DESIGN OF A PLANAR PROBE DIAGNOSTIC SYSTEM FOR PLASMATRON VISION I AND ITS APPLICATION FOR THE STUDY OF DEUTERIUM RETENTION IN TUNGSTEN

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Tungsten is considered as a possible first-wall material for ITER and definite choice for DEMO [1]. One of the issues still to be clarified is the retention of hydrogen isotopes (including radioactive tritium) in tungsten and the influence of various factors (such as the presence of helium ash, neutron irradiation, thermal shock etc) on it [2].

The plasmatron VISION I (Versatile Instrument for Study of ION Interaction) is a high flux, low temperature plasma simulator, installed at the Belgian nuclear research center SCK•CEN [3]. Its unique feature is the ability to handle radioactive materials – neutron irradiated samples and tritium plasma – as well as toxic materials. Research is focused on tungsten and tungsten alloys, with possible extension to study of beryllium and CFC. In this device, plasma is generated via hot-filament discharge. The applied voltage between the anode and the target holder, the latter holding specimens of materials to be investigated, provides simulation of plasma influx towards the first wall.

Until now the plasmatron VISION I was equipped with only one plasma diagnostic system – a quadrupole mass-spectrometer coupled with energy analyzer (referred to as “plasma monitor”, Fig.1). It does not allow measurements of neutral gas/plasma composition and ion energy in the direct vicinity of the investigated specimen. To monitor plasma parameters near the specimen, a planar probe system is being developed. The main concept is to use the specimen itself as a probe. Current design uses tungsten disc with diameter 1.13 cm – the typical size of future specimens. It can be biased with respect to the target holder, allowing the recording of volt-ampere characteristics and eventually – to estimate electron temperature, the plasma density, the electron and ion energy distributions of the plasma directly in front of the specimen. Therefore, it is possible to monitor precise parameters of plasma-surface interaction *in-situ*.

Hydrogen isotopes retention study is performed using scanning electron microscopy analysis (for study of surface modification) and thermal desorption spectroscopy. The current experimental campaign is focusing on experiments with deuterium retention. Tritium licensing is in progress.

Details of design of probe system and measured plasma parameters together with the results of deuterium retention studies are presented in the paper.

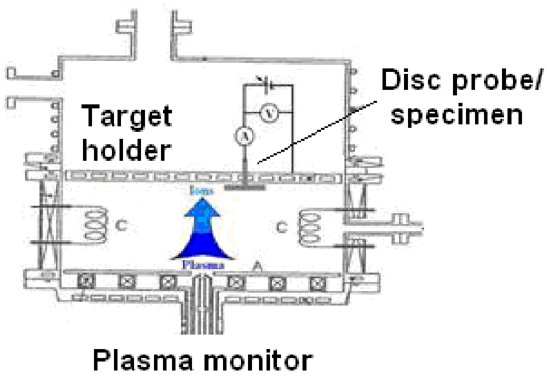

Fig. 1 Diagnostic system of plasmatron VISION I

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[2] R. Causey, Journal of nuclear materials 300 (2002), 91-117
[3] I. Uytdenhouwen et al., Plasma and fusion science 996, AIP proc. 17th RUSFD (2007), 159-165