Priliminary experimental investigation of stainless steel electrode surface evolution under pulsed MG magnetic field on the Primary Test Stand

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Thermal formation of plasma and uniform expansion of evaporated surface under pulsed megagauss (MG) magnetic field are simultaneously observed in the same shot of the Primary Test Stand (PTS). Thick stainless steel rod with an initial radius of 1.0 mm as the cathode and an initial radius of 2.5 mm as returning anodes are pulsed by current whose amplitude is 2.78 MA and the rising time is 120 ns. On the current rising edge, a magnetic field with nominal rising rate of $10^{-50}$ MG/µs and nominal maximum of several MG is induced on the cathode surface, which results in the thermal plasma formation. The magnetic field on anode surface is lower than the threshold for thermal plasma formation, so no plasma forms on the anode surface, but the electrode also expands after evaporated. Electrode surface profiles at 0.5 µs since the beginning of current are captured by a four-frame shadowgraphy system. The average expansion velocity for cathode plasma within 0.5µs is estimated to be 4.2~11.8 mm/µs. However, within 18 ns in the trailing pulse, the velocity is estimated to be 19.5 mm/µs, indicating the plasma expansion is accelerated after the current peak. Within the same 0.5µs, the anode expansion velocities on the inner and outer surfaces are 0.8 mm/µs and 3.2 mm/µs.