Establishing Procedures for Measuring Thermal Annealing Recovery in Irradiated III-V Multijunction Solar Cells

Jann Grovogui, Alexandra Pettengill, John Nocerino, Don Walker, Simon Liu, Yao Lao

The Aerospace Corporation

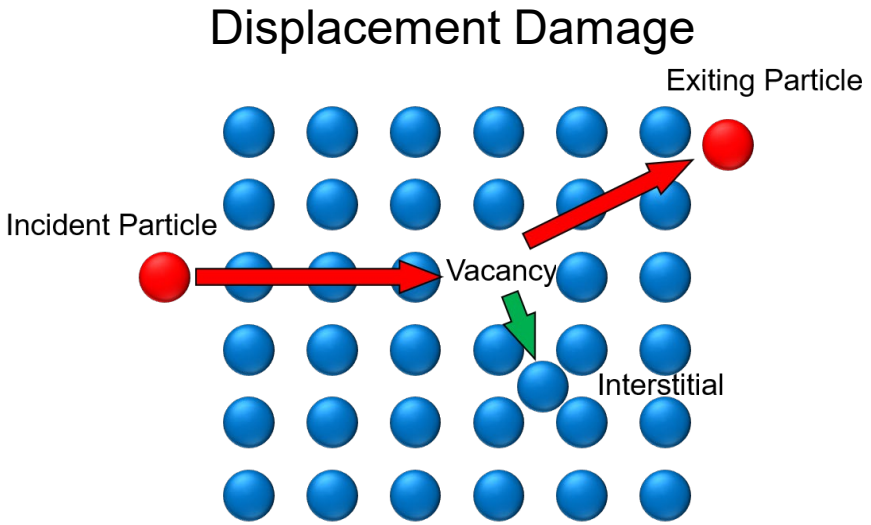
4/29/2022

Radiation Damage and Annealing Recovery

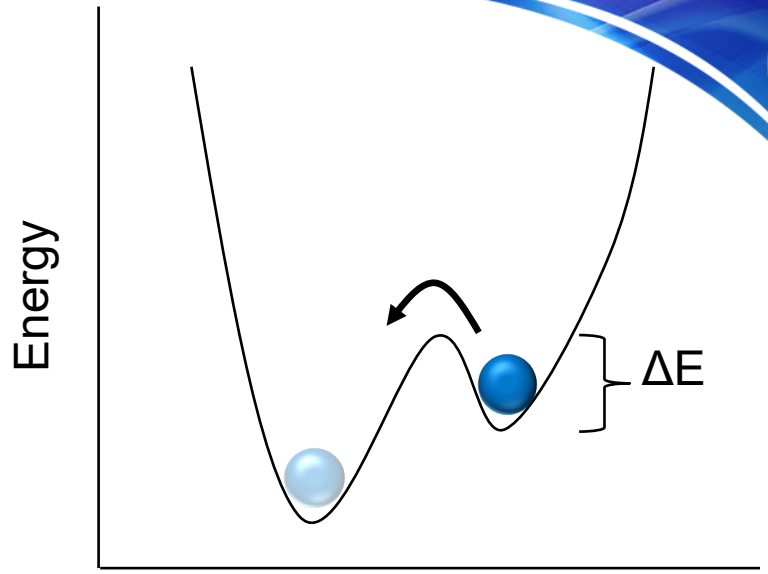
- Charged particle irradiation causes a variety of defects in space-based PVCs
- Thermal Annealing: The removal or rearrangement of defects when a material is exposed to elevated temperatures

1. *Can provide insight into presence of high and low energy defects*

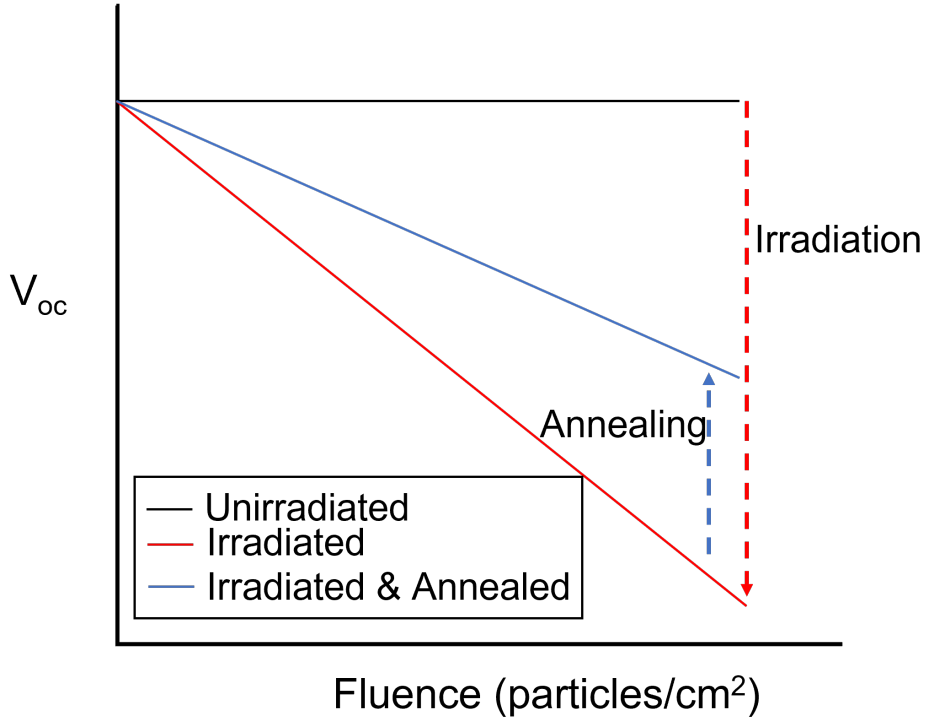
2. *Critical for predicting on-orbit solar array performance*



