

Wave Excitation and Ion Beam Effect in Double Plasma Device

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박병재, 나채현, 이동협, 문성익, 조무현, 남궁원

Plasma Sheath Laboratory

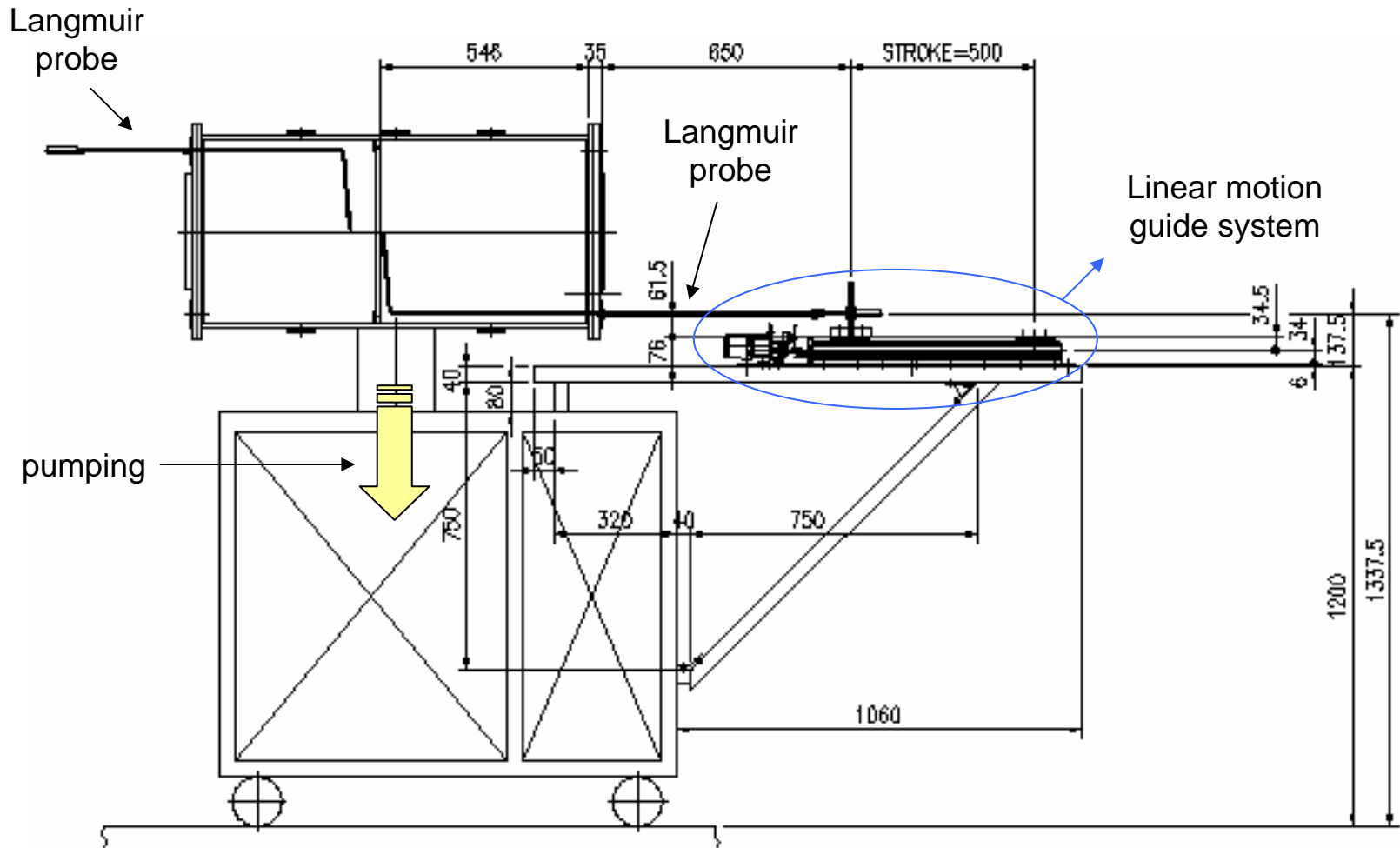
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Abstract

