Plasma Dynamics and Future of LPP-EUV Source for Semiconductor Manufacturing

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Recently progress of LPP EUV light source is remarkable. Ten years ago, power level is only several 10 W level. At present 250W power level is realized in semiconductor mass production factories[1) by ASML. On the other hand, pioneer of this Unique technologies including; combination of pul sed CO2 laser and Sn droplets, dual wavelength pico second laser pulses for shooting and de bris mitigation by magnetic field have been applied by Gigaphoton[2)].
They have demonstrated high average power >300W EUV power with CO_2 laser more than 27kW at o utput power in cooperation with Gigaphoton and Mitsubishi Electric[3)]. In near future more higher p ower (>800W) EUV source is required to fit High NA (>0.55) lithography of semiconductor indu stry.In this paper we will discuss about the Sn plasma dynamics which dominate the EUV emis sion by using Tomson scattering (TS) measurement[4)] (FIG.1). Recent TS results have revealed whole profiles of electron temperature and ion density in the EUV sources. These results menti on that there is still sufficient potential to increase EUV output in the future.

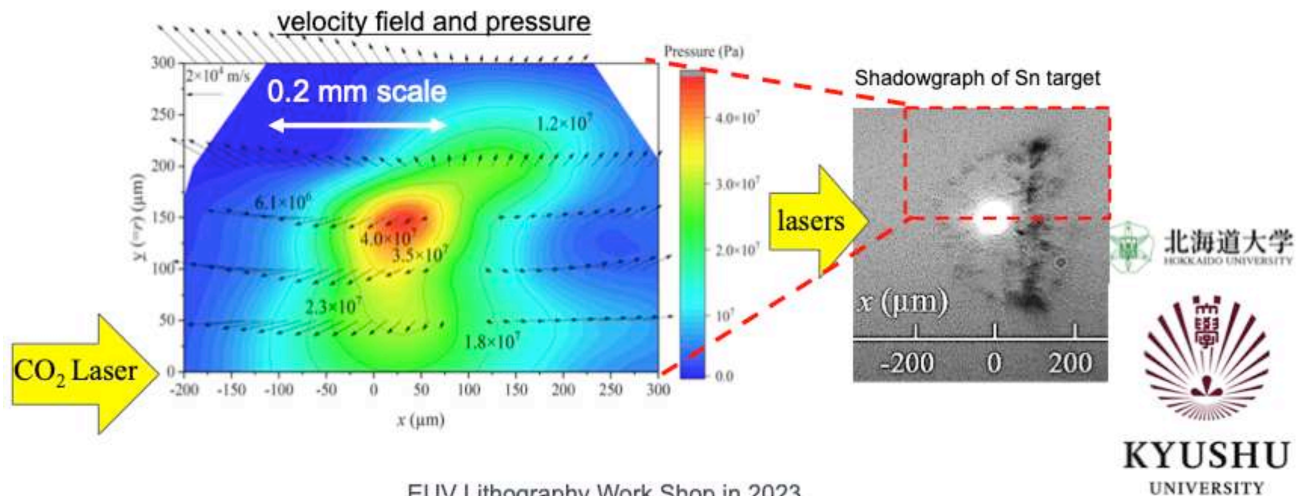

FIG.1 EUV PLASMA PARAMETER DISTRIBUTION

REFERENCE

1) Michael Purvis, Igor Fomenkov, et al.: Proc. SPIE. 10583, Extreme Ultraviolet (EUV) Lithography IX (2018)
2) Yoshifumi Ueno, Hideo Hoshino, et.al.; Proc. SPIE 6517 (2007) .
3)] Hakaru Mizoguchi, et.al.; HProc. SPIE 10143, Extreme Ultraviolet (EUV) Lithography VIII (2017)
4) Kentaro Tomita, et.al.; Scientific Reports [www.nature.com/scientificreports] (2017)