§17. Experimental Study on Heat Flux of Divertor Plasma (Measurement of Sheath Heat Flux on the Surface of Gamma 10 Divertor Plates)

Matsuura, H. (Osaka Pref. Univ.), Nakashima, Y.,
Sakamoto, M., Hosoi, K., Takeda, H.,
Ichimura, K., Ueda, H. (Tsukuba Univ.),
Nagaoka, K., Shoji, M.

In the GAMMA 10 tandem mirror, high heat-flux generation experiments (E-divertor) with high-power plasma heating systems have been started. In 2011FY experiment, plasma heat flux was estimated with calorimetric method based on Lumped-Heat-Capacity system approximation. Total heat load from plasma is estimated as the product of heat content of the calorimeter target (see Fig. 1) and temperature jump at plasma discharge. But this method can not give us information on time evolution of heat flux. Moreover, sampling speed of the recorder for TC data of the calorimeter was too slow to catch the transient heat pulse propagation in the target, and temperature peak value might be underestimated, since the thermal diffusion time of the target is the order of 1[s] for thermal diffusivity of probe tip material (Cu).

For 2012FY experiment, a new calorimeter target was designed and constructed. Figure 2 shows the schematic difference of two calorimeter head. While TC of the old sensor was connected to backside of the target, TC connection point of this new sensor is moved through the left tube shown in the figure to $x = 2$ mm position apart from the irradiation surface and thermal diffusion time is expected to be smaller than an old one by a factor of 25.

Figure 3 shows comparison of raw signal of these calorimeters. Data recorder used here is GL900 (GRAPHTEC Corporation), whose sampling interval is 1[ms]. The TC signal of an old calorimeter sensor is found to needs 30[s] or more to reach the maximum value of the sensor temperature. The maximum of the new sensor shown in Fig. 2 appears at $t < 1$[s]. Both signal have large noise at the beginning of sampling.

When TC signal during and just after plasma discharge is observed in detail, this noise can be categorize into two types[1]. One is a large positive spike which appears during plasma discharge and disappear in no plasma production shot. So its origin is thought to be RF power device. Another noise is negative pulses seen around $t \sim 700$[ms] and observed even in only magnetic coil operation without plasma production. At this timing, the coil current for confinement magnetic field is reduced to zero. If the TC signal for no plasma discharge is subtracted from those for normal discharge, this noise is compensated fairly.

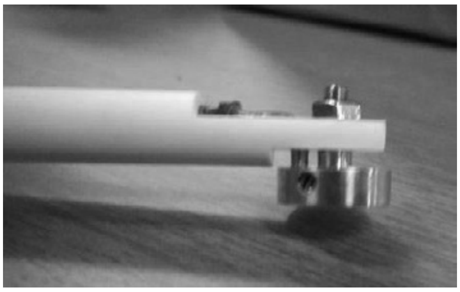

Fig. 1: Constructed calorimeter head.

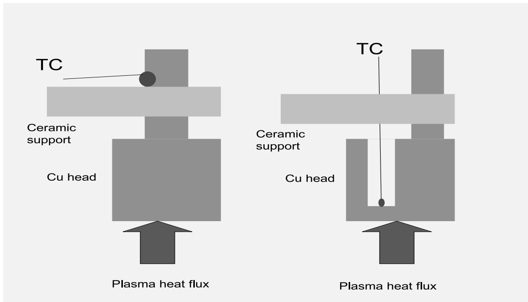

Fig. 2: Schematic drawing of the old calorimeter head (left figure) and the new one (right).

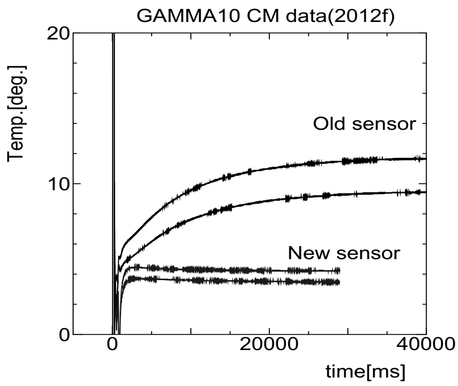

Fig. 3: Comparison of raw signal of calorimeters. The TC signal of an old calorimeter sensor needs 30[s] to reach the maximum value. The maximum of the new sensor shown in Fig. 2 appears at $t < 1$[s].

1) H.Matsuura et al.: OS2012/PMIF2012, (Tsukuba, 2011 Aug.) O-19.