CHALLENGES AND SOLUTIONS FOR EEDF EXTRACTION FROM CYLINDRICAL LANGMUIR PROBES

Ahmed El Saghir and Steven Shannon
North Carolina State University, Campus Box 7909
Raleigh, NC 27695 USA

One of the most valuable plasma characteristics that can be obtained from a Langmuir probe is the Electron Energy Distribution Function (EEDF). Due to the integral relationship between the probe VI characteristic and the EEDF, it is also one of the most challenging aspects of Langmuir probe analysis.

In this paper, a methodology for obtaining EEDF's from digitized Langmuir probe data is presented. This methodology uses a hybrid TSVD / modified Tikhonov filter technique to minimize both noise amplification and distribution distortion brought about by integral reconstruction. Previous results using standard regularization methods are compared to this hybrid approach to demonstrate the benefits and limitations of this reconstruction technique, as well as other more typical techniques such as data smoothing and filtering.

The integral problem for both planar and cylindrical geometries are presented to highlight differences in the EEDF relationship to VI characteristics due to probe geometry, and the impact on EEDF and electron temperature extraction for both Maxwellian and non-Maxwellian distributions. Modified integral relationships for velocity distributions (EVPF) and probability functions (EEPF) are also presented, and the impact of these seemingly semantic differences with respect to the ill-posed nature of the integral problem are shown.

This paper will highlight both computational and experimental efforts to improve EEDF analysis using advanced reconstruction techniques, and will demonstrate the extended energy range over which EEDF's can be accurately obtained when these techniques are employed.

---

* Work supported by the North Carolina General Assembly and by a gift from Applied Materials Inc.