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Analyses of Different Techniques for the Plasma Probe Diagnostics VALERY GODYAK, University of Michigan, BENJAMIN ALEXANDROVICH, Plasma Sensors — The subject of this publication is comparison of the plasma parameters inferred from classical Langmuir probe procedure, from different theories of the ion current to the probe, and from measured EEDF using double differentiation of the probe characteristic We concluded that the plasma parameters inferred by the classical Langmuir procedure are subjected to significant inaccuracy due to non-Maxwellian EEDF, uncertainty of locating the plasma potential and arbitrariness in approximation of the ion current. The plasma density inferred from the ion part of the probe characteristic was found to diverge by as much as an order of magnitude from the density calculated as the EEDF integral, while the electron temperature is derived with significant uncertainty. Such inaccuracy is attributed to deficiencies in the ion current theories, i.e. unrealistic assumptions about Maxwellian-shaped EEDFs, underestimation of the ion collisions and the ion ambipolar drift, and some others. We concluded that for highly non-equilibrium gas discharge plasmas at low gas pressure the probe measurements based on EEDF diagnostics is single reliable tool of for the basic research and industrial applications. Examples of EEDF measurements reiterate significance of the instrument technical characteristics, such as high energy resolution and wide dynamic range and importance of displaying the probe current derivatives in real time.

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