

A.11: Development of 90 kV, 1 A triode type electron gun

Thermionic emission based triode type 90 kV, 1 A electron gun has been designed and developed. M-type dispenser cathode having area of 0.5 mm² has been used as a source of electron. Heater power required for this cathode is less than 20 W. Specifications of the electron gun are given in Table A.11.1. The geometry of the electrodes of the gun has been designed using EGUN code.

Table A.11.1: Specifications of the electron gun.

Parameter	Value
Cathode voltage	90 kV
Cathode current	1 A
Pulse width	15 μs
Grid voltage	300-1400 V
Type of cathode	M-Type dispenser
Cathode temperature	1050 °C
Cathode area	0.5 mm ²
Heater voltage	8 V
Heater current	1.5 A
Vacuum	< 1 × 10 ⁻⁷ mbar

Alumina ceramic of diameter 200 mm and length 185 mm has been used for high voltage isolation between anode and cathode. All the electrodes have been fabricated in SS304 material. Heater power is provided to the cathode heater using feed-through. A test stand with 90 kV pulse modulator, grid supply, heater supply and vacuum system have been built for high voltage test. Two SIPs having pumping capacity 70 l/s have been used to achieve vacuum better than 1 × 10⁻⁷ mbar. After activation of the cathode and high voltage conditioning, electron gun has been tested at 90 kV cathode voltage. The output of electron gun is terminated with faraday cup assembly (isolated from the body of the electron gun) terminated by 50 Ω resistances. The photograph of the test stand is shown in Figure A.11.1.

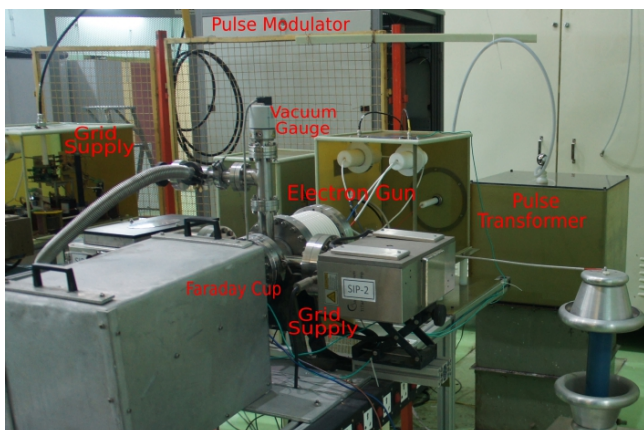


Fig. A.11.1: Photograph of the electron gun test stand.

During testing peak current of 950 mA has been measured at 90 kV cathode voltage. The emission current of the electron gun is controlled by varying the grid voltage. The V-I characteristic of the electron gun is shown in Figure A.11.2.

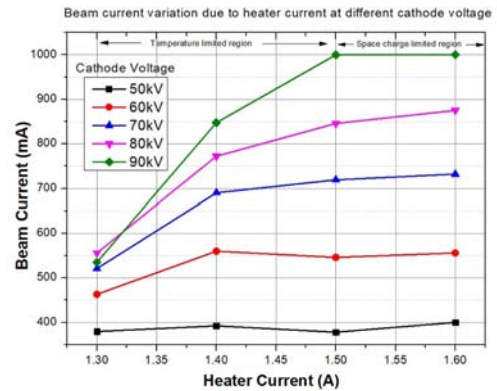


Fig. A.11.2: V-I characteristic of the electron gun.

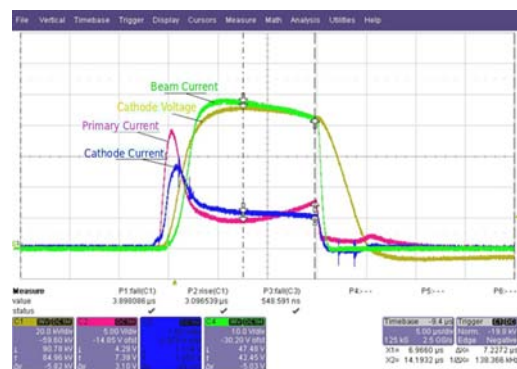


Fig. A.11.3: Oscilloscope traces of cathode voltage (20 kV/div), primary current (20 A/div), cathode current (1 A/div) and beam current (0.2 A/div).

Oscilloscope traces of high voltage pulse, beam current pulse at 90 kV cathode voltage are shown in Figure A.11.3. Variation of emission current at 90 kV cathode voltage by varying the grid voltage from 300 V to 1400 V is shown in Figure A.11.4.

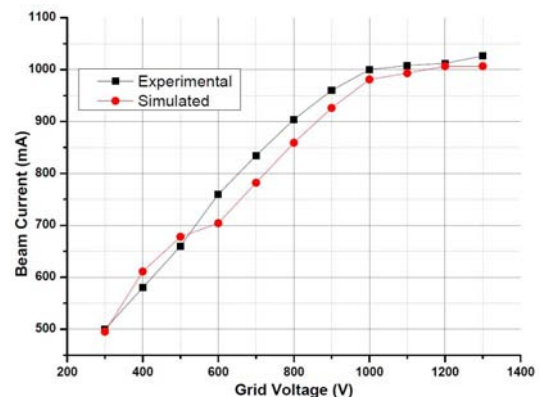


Fig. A.11.4: Variation of beam current by varying the grid voltage.

Experimentally measured beam current is in good agreement with simulated current. Further characterization of beam parameters is planned to be measured on this test set-up using beam diagnostic device.

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