

Fig. 2. Schematic diagram of an end-Hall ion source.

GRIDLESS ION SOURCES

There are many types of gridless ion sources [2,3], but only the end-Hall and anode-layer are common in industry. The ions in a gridless source are generated by the discharge supply, with the accelerating potential difference produced by electrons from the cathode-neutralizer crossing magnetic-field lines (not shown) to reach the anode.

End-Hall Ion Source

An end-Hall ion source [2,4] is shown in Fig. 2. It has a discharge chamber that is circular or elongated. The acceleration of ions takes place in a quasi-neutral plasma, with approximately equal densities of electrons and ions. Consequently there is no limitation on ion-beam current, I_b , as expressed in Proportionality (1). The ion beam equals about 20-30% of the discharge current and the mean ion energy corresponds to about 60-70% of the discharge voltage. An end-Hall ion source operates at a background pressure of about one milli Torr or less. Compared to a gridded ion source, it is reliable and rugged. It can generate large ion-beam currents at ion energies of 200 eV or less. It cannot easily generate higher ion energies and the ion-beam profile is limited to a divergent shape.

Anode-Layer Ion Source

An anode-layer ion source is shown in Fig. 3. It is also known as a closed-drift ion source, which refers to the electrons precessing in a closed path around the annular or racetrack shaped discharge chamber. The anode-layer is a type of closed-drift source in which most of the acceleration takes place in a thin layer near the anode [3]. There are also different modes of operation for this type of source. The anode-layer type used in industry operates in

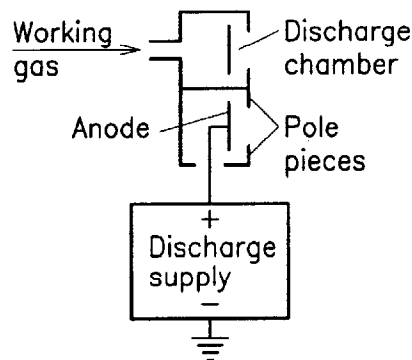


Fig. 3. Schematic diagram of anode-layer ion source.

the vacuum mode, as shown by the absence of a cathode-neutralizer [3]. The discharge voltage ranges from about 800-2000 V. The ion energies are higher than for an end-Hall ion source. This type of ion source also operates at a background pressure of several milli Torr or less [5]. The ion beam potential must be elevated to obtain neutralizing electrons from the surroundings, thus exposing the target to high electric fields and, for dielectric targets, high potentials. Target damage can therefore be a concern. Coatings on, or warping of, the pole pieces and anode can degrade performance. However, if this type of source can perform an application in a satisfactory manner, it is a very simple type of ion source.

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