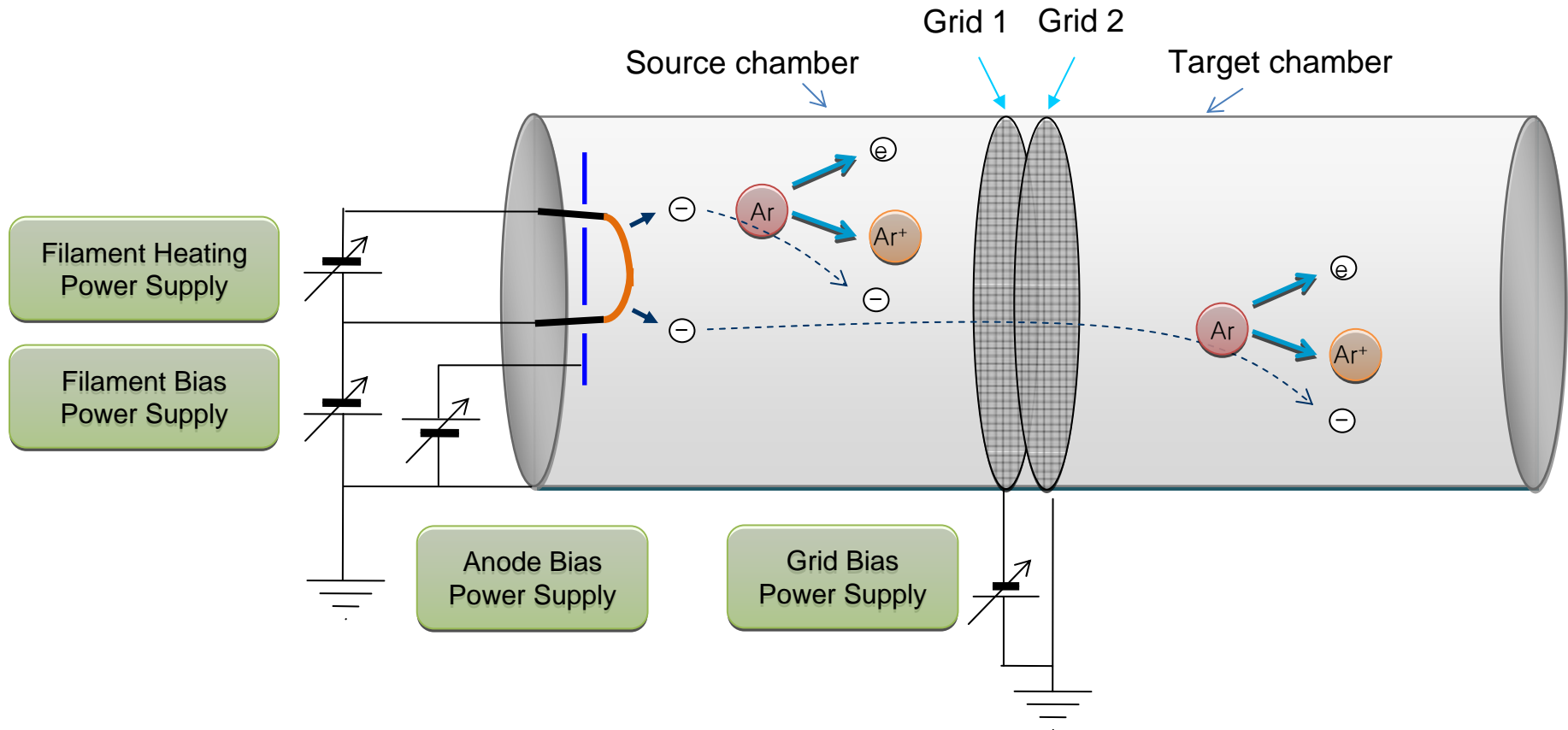


The double plasma device consists of two plasmas that are separated from each other by the grid. The potential difference between source and target chamber generates the ion beam. The mechanism of the appearance of a knee point on I-V trace with an incident ion beam was investigated experimentally in Ar plasma with 2×10^{-4} torr gas pressure. And the wave excitation experiment also was carried out. By the ion beam flow, the wave speed measured by the probe is faster than the speed of ion acoustic wave calculated from the measured electron temperature.

