EFFECT OF NONIDEAL PLASMA MODEL ON THE CALCULATION OF PLASMA PARAMETERS IN AN ELECTROTHERMAL PLASMA SOURCE*

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Electrothermal plasma sources have numerous applications including hypervelocity launchers, fusion reactor pellet injection, and space propulsion systems. The time evolution of important plasma parameters at the source exit is important in determining the suitability of the source for different applications.

In this study a capillary discharge code has been modified to incorporate plasma nonideality by using an exact analytical model for the Coulomb logarithm in the plasma electrical conductivity formula[1,2]. Actual discharge currents from eletrothermal plasma experiments were used and code results for both ideal and nonideal plasma models were compared to experimental data, specifically the ablated mass from the capillary and the electrical conductivity as measured by the discharge current and the voltage[2,3]. The set of experimental data were for the use of Lexan polycarbonate as the capillary material. The experimentally measured ablated mass follows the same trend of the code predicted ablated mass calculated from the nonideal model. Slight differences in magnitude are attributed to the assumption that the ablated material was fully dissociated. The experimentally obtained electrical conductivity also follows the trend of the code prediction for the nonideal model. However both the ideal and nonideal models predicted the conductivity well at low energy input to the source. As the input energy increases the behavior of the conductivity becomes more nonideal, which is expected given that electron number density increases at higher energies while the plasma electron temperature is almost unchanged.

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