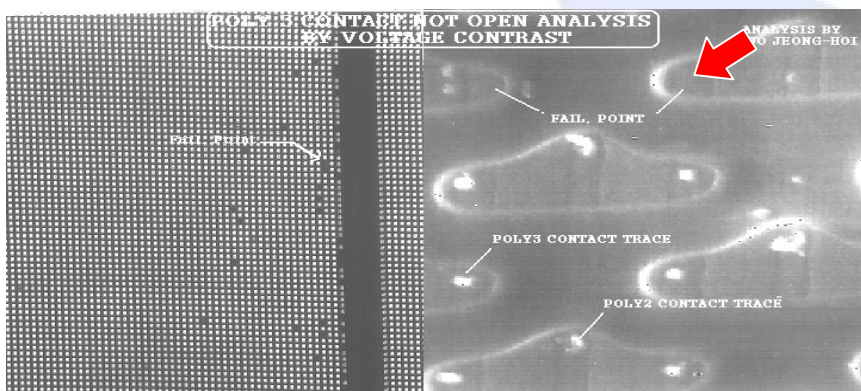


### IC sample with applied potential

- surface **+ve** → electric field  $< 100\text{V/cm}$  (collection efficiency ↓)
  - **SE recollection,  $\delta$  ↓**
  - **darker** than grounded surrounding
- surface **-ve** → electric field  $> 100\text{V/cm}$  (collection efficiency ↑)
  - **brighter** than grounded surrounding



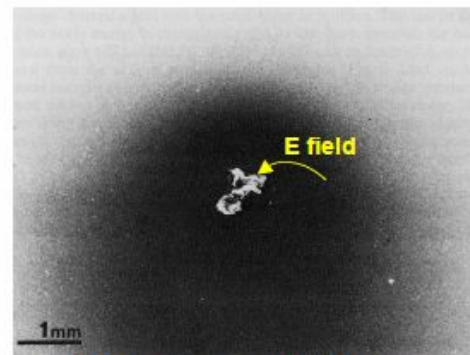
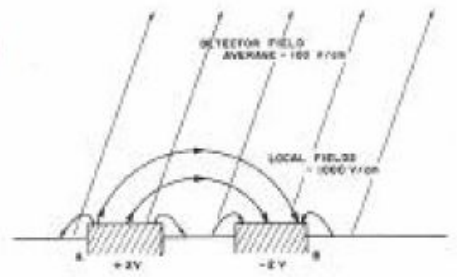
- Voltage Contrast point in Metal Loop Contact Chain Pattern of DRAM Test Pattern.
- Bright is the floating area by negative potential from Vcc to Vss



- Voltage Contrast point in poly capacitor (storage node) contact of 256 DRAM.
- Dark point by ONO film, is caused by not open contact (All the conducting grounded)

## Static Voltage Contrast

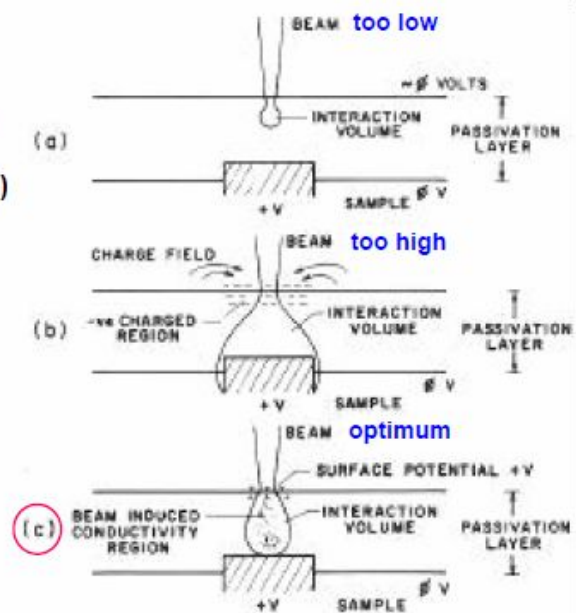
- give a quick visual impression
    - layout of circuit
    - magnitude & polarity of applied potential
  - but, difficult to quantify
  - variation of signal level → not symmetrical
    - { +ve : collection efficiency ↓↓↓
    - { -ve : collection efficiency ↑
  - signal level vs. surface potential
    - not unique correlation
    - local field effect
      - SE returns back to specimen (not collected by detector)
- ⇒ “ field contrast “



Charge ring around dust particle

## Important Practical Factors

- 1) Beam energy
  - in general, best at low kV (~2 kV)
  - (charging → fade voltage contrast)
- for device with passivation layer (~1μm)
  - need to find optimum kV (by experiment)
  - { if too low → no contrast
  - { if too high → charging
- 2) Scan rate
  - fast scan to avoid charging



Optimization of voltage contrast