A CROSSED-FIELD AMPLIFIER USING A DISTRIBUTED FIELD EMISSION CATHODE*

J. Browning, C. Lester, L. Matthews
Boise State University, Boise ID 83725, USA

J. Watrous
NumerEx, Albuquerque, NM 87106, USA

A Crossed Field Amplifier (CFA) has been developed that uses spatially addressable arrays of gated Field Emitter Arrays (FEAs) to provide a distributed electron source. This approach should provide improved device performance including higher gain and efficiency. The linear format CFA operates at 1 GHz and uses a meander line slow wave circuit. The FEAs are placed beneath a sole electrode structure which contains slits. The electrons are injected through these slits into the interaction space of the amplifier. In one case the electrons are simply extracted through the slit by biasing the emitters more negative than the slit electrode. In this approach the electrons will back bombard the sole electrode and be lost or generate secondaries. In a different approach a hop funnel[1] configuration is used to extract the current. Hop funnels use a sloped dielectric wall and secondary electron emission to provide unity current gain at the slit exit. Using this approach the electrons can be injected with energies that are less negative than the sole electrode, so these electrons will not back bombard the sole. The configuration protects the emitters from the interaction space, and the use of a distributed cathode reduces the required current density for the FEAs. Significant issues with charging and breakdown in the structure have limited operation so far, and several design modifications have been made. Experimental results from the amplifier operation will be presented. The combined CFA/smart-MVED concept is being explored through calculations using ICEPIC[2], AFRL's 3D electromagnetic particle-in-cell code. The calculations include multiple independent electron emission sites to enable analysis of the benefits of control of emission on the device gain. The geometrically faithful three-dimensional calculations are also being used to inspire abstraction of two-dimensional field/particle interaction models for more rapid assay and analysis.

1. N.C. van der Vaart, et al., Proc. of SID, 1392 (2002).
2. Peterkin and Luginsland, Comp. Sci. Engin., **4**, #2, p42 (2002).

---

* This research is supported by the Air Force Office of Scientific Research (AFOSR) under the DEPSCOR Grant # FA9550-08-1-0396 and by the Electrical and Computer Engineering Department at Boise State University.