

Utah State University

DigitalCommons@USU

Presentations

Materials Physics

Fall 10-21-2011

Electron Energy Dependent Charging Effects of Multilayered Dielectric Materials

Gregory Wilson
Utah State University

Amberly Evans Jensen
Utah State University

JR Dennison
Utah State University

Follow this and additional works at: https://digitalcommons.usu.edu/mp_presentations

 Part of the [Physics Commons](#)

Recommended Citation

Wilson, Gregory; Evans Jensen, Amberly; and Dennison, JR, "Electron Energy Dependent Charging Effects of Multilayered Dielectric Materials" (2011). American Physical Society Four Corner Section Meeting. *Presentations*. Paper 73.

https://digitalcommons.usu.edu/mp_presentations/73

This Presentation is brought to you for free and open access by the Materials Physics at DigitalCommons@USU. It has been accepted for inclusion in Presentations by an authorized administrator of DigitalCommons@USU. For more information, please contact digitalcommons@usu.edu.



Electron Energy Dependent Charging Effects of Multilayered Dielectric Materials

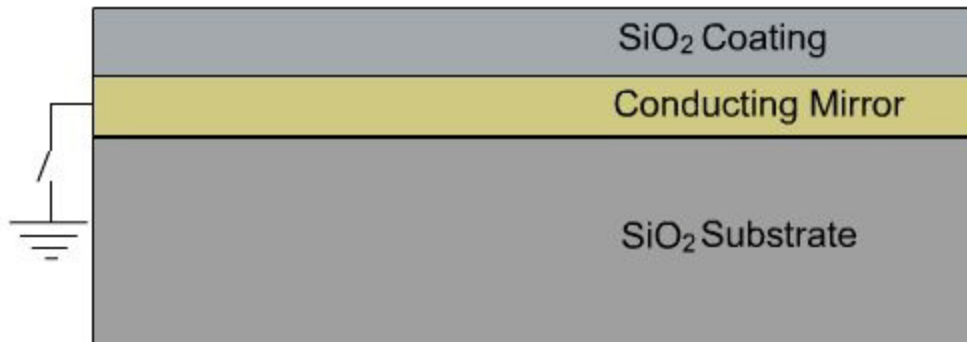
Gregory Wilson, Amberly Evans and J.R.
Dennison

Physics Department, Utah State
University

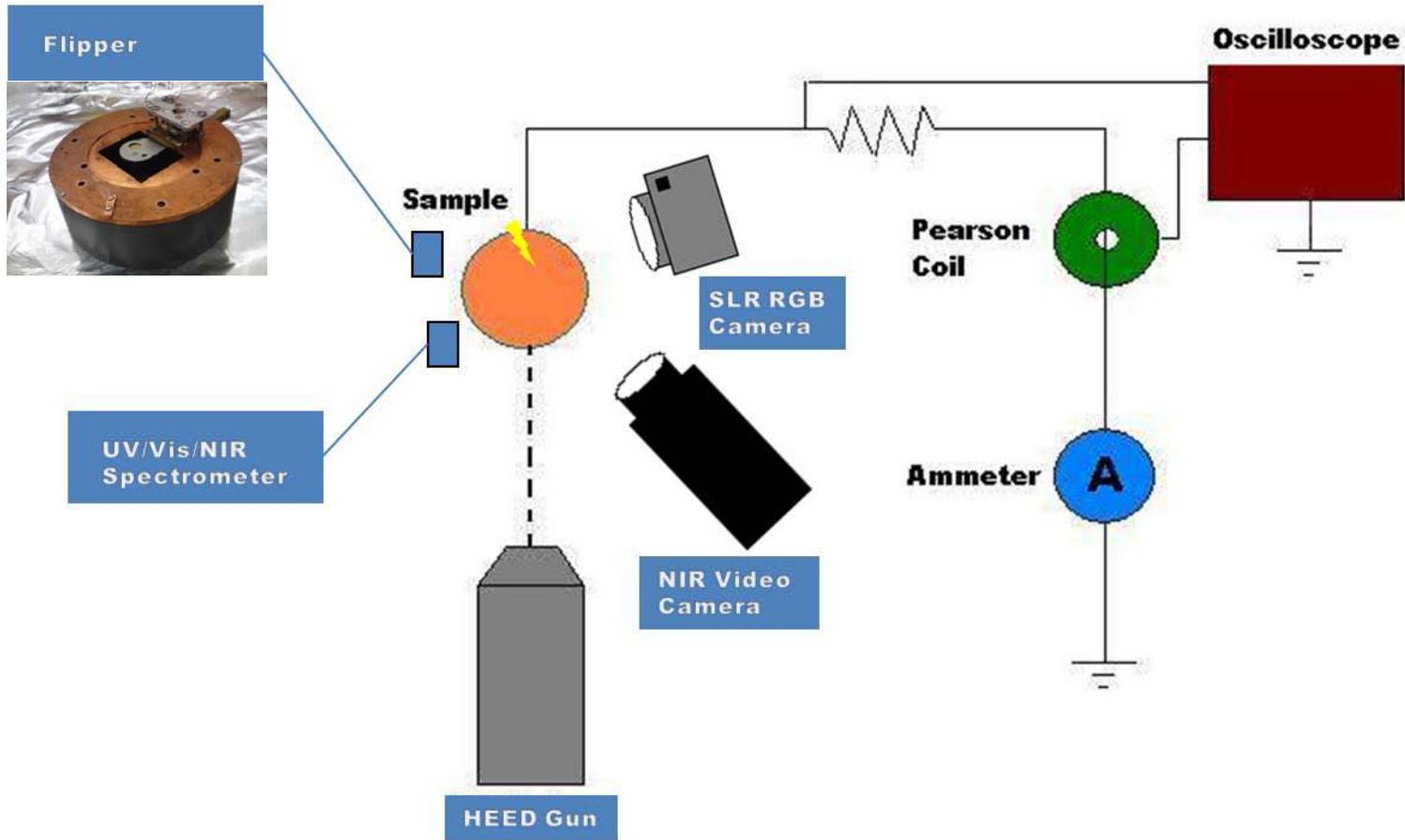
Charging of Materials in the Space Environment

