THEORY AND MODELING OF ELECTRON EMISSION FROM CESIATED SEMICONDUCTOR SURFACES

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Abstract

Laser switched photocathodes are now the electron source of choice for short wavelength Free Electron Lasers. The photocathode requirements are profound: ideally, capabilities such as high peak and average current, high quantum efficiency (QE) in the visible, long lifetime in an rf injector and the ability to be repaired in situ are desired. We are pursuing cathodes with self-rejuvenating surfaces based on cesium dispenser cathode technology*,**, in which the physics of recesiation, evaporation, diffusion, and evolution of the surface coating and the QE are the metrics of performance. Here, we present predictive theoretical models of surface evolution and QE in a manner appropriate for inclusion in beam simulation codes, wherein emission nonuniformity and dark current affect emittance, beam halo, and dynamic evolution of bunched electron beams***. The emission models focus on bulk transport issues (including scattering processes) and surface conditions (including diffusion in the presence of random, non-uniform submonolayer coverage), and relate these factors to recent experimental characterizations of the surface evolution.

* K.L. Jensen, *et al.*, JAP102, 074902; N.A. Moody, *et al.*, APL90, 114108.

** E. Montgomery, *et al.*, this conference.

*** J. Petillo, *et al.*, Proc IEEE PAC (2007); K.L. Jensen, *et al.*, PRST-AB 11, 081001.

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