Optoelectronic Devices Fabricated With Defect Tolerant Semiconductors
Technology #17793

Applications

Use of defect-tolerant semiconductors in optoelectronic devices have useful applications to commercial manufacturing of thin-film photovoltaic (PV) cells, green light-emitting diodes (LEDs), photodetectors, and other sensors.

Problem Addressed

Conventional screening methods for use of semiconductor materials in optoelectronic devices typically emphasize optical properties and scalability concerns. Optical bandgap energy, absorption coefficient, elemental abundance, toxicity, stability, and manufacturing cost of a material represent key criteria for candidate semiconductor materials. However, many materials meet these criteria but fail to achieve industrially relevant conversion efficiencies (above 10-15%) required for high-performance PV materials.

Consideration of additional properties that enable bulk transport in the presence of defects can help identify high-performance semiconductor materials with enhanced stability and reduced toxicity. The new design criteria incorporates defect-tolerance in the minority carrier lifetimes of semiconductors and presents a new screening path for candidate materials applicable to optoelectronic devices.

Technology

This expanded criteria focuses specifically on electronic structures that enable bulk transport in the presence of defects, which enhances conversion efficiency of a semiconductor material. Materials that contain partially oxidized cations with a lone 6s2 or 5s2 pair of electrons may exhibit defect tolerant transport properties promoted by high dielectric constant, low effective masses, and valence bond (VB) antibonding characters. Inspired by recent successes in methyl-ammonium lead iodide as a highly-efficient PV material, this new design criteria identifies several classes of defect-tolerant semiconductor materials for use in high-performance optoelectronic devices.

Advantages

- Accelerates discovery of new semiconductor materials for PV
- Improves minority carrier transport due to defect tolerance
- Potential for decreased cost to process materials

Categories For This Invention:

Electronics & Circuits
Semiconductors & Integrated Circuits
Energy
Solar
Photovoltaics
Thin Film PV

**Intellectual Property:**

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**Publications:**

*Identifying defect-tolerant semiconductors with high minority-carrier lifetimes: beyond hybrid lead halide perovskites*
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**Image Gallery:**