§8. Study of shielding effect of resonant magnetic perturbation and the interaction with MHD instabilities

Okamoto, M. (Ishikawa National College of Technology), Ohno, N., Hayashi, Y. (Nagoya Univ.), Sakakibara, S.

In several toroidal plasma confinement devices, the effect of resonant magnetic perturbation (RMP) fields in the plasma is researched. In ITER, RMP fields are expected to reduce the heat load to the diverter plates during ELM^{1} . And the stabilization of resistive wall mode (RWM) by using feedback control coils was reported²⁾. Therefore, it is one of important issues to investigate the penetration and propagation processes of RMP fields into the plasma in order to understand interaction between RMP fields and magnetic confinement plasmas. In this study, new probe arrays are made to measure the profile of electron density, temperature and plasma flow in HYBTOK-II tokamak plasma with m/n= 2/1 RMP fields, where m and n are the polodial and toroidal mode numbers. The RMP coils with m/n= 2/1 mode structure were installed to HYBTOK-II tokamak in 2014.

We newly make the triple and Mach probe arrays shown in figure 1 in order to estimate the electron density, temperature and plasma flow profile around the resonant surface. The spatial resolution of triple and Mach probe are 5 mm and 2 mm, respectively. In this experiment, the RMP frequency is set to 1 kHz and coil current is about 130 A/turn. In addition, q profile is also estimated by magnetic probe array which can measure the poloidal component of magnetic field.

Figure 2 shows the typical waveform of floating potential V_f measured by triple probe array with RMP field. It is found that 1 kHz component of V_f is appeared by applying RMP fields. The analysis result of V_f fluctuation during the applying RMP field is shown in Fig. 3. From Fig. 3(a), the resonant surface of q = 2 and 3 exist at $r/a \sim 0.65$ and 0.93, respectively. The standard deviation of V_f around resonant surface of q = 2 with RMP field is larger than without RMP field. Figure 3 (c) shows the 1 kHz component profile of V_f is increased at each side of q = 2 resonant surface, it is considered that m/n = 2/1 magnetic island is formed at $r/a = 0.5 \sim 0.8$ by RMP field and the component is appeared by the rotation of the magnetic island.

In this study, we make new probe arrays and the formation of magnetic island is observed by triple probe measurement. In future, relation between the amplitude of RMP field and plasma flow is measured by Mach probe array to clarify the appearance condition of the penetration and shielding of RMP field.



Fig. 1 Picture of triple probe array (a) and Mach probe array (b).



Fig. 2. Temporal evolution of plasma surface safety factor q_a , horizontal position of plasma center, RMP coil current and floating potential V_f around q = 2 resonant surface.



Fig. 3. Profile of safety factor (a), standard deviation (b) and 1 kHz component of floating potential (c).

Schmitz O., et al.: J. Nucl. Mater. 438 (2013) S194..
Okabayashi M., et al.: Nucl. Fusion 45 (2005) 1715.