§41. Overall Evaluation for Plasma Facing Material and Divertor of LHD

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In order to achieve an excellent plasma confinement and to enhance the reliability of plasma facing components, the developments of divertor walls are necessary in addition to the suppressions of the erosion and the hydrogen recycling. In particular, the handling of both heat and particle fluxes is an important issue.

The research group consisting of seventy researchers of universities, JAERI and industries was organized to contribute to the design of the LHD plasma facing walls. In this group, the following subjects were discussed through six meetings in the fiscal year of 1994.

(1) LHD divertor configuration,
(2) LHD plasma facing materials such as graphite, CFC and B_4C,
(3) Conditioning methods such as baking and helium discharge cleanings,
(4) Plasma surface interactions such as erosion and hydrogen retention.

Based upon the existing data, and the new experimental and theoretical data taken for above purposes, we obtained numerous important results.

In this note, only the results concerning the divertor, brazing material and conditioning are described below.

(1)As the LHD divertor, the localized pump limiter called Local Island Divertor, LID, has a simple structure and a sufficiently high particle pumping efficiency (30 %). The high heat flux acting on the divertor wing heads may be able to be reduced by expanding the island width with using additional coils. Thus, it is adequate to employ the LID in the initial operation of LHD.
(2) Both the LID and the helical divertor require the brazing material with active coolings. It now is quite possible to fabricate the components which can survive to the heat load of LHD (10 MW/m^2).
(3) Since the oxygen impurity has to be well suppressed in LHD plasma, the boronization or the boron carbide has to be applied. For the suppression of the recycling, the hydrogen amount of the boron material has to be reduced.
New experimental data showed that the hydrogen can be easily removed by the baking with a temperature of 300 °C and/or by the helium discharge cleanings.

Theses results have largely contributed to the design of the LHD walls and to the construction of the LHD discharge scenario.

References

1)Hino, T. and Ulrickson, M., Proceedings of J-US Workshop P243 on High Heat Flux Components and Plasma Surface Interactions for Next Fusion Devices, Jan. 31-Feb.3, 1995, Hokkaido Univ.