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Ion source for shallow implantation

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Regarding semiconductor-device production, ion-implant energy is decreasing since the junction depth becomes shallower along with the shrinkage of device size. The lowest energy level for practical use has been around several 100eV and will become lower than 100eV in a near future [1]. For realizing such low-energy beams, ions are decelerated before implantation. We reported in the past that the exact energy value of such low-energy ion beam was determined not only by the potential difference between the ionization chamber and the target, but by the summation of the potential difference and the plasma potential in the chamber [2]. For the case of low ion energy of several 100 eV the plasma potential is comparable with the potential difference.
Up to now the plasma potential has been given under the assumption that the plasma was in a stationary condition in which both the ion and electron fluxes going out from the plasma were equal in absolute value and balanced at every point of the plasma boundary, i.e., there was no electric current intersecting the boundary. However, only ions go out and electrons are retarded backwards at the ion-exit slit of the practical discharge chamber. Thus, there exists a one-directional electric current intersecting the plasma boundary at the exit slit. In this study we deduce a new formula by taking into account the ion electric current at the slit. Resultantly it is found the plasma potential is changed not only by the electron temperature as usual but also by the chamber structure.

[1] N. Suetsugu, M. Tsukihara, M. Kabasawa, F. Sato and T. Yagita, Proc. of 20th International Conference on Ion Implantation Technology, (2014) 157-160.
[2] N. Sakudo, K. Hayashi, Rev. Sci. Instr. 67 (1996) 1218-1220.

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