Source Excited by a DC High-Current Electron Beam

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A DC high-current electron beam gun has been investigated for development of new type ion source, which has optimum energy for ionizing inert gas atoms by collision. We report here on the measurement of electron density and temperature by the Thomson scattering with the YAG laser.

The experimental setup has been shown in Ref.1. The scattering profiles reflect the distribution of the electron velocity perpendicular to the electron beam propagation. An example of the profile is shown in Fig.1, of which conditions are a helium gas pressure (P) of 0.22 Torr, an acceleration voltage (Va) of 100V and an electron beam current (Ib) of 15A. Each dot shows an average value of every 30 shots. A solid line indicates Maxwell distribution corresponding to the electron temperature of 2.2 eV. All the profiles fit the Maxwellian except the case of P =6.7 mTorr. In this case, the profile has several peaks symmetrically about the laser wavelength as shown in Fig.2. This separation disagrees with the predicted value from the electron gyromagnetic frequency. Other discussions need to explain this structure of the spectrum, which is under investigation.

The results are summarized in Table 1. This plasma source can produce a plasma which has wide range temperature of one order with the density of about 10^{14} cm^{-3}. These parameters are difficult to be reached with usual plasma sources. Especially, in P=0.5 Torr the electron temperature is very low as 0.6 eV with high electron density of ~ 10^{14} cm^{-3}. It is thought that the plasma of such parameters has advantage to produce negative ion because low temperature plasma with high density shows tendency to produce negative ion in the volume.

1)Ohgo, T, et al. : Ann. Rep. NIFS (1993-1994) 100.

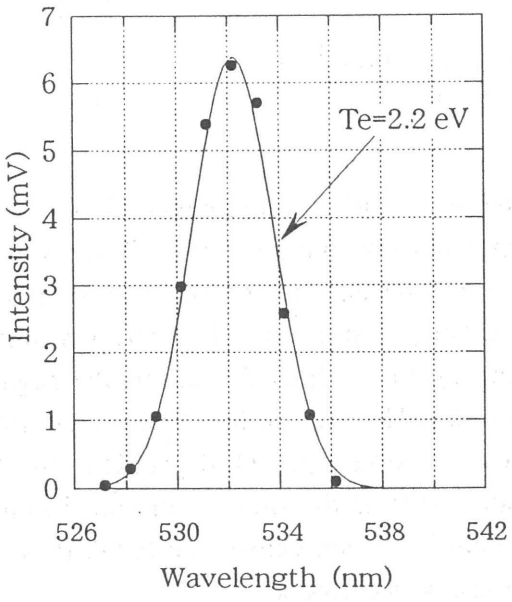

Fig.1. Typical example of the scattering profile and the Maxwellian distribution.

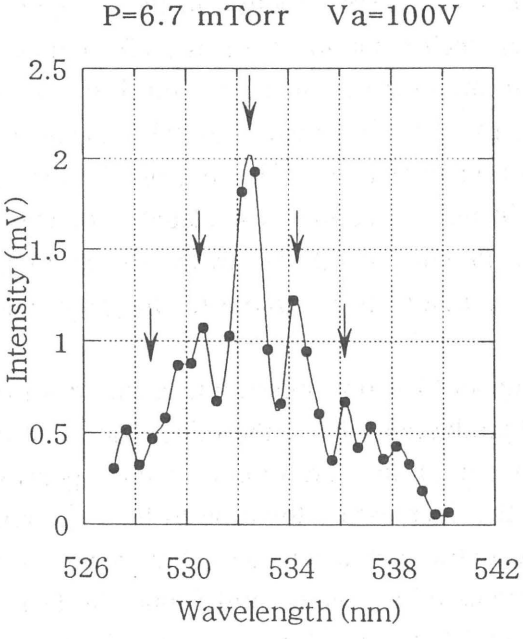

Fig.2. Scattering profile at P=6.7 mTorr.

P(Torr)	$6.7x10^{-3}$		0.22		0.5	
Ib(A)	19		15		15	
Va(V)	50	100	50	100	50	100
Te(eV)	-	10	2	2.2	0.42	0.58
Ne($x10^{13}cm^{-3}$)	-	3.2	9.6	8.6	7.2	8.9

Table 1. Electron densities and temperatures.