- Electrostatic discharge is the leading cause of spacecraft failure due to the space environment

Experimental Design



Experimental Setup

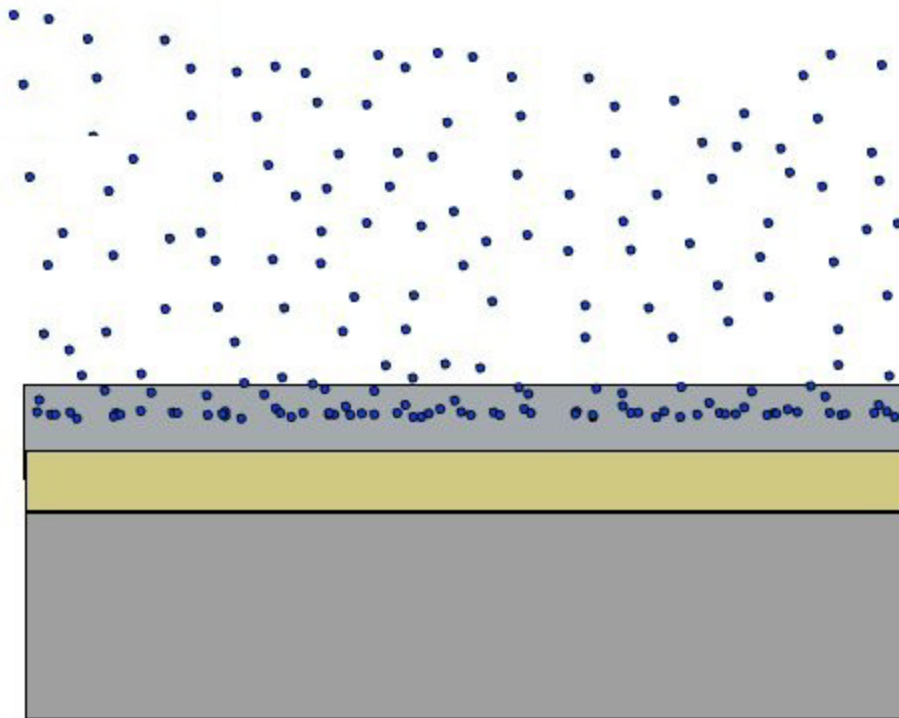


Internal Charge Evolution

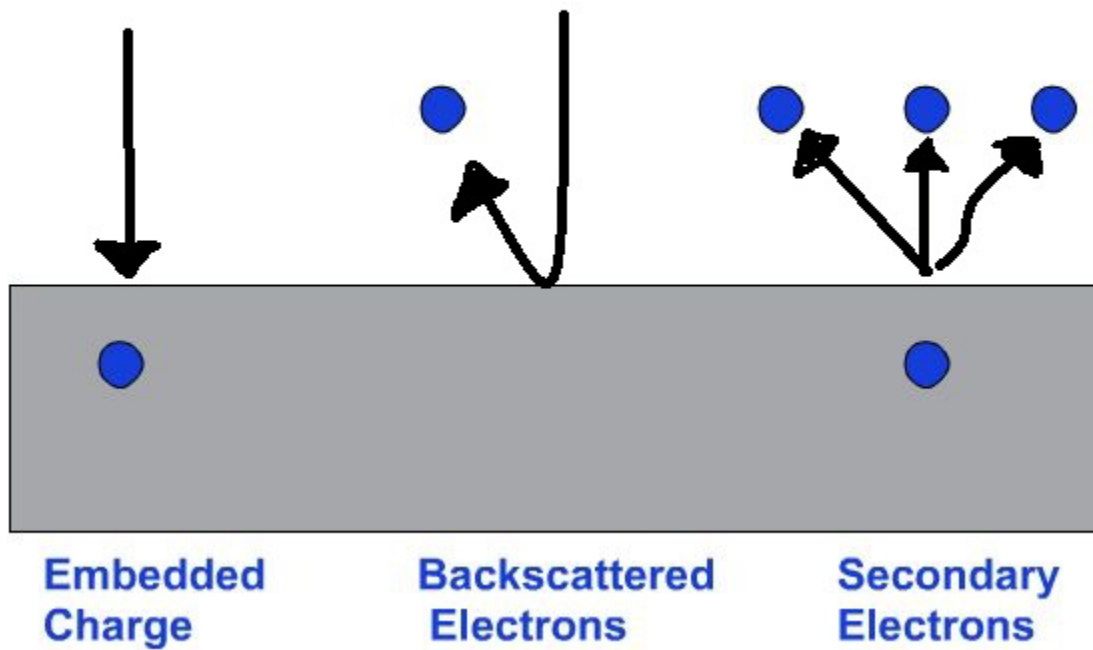
- Range
