Plasmas within the diode region of a pulsed power driven flash X-ray machine at voltages up to 14MV.

J. Threadgold (Jim.Threadgold@awe.co.uk), D. Short, A Jones, A Critchley, G Cooper J. McLean
Diode Research Group, AWE Aldermaston, Berkshire, RG7 4RP, UK.

K Hahn, S Portillo,M Johnson, J Maenchen
Sandia National Laboratories, Albuquerque, New Mexico, US

D Welch, D Rose
ATK Mission Research, Albuquerque, New Mexico, US

E Schamiliglu
University of New Mexico, Albuquerque, New Mexico, US

D Hinshelwood, D Ponce, B Weber
Naval Research Laboratory, Washington, US

The Atomic Weapons Establishment (AWE) UK has a number of pulsed power driven flash X-ray machines that are used to take transmission radiographs of hydrodynamic experiments at voltages up to 10MV. A project is taking place to develop a new facility with higher voltage (14MV) flash X-ray machines. High class (1000 Rad at 1m) small diameter sources (2mm) are required for this project. A number of candidate diodes both high impedance (several hundred Ohm) and low impedance (<50 Ohm) are being researched as possible radiographic sources.

Electrode plasmas are an unavoidable feature in radiographic diodes as they are required to supply the high current densities found in such diodes. In addition paraxial diodes require plasma within a confined gas cell region to produce electrical and magnetic neutralisation and allow ballistic focussing of an electron beam. On the other hand plasma expansion within radiographic diodes, particularly the self magnetic pinch diode can produce rapid impedance collapse and loss of dose. Plasmas in diodes and in the power feed region can also facilitate parasitic current flow that diverts power from the diode.

The diode research group at AWE together with Sandia National Laboratories, the Naval Research Laboratory and ATK Mission Research in the USA are investigating characteristics of diode and gas cell plasmas such as density, temperature, expansion velocities and creation mechanisms. Presented are initial experimental data from experiments carried out on the RITS3 accelerator in the US together with theory and electromagnetic particle in cell (PIC) simulations on the ways that plasmas affect the operation of such flash X-ray diodes.