

Resonant absorption of near field of wave guide slot antennas in microwave plasma

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A near E-field from wave guide slot antennas parallel to a density gradient would resonantly excite an electron plasma wave at approximately the cutoff density, resulting in highly efficient energy absorption and leading to high density plasma sustainment [1]. The resonantly enhanced E-field of the electron plasma wave would accelerate some electrons [2], which would ionize neutral gas and produce a lot of low temperature electrons. Then the average electron temperature would drop [1].

We examined the above prediction experimentally. The dependence of electron density, temperature and electron energy distribution in a microwave plasma source with slot antennas on input power has been measured with Langmuir probes, which are corrected with a microwave interferometer. The detail of an experimental setup is described elsewhere [3]. The increase rate of the electron density with the input power rapidly changed to higher one when it reached the cutoff density, and electron density became higher. On the other hand, the electron temperature started to decrease and a low energy component of the electron energy distribution complementally increases at the same time. These results strongly suggest that the resonant absorption would occur in a microwave plasma source with slot antennas. It also suggests the plasma source may produce high density radicals due to high energy electrons.

[1] T. Omaru, et. al., *Japanese Journal of Applied Physics* **43**, 2690 (2004)

[2] Y. M. Aliev, et. al., *plasma Sources Sci. Technol.* **1**, 126 (1992)

[3] S. Kogoshi, et. al., *Japanese Journal of Applied Physics* **48**, 08HB01-1 (2009)