- Electron Yield
- Conductivity

Range

- Depth electrons penetrate is energy dependent

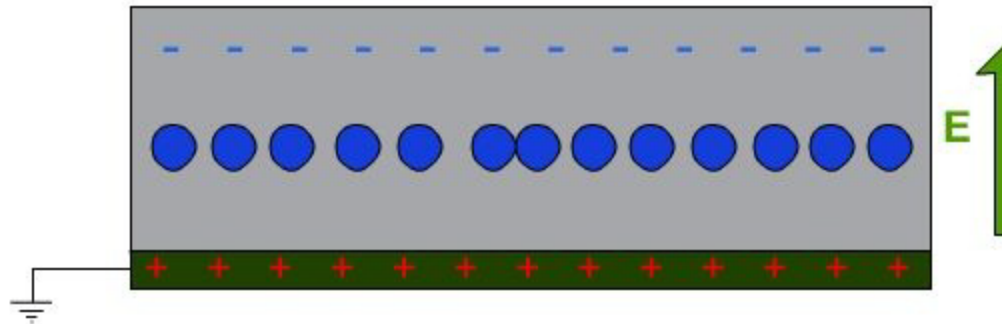


Electron Yield



Conductivity

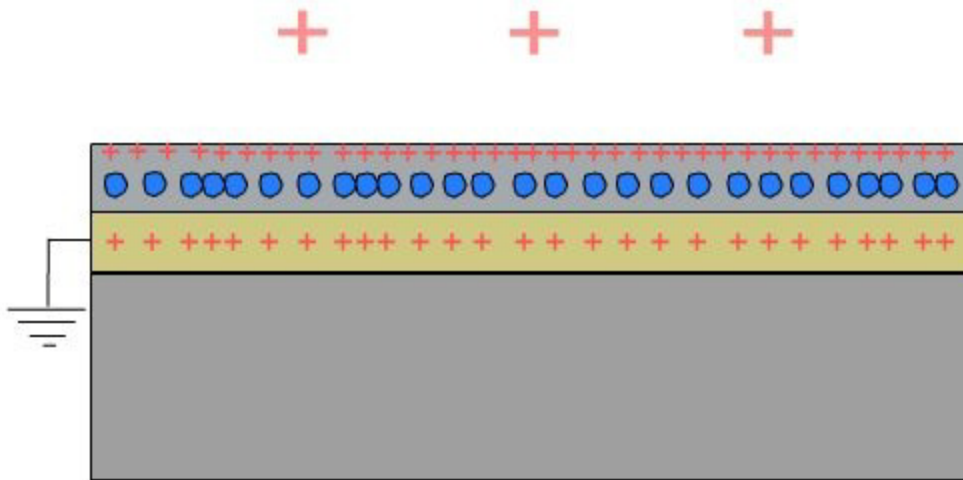
- Conductivity determines deposited charge layer movement



