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Self-Aligned Fabrication of Silicon Heterojunction Interdigitated Back Contact Solar Cells

Silicon Heterojunction Interdigitated Back Contact (SHJ-IBC) Solar Cells have both emitter and base contacts on the rear of the substrate that are interlocked like the fingers of two clasped hands. SHJ-IBC cells are advantageous, providing higher energy conversion efficiency and simplifying the interconnection of cells within a solar module. However, manufacturing such cells is expensive and complicated due to the intricate placement of emitter and base contacts on the rear of the cell. Current methods require carefully aligned photoresist patterning or screen-printed resist patterning that are difficult to implement and can decrease performance by contaminating heterojunctions with resist residue. Therefore, there is a need for a simpler, cleaner, and more cost-effective approach.

Researchers at ASU have developed a self-aligned fabrication method for SHJ-IBC solar cells using stacked shadow masks and tunnel junctions to define areas where the different semiconductor materials are to be deposited. First, a master shadow mask is aligned and fixed to the rear of the solar cell before being overlaid with a second blocking shadow mask. The openings in the blocking mask are oversized compared to the openings in the master mask, simplifying alignment, and are arranged such that selected openings in the master mask are covered while the others remain uncovered. Doped layers of amorphous silicon (a-Si) form heterojunctions with the solar cell's rear substrate, and after the blocking mask is removed, additional layers of a-Si and transparent conducting oxide are deposited to form base contacts and tunnel junctions. The masks can be made from simple metallic or ceramic material and only need to be aligned once, making them easy to apply. By using shadow masks this method saves time, money, and material, and prevents short circuiting and yield loss by ensuring no resist residue contaminates the heterojunctions.

Potential Applications

- Interdigitated Semiconductors
- SHJ-IBC Solar Cell Fabrication

Benefits and Advantages

- Cost-Effective – Shadow masks can be made from inexpensive sheet metal or ceramic material.
- Efficient – No lingering resist residue results in fewer product defects and higher manufacturing throughput.
- Practical – Shadow masks only need to be aligned once, making their

application convenient and straightforward.

For more information about the inventor(s) and their research, please see

[Dr. Clarence Tracy's directory webpage](#)