DEPENDENCE OF MILLIMETER WAVE BREAKDOWN STRUCTURE ON BEAM PROFILE*

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The atmospheric millimeter-wave breakdown is an important phenomenon in the application of high power millimeter waves. The breakdown on a high power millimeter wave beam in high pressure gas generates plasma with a filamentary structure. The ionization front of breakdown plasma consists from small plasma spot under atmospheric pressure. They propagate towards the beam source absorbing the millimeter wave energy and their trajectories dominate the macroscopic structure of plasma. Thereby the spatial profile control of the millimeter wave beam is considered as an important method to control the millimeter wave plasma profile for various applications.

The breakdown plasma formed on the high power millimeter-wave beam was observed using a 1MW-class 170GHz gyrotron. To observe the influence of the spatial beam profile to the breakdown plasma shape, breakdown plasma was generated using a hollow profile beam and a flat profile beam instead of the Gaussian beam profile. These non-Gaussian beam profiles were converted from the Gaussian beam using two phase correcting mirrors. Breakdown plasmas on different beam profiles were compared to plasma by the Gaussian beam.

The diameter of the ionization front on the flat beam was found greater than the plasma on the Gaussian beam. In contrast, the plasma by the hollow profile had four separated ionization fronts. These indicate that the plasma shape is influenced by beam profile. The propagation velocity of plasma front was dependent on the peak power density.

The shock wave generated by the millimeter wave plasma was also measured. The stronger shock wave was detected with the flat beam profile. This was because diameter of plasma front was larger than plasma by Gaussian beam and greater RF energy was absorbed by plasma and it could support propagation of the shock wave.

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