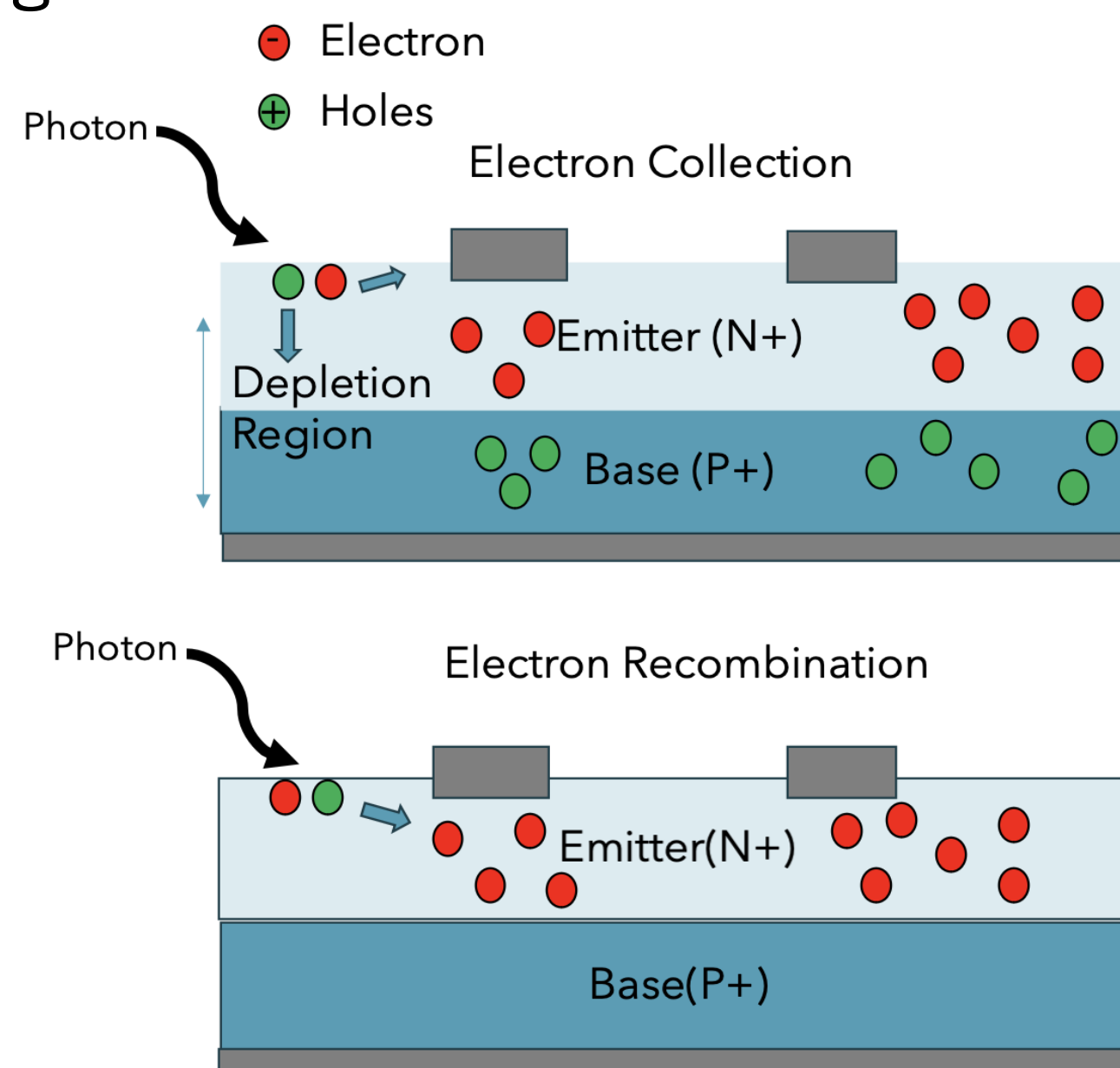


OBJECTIVE / KEY REQUIREMENTS

- Develop a silicon solar cell structure with a corresponding semiconductor fabrication and testing procedure.
- Combine research, design, fabrication, and testing to establish a hands-on undergraduate lab course for teaching practical solar cell production and optimization.

