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Operation Modes of Hydrogen Ion Beam Source Based on Pulsed Penning Discharge with Hollow Cathode

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We report on an experimental study of the ion source based on a Penning discharge with a hollow cathode [1] that was transferred to high current (tens A) pulse (tens μs) mode to produce intense beam of hydrogen ions. With operating gas of molecule hydrogen H_2 the ion beam contains the three ion species: H^+ , H_2^+ and H_3^+ . For all experimental conditions ion beam fraction of the H_2^+ was about 10-15% of the total ion beam current and it did not change much with ion source parameters. From the other hand, ratio of H^+ , and H_3^+ strongly depends on discharge current, especially on distribution the discharge current between planar cathode and hollow cathode. The higher discharge current the more protons in the ion beam present. Maximum part of H^+ was as high as 80% of the total ion beam current. Forced redistributing the discharge current between the cathodes so that the current increase in the hollow cathode can dramatically increase the proportion of H_3^+ ions in the ion beam. For optimal parameters part of the H_3^+ ions reached 60% of the total ion beam current.

References

1. Low-energy dc ion source for low operating pressure / Efim Oks, Maxim Shandrikov, Cecilia Salvadori and Ian Brown // Rev. Sci. Instrum. 85, 083502 (2014);