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Study on effect of pre-existing plasma on the characteristics of local sheath plasma

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Local sheath plasma, so called fireball, which generates in electron sheath in front of a small positively biased electrode immersed in pre-existing plasma plays a key role to increase plasma ion beam current by two orders of magnitude only with a few watts in input power.[1] Although characteristics of the localized plasma depends on the ambient plasma, correlation between the two contiguous plasmas was not elucidated sufficiently. In this study, characteristics of the local sheath plasma such as breakdown voltage, saturation current and mode-transition have been investigated experimentally in terms of the operating conditions of the pre-existing plasma. The local sheath plasma generates at lower breakdown voltages in lower electron density and higher pressure plasma. On the contrary, higher electron density and lower pressure is preferable to maintain higher current at the biased electrode which implies the higher plasma density in the localized plasma. In operating the local sheath plasma, mode-transition occurs over a certain voltage, which is also affected by the ambient plasma. These experimental results suggest that appropriate control of the pre-existing plasma is needed according to phase of the local sheath plasma.

[1] Y. J. Kim, D H. Park, H. S. Jeong, and Y. S. Hwang, *Rev. Sci. Instrum.* **77**, 03B507 (2006).