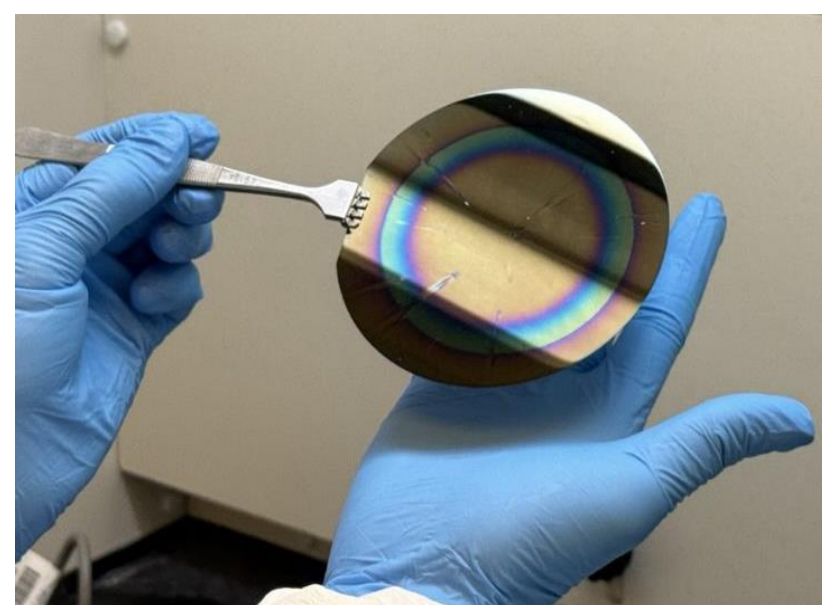
BACKGROUND

- Solar cells use the photovoltaic effect to generate electron-hole pairs from sunlight photons.
- A p-n junction forms a depletion region with an electric field that separates the charges and drives current flow.
- Metal contacts collect charges, allowing power generation.
- Efficiency improves by optimizing charge collection and reducing electron recombination.



VALUE PROPOSITION

- This project addresses the demand for semiconductor training by creating a hands-on course with documented design, fabrication, testing, and cleanroom procedures to build skills and support future education.



