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Study of H-mode transition triggered by high-intensity gas puffing in NBI plasmas of Heliotron J

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In this study, we report on the H-mode transition triggered by high-intensity gas puffing (HIGP) in NBI plasmas of Heliotron J. Heliotron J is a medium sized (R/a = 1.2/0.17m) helical-axis heliotron device with an L/M=1/4 helical coil, where L is the pole number of the helical coil and M is the pitch number. An H-mode transition has been observed in the high density NBI plasmas. In the H-mode phase, an improvement in the energy confinement time normalized to that of the international stellarator scaling law around 2 has been achieved.
In the case when the H-mode transition occurs, the recovery of the stored energy is found after the stop of HIGP. The recovery phenomenon is similar to that of so-called “reheat mode” observed in CHS. During the applying HIGP, a bursting n =2 mode with f = 5-30 kHz appears until the occurrence of the H-mode transition. The density fluctuation with the burst frequency (f = 0.8-3 kHz), measured by beam emission spectroscopy (BES), propagates in the outward direction, which is synchronized with the H_alpha / D_alpha intensity. These observations indicate the particle exhaust phenomena. The time evolution of the density gradient in the peripheral region (r/a = 0.9) calculated by the BES signals suggests the repetition of the increase/decrease in the density gradient before the transition, indicating so-called “dithering” phenomena. At the timing of the H-mode transition, the density gradient increases along with the disappearance of the particle exhaust. After that, the formation of the steep density gradient is observed in the peripheral region (r/a = 0.8-1). In the case where the amount of HIGP is smaller than that when the H-mode transition occurs, the particle exhaust is not observed, although the reheat mode is found. In this case, the density gradient is smaller than that in the H-mode case.

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