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Materials considerations for the efficiency of photon-enhanced thermionic emission JARED SCHWEDE, DANIEL RILEY, KUNAL SAHASRABUDDHE, NICHOLAS MELOSH, ZHI-XUN SHEN, Stanford University — Photon-Enhanced Thermionic Emission (PETE) is a promising method of solar energy conversion that is based on thermal emission of photoexcited electrons from a high-temperature semiconductor, making it attractive for use in tandem with solar thermal systems. Theoretical efficiencies of PETE devices can exceed those of single junction photovoltaics, but experimental tests of the PETE process have displayed low efficiencies.[1] Here we examine this disconnect between experimental results and theoretical promise. We analyze the effects of real semiconductor parameters on the PETE process and relate them to the ultimate performance of a PETE device, directly translating non-idealities of practical materials into constraints on conversion efficiency. The analysis identifies fundamental challenges to efficient conversion based on PETE and establishes design rules that direct the search for semiconductor systems to form the basis of real devices. We also review experimental work guided by these insights that shows increased emission efficiency due to reduced surface recombination, one of the key challenges for realistic solar energy conversion based on PETE.
[1] J.W. Schwede, *et al.*, Nat. Mater. **9**, 762-767 (2010)

Jared Schwede
Stanford University

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