PROCESSING EQUIPMENT

Spin Coater Within Fume Hood



Screen Printer



Physical Vapor Deposition Chamber



Vacuum Tube Furnace

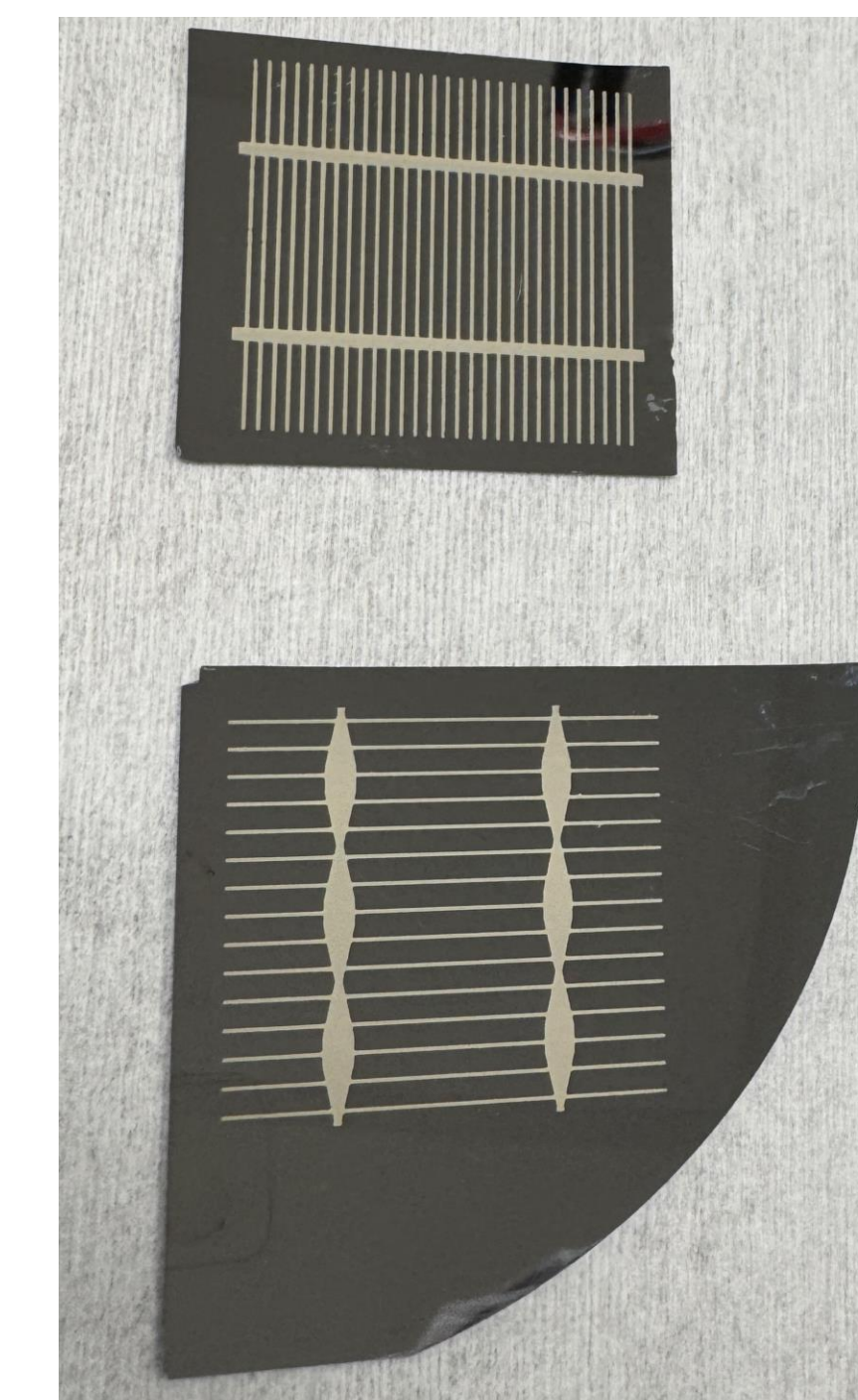


VALIDATION

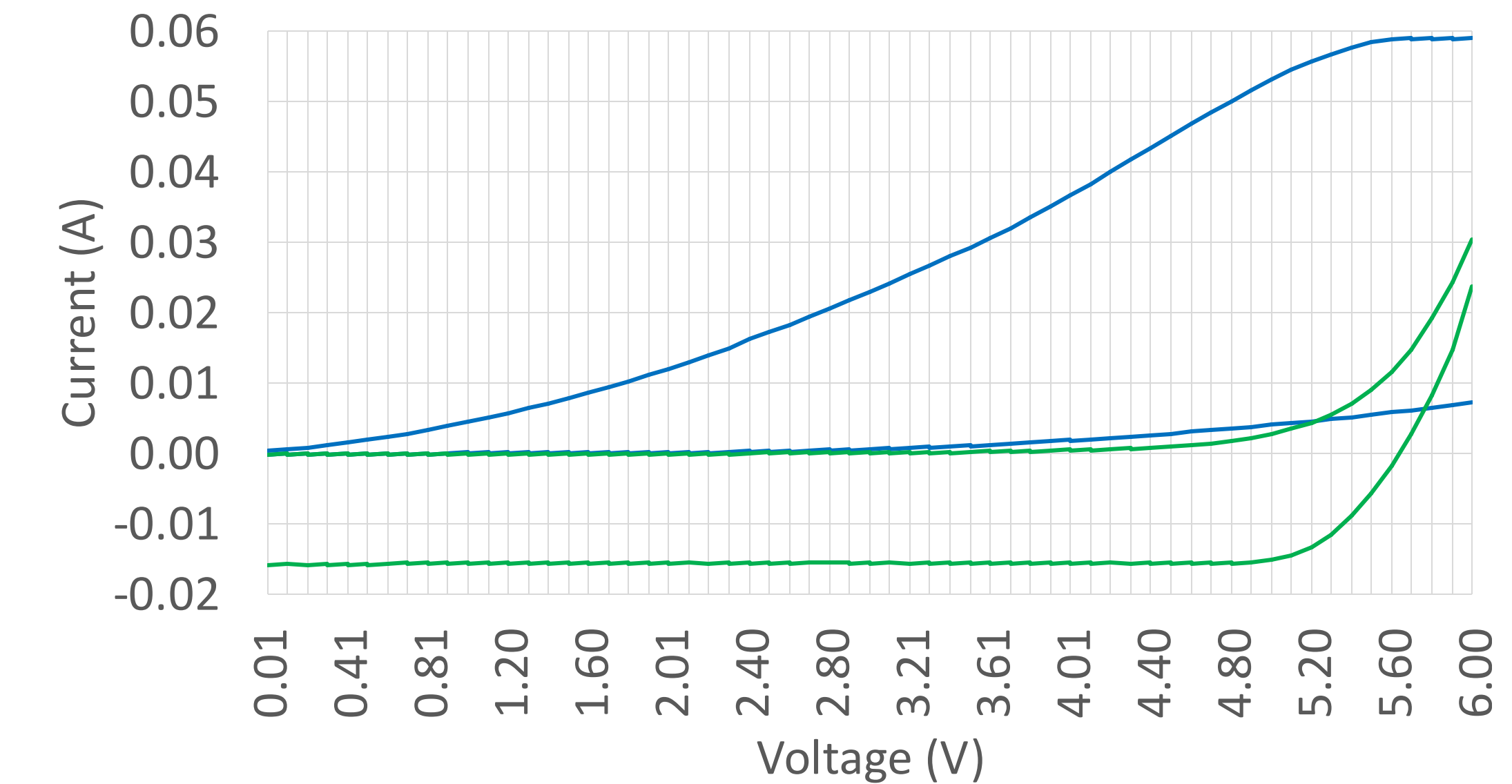
Sheet Resistivity to Estimate Ion Concentration

Measurement	Resistivity (Ω/sq)	Ion Concentration (N/cm ²)	% Error
Solution	N/A	4.21 * 10 ²¹	N/A
Diffusion Goal	N/A	10 ¹⁷	0
Surface S1 [Avg]	20.5	8.1 * 10 ¹⁷	7.1%
Surface S2 [Avg]	24.23	7.6 * 10 ¹⁷	6.6%

- Degradation of the original solution concentration is highly dependent on equipment and deposition time/temps.
- Classifying this before vs after diffusion allows for effectively decreasing these times/temps.



Light vs. Dark IV Curve Failure Analysis



- Our sample (in blue) has similar characteristics to a pn diode rather than a solar cell. However, the light activating this diode (- current) shows we have photo-absorption.
- This suggests that doping and internal junctions significantly differ, creating large depletion regions that the bulk of generated electrons cannot overcome.

CONCLUSION

- With the groundwork developed for a revisable, repeatable, and testable solar cell fabrication process, lab courses can introduce sub-procedures of this project to undergraduate students, improving semiconductor workforce development at the University of Idaho.
- Further testing along previous diffusion recommendations made can improve defects seen in initial testing



University of Idaho
College of Engineering



2025 Capstone Project