

A High Efficiency Micro-thermophotovoltaic Generator System

Technology #14212

Applications

Thermophotovoltaic (TPV) systems convert thermal radiation into electricity via low-bandgap photovoltaic cells. They can be used in applications ranging from off-grid generators to hybrid/electric vehicles.

Problem Addressed

Previous TPV systems have extremely low power conversion coefficients – on the order of 1% or less – mainly due to thermal emission loss in the mid-wavelength infrared photons. The proposed system uses photonic crystals to create up to a 27-fold increase in efficiency and power output in micro-TPV generators, which makes them comparable to current photovoltaic systems.

Technology

The micro-TPV generator operates as follows: hydrocarbon fuel (e.g. propane or butane) is fed with oxygen into a microchannel defined within a silicon structure. The hydrocarbon is catalytically combusted on the channel surface, releasing energy in the form of heat through the emitter. The microcombustor is designed such that the majority of the heat is released through radiation. The radiation falls on the TPV cells positioned opposite the two large faces to directly convert the radiation into electrical power. By adding up to four sub-micron bilayers of silicon and silicon dioxide and an optically thick layer of platinum to the TPV cells, the figure of merit – the product of the power and the power conversion efficiency – is maximized to be 291% relative to a plain silicon wafer. The TPV cells can be multijunction cells – cells with multiple bandgaps – to increase the absorbed spectrum. Additionally, optimizing the emitter creates a 29.8% power density increase.

Advantages

- Increases power conversion efficiency
- Increases power density

Categories For This Invention:

Energy

Solar

Photovoltaics

Thermal PV

Intellectual Property:

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Publications:

[Building a Better Suntrap](#)
The Economist
Dec 31, 2011

External Links:

Joannopoulos Research Group
<http://ab-initio.mit.edu/>
Jensen Research Group
<http://web.mit.edu/jensenlab/>
Nanostructures and Computation Group
<http://math.mit.edu/~stevenj/group.html>
Photonics and Modern Electro-magnetics Group
<http://www.rle.mit.edu/marin/>

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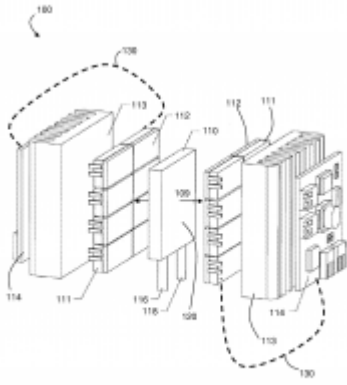


FIG. 1