Radial Structure of Edge Transport Barrier Formed in Helical Divertor Configuration of the Large Helical Device

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In the Large Helical Device (LHD) where helical divertor with wide ergodic layer is formed, edge transport barrier (ETB) is produced by the L-H transition in relatively high beta plasmas (diamagnetic beta value $<\beta_{dia}>$ > 1%). In the majority of these H-mode plasmas, electron density profile has a clear ETB structure without showing a clear pedestal in electron temperature profile. Electron density profile just before the transition has a hollow shape, and evolves to a profile with strong hollowness due to strong rise in electron density near the edge after the transition. The width of ETB has been evaluated from the change of the electron density profile, of which width would correspond to the pedestal width. This width averaged over the magnetic surface is fairly large (~10 cm to ~20 cm for the averaged plasma minor radius of ~60cm), and does not show an inverse dependence on B_t (B_t: toroidal field strength). Neutral penetration and MHD stability of ETB are thought to be dominant mechanisms to determine the ETB width. The width increases having a dependence on $(\beta_{ETB})^{1/2}$ (β_{ETB}: beta value at the ETB top). This suggests that MHD stability of ETB zone would play an important role in determining the width. On the other hand, the width normalized by $(\beta_{ETB})^{1/2}$ does not show a clear dependence on the electron density at the ETB top. This suggests that neural penetration would not play an essential role in determining the ETB width in LHD.

Effects of applied large magnetic perturbations with m/n=1/1 Fourier component, which can produce a sizable m/n=1/1 magnetic island near the edge, on ETB structure were also investigated to clarify an important control mechanism of the ETB width in helical divertor configuration.