

2 MeV LIA INJECTOR DESIGN

L. Zhang, N. Cheng, G. Dai, H. Wang, L. Chengjun, J. Deng, B. Ding
Institute of Fluid Physics, CAEP P.O.Box 523-56, Chengdu, China, 610003

Abstract

This paper describes a design for 2 MeV LIA Injector. The injector is composed by eight accelerating cells in which for four accelerating cells form an anode and others make a cathode. A foilless diode or a diode with a tungsten mesh anode is used in the injector, and the voltage for the diode is 2 MeV. The electron beam current is more than 3kA in the end of injector. The pulse power system, beam transport system. Auto-control system and auxiliary system also are discussed.

1 INTRODUCTION

The purpose for the injector is to produce a high-brightness, low energy spread electron beams [1,2]. The injector is consisted of 8 accelerating cells, foilless diode, solenoid magnet and pulse power system. The length of the injector is 6 m. In order to satisfy the requirement of resistant match, the cathode bar and anode bar are formed as cylinder stairup-like. Internal diameter of anode accelerating cell is bigger than that of cathode for accommodating focusing solenoid. The cathode is cold cathode field-emission and the cathode material is velvet. We use solenoid producing a focusing magnet to transport electron beams.

2 DESIGN OF THE INJECTOR

It is necessary to improve beams brightness, lower beam energy spread and control transversal movement of beams. We make following design.

2.1 The design of diode

To design a diode, first of all, we must optimize the shape of diode by using foilless anode or tungsten mesh anode so that the field in the cathode is uniform. This is beneficial to increase the brightness of electron beams. The optimizing choice is carried out by using numeral simulation and experiment. The experimental result shows that a plane diode can produce a high-quality electron beam which brightness is higher than $1.5 \times 10^8 \text{ A}/(\text{m} \cdot \text{rad})^2$

2.2 The system design for pulse power

To realize the wide flat top in the diode, the pulse power source need good synchronism [3]. Then the influence of resistant variance should be controlled. in the process of electron emission, the plasma moves toward anode and the emission current gradually increased, the resistance of diode decrease. In this way, the diode

voltage induces. The way to induce this kind of influence of to choose the proper resistance of accelerating cavity and proper diode shape. While design pulse power system, we use a Max generator and Blumlein line to produce a 250 kv 110 ns pulse. The Max generator charge four Blumlein lines and each line provide pulse power to two accelerating cells. We use spark gap switch to control the synchronism.

2.3 The system design for beam transport

Eight solenoids are used to build up a beam transport magnet, two solenoids for introducing electron beam out the diode, one solenoids for producing a compensate magnet field at cathode, four solenoids in the accelerating cavity for transporting electron beams and others for adjusting output beams.

2.4 Auto-control system and auxiliary system

We use personal computer and Bitbus net to build up our auto-control system. A personal computer is used as central control computer and several industrial control computers are used as station. A data analyze system for analyzing experiment result is also accomplished. The auxiliary system includes vacuum (4×10^{-4} Pa), pure water (5 MΩcm), gas (N_2 , SF_6) and oil.

3 CONCLUSION

The injector should arrival following criterion:

$$\begin{aligned} \text{energy} &\geq 2\text{Mev} \\ \text{beam} &\geq 3\text{KA} \\ \text{pulsewidth} &\geq 60\text{ns} \\ \text{energyspread} &\leq 1.5\% \\ \text{emission} &\leq 0.28 \text{ cm} \cdot \text{rad} \\ \text{brightness} &\geq 1.5 \times 10^8 \text{ A}/(\text{m} \cdot \text{rad})^2 \end{aligned}$$

The 2 MeV LIA injector was resemble in 1997 and the first experimental result show that our design is reasonable.

REFERENCES

- [1] Mascurea J. De, et al, A Progress of the AIRIX Induction Accelerator 1993.
- [2] B.N Ding, Performance of 10 MeV LIA. Proceeding of 10 MeV LIA 1994.
- [3] Jaitly N.C et al, Design and Testing of a Multi-output 300 kv Prototype Induction Cell Pulse Power Supply for DARHT.