Formation of the internal transport barrier in KSTAR


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One of important goals of tokamak experiments is the exploration of enhanced confinement regimes, and the access of the internal transport barrier (ITB) formation is dealt with an important physics issue in the most of major tokamaks [1-3]. Also, the advanced tokamak scenario with ITB is expected to lead to a continuous reactor with high fusion power density. From this point of view, the formation of the ITB in KSTAR which is designed for long pulse operation capability is very important although its heating and current drive systems are not fully equipped yet. We have therefore assumed that an early injection of the full NBI power (~ 5.5 MW) during the current ramp-up would give a chance to form an internal barrier if the plasma could stay in the L-mode. To avoid the H-mode transition, we have produced inboard limited plasmas with detaching from the both upper and lower divertors. Using this approach, an ITB formation during L-mode has been observed which shows improved core confinement. Time trace parameters indicating the plasma performance such as temperatures, the stored energy and the $\beta_N$ are comparable to the H-mode in the discharge. Ion and electron temperature profiles show the barrier clearly in the temperature, and it was sustained for about 7 s in the dedicated experiment. This is the first stationary ITB observed in the superconducting tokamak. This operation scenario with the ITB could be an alternative way to achieve a high performance regime in KSTAR, and the length of the ITB discharge could be extended even longer. In this work, we present the formation of the ITB using measured and simulated characteristic profiles.

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