Recent developments in probe diagnostics

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Plasma probes are well established diagnostic tools. The easiest and fastest accessible parameter is their floating potential. While the floating potential of a cold probe is not very significant, we report on probes with the floating potential close to or ideally equal to the plasma potential. Such probes can either be electron emissive probes or so-called electron screening probes (e.g. ball-pen probes). We have developed strong emissive probes and a new type of electron screening probe, the bunker probe. By arrays of such probes also the electric field can be determined.

1. Introduction

Plasma probes are simple and inexpensive with good spatial and temporal resolution. The easiest measureable parameter of a probe is its floating potential V_{fl}, which in case of a Cold Langmuir Probe (CLP) is of limited value since V_{fl} will regularly be more negative than the more important plasma potential Φ_{pl}.

We developed Plasma Potential Probes (PPP) the floating potential of which is close or even equal to Φ_{pl}. The best known are Electron Emissive Probes (EEP). Other types are the Ball-Pen Probe (BPP) [1] and the novel BUnker Probe (BUP) [2].

2. Plasma Potential Probes (PPP)

To shift the floating potential of a probe as close as possible to Φ_{pl}, (i) the inflowing plasma electron current must be compensated by an approx. equal emission current or (ii) the surplus of electron current must be screened off the probe until its magnitude roughly equals that of the ions. This is tantamount to making the probe's current-voltage characteristic (*IV*-trace) symmetric. Method (i) is realised in EEPs by heating the probe until sufficient electron emission; (ii) can only be attained in a strong magnetic field as in case of the BPP or the BUP.

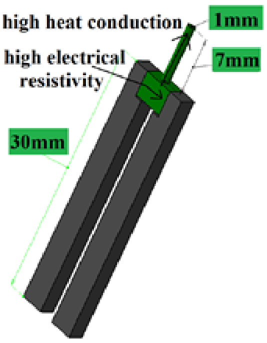

Fig. 1: Electron Emissive Probe

2.1. Electron Emissive Probes (EEP)

Our novel strong and robust EEP [3] takes favourable use of the basic properties of Highly Orientated Pyrolytic Graphite (HOPG). An indirectly heated HOPG pin is shown in Fig. 1. HOPG has strongly different values of electric resistivity and heat conduction in directions perpendicular to each other as indicated in Fig. 1.

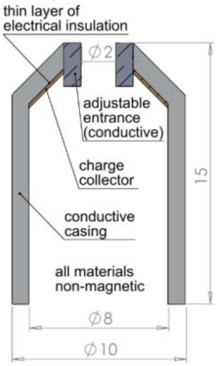

Fig. 2: Bunker probe

2.2. Electron Screening Probes (ESP)

For a BPP to work properly it must be quite exactly aligned perpendicular to the magnetic field ***B***. In contrast to that, our novel BUP (Fig. 2) floats on the plasma potential also for a much larger range of angles with respect to ***B***.

3. Acknowledgement

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4. References

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