Spectroscopic investigation of species separation in opening switch plasmas

S.L. JACKSON, D.G. PHIPPS, A.S. RICHARDSON, R.J. COMMISSO, D.D. HINSHELWOOD, D.P. MURPHY, J.W. SCHUMER, B.V. WEBER, Plasma Physics Division, Naval Research Laboratory, C.N. BOYER, Engility Corporation, R. DORON, S. BISWAS, Y. MARON, Weizmann Institute of Science — Interactions between magnetic fields and current-carrying plasmas that lead to the separation of plasma species in multi-species plasmas are being studied in a plasma opening switch geometry. Several Marshall guns are used to inject single or multi-species plasmas between coaxial conductors connected to the output of the Naval Research Laboratory’s Hawk pulsed-power generator. Following injection of the plasma, the generator is used at roughly half power to apply an electrical pulse with a peak current of 450 kA, a peak voltage of 400 kV, and a rise time of 1.2 μs. The resulting magnetic field interacts with the plasma through a combination of field penetration and magnetohydrodynamic (MHD) pushing that is not well understood but can lead to the separation of plasma species in multi-species plasmas. An ICCD-coupled spectrometer has been used in combination with magnetic probes, a ribbon-beam interferometer, and particle-in-cell (PIC) modeling to diagnose and understand conditions in the plasma from the time it is injected until the end of the conduction phase of the opening switch.

1This work supported by the Naval Research Laboratory Base Program and the Office of Naval Research

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Date submitted: 24 Jul 2015