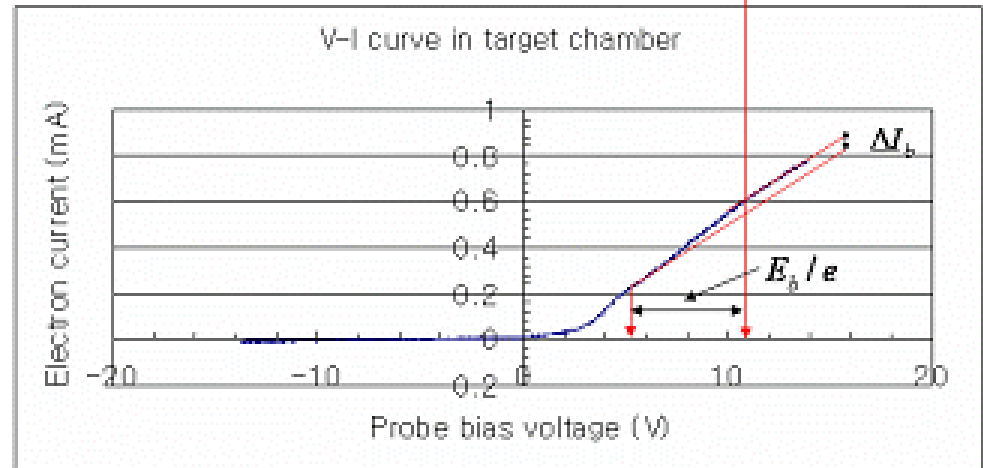
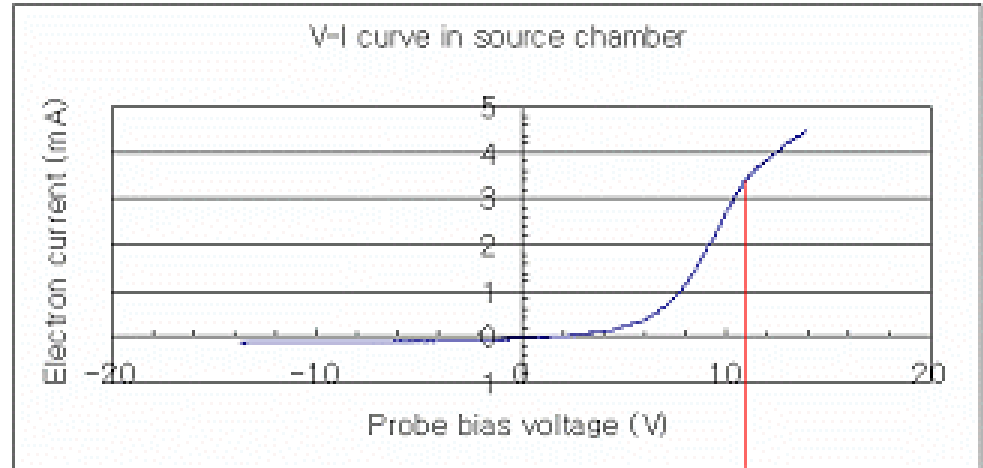
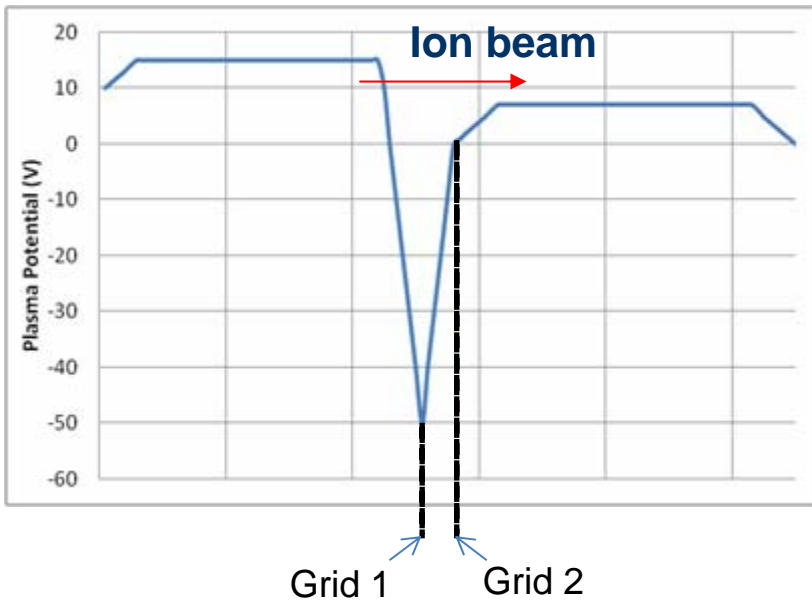
Double plasma device




