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TST-2 におけるプラズマ電流分布計測用の小型ロゴスキープローブ開発

Development of small Rogowski probe for plasma current profile measurement on TST-2

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Current-drive (CD) experiments by wave in the lower-hybrid (LH) range of frequency have been conducted to explore tokamak start-up operation by radio-frequency (RF) wave, and a plasma current up to 15 kA with 60 kW of RF wave power was achieved on the TST-2 spherical tokamak. In the CD experiments, measurement of plasma current density profile has been required to clarify the physical mechanism to determine the current profile and the effect of RF waves on CD.

we are developing a diagnostic system to measure the stationary plasma current density profile just inside the last closed flux surface. The system is composed of two small Rogowski probes, a two-dimensional (toroidal and poloidal) magnetic pick-up coil, and five Langmuir probes. The photograph of the system is shown in Fig. 1. The small Rogowski probes have a diameter of 21 mm. To check the sensitivity of the Rogowski probes to external magnetic sources other than the current flowing through the central hole of the probe, the center hole of one Rogowski probe is closed. Further, Rogowski coils are so weak to noises from undesirable external stray fields that we put Rogowski coils in the copper box which is the second metallic in skin effect.

The probe head was inserted to the edge plasma. We obtained two results. One result is that Rogowski probe raw signals with and without a hole are different. The other result is that Rogowski probe integral data with and without a hole is very similar and these signals are also similar to integral data of pick-up coil for poloidal fields measurement. Since the probe signals are contaminated by the external magnetic fields mainly from whole plasma current, the components should be extracted from the signal to obtain the components due to the plasma current through the hole.

Another work we conducted is comparing two integration methods; numerical integration and integration by an integrator circuit. We found that the latter is more precise than the former, in terms of the drift of integrated signals.

In addition, the integrator circuit has susceptibility to noises from the magnetron and RF source used in RF plasma operation. However, we have succeeded in elimination of these noises by covering the circuit with the electrical shield and by connection of circuit to ground.

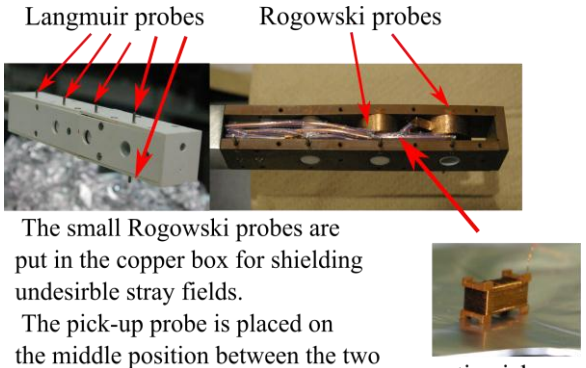

Fig.1 photgraphs of the probes