§20. Observations of Temperature Profiles on Modified Divertor Plates in LHD

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Long pulse discharges sustained by ICRF and ECH were often terminated with emission of large amounts of dusts released from closed divertor regions in the previous (17th) experimental campaign in FY2013.[1)] The position of the main dust source was identified by the observations with fast framing cameras and CCD cameras for monitoring LHD plasmas, which locates on the surface of a dome structure in the closed divertor region near a lower/upper ports in the inboard side of the torus. After the experimental campaign, the traces of the exfoliations of carbon-rich mixed material layers were found on the site. This area is enclosed by the dome structure and inclined divertor plates which are installed so as to intersect a divertor leg for concentrating the strike points in the closed divertor region (in the inboard side of the tours) for efficient particle pumping by a cryo-sorption pump installed in the back side of the dome structure. It is possible that carbon, which was sputtered from the divertor plates by highly concentrated heat load, was deposited around the divertor region.

In order to control the deposition of the carbon-rich layers in the closed divertor region, the configuration of a part of divertor plates near the lower/upper ports was modified so as to broaden the plasma wetted area on the plates for alleviating the heat load. In addition to this, the front surface of the divertor plates was rearranged to face to the main plasma for reducing the carbon deposition. Figure 1(a) shows a picture of the top view of the modified divertor plates installed near a lower port. Figure 1(b) is a typical observation of the image of the temperature profile on the modified divertor plates taken with an infrared camera installed in an upper port (4.5-U) for a standard magnetic configuration (the radial position of the magnetic axis R_{ax}=3.60m). It is found that the plasma wetted area was slightly broadened compared to that for the original divertor.

The heat load profile on the modified divertor plates was calculated by a three-dimensional peripheral plasma simulation code (EMC3-EIRENE). The calculation of the heat flux on the divertor plates is shown in Figure 2, which is viewed from the upper side of the divertor configuration. It seems to be consistent with the observed temperature profile. After the experimental campaign, it was found that the deposition of carbon-rich mixed material layers was significantly reduced in the area close to the modified divertor plates compared to that for the original divertor configuration. The original purpose of the modified divertor configuration has been successfully achieved.

1) Shoji, M. et al.: Plasma Fusion Res. (to be published).

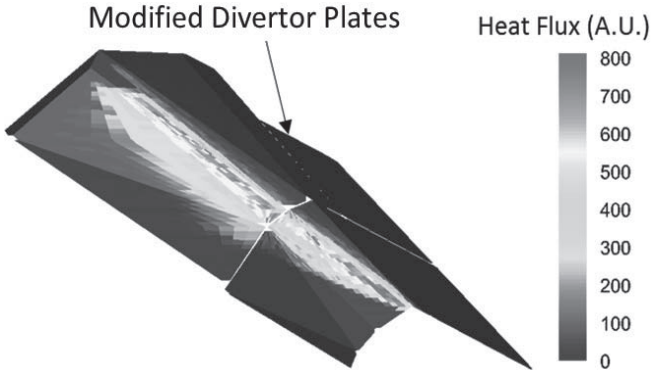

Fig. 2. The top view of the calculated heat flux profile on the front surface of the modified divertor plates by the EMC3-EIRENE code.

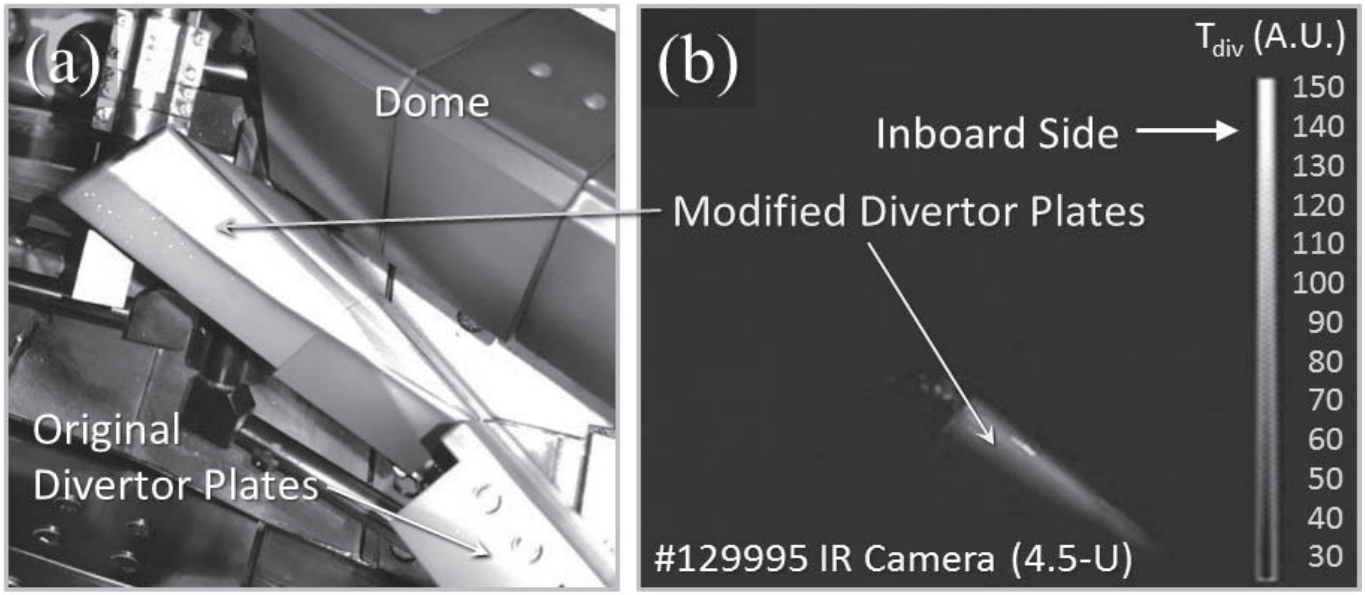

Fig. 1. A picture of the top view of the modified divertor plates installed near a lower port (a), and a typical observation of the infrared image (temperature profile) on the surface of the modified divertor plates taken with an infrared camera installed in an upper port (4.5-U).