

KSTAR NBI

가

Discharge Characteristics of KSTAR NBI Ion Source According to the Filament Heating Condition

150

KSTAR NBI 가
 . FIC(Filament Initial Current)가 가 가 ,
 uniformity FCR(Filament Current During Arc)
 40 sccm 80V FIC 가 3300 A
 ~ 3400 A, FCR 2850 A ~ 2900 A , . Langmuir probe
 power
 CP(Constant Power)
 가 CP

Abstract

The effect of the filament heating condition to the arc discharge characteristics of the KSTAR NBI ion source has been studied. Arc discharge current is increased by FIC(Filament Initial Current) and the uniformity of the arc current after arc discharge is affected by FCR(Filament Current During Arc). Under the 40 sccm of hydrogen gas flow and 80 V of arc voltage, the optimum filament heating conditions are 3300 A ~ 3400 A of FIC and 2850 A ~ 2900 A of FCR. The optimum operation mode of the power supplies has been studied. The optimum operation mode of the arc power supply is CP(Constant Power) mode because the ion saturation current of Langmuir probe is increased with arc power.

1.

TFTR, D -D , JT-60U, JET, ASDEX-U, ITER
 가 , KSTAR(Korea
 Superconducting Tokamak Advanced Research) 가 . KSTAR NBI(Neutral Beam

1.

Table 1. Electrical specification of filament P/S and arc P/S

	Filament P/S	Arc P/S
Output DC Voltage[V]	15	160
Output DC Current[A]	3200 CW 5500 for 6 sec	1200 CW
Current Ripple	2 %	2 %
Pulse Width	350 sec/30 min	320 sec/30 min
Current rising time	30 ms	30 ms at start 1 ms during operating
Current falling time	30 ms	0.1 msec
DC 가	inverter	Chopper

가

2

FCR(Filament Current during Arc)
Probe
control system (MKS type 146A)
sccm
gauge

가 FIC(Filament Initial Current)

가 Langmuir
vacuum gauge measurement and
100 sccm MFC 40, 50, 60
 $10^{-1} \sim 10^5$ torr 가 Baratron
50 V 80 V 10 V

2. 가

Table 2. Conditions of filament heating

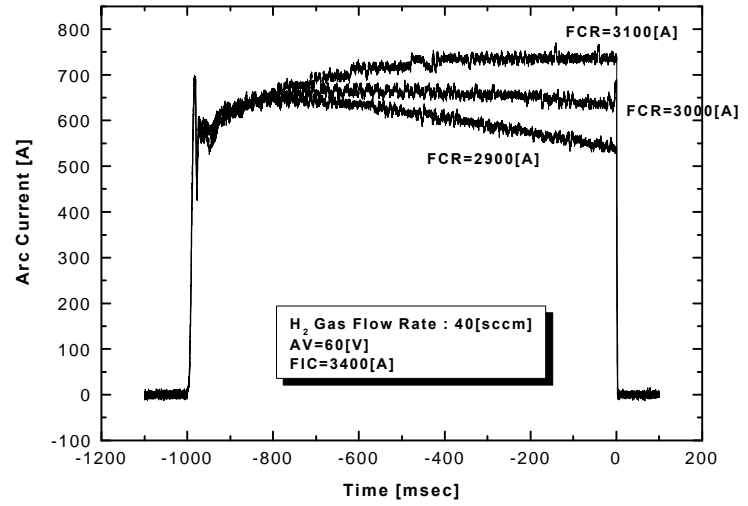
Filament Initial Current		Filament Current during Arc	
FIC[A]	FIC Time[sec]	FCR[A]	FCR Time[sec]
3100-3600	18	2600-3200	1-2

3.

