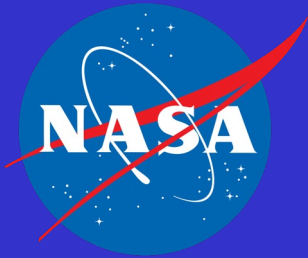


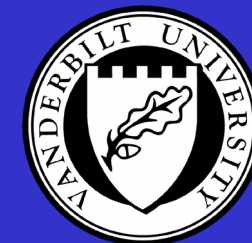
An Investigation into the Economic Design and Use of Pulsed-Lasers to Simulate the Effects of Heavy-Ion Bombardment on Radiation-Hardened Microelectronics



SLU SCALE Project
Concept Design Phase
Spring 2022



SAINT LOUIS UNIVERSITY
—
PARKS COLLEGE OF ENGINEERING,
AVIATION AND TECHNOLOGY



Problem Statement

"Develop an alternative to Heavy Ion testing, that allows for basic radiation-hardened product verification, while remaining accessible, in terms of both cost and time, to academic and commercial consumers."



Concerning Extent Radiation Testing Techniques

Heavy Ion Testing:

- Fiscally Expensive
- Energy Intensive
- Long Wait Times

Summary of Approach

1. Introductory Explanation and Topic Orientation
2. Division of Project Team into Sub-Groups
3. Literature Review Process
4. SME Interviews
5. Improved Definition of Problem Statement and Customer Needs
6. Proposal Creation
7. Proposal Refinement and Editing



Stakeholders and Needs

Potential Customers:

- Commercial Entities
- Academic Institutions
- Hobbyists
- Defense Contractors
- Government Research Agencies

Needs:

- Inexpensive
- Easy to Use
- Reliable with Little Error
- Make Small, Accurate Measurements



Project Scope

Alternative to heavy-ion radiation testing:

- Cost-efficient construction (commercial-off-the-shelf)
- Readily deployable in most commercial and academic research environments
- Minimal maintenance, operation, and personnel training costs
- Scalable cubic test volume; easily modified



Technical Requirements

- Shall require minimal laser safety equipment and protocols.
- Shall integrate with common laboratory infrastructure.
- Shall accommodate most microelectronic specimen.
(e.g., de-capped ICs, photoelectric diodes, etc.)
- Shall produce a fixed wavelength beam capable of causing SEEs.
- Should interface with most common data acquisition software suites.
(e.g., LabView)



Lasers and Physics

- Substrate(s): Silicon-based semi-conductors
- Laser type: Q-switched pulsed laser
- Target Wavelength(s): 650 to 800 nm (fixed)
- Duration of Exposure: 5 to 300 ps
- Pulse Energy Range: 5 to 40 nJ
- Beam Aperture: 0.5 to 1.5 μm
- Target Depth of Saturation: 10 to 300 μm
- Target Band-Gap Range: 1.0 to 1.5 eV
(*simulated*)



Mechanics, Apparatus, Structure

Needs to be considered

- Test area size
- Method of adjustment
- Range of adjustment
- Configurable laser beam

Current ideas

- Volume of 1 cubic foot
- Moveable plate
- 30-100 mm in X and Y axes
- Various lens sizes



Software and User Interface Environment

What should it do?

- Easy to learn UI to control necessary variables.
- Interface with data collection software (LabView).
- Synchronization with external testing device.

What does it look like?

- Digital interface to input testing specifications
- Preset vs Customized testing procedure



Safety Protocols (Environment and Procedure)

Safety considerations:

- Wavelength of the laser
- Average accidental exposure time
- Maximum irradiance of the laser

Solutions:

- Operational curtain to shield any reflection of the laser during testing.
- Wavelength specific safety glasses (~700 nm)



Proposal

2022-2023 School Year

- Fall:
 - Develop design which can be used to create a working prototype
 - Research acquisition of materials.
- Spring:
 - Continue design and finalize initial design

2023-2024 School Year

- Fall:
 - Begin construction of prototype
- Spring:
 - Continue construction of prototype
 - Begin testing for prototype



Conclusion

Questions?