AN ELECTRON GUN FOR JAERI-FEL

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Abstract

A new conceptual design of an electron gun system which consists of a thermoionic cathode and a pulsing grid is reported. This is designed for a free electron laser of JAERI to get a high quality beam, that is to say, a small diameter cathode, high voltage and a special curvature of electrodes are adopted to achieve a low emittance, a low emittance growth and a high brightness. Furthermore, to produce a fast pulse for the grid on a high voltage stage, improvements of a grid pulser circuit and spatial arrangement of its elements are required.

1.Introduction

There are two ways to get a low emittance and high brightness beam. The one is using a careful and gradual acceleration with a plenty of magnets for a adjustment of beam shape, the other is quick rise of the beam energy at the early stage of the acceleration. Our choice is the latter, which is enable to be a simple device, and to reduce the load of bunching and preaccelerating sections. As the same choice, there is a high voltage gun system(400kV) with photoemitter at Stanford, and there is a gun(440kV) of a high duty factor machine at MIT. On the other hand, LISA (RF linac for FEL) of FRASCATI chose the former way.

2.Structure of the gun

The system based on a high voltage stage(<300kV) in a tank which is filled with 2-atm SF6. The micro-pluse is 2ns, and the macro-pluse is 80ns and duty is 1%, then the constant D.C. voltage supply doesn't always necessarily.

The side view of the gun is shown in fig.1. The anode, instead of the cathode, is put on the top of a corn-shape block. This scheme enables to arrange the cathode assembly near the high voltage terminal in the tank, and to cut the distance short between the grid pulser circuit to the cathode and the grid. Because of a accomplishment of a fast pulsing control, it is not enough to take a matching impedance, and it is very impor-

tant to reduce a stray capacitance and the length of a transmittance from a grid pulser to a grid. Moreover, a large space around the back of a cathode makes easier setting and maintenance of cathode assembly, and the position near the center of the vessel is better to put a cathode assembly, that is at high voltage, at the view point of electric insulation.

One more difference from a conventional gun is that the wenelt is insulated from cathode-grid assembly. To get a small beam diameter, the Wehnelt covers the cathode which has smaller diameter than its of the Wehnelt-hole. Suppling a low voltage between the wenelt and the grid can get rid of electron confusion and can put in order the beam shape by weak focusing effect. Optimal shapes of the electrodes was calculated and next article of this book reports detail about it.

Acknowledgment

An extremely accurate beam is needed for FEL then new ideas and improvements are in demand. The pulse circuit which consists of solid-state elements is simple but it is difficult to choose a adaptable elements which have a very short response time and large thermal conductivity. Next phase of this experiment, a photoemittive gun will be employed. Authors thank JAERI FEL's group, Y.Kawarasaki, M.Ohkubo, M,Sugimoto and M.Takabe, for discussions and comments on this work.

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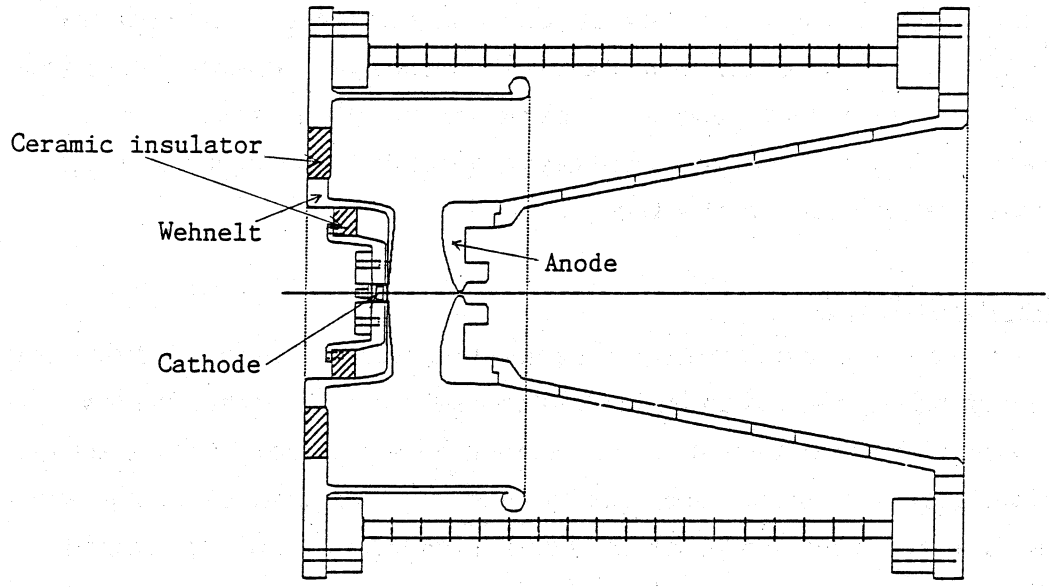

Fig.1 Cross sectional view of Electron Gun Assembly Anode is put on the top of corn-shape block which has hollows for the vacuum condition. Cathode,Grid and Wehnelt are built up on a flat flange.