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D. N. LAZUCHENKOV

DETERMINATION OF THE ELECTRON TEMPERATURE IN A SUPERSONIC JET OF A GAS-DISCHARGE SOURCE FROM CURRENT MEASUREMENTS BY AN INSULATED PROBE SYSTEM

Institute of Technical Mechanics
of National Academy of Sciences of Ukraine and State Space Agency of Ukraine,
15 Leshko-Popel St., Dnipro 49600, Ukraine; e-mail: lazuch.dn@gmail.com

The aim of this work is to substantiate the possibility of using the classical procedure for determining the electron temperature for diagnosing a supersonic jet of a collisionless plasma of a diatomic gas using the current-voltage characteristic of an insulated probe system. The probe system consists of a cylindrical probe and a reference electrode composed of several cylinders, all placed transversely in the plasma flow. The ratio of the current-collecting surface area of the reference electrode to the area of the probe is arbitrary and can be significantly less than required by the theory of a single probe.

Based on a previously constructed mathematical model of current collection, which includes the calculation of the equilibrium potential of the reference electrode as a function of the probe bias voltage, a procedure is developed for determining the electron temperature by measuring the probe currents in a jet of a gas-discharge source of a laboratory dissociated plasma. An approximation of the floating potential of the insulated probe system in a strongly nonequilibrium plasma of a gas-discharge source jet is found, which allows one to determine the boundaries of the transition region of the current-voltage characteristic using a priori information on the plasma parameters. A formula is obtained for extrapolating the ion probe current vs. bias potential relationship into the transition region of the current-voltage characteristic.

Within the framework of the adopted mathematical model of charged plasma particle collection, a numerical analysis of the method error of the electron temperature determination procedure is performed. Quantitative characteristics of the effect of the insulated probe system geometry on the method error are obtained. A numerical simulation of the effect of the probe current measurement errors showed that, within the framework of the adopted model, the accuracy of determining the electron temperature using the insulated probe system is comparable with the accuracy of measurements with a single cylindrical probe.

The results obtained may be used in the diagnostics of a laboratory plasma of a gas-discharge source.

Keywords: *collisionless plasma jet, strong nonequilibrium, two-species ions, insulated probe system, electron temperature determination procedure, method error estimates.*

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