

Solar thermoelectric energy conversion

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The conversion of sunlight into electricity has been dominated by two approaches: photovoltaic (PV) and solar-thermal power generation. Photovoltaic cells are mostly deployed as flat panels on rooftops or solar farms, while solar-thermal electricity generation technology relying on bulky optical concentrating systems and mechanical heat engines are used in large power plants. In this talk, I will discuss the potential of using thermoelectric effect to harness solar energy into electricity. We will start with an introduction to thermoelectric energy conversion and materials, including recent advances using nanostructuring approaches, and move on to discuss solar thermoelectric generators (STEGs) that combine solar power with thermoelectric generators. We have recently demonstrated flat-panel solar thermoelectric generators with 4.6% solar-to-electricity conversion efficiency under AM1.5G condition and 5.2% at a solar intensity of 1.5 kWm^{-2} . These results are 7-8 times better than reported before, and are enabled by advances in nanostructured thermoelectric materials, optical selective surfaces, and innovative device design. Research needs in thermoelectric energy conversion technology will be briefly discussed.