CONSTRUCTION AND PERFORMANCE TEST OF A 100 MeV RACE TRACK MICROTRON

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Abstract

A 100 MeV Race Track Microtron has been designed and constructed. This machine will be used as the injector of a Superconducting Synchrotron Light Source. The 5 MeV, 3 GHz standing wave accelerating column has been constructed and the rf system has 2 MW magnetron, rf circuit, and power modulator with Blumlein type PFN. Two bending magnets (1 T, 4 % field gradients) with reverse field clamp had been constructed. A quadrupole magnet is used for beam focusing in the common orbit. All components have been assembled and the machine is under test.

1 INTRODUCTION

A compact superconducting synchrotron light source is planned in Seoul National University for many synchrotron light application experiments, such as the lithography[1],[2]. A 100 MeV Race Track Microtron has been designed and constructed as the injector because of compactness and reasonable cost.

The Race Track Microtron has the simplest design and consists of an electron gun, a linac, two bending magnet with reverse field magnet, focusing magnets and a vacuum system. The design parameters of the Race Track Microtron are given in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Final electron energy</td>
<td>100 MeV</td>
</tr>
<tr>
<td>No. of orbits</td>
<td>18</td>
</tr>
<tr>
<td>Pulse length</td>
<td>1 μs</td>
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<tr>
<td>Repetition rate</td>
<td>10 Hz</td>
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<tr>
<td>Pulsed electron beam current</td>
<td>max. 10 mA</td>
</tr>
<tr>
<td>Magnetic flux density of bending magnets</td>
<td>1 T</td>
</tr>
<tr>
<td>Rf frequency</td>
<td>3 GHz</td>
</tr>
</tbody>
</table>

Table: 1 Design parameters of 100 MeV Race Track Microtron

2 ELECTRON GUN

The electron gun has been made of 10 mm diameter LaB₆ cathode with the spherical Pierce type electrode. It operates in the temperature limited region and supplies 45 keV, maximum 100 mA electron beam. The electric heater power is maximum 50 W. Figure 1 shows the manufactured electron gun and Figure 2 shows the heated cathode during the cathode heating test.

3 LINAC

The linac structure is an electrically coupled π/2 mode standing wave type. Operation frequency is 3 GHz and the energy gain per turn for synchronous relativistic electron is 5 MeV.

The disc and cylinder of the linac has been machined by NC lathe with diamond bite (Figure 3) and assembled by electroforming in the coppersurfate bath. Figure 4 shows the linac which is installed in the vacuum chamber.

The RF source of the linac is 2 MW Magnetron (EEV M5125). The power modulator for the Magnetron has been consisted of 10 stages Blumlein type pulse forming network (Figure 5), charging power supply, thyratron switch, end-of-line clipper and step-up pulse transformer (1:4). The output voltage of the power modulator is shown in Figure 6.
4 MAGNET

Two bending magnets with reverse field clamps has been manufactured with low carbon steel. In order to obtain uniform magnetic flux density, the floating poles (Figure 6) are used. The pole gap length is 10 mm and the field gradient is 4%.

5 OPTICS MAGNETS

The electron beam generated in the electron gun is focused by a solenoid magnet which is installed between the electron gun and the chicane magnets. Because of the large difference between the injection energy and the first orbit beam energy, it is easy to inject the beam into the linac through three chicane magnets. The injection angle is 45 degree.

The orbit electron beam is focused in horizontal direction by a quadrupole magnet which locates in the common orbit.

6 VACUUM SYSTEM

The main vacuum chamber in which the linac is installed is evacuated by 1,000 l/s turbo molecular pump. The base pressure of the chamber is less than 10⁻⁶ torr.
The electron gun is evacuated by 1,000 l/s turbo molecular pump independently. The working pressure is \(2 \times 10^{-6}\) torr.

**7 SUMMERY**

The 100 MeV race track microtron has been designed and the components have been fabricated. The assembly of the race track microtron is completed. The machine is tested and adjusted.

![](image)

**Figure 8: 100 MeV Race Track Microtron**

**REFERENCES**
