VOLTAGE AND ION CURRENT MEASUREMENTS FOR AN ION DIODE DRIVEN BY MERCURY IN POSITIVE POLARITY WITH LAYERED MITL FLOW*

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For pulsed power machines with an inductive voltage adder (IVA) architecture and a magnetically insulated transmission line (MITL), positive polarity operation results in layered MITL flow as emitted electrons are born at different potentials in each of the adder cells.[1] Because of this layered flow, the usual prediction of the voltage using the Mendel formula is not accurate in positive polarity. In an attempt to directly measure the voltage across an ion diode on Mercury in positive polarity[2,3], a number of diagnostics have been fielded, including a vacuum wire voltmeter, stacked radiachromic films, nuclear activation, and a ^{7}Li(p,n) neutron-yield technique. Additionally, the ion current produced by the diode is measured using magnetic probes and the proton current is estimated by the same ^{7}Li(p,n) neutron-yield technique. An ion diode model is developed to predict the diode voltage and ion current based on the measured total current. This model is based on previous pinched beam ion diode work[4,5] and is only applicable when the diode presents an under-matched load impedance compared with the self-limited impedance of the MITL so that the flow current becomes part of the diode current. The self-limited impedance in positive polarity layered flow on Mercury is also investigated. PIC and circuit simulations are used to analyze the problem as well. The experimental results will be discussed and compared with the theoretical predictions.

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