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Lattice Matched Multi-Junction Photovoltaic Devices

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Intellectual Property Status

Patent Pending

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Invention Description

Currently, Si wafers and related wafer processing accounts for seventy-five percent of the cost of producing conventional solar panels. With a potential concentration ratio of 500 – 1000 and double the efficiency over conventional single junction cells, the use of concentrator multi-junction solar cell technologies will dramatically reduce the fraction of the wafer cost for solar panels, which will solve the semiconductor materials bottleneck and lower the overall cost for electricity generation using PV cells. Essentially, multi-junction photovoltaic devices employ a stack of different materials (with different bandgaps) such that every solar cell in the stack absorbs part of the incident spectrum. By choosing a suitable combination of bandgaps for the various materials, an improvement of the conversion efficiency over the single-junction approach results.

State-of-the-art GaInP/(In)GaAs/Ge 3-junction solar cells have demonstrated a record efficiency of roughly forty-one percent. By increasing the number of junctions, it is possible to achieve even higher efficiencies; however, this is difficult to achieve in practice due to lattice mismatch and current-matching issues. Consequently, researchers at Arizona State University have developed lattice matched hybrid II-VI/III-V multi-junction stacks to circumvent these complications.

Potential Applications

- Higher efficiency terrestrial concentrator photovoltaic arrays
- Photovoltaics for space and aerospace applications
- Thermo-photovoltaics
- Multi-color detectors

Benefits and Advantages

- Enables lattice matched materials with bandgaps covering the entire solar spectrum (UV – 3 μm) on a single substrate.
- Lattice matching possible for optimally spaced bandgaps
- Higher efficiency – up to 50% (at concentration of 500).