Design of new material solar cell and analysis of efficiency, cost and resource availability

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Introduction

Problem: Today's solar cells are made from Silicon, which is a **highly developed technology** that is reaching its **theoretical maximum efficiency of ~32%**.

Solution: **Introduce Cadmium Selenide (CdSe) as a tandem cell** with silicon to boost overall efficiency of solar farms while minimizing additional costs.

Intended Users & Uses:

1. **Vikram Dalal** – A professor at ISU that is interested in the **viability** of CdSe as a method of boosting the efficiency of Si cells.
2. **First Solar** – A solar cell manufacturer that is also interested in CdSe, and would benefit from **more detailed fabrication research**.

Design Approach

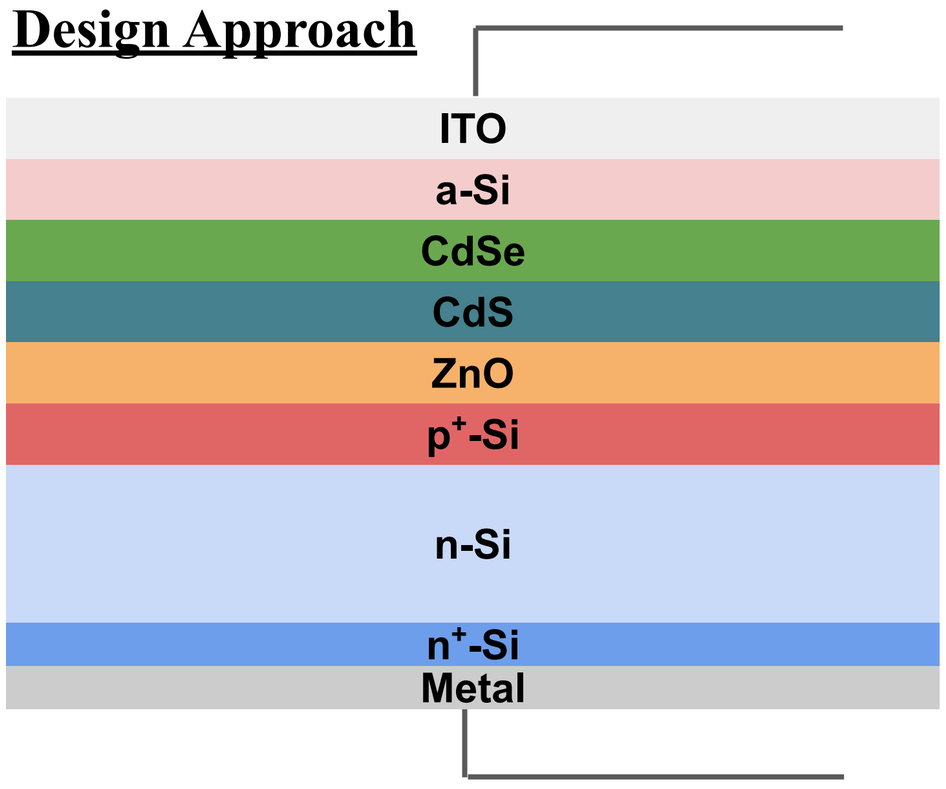
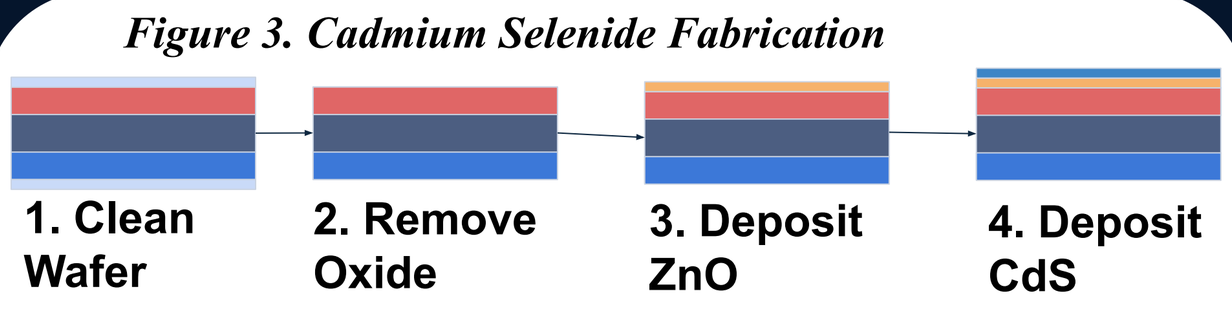
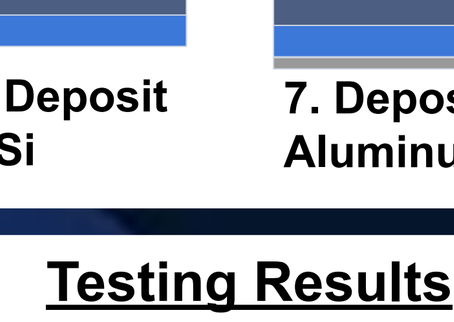


