Concept of Maximizing the eGun Lifetime of an Field Emission Ionization Vacuum Gauge

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ABSTRACT

Ionization vacuum gauges are commonly used in different fields of application, including scientific applications for measuring low pressures under specific conditions, such as low temperatures. Their operating principle is based on impact ionization caused by accelerated electrons and the proportionality of ion current to particle density. The most common electron source for these gauges is a hot cathode. This type of electron source has many disadvantages like a significantly high loss due to thermal radiation. Furthermore, the heat can lead to problems in some applications, like in cryostatic environments. The investigation to overcome such limitations and to achieve higher efficiency led to the usage of the field emission effect in alternative electron emission sources like carbon nanotubes (CNTs) and silicon-based emitters. [1] Due to degradation and other influences, the lifetime and reliability of these field emission sources (FES) are still not sufficient to be used on a large scale in vacuum gauges. [2] To counteract these influences and extend the lifetime there are investigations to distribute the emission current across multiple integrated silicon field emission electron source chips to extend their lifetime. [3] This work aims to test whether a design featuring an electron source with multiple field-emission arrays (FEAs) is suitable for operating an ionization vacuum gauge. A Bayard-Alpert setup was therefore constructed with a developed silicon-based multi-chip FEA (Fig. 1). The study has shown that a Bayard-Alpert ionization vacuum gauge works with this configuration. To obtain a measurable ion-current in different pressure ranges, a max. current of 200 µA was required for the entire multi-chip-array. This is a fraction of the usual amount of current needed in an Bayerd Alpert setup with a hot cathode. The current could be distributed accordingly, and no significant degradation was observed. Further results are presented at the conference.

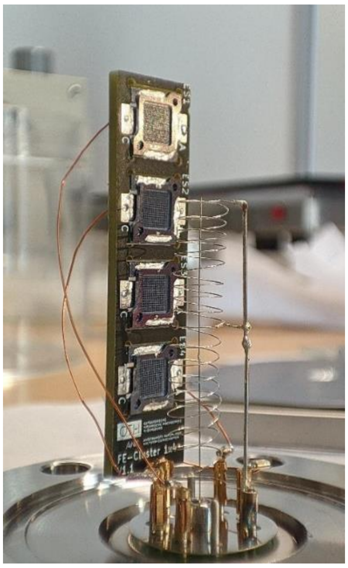

Fig. 1: Sensor assembly

References

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