Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Optimized vacuum thermionic energy conversion using diamond materials JOSHUA SMITH, Carnegie Mellon University, GRIFF BILBRO, North Carolina State University, ROBERT NEMANICH, Arizona State University — The vacuum thermionic energy conversion device (TEC) has been an attractive alternative to other means of energy production for some time due to its potentially high efficiency operation, but practical devices have been difficult to develop as a result of the negative space charge effect. It is well known that a hydrogen termination layer on a diamond material induces a negative electron affinity (NEA). In this study we present a theoretical analysis showing it is possible to tune the parameters of a thermionic device featuring a doped diamond material as the emitter electrode to maximize the output power produced. For example, a TEC operating between $950K$ and $300K$ with an emitter negative electron affinity of $0.5eV$, a collector barrier height of $0.6eV$, Richardson's constant of both electrodes equal to $10Acm^{-2}K^{-2}$, emissivity of both electrode of 0.5, and interelectrode spacing of $10\mu m$ will have a maximum output power of $1.5Wcm^{-2}$ and efficiency of 20% occurring at an emitter barrier height of $1.2eV$. The efficiency calculation includes electronic and blackbody heat transport across the device. The analysis establishes approaches to increase the efficiency to values greater than 20%. This work was funded by the Office of Naval Research through the TEC MURI Program.

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Date submitted: 21 Nov 2008 Electronic form version 1.4