Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Sorting Category: 13.6.3 (E)

High current density diamond based electron emitters for vacuum thermionic energy conversion[1] FRANZ KOECK, Ariaona State University, ROBERT NEMANICH, Arizona State University — Vacuum thermionic energy conversion utilizes thermionic emission to release electrons from an emitter into vacuum and collection at a counter-electrode. In our approach for an efficient thermionic emitter a multi-layer diamond thin film structure was synthesized by plasma-assisted CVD on a metallic substrate with controlled surface roughness including a nanodiamond pretreatment step. Introduction of nitrogen during ultra-nanocrystalline diamond (UNCD) film growth resulted in a low resistivity interstitial layer significantly enhancing emission current density which can be related to the Richardson constant. The top layer of polycrystalline nitrogen doped diamond was exposed to a hydrogen plasma inducing negative electron affinity characteristic presenting a low effective emitter work function < 1.3 eV. Thermionic emission from this material commences at temperatures as low as 260^{o}C and observes the law of Richardson – Dushman. From a data fit a significant Richardsons constant > 2 A/cm^2 K^2 was extracted and at a temperature of 500^{o}C a thermionic emission current > 5 mA was measured. This may well be the highest current density reported from a thermionic emitter operating at the moderate temperature of 500^{o}C.

[1]This research is supported by the TEC-MURI project.

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[X] Prefer Oral Session
[ ] Prefer Poster Session

Date submitted: 20 Nov 2009

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