3-1. 가

2 40 sccm 60 V, FIC 가 3400 A , FCR 1
2900, 3000, 3100 A ,
1.8 mtorr . FCR
FCR

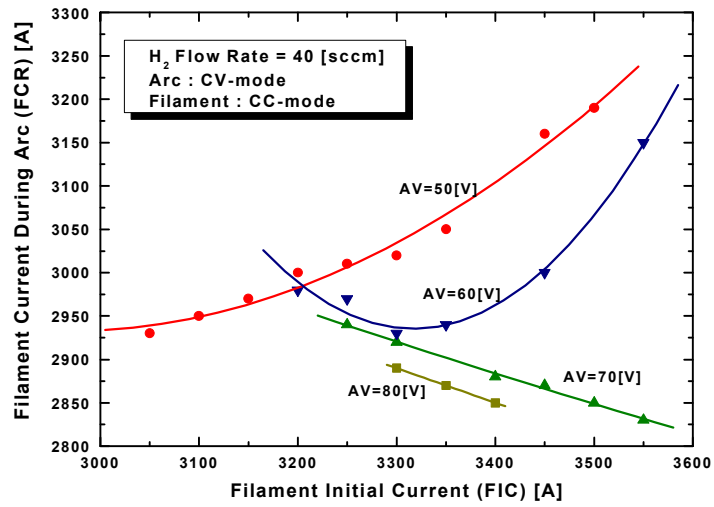
. FCR 3100 A 가
 , Langmuir probe 가
 가
 FIC FCR



2. FCR

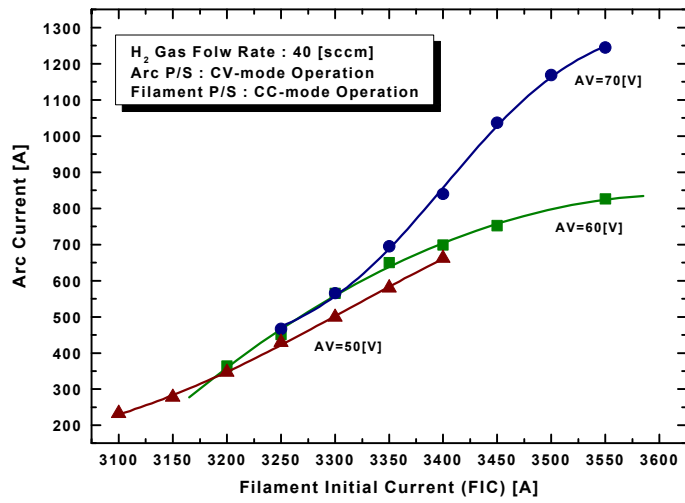
Fig. 2. Discharge Characteristics according at various FCR.

3 2 50 V 80 V 10 V
 가
 FIC , FIC
 FCR
 가
 가 가 가 가 가
 FIC
 hot cathode
 emission limited space charge limited 가
 4 FIC
 FIC 3400 A 가
 emission limited FIC 3400 A
 가 가 가 space-charge limited 가
 FIC 가 가 가



3. 가

Fig. 3. Discharge characteristics curve according to the filament heating condition



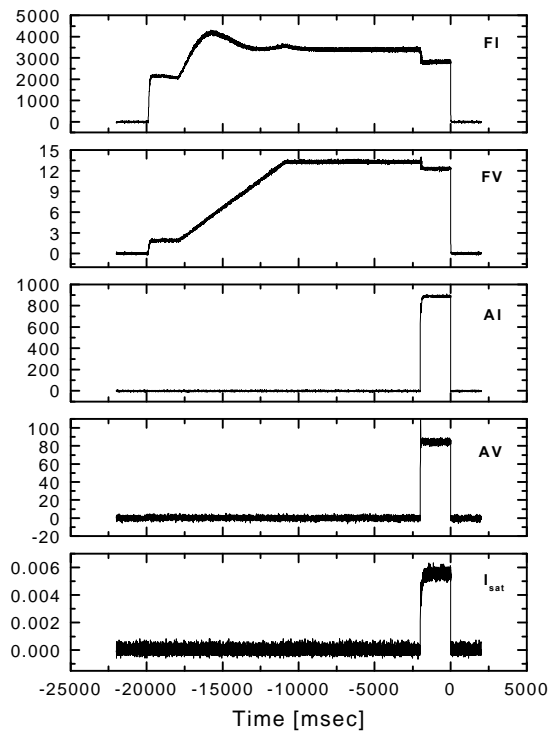
4. 가

Fig. 4. Arc Current according to FCR

5 FIC 3250, 3300, 3350, 3400, 3450 A 가 , FIC 가

3-2.

(CC) (CV) 가
9, 10, 11, 12
12.5 V, 11.5 V , 80 V
20 %



9. 가

Fig. 9. Typical discharge curve of the CV mode arc discharge under CV mode filament heating condition.

