24pD10P

JT-60Uにおける電子サイクロトロン共鳴加熱による壁調整用プラズマの生成
Production of wall conditioning plasmas using electron cyclotron resonance heating

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Wall conditioning is necessary to start up a tokamak discharge after a plasma disruption. In a conventional tokamak with normal conducting coils, glow discharge cleaning (GDC) and Tayler discharge cleaning (TDC), which are necessary to demagnetize the coils, have been commonly used as an inter-shot wall conditioning. In superconducting tokamaks such as ITER and JT-60SA, because the toroidal magnetic field is applied at the inter-shot, GDC and TDC are practically difficult to be used. Alternative inter-shot wall conditioning methods have to be developed. In JT-60U, inter-shot wall conditioning plasmas using electron cyclotron heating (ECH) have been studied for a future use in JT-60SA.

The experiments were performed using the 2nd harmonic EC wave with a frequency of 110 GHz. Figure 1 shows the poloidal cross-section of JT-60U. The toroidal magnetic field of B_T = 1.86 T at R = 3.32 m was applied. The resonance layer was positioned at R = 3.14 m. Helium gas was injected with a rate of Q_{He} = 0.8 Pa·m^3/s. The 2.0 MW EC wave was injected. The horizontal magnetic field was scanned from a current I_H of 0 to 10.8 kA. FIR interferometers measured the plasma density along a vertical chord at R = 2.88 (U1 chord) and R = 3.55 m (U2). A Penning gauge measured deuterium partial pressure.

Figure 2 shows time evolutions of the line-integrated electron density and the D_2 partial pressure. Without the horizontal magnetic field, the electron density along the U1 chord is lower than that along the U2 chord, showing ununiformed plasma (Fig. 2(a)). Application of the horizontal magnetic field results in closer electron density between the U1 and U2 chords (Fig. 2(b)). Further increase in the horizontal magnetic field leads to the identical electron density (Fig. 2(c)). These results indicate that the plasma originates from the resonance layer at R = 3.14 m expands towards the high field side. Deuterium ejection from the plasma-facing wall was monitored by the D_2 partial pressure. The D_2 partial pressure does not increase at I_H < 3.3 kA. With the strongest horizontal magnetic field (I_H = 10.8 kA), significant increase of the D_2 partial pressure is observed after the plasma breake-down, suggesting that the plasma reached to the plasma-facing wall and deuterium retained in the wall is ejected.

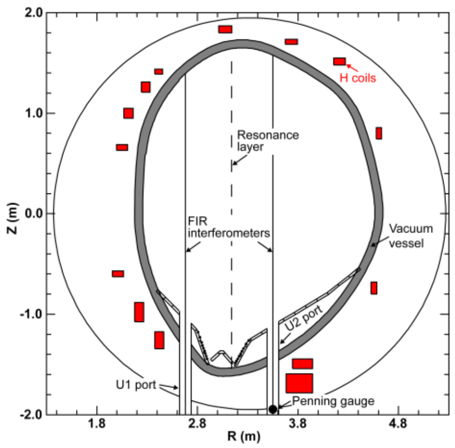

Figure 1. Poloidal cross-section of JT-60U.

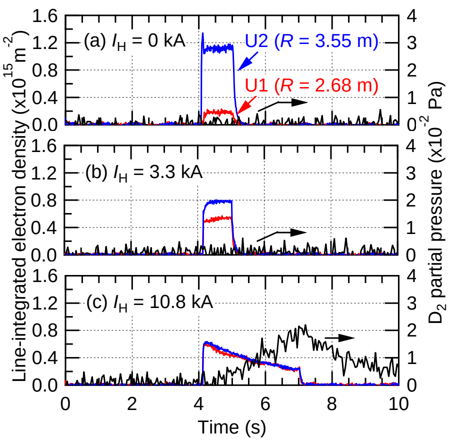

Figure 2. Time evolutions of the line-integrated electron density and the D_2 partial pressure.