Ion beam effect experiment



V-I curve by ion beam effect



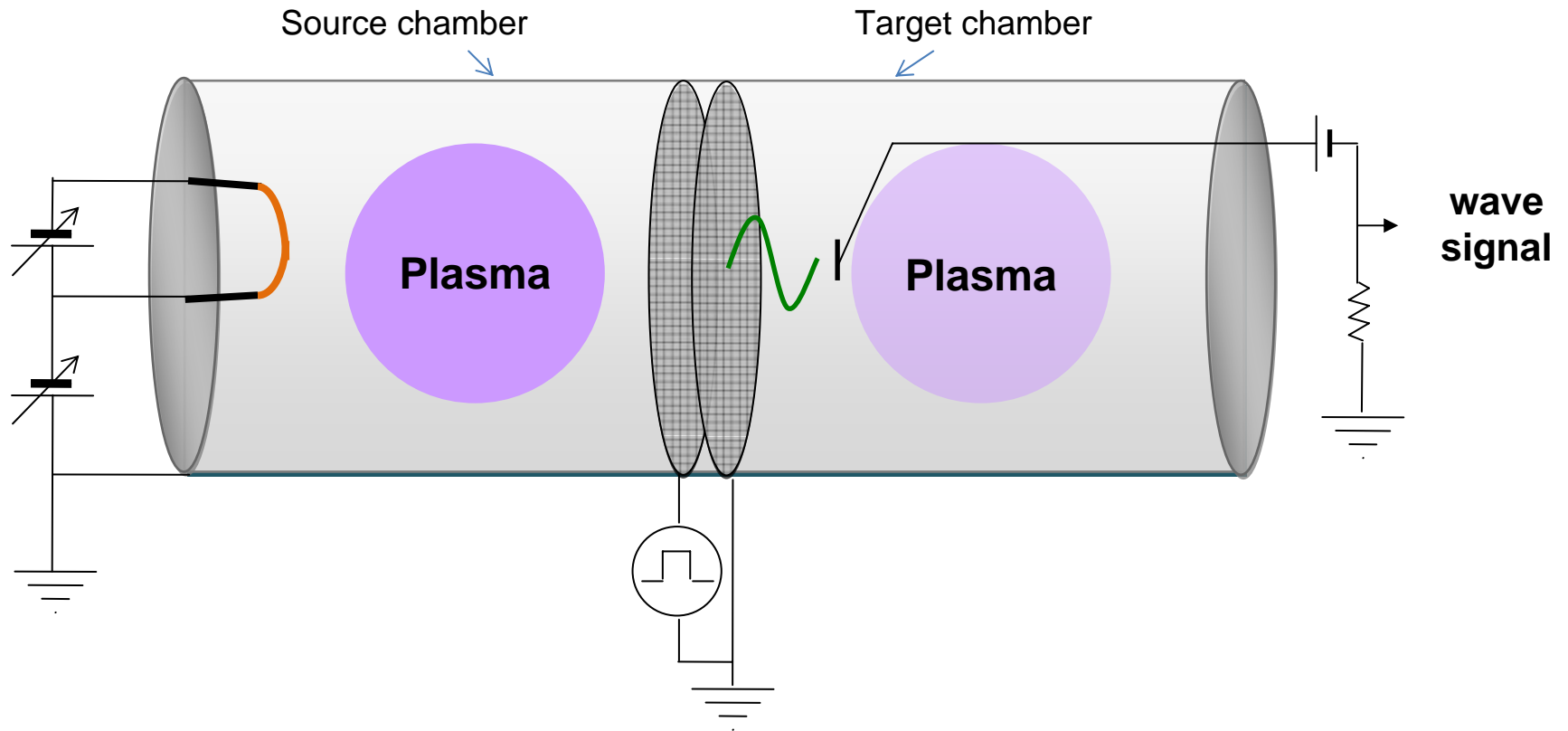
Plasma parameters



Plasma generation condition	
Base pressure	1.2×10^{-6} torr
Gas pressure	2×10^{-4} torr
Discharge current	0.8 A