10

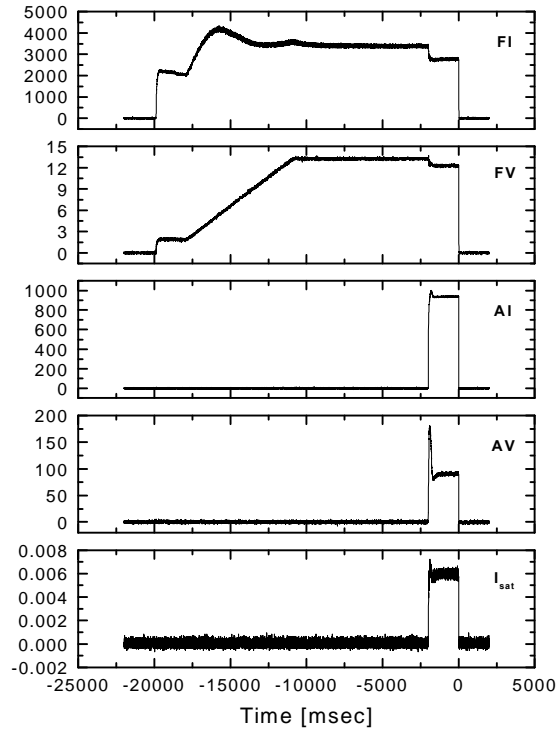
890 A

가

가

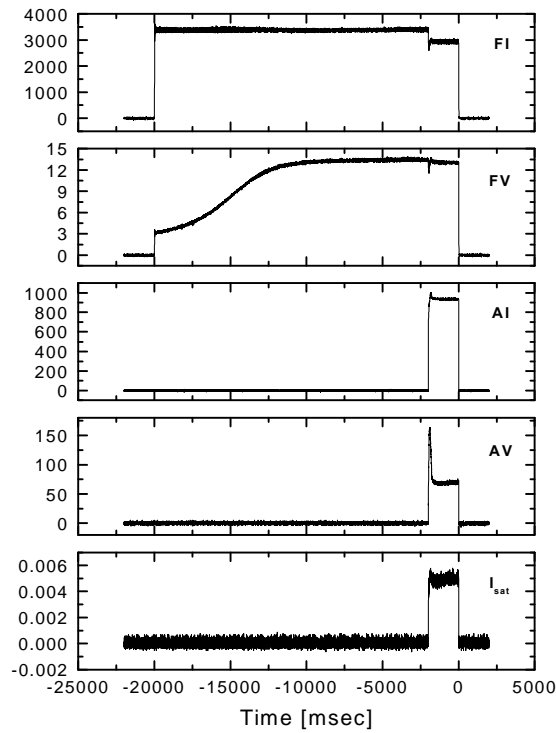
890 A

11



10. 가

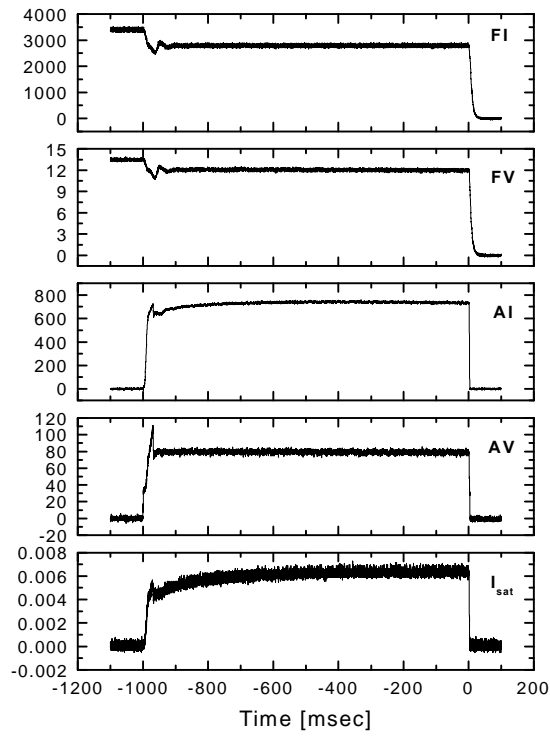
Fig. 10. Typical discharge curve of the CC mode arc discharge under CV mode filament. Heating condition.



11. 가

Fig. 11. Typical discharge curve of the CC mode arc discharge under CC mode filament heating condition.

Langmuir probe 가 , 가 , 가



12. 가

Fig. 12. Typical discharge curve of the CC mode arc discharge under CC mode filament heating condition.

4.

KSTAR NBI 가 FIC 가 가 , 40
 FCR
 sccm 80V FIC 가 3300 A ~ 3400 A, FCR 2850 A ~ 2900 A ,
 . Langmuir probe
 power ,
 가 가 ,
 constant power .

5.

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