Suppression of Externally Induced Magnetic Island by Plasma Current Oscillation in HYBTOK-II

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In several tokamak devices, in order to suppress MHD instabilities, especially classical and neoclassical tearing modes (NTM), the plasma current density profile control have been performed by a ramp-up or ramp-down of plasma current and local plasma heating (or current drive). Recently, the plasma current oscillation experiment has been done to suppress self-generated tearing modes in HT-7 tokamak [1]. The conditions under which the tearing modes were suppressed by the plasma current oscillation are as follows: (a) Oscillation amplitude of the plasma current is large enough to move the resonance surface outside the magnetic island, and (b) the oscillation period is faster than the growth time of the tearing modes.

In HYBTOK-II tokamak, the magnetic islands are generated by externally applied rotating helical magnetic perturbation (RHMP) with the poloidal and toroidal mode numbers of m = 6 and n = 1 [2]. An amplification of RHMP in the plasma was observed when the magnetic islands were formed around the resonance surface. In the preliminary experiment, the frequency of the plasma current oscillation and RHMP are set to 5 kHz and 30 kHz, respectively. The half-period of the plasma current oscillation (100 μs) is the same order of the growth time of magnetic islands (~ 70 μs) estimated by linear tearing mode theory, where the electron temperature is 20 eV. On the other hand, the radial excursion length of the resonance surface with the plasma current oscillation (~ 1 cm) is larger than the width of the magnetic island (~ 0.7 cm) estimated by the vacuum field, where the fraction of the oscillating plasma current is about 20 %. Under these conditions, we have confirmed that the amplification of RHMP in the plasma is suppressed by the plasma current oscillation. It follows from this result that the growth of magnetic islands is suppressed by the plasma current oscillation. In the conference, the experimental results in other conditions (e.g., high frequency of plasma current oscillation ~ 10 kHz) will be also discussed.

[1] MAO, J., et al., Nucl. Fusion **41** (2001) 1645.
[2] TAKAMURA, S., et al., Proc. of 19 th IAEA Fusion Energy Conference Lyon, France (2002) EX/P5-09.

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