SEMINAR:

PLASMA PHYSICS

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

UNIVERSITY OF CALIFORNIA, SAN DIEGO

"Electric Field Screening of Carbon Fiber Cathodes"

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ABSTRACT

Electron field emission remains a topic of considerable interest even after more than one hundred years of research beginning with the work of Fowler and Nordheim.[1] Current research efforts range from studies of field emission in graphene[2] to field emission using femtosecond lasers.[3] In this talk, we begin with a review of basic emission physics, and then study a key parameter in the field emission process, the field enhancement factor β. Using a carefully controlled array of one, two, and four carbon fiber emitters, we study the field screening in this simple geometry, beginning with DC emission and extending up to femtosecond laser pulses. While it is well known that packing density of the field emitter arrays significantly affect the emission current, previous experiments were conducted with thousands of field emitters which makes the analysis of electric field screening difficult. Here we describe experiments in a dual-cathode and four-cathode configuration. The experiments used different numbers of carbon fiber field emitters (two and four) with variable spacing to investigate the effect of electric field screening on current emission. We compare the emission characteristics for the case of two and four field emitters with different spacings, utilizing an analytic model and particle-in-cell simulations to compare with the experiments. We then proceed to describe future experiments in which pulsed emission can be studied from DC to the femtosecond regime.

[1] Fowler, R.H.; Dr. L. Nordheim (1928-05-01). "Electron Emission in Intense Electric Fields", *Proceedings of the Royal Society A* **119** (781): 173–181.

[2] S. Sun, L. K. Ang, D. Shiffler, J. W. Luginsland, Appl. Phys. Lett. 99, 013112 (2011).

[3] L. Wu and L. K. Ang, Nonequilibrium model of ultrafast laser-induced electron photofield emission from a dc-biased metallic surface.

BIO

Dr. Don Shiffler is the Research Advisor for the High Power Microwave Division, Air Force Research Laboratory, Kirtland AFB, NM. He provides scientific and technical guidance to the division on research areas involving High Power Microwaves (HPM), pulsed power, and particle beam research, which includes a staff of over 40 scientists and engineers. Additionally, he still pursues research in the areas of field emission cathodes, metamaterials, and microwave sources. Dr. Shiffler received his BS in Physics from North Carolina State University in 1986 and received an MS and PhD from Cornell University in Applied Physics where he performed research in plasma physics. He continued with post-doctoral work at Duke University, conducting research on linac driven infrared free electron lasers as well as storage ring based FELs. In 1992, he served as an assistant professor on the faculty in Electrical and Computer Engineering at the University of New Mexico. Dr. Shiffler then moved to the High Power Microwave Division, Directed Energy Directorate, Air Force Research Laboratory, in Albuquerque, NM, working extensively on electron emission physics.