A THIN FILM VLS SEMICONDUCTOR GROWTH PROCESS

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ABSTRACT

A team of Berkeley Lab researchers has invented the first vapor-liquid-solid (VLS) growth technology yielding III-V photovoltaics. The photovoltaics achieve 25% power conversion efficiency at a cost significantly lower than current approaches due to the non-epitaxial processing approach and high material utilization rate.

The films have grain sizes of 100-200 microns (100 times larger than yielded from conventional growth processes), minority carrier lifetimes up to 2.5 nanoseconds and electron mobilities reaching 500 cm2/V-s. Under one-sun equivalent illumination, an open circuit voltage of up to 930 mV can be reached, just 40 mV lower than measured on a single crystal wafer.

Berkeley Lab researchers fabricated continuous thin films of polycrystalline indium phosphide (InP) directly on metal foils by, first, depositing an indium (In) thin film directly on molybdenum (Mo) foil. Next, they deposit a thin capping layer to prevent dewetting of the indium from the substrate during subsequent high temperature processing steps. The resulting stack (Mo – In – capping layer) is then heated in the presence of phosphorous precursors causing supersaturation of the liquid indium with phosphorous, followed by precipitation of InP, thus turning all the In into InP.

III-V photovoltaics deliver the highest power conversion efficiencies, but significant processing costs (expensive materials and equipment, low precursor utilization rate) have limited their use. Berkeley Lab's non-epitaxial growth technology overcomes these limitations to deliver a promising low cost solar cell.

APPLICATIONS

- Photovoltaic cells
- Photoelectrochemical cells
- Thin film transistors

ADVANTAGES

- High power conversion efficiency (25%)
- High material utilization (90%)
- Large crystal size (100 - 200 µm)
- Optical and electrical properties approaching state-of-the-art

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Enhancing Photoluminescence Quantum Yield for High Performance Optoelectrics
- Chemical-Sensitive Field-Effect Transistor

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OTHER INFORMATION

CATEGORIZED AS

- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2013-036-0

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