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TOPIC: A) Edge - SOL turbulence and transport

Probe arrays still offer the only possibility to measure various transport parameters localized, although we have to put up with more or less perturbing the plasma. In tokamaks probe arrays have been successfully used by many authors in the far and medium Scrape-Off Layer (SOL) (see e.g. [1,2,3,4]). Radial particle transport, Reynolds stress and radial transport of poloidal momentum can be determined in this way. Although highly desired, measurements inside to the Last Closed Flux Surface (LCFS) have so far not yet been ventured due to the strong particle bombardment in this region, leading to severe damages of the probe pins as well as of the probe head as such. Usually the probe heads and pins are manufactured from graphite, which is susceptible to sputtering and evaporation. An additional unwelcome effect of the sputtering is that the sputtered-off electrically conductive graphite deposits on the material which isolates the probe pins from the probe head (usually boron nitride), thus leading to short circuits of the probe pins.

We have tested a graphite probe head coated by a layer of electrically isolating UltraNano-Crystalline Diamond (UNCD) by the KOMET RHOBEST Company in Innsbruck, utilizing a Chemical Vapour Deposition (CVD) method. The thickness of the UNCD layer was in the range of 10 to 15 μm. The UNCD coating extended over the front side and up to about 3 cm towards the rear side of the probe head. One probe head carrying 3 graphite pins was mounted on the reciprocating probe manipulator of the Experimental Advanced Superconducting Tokamak (EAST). The floating potential, the poloidal and radial electric field component and the Reynolds stress were determined up to a distance of 15 mm inside the LCFS in high confinement regimes. In a similar discharge, another 5-tip Langmuir-Mach probe coated by diamond can successfully provide measurements for plasma density, temperature, plasma potential, as well as toroidal rotation near the separatrix.

A very important preliminary result was that the UNCD coating prevented the sputtering of graphite from the probe head and the subsequent coating of the BN isolation by a layer of conductive graphite between probe pins and probe head almost completely.

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