Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

The effect of negative electron affinity emitter materials on space charge mitigation of vacuum thermionic energy conversion devices JOSHUA SMITH, North Carolina State University, GRIFF BILBRO, North Carolina State University, ROBERT NEMANICH, North Carolina State University — Vacuum thermionic energy conversion (TEC) devices provide a way to convert heat directly into electrical work. The negative space charge effect has been an effect that significantly degrades the performance of these devices, requiring small inter-electrode spacings for reasonable performance. Recently, Nitrogen doped, Hydrogen terminated, ultra-nanocrystalline diamond films have been investigated as possible candidates for low operating temperature, low work function emitter materials. Furthermore, these materials exhibit a so-called negative electron affinity (NEA) where the vacuum level lies below the conduction band minimum of the material. As a result of this NEA property, the distribution of thermionically emitted electrons will have some nonzero minimum initial velocity. A model was developed to determine the effect that the NEA property of these types of emitters have on mitigation of the space charge effect. The model shows that a TEC with an NEA emitter material will have comparable performance with a non-NEA emitter TEC with a smaller gap. Thus, it is possible to use NEA emitters to relax the requirement of a small gap distance.

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Date submitted: 30 Nov 2005 Electronic form version 1.4