# Microscopic modification of wall surface by helium bombardment and mixed-material deposition layer during a long pulse discharge in LHD ~its impact on steady state plasma operation~

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Ultra-long-pulse helium discharge with ion and electron cyclotron heating (ICH+ECH) in the Large Helical Device (LHD) was achieved in a 48 min plasma ($n_e$ ~$1.2 \times 10^{19}$ $m^{-3}$, $T_{i,e}$ ~2 keV) with an average heating power of 1.2 MW. The temperature of the first-wall surface during discharges remained at nearly room temperature. However, even in ultra-long-pulse helium discharge, the discharge conditions cannot be said to be in a steady-state, because of two major issues interrupting the steady-state condition. One is the "dynamic change of the wall pumping rate" and the other is the "termination of the discharge with the exfoliation of the mixed-material deposition layers."

Material probe experiment was carried out by exposing the stainless steel specimens on the first wall equivalent position through the retractable material probe system for analyzing the plasma wall interaction (PWI) during the long pulse discharges. It was clarified that helium radiation damage and the formation of the mixed-material deposition layers composed of C (~98%) and Fe (~2%), on the plasma facing components (PFMs) simultaneously occurred during the discharges. These surface modifications likely influence the two major issues.

## References

[1] H. Kasahara *et al*., 2014 IAEA *FEC*