Deviation from local thermal equilibrium in SF6 post-arc channel exposed to transient recovery voltage

2B08

MACH2 Simulation of an Explosively Formed Fuse Opening Switch

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MACH2 is a general purpose MHD code that previously has been used to simulate a wide variety of pulsed power plasma devices. Recent extensions to the code permit accurate tracking of moving material interfaces. The code has been used to simulate the evolution of an explosively formed fuse[5] consisting of a thin cylindrical aluminum shell that is driven into a Teflon die by an explosion. The resulting rapid increase of the fuse resistance operates as an opening switch to transfer stored magnetic field energy into a load. The simulation included the initiation and propagation of the explosive detonation wave and tracked the extrusion of the fuse into the Teflon die. The transient fuse resistance was determined from the changing inductance and the ohmic heating of the fuse. The code predicted that the fuse resistance increased by approximately three orders of magnitude during a time of approximately 1 microsecond. The increase in resistance was due to the lengthening and thinning of the fuse material and the rise of temperature caused by the ohmic heating. The simulation results will be compared with recent experimental measurements performed at Los Alamos National Laboratory.

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2B09

Deviation from Local Thermal Equilibrium in SF_6 Post-Arc Channel Exposed to Transient Recovery Voltage

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In a circuit interruption process of an SF_6 circuit breaker, there remains a post-arc channel with temperatures below 6000 K between the electrodes. The post-arc channel is exposed to high electric field induced by a transient recovery voltage. The high electric field can elevate the kinetic energy of electron, resulting in higher electron temperature T_e than gas temperature T_g. It causes properties to differ from those under the condition of local thermal equilibrium.

This paper describes the influence of applied electric field on properties of SF_6 post-arc channel. First, electrical conductivity, enthalpy and mass density of electron and heavy particles in an SF_6 plasma were calculated as a functions of T_e and T_g. Secondly, using the data derived above, time variations in T_e and T_g were computed in an SF_6 plasma to which high electric field was applied. The calculated results revealed that applied electric field increased T_e and caused deviation from local thermal equilibrium. Finally, time evolution of electrical conductivity σ of SF_6 plasma exposed to electric field was also calculated. It was found that σ was enhanced by increasing T_e particularly at initial temperature ranges 3000-3500 K and 5500-6500 K.