DPP07-2007-001684

Abstract for an Invited Paper
for the DPP07 Meeting of
the American Physical Society

High Intensity e-beam Diode Development for Flash X-ray Radiography[1]

BRYAN OLIVER, Sandia National Laboratories

A variety of electron beam diodes are being used and developed for the purpose of creating high-brightness, flash x-ray radiography sources. In these diodes, high energy (multi MeV), high current (multi kA), small spot (multi mm) electron beams are generated and stopped in high atomic number anode-targets (typically Ta or W). Beam stopping in the target creates copious amounts of bremsstrahlung radiation. In addition, beam heating of the target liberates material, either in the form of low density ($\sim 10^{12}$-10^{14} cm^{-3}) ion emission or higher density ($> 10^{15}$ cm^{-3}) plasma. In all cases, beam/target collective effects dominate the diode and beam characteristics, affecting the radiation properties (dose and spot-size). Recent experiments at Sandia National Laboratories have demonstrated diodes capable of producing > 350 rad@m with 1.7mm FWHM x-ray source distributions. A review of our present theoretical understanding of the diode (s) operation and our experimental and simulation methods to investigate them will be presented. Emphasis will be given to e- beam sources used on state-of-the-art Inductive Voltage Adder (IVA) pulsed-power accelerators. In particular, the physics of magnetically pinched diodes (e.g. the rod-pinch [1,2]), gas-cell focusing diodes [3] and the magnetically immersed [4] diode will be discussed. Various proposed methods to optimize the x-ray intensity and the direction of future diode research will be discussed.

[1] G. Cooperstein, et al., Phys. Plasmas **8**, 4618 (2001).
[2] B.V. Oliver et al., Phys. Plasmas **11**, 3976 (2004)
[3] B.V. Oliver, et al., IEEE Trans. on Plasma Science **33**, 704 (2005).
[4] M.G. Mazarakis, et al., Appl. Phys. Lett. **70**, 832 (1997)

[1]In collaboration with the Atomic Weapons Establishment, U.K., the Naval Research Lab, Los Alamos National Laboratories and NSTec.