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Development of Cold Cathode PIG with Floating Reflector

The cold cathode type PIG ion sources were often employed for compact cyclotrons with high magnetic field as internal source. The ion sources are preferable to conduct maintenance easily without vacuum break of cyclotrons to avoid long downtime. In this study, cold cathode PIG H⁺ ion source was developed with extraction mechanism along to main magnetic field direction for the spiral sector AVF cyclotrons which were difficult to be accessed on median plane.

Ordinary cold cathode type PIG ion sources consist of a pair of cathodes and a cylinder shape anode. The bias voltage to generate discharge is loaded to both cathodes. But in this study the bias voltage was loaded to only single side of cathodes and another side of cathode was floating from the ground so that the ion source was made small as the bias line to another side cathode was omitted. The potential level of floating cathode was equipotential through plasma. The discharge characteristic and extraction beam current were measured with this developed ion source for performance evaluation. The extraction current with DC beam was 3 μ A maximum and it is relatively low output when compared among other cold cathode PIG ion sources. The reason of low current was that insulation break-down occurred before the discharge transferred to arc mode so that enough ionized current could not be obtained. The bias voltage could not be loaded over 2.2 kV stably. Besides, the cooling pathway performs too much to heat up the cathode by ionized current of glow discharge and the temperature did not raise so hot that thermal electron emission starts. Some modifications are needed to achieve H⁺ 300 μ A output.

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