Figure 1. Tandem Cell Layer Stack

Figure 3. Cadmium Selenide Fabrication



Testing Results



Design Requirements

Functional Requirements:

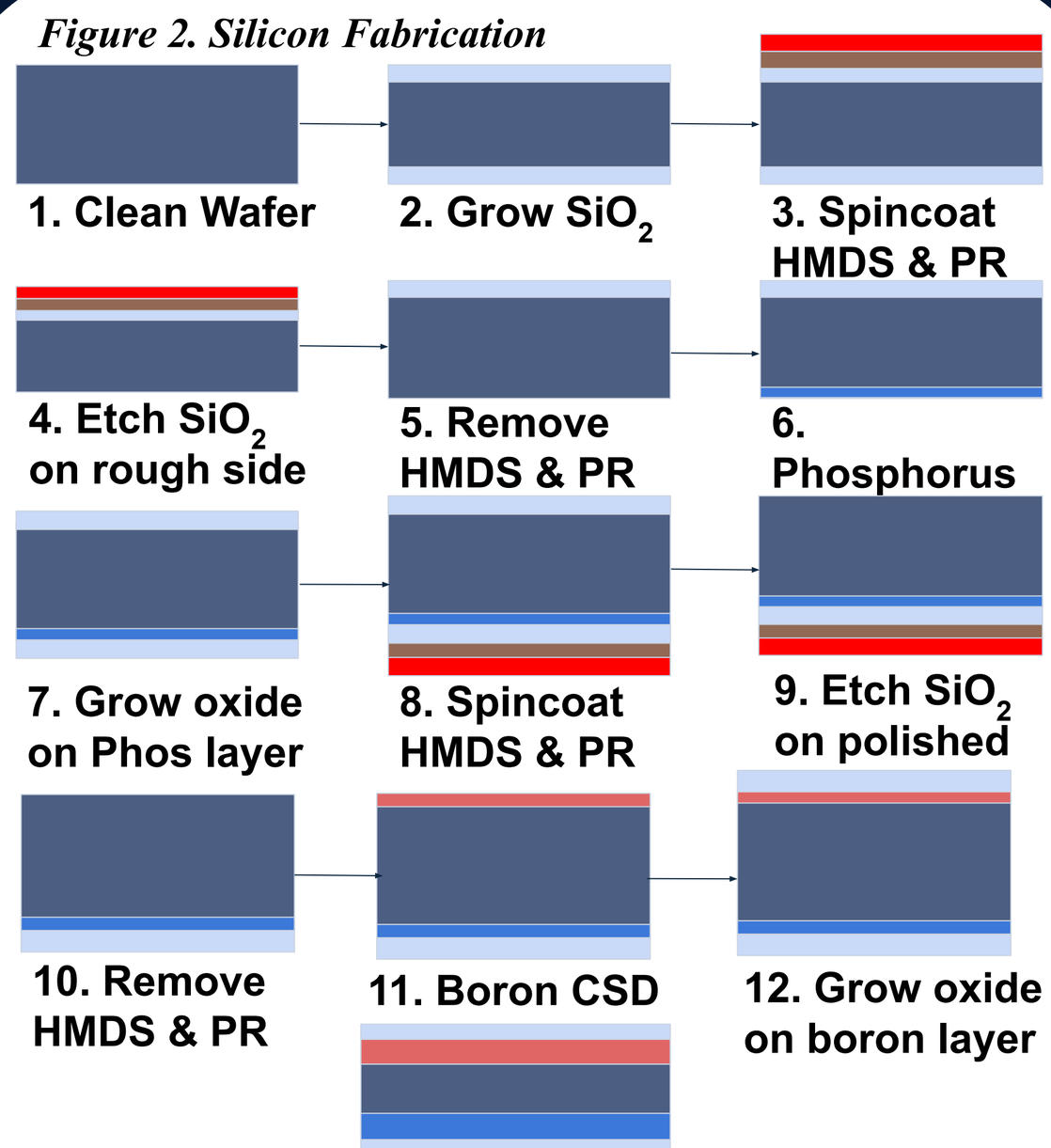
1. Fabricate a tandem cell with an open circuit voltage of **at least 1.2V**
2. Supporting materials must be **transparent** to allow light to pass through to the lower layers
3. Economic analysis must show the **utility-scale viability** of the design

Constraints: Fabrication processes are limited to the technology available at the Microelectronics Research Center (MRC).

Standards: Many standards will apply to solar cell technology including but not limited to:

1. **IEEE 1547**: "Standard for Interconnection and Interoperability of Distributed Energy
2. **IEEE 1562-2021**: "Recommended Practice for Sizing Stand-Alone Photovoltaic Systems"
3. **IEEE P2778**: "Guide for Solar Power Plant Grounding for Personnel Protection"
4. **IEEE 1526-2020**: "Recommended Practice for Testing the Performance of Stand-Alone
5. **OSHA 1910.1027**: "Toxic and Hazardous Substances: Cadmium"
6. **OSHA 1926.55**: "Safety and Health Regulations for Construction"

Figure 2. Silicon Fabrication



Economic Analysis Results