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Optimization of space-charge limited thermionic energy converters with self-consistent simulation[1] CHRISTOPHER HALL, NATHAN COOK, JONATHAN EDELEN, RadiaSoft LLC , JEAN-LUC VARY, Lawrence Berkeley National Laboratory — Thermionic energy converters (TEC) are an attractive technology for modular, efficient transfer of heat to electric energy. A traditional TEC is comprised of narrowly-separated plates; thermionic emission at the cathode releases electrons which travel to the anode, producing a current which may generate electrical power.Simple structures are often space-charge limited, as operating temperatures may produce currents exceeding the corresponding Child-Langmuir limit, and prevent the TEC from reaching maximum efficiency. To raise the current limit, and the efficiency, gridded electrode structures, along with dielectric supports, may be placed in the gap between the plates. Using the particle-in-cell code Warp we show simulations of TECs including self-consistent dynamics of the electrons in the gap and accounting for loss mechanism such as thermal and radiative heat transfer and dielectric charging. These simulations are used in conjunction with a nonlinear optimizer to optimize the TEC design for maximal efficiency of power generation. Finally, we discuss the use of TECs as individual power sources or as a topping cycle for conventional power plants.

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Christopher Hall
RadiaSoft LLC

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