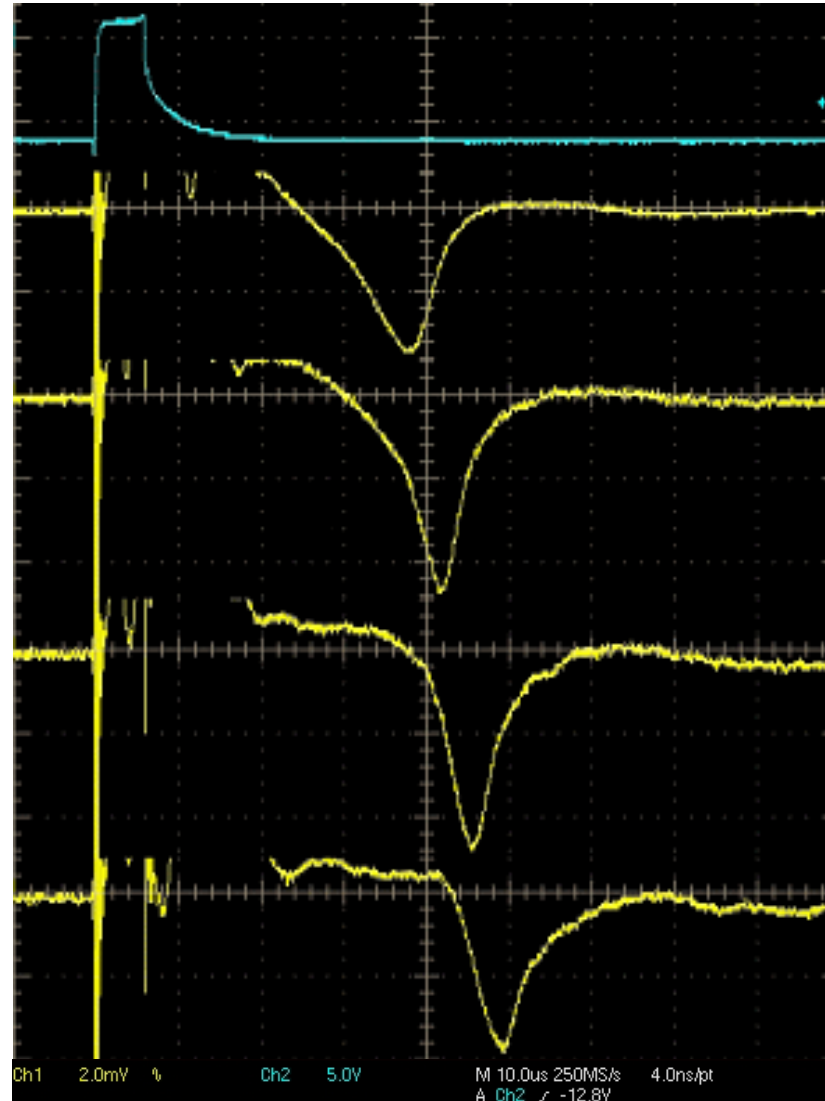
	Source chamber	Target chamber
Plasma potential	11.69 V	5.25 V
Electron saturation current	3.68 mA	0.21 mA
Electron temperature	1.96 eV	1.59 eV
Electron density	3.47×10^9 #/cm ³	0.22×10^9 #/cm ³

Wave excitation experiment schematic



Ion acoustic wave propagation

Input
signal



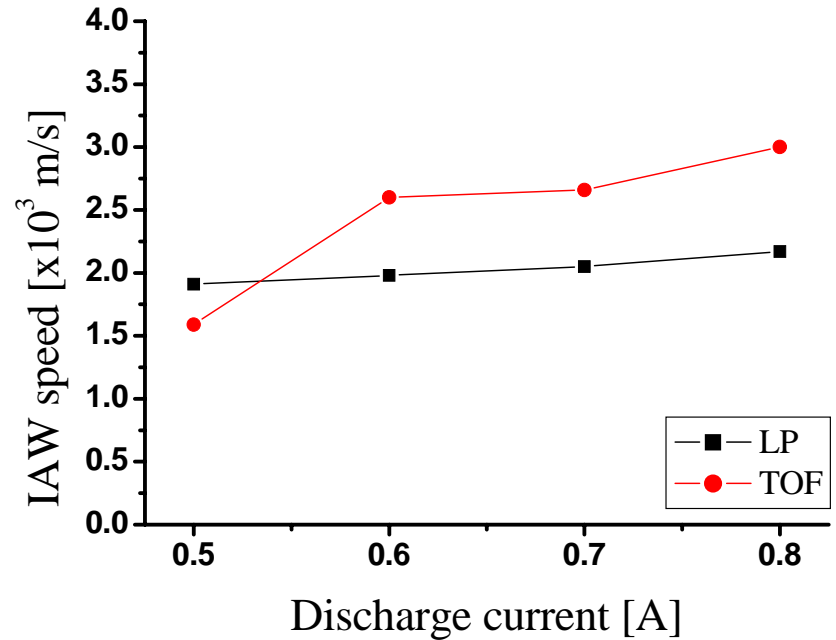
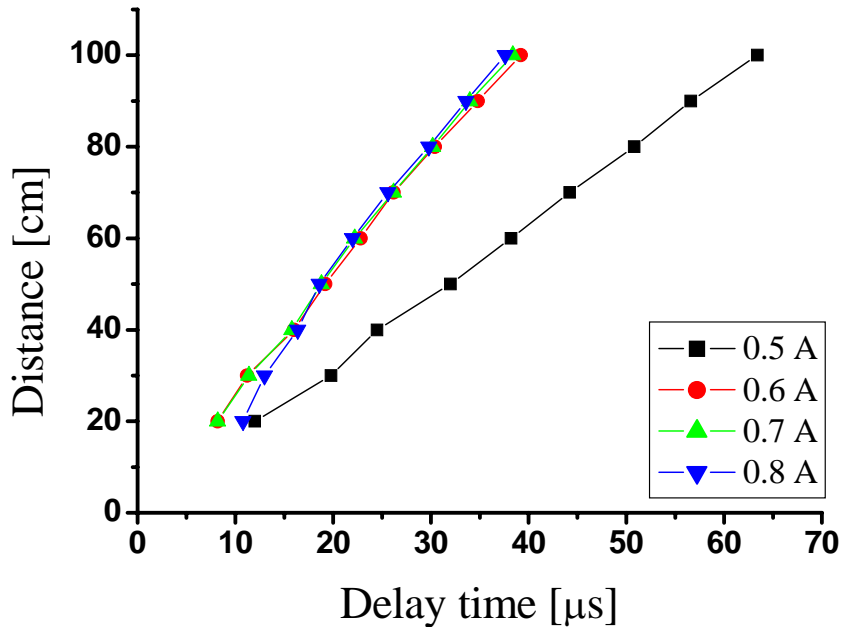
Probe position
= 1 cm

