§14. Measurements of Reflectivity and Absorptivity for mm-Wave Absorber

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In order to attain local deposition of Electron Cyclotron Heating(ECH) power, the well-focused beam is used for ECH experiments in Compact Helical System. Since the one-path absorption rate for target plasmas heated by neutral beam and ion cyclotron range of frequency is not sufficiently large, the remain of one-path absorption is absorbed even at the other resonance region excluding the focal point, due to multiple wall-reflection. To observe clearly the effect of the local ECH, the absorptive materials for mm-wave with low wall-reflection should be set up at the opposite port to injection one. The reflectivity and absorptivity measurements for the material such as SiC are described here.

In cold test, the well-defined Gaussian beam with the waist size ($\sim$ 36mm) is injected to Al reference plate and SiC sample plate at the polarizations both in parallel and perpendicular to the incident plane. Here, the frequency of the injected mm-wave is 53.2GHz. The reflectivity is defined as the ratio of the measured intensity after the reflection at the SiC plate to that at the Al plate. Figure 1 shows the reflectivity obtained from the measurements, and calculated from the boundary conditions that should be satisfied at the dielectric plane interface. In the calculation, the real and imaginary parts of the refractive index are taken as 5.0 and -2.0, respectively. Although the identification of the refractive index for the sample plate is left as the future work, the obtained reflectivity is consistent with the calculated one. Since the signal transmitted through the SiC plate can not be detected at the significant level, the absorptivity is approximated as (1-R) in the cold test, where R is the reflectivity. The hot test with the high power ($\sim$ 400kW) mm-wave from the gyrotron is carried out. In this test, the measured temperature increase due to the absorption may be a measure of the absorptivity. However, since the incident power density depends on the injection angle, the temperature increase integrated over the whole plate should be measured. The power from the gyrotron is radiated at the 0.1% duty during 2 minutes. Although the temperature becomes uniform over the plate more or less during the 2 min. injection, after more 2 minutes, the increase being uniform over the plate is measured with the thermistor that is set at the center. The uniformity is checked by the IR camera measurement. Here, the radiation effect is neglected, and the thermal diffusion to the supports of the plate is also neglected. Figure 2 shows the temperature increase in the hot test, as a measure of the absorptivity, and the absorptivity in the cold test for various injection angles. The dependence of the absorptivity on the injection angle is similar in both the tests. It is indicated that the absorption of mm-wave at the SiC plate is sufficient, and the plate is available to reduction of the multiple reflection, provided that the incident angle and the polarization are properly chosen.

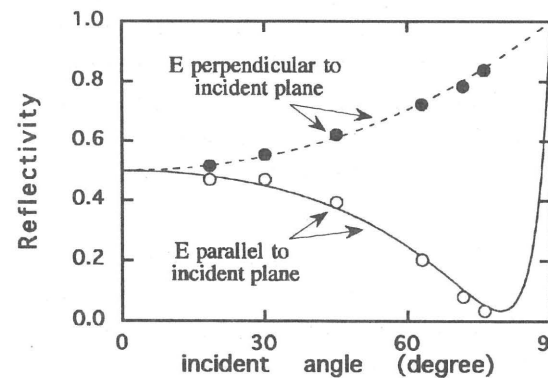

Fig.1 : Reflectivity obtained from measured intensities, and calculated.

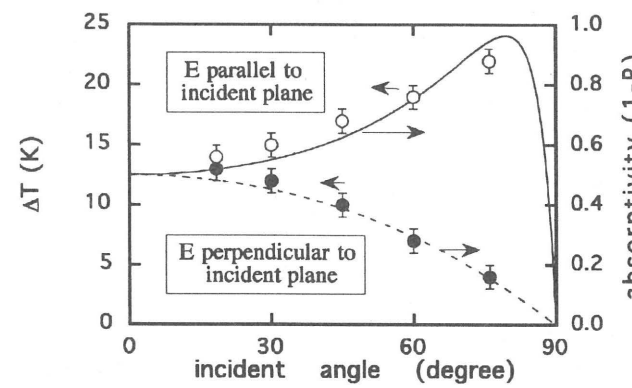

Fig.2 : Temperature increase ΔT in hot test and absorptivity $(1 - R)$ in cold test.