Problem: Many defects unknown → annealing recovery rates not well understood or documented for III-V's



Schematic of Irradiation and Annealing Effects



Test Protocol and Samples/ Temperature Profiles

Overview

Cells	3J
Radiation	p^+
Light I-V	Isocal
Annealing	RT & 60 ºC (HT)

Radiation Details

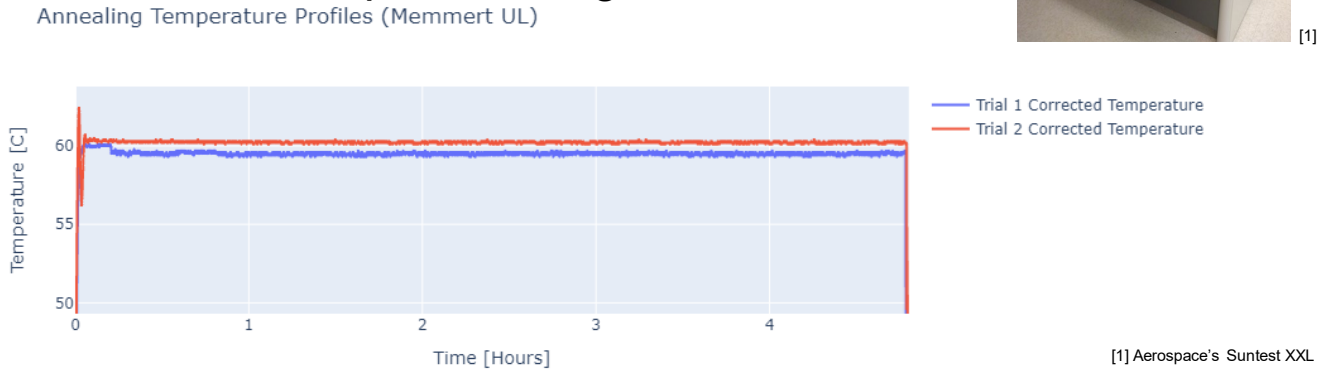
Proton Energies and Fluences

Energy	MeV	1						3						
Fluence	p^+/cm^2	1e+10	5e+10	1e+11	5e+11	1e+12	2e+12	5e+12	1e+11	5e+11	1e+12	2e+12	4e+12	1e+13

Annealing Details

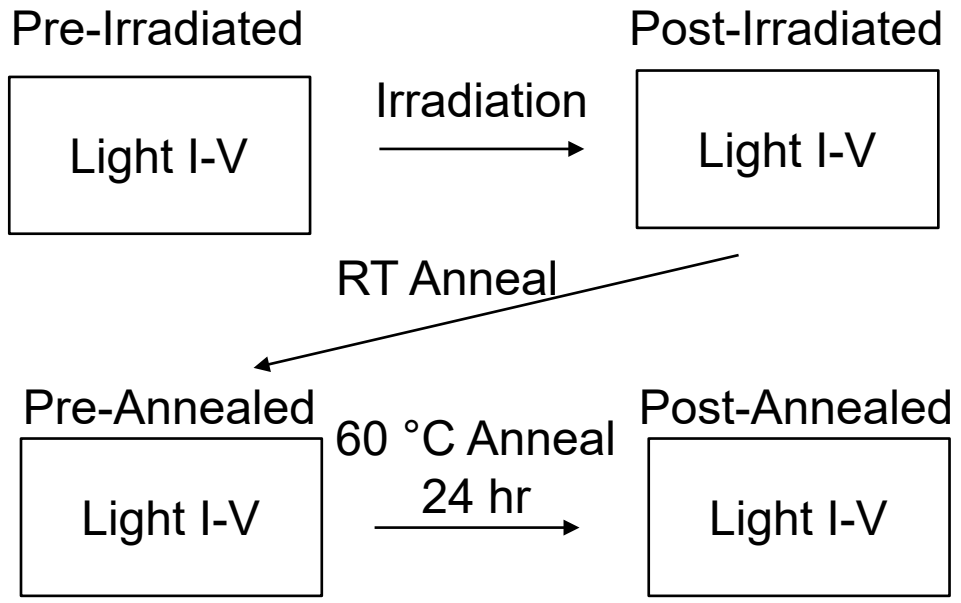
- 24 hours at 60 °C (AIAA S-111 2014 Std)
- >1 year at RT
- Forced Convection Furnace
- Furnace Temperature log: 10 sec intervals

[1]



[1] Aerospace's Suntest XXL

Procedure



Results

- For III-V cells, annealing recovery is small
  - Close to bounds of measurement error
- RT annealing can produce a significant portion of this recovery
  - Suggests presence of low energy defects

Summary

- To properly document the effects of HT annealing:
  - Perform HT anneal and pre- & post-annealing LIV as soon after irradiation as possible
- Absence of RT recovery improves sample “Shelf Life”

Acknowledgements

Thank you to our collaborators at Auburn University