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$p \times n$ Transverse thermoelectrics: A new class of materials with possible optoelectronic applications

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This work introduces a new class of transverse thermoelectric that may have promising optoelectronic device applications due to its scalability, geometric flexibility, and ability to operate at cryogenic temperatures. The so-called $p \times n$-type transverse thermoelectric ("p-cross-n") with *p*-type Seebeck in one direction and n-typeorthogonal is a narrow gap semiconductor with both electrons and holes carrying comparable magnitudes of orthogonally directed heat currents. Off-diagonal terms in the Seebeck tensor drive the net heat flow transverse to the net electrical current. Whereas thermoelectric performance is normally limited by the figure of merit ZT, these $p \times n$ type materials can be more easily geometrically shaped and integrated for device applications, leading to simpler, more compact, and efficient thermal elements for infrared detector cooling or photovoltaic waste heat generators. Unconventional geometries for possible detector pixel cooling, and solar cell waste heat recovery are described.

Biography

Matthew Grayson is an Associate Professor of Electrical Engineering and Computer Science, as well as the Co-Director of the Global McCormick initiative to increase international networking opportunities for students. In his research, he engineers semiconductor nanosystems where interactions and unconventional electron transport can be controlled and studied. Systems of interest are quantum wires, quantum wells, superlattices and quantum Hall effect. His other research areas of interest include thermal transport, thermoelectricity, thermoelectrics, particularly the field of transverse thermoelectrics, and amorphous oxide semiconductors.

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