2 cm

3 cm

4 cm

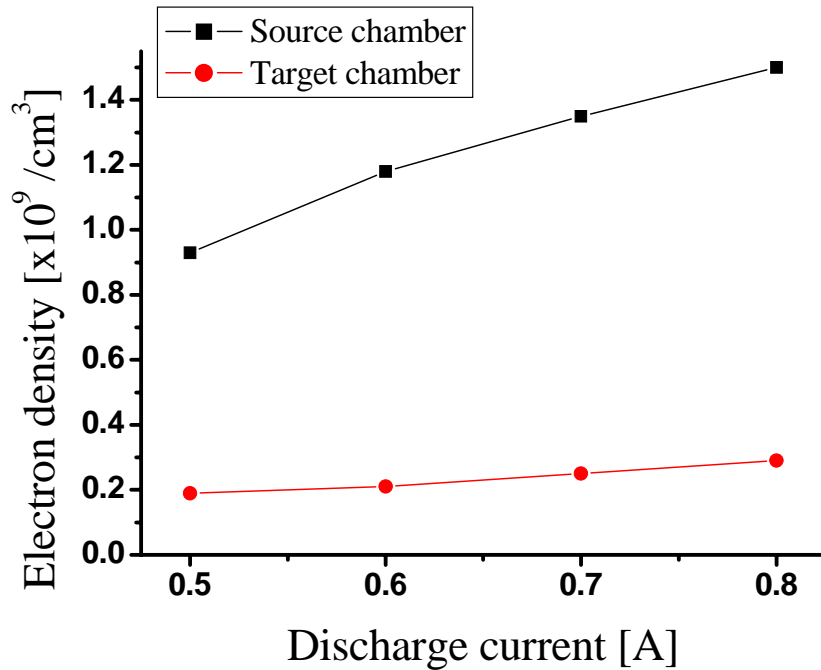
IAW speed by discharge current



As discharge current increases, Ion acoustic wave speed also increases.

$$C_s = \sqrt{\frac{kT_e}{M_i}} \text{ (by Langmuir probe)}$$

Plasma flow speed



$$v_m = \sqrt{\frac{kT_e}{M_i}} + v_d = C_s + v_d$$

v_m : speed measured by
time of flight method

C_s : Ion acoustic wave speed
measured by Langmuir probe

v_d : plasma flow speed

Plasma flow speed increases as density difference between source and target chamber increases.

Summary



- Ion beam effect and wave excitation were investigated experimentally in Ar plasma with 2×10^{-4} torr gas pressure.
- Ion beam can be generated in double plasma chamber, ion beam energy is measured by using Langmuir probe.
- Plasma flow from the source to the target chamber due to density gradient was measured. The flow speed has the dependence with plasma density difference.