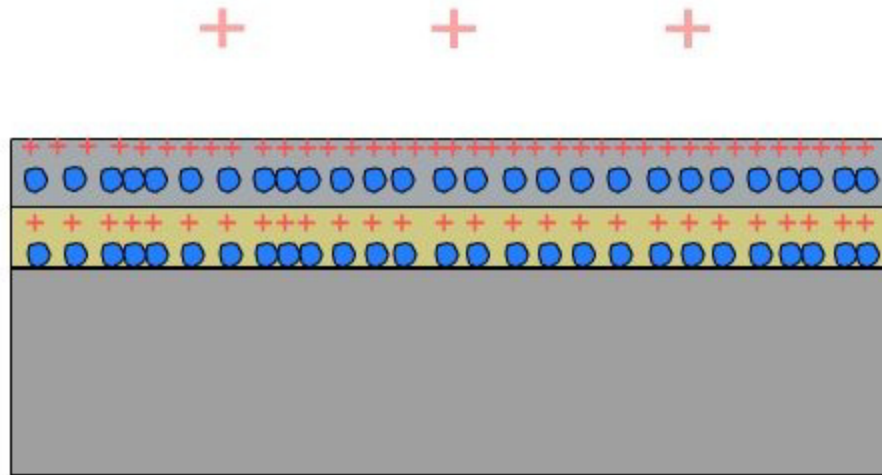
Charging Scenarios

- Low Energy
 - Grounded
 - Ungrounded
- High Energy
 - Grounded
 - Ungrounded

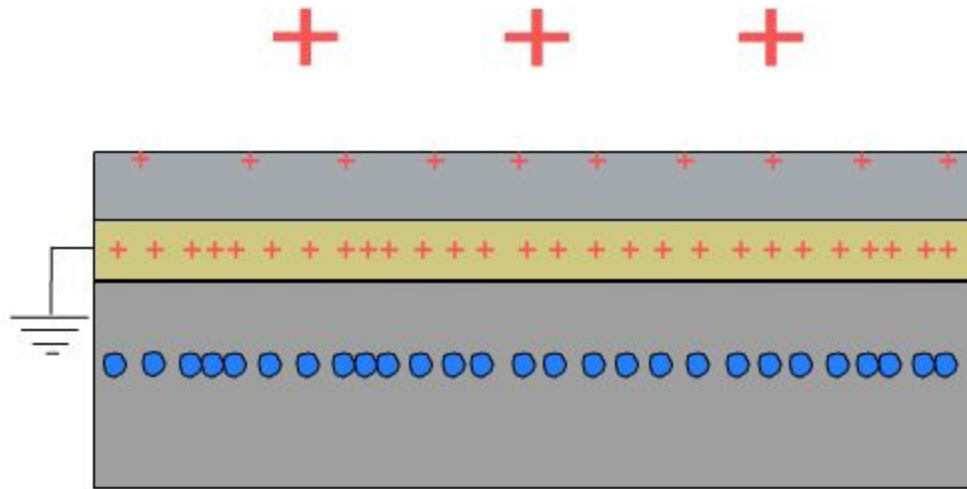
Low Energy - Grounded



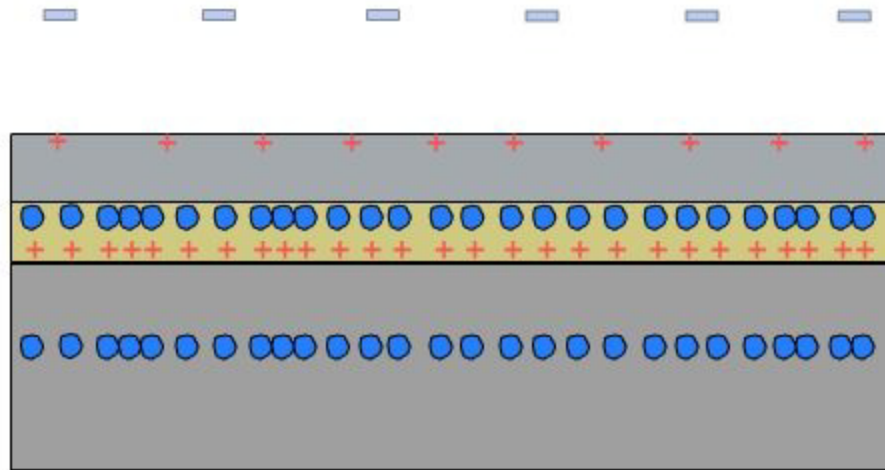
Low Energy - Ungrounded



High Energy - Grounded



High Energy - Ungrounded



Electrostatic Discharge

- High negative net potentials led to breakdown and arcing

In Conclusion We Observed:

- The charging of materials is dependent on the incident electron energy (through the range and electron yield) and conductivity of the material

$$V_s = \frac{\bar{J}_0 [1 - Y(E_b)]}{\sigma_{DC}} R(E_b) \frac{[D - R(E_b)]}{D}$$

- Internal conductive layers, if grounded, can mask deep internal charging
- High negative net surface potentials resulted in electrostatic discharge

In Conclusion We Observed:

- These measurements and models allow the quantization and assesment of the charging of multilayered dielectric optical materials due to the space environment