§50. Surface Analysis of Wall Samples Exposed to LHD Plasmas

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The conditioning of wall is quite important for steady state operation. The deposit elements on the LHD first wall were analyzed by using surface probe samples. After finishing the plasma experimental campaigns and opening the vessel to the air, surface samples have been under analyses using RBS, ERD, AES, TEM, SEM and EDS. The results of the first campaign and second campaign are presented.

The LHD plasma vacuum vessel is made of 316 stainless steel, which total volume and inner surface of the vessel are 210 m^3 and 870 m^2, respectively [1]. Each set of probes is made of stainless steel and carbon samples. Four sets were put on the nearest position from helical coil. Two sets were set on torus parts. One set was put on the farthest position on an outer port flange of the cryostat vessel. Total 7 are put on the almost same poloidal cross section. Another types of two carbon samples were set on the striking point of divertor leg (in the first campaign).

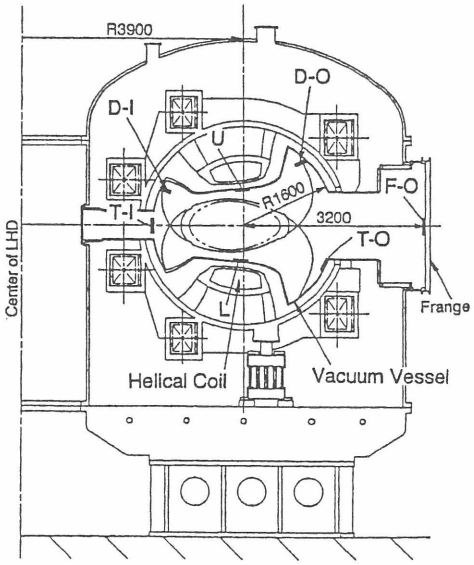

Fig.1 The probe position on the LHD plasma vacuum vessel.

The wall conditioning without baking at high temperatures is quite desirable to minimize the heat load on cryogenics. Then, ECR-DC, 368 K baking and Ti gettering were performed in the first campaign, and G-DC was added from the second campaign [2].

The four sets near helical coil (inner, outer, upper and lower) show almost same amount of deposit elements. O, Fe and Mo are found on the graphite samples by RBS, and the amounts and compositions are 7.4 x 10^{16} at/cm^2 (27.4 at%), 2.2 x 10^{17} at/cm^2 (72.3 at%) and 7.7 x 10^{14} at/cm^2 (0.3 at%), respectively (in the case after second campaign). On the outer port flange, which is the farthest from plasma, the sample shows about one order low of deposit element. EDS results also shows the same tendency on the poloidal distribution of deposit element. Deposition mechanism will be discussed. C is the base material and Mo is assumed to come from the trace element of 1.2 at% contained in 316 stainless steel of the vessel as well as Fe. The graphite sample which was located 1.25 helical pitch away from the nearest Ti-head and was exposed to the outer divertor plasma. There is not detected any Ti element by RBS, AES and EDS, suggesting that these detected metals are locally sputtered and redeposited one [3].

References:
[1] N. Inoue et al., Fusion Engineering and Design 41 (1998) 331-336.
[2] A. Sagara et al., J. Plasma and Fusion Research 75 3(1999) 263-267.
[3] A. Sagara et al., J. Nuclear Materials 196-198 (1992) 271.

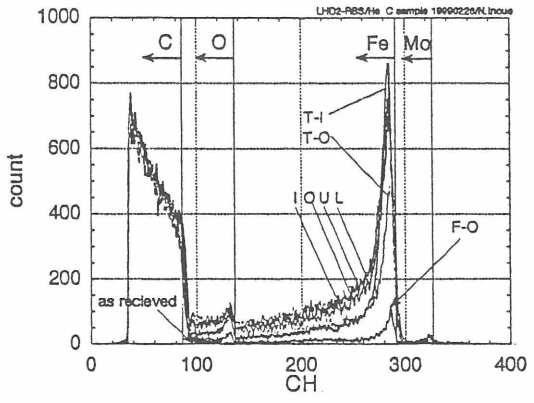

Fig.2 The change of counts with channel (CH) by RBS on the eath position of probes.