15 mA CW H^- Source for Accelerators

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A CW surface-plasma type ion source is developed. H^- beam with current >15 mA and energy of 32 keV is regularly produced in the runs with duration $>10^2$ hours. The ion source geometry is similar to that of the experimental source, reported earlier in [1]. It uses a combined discharge with the Penning glow driven by plasma injection from the hollow cathodes. Hydrogen and cesium enter to the Penning discharge region through the plasma of hollow cathode arc. Cesium seeding is supplied by heating of the external oven loaded with Cs pellets (Cs_2CrO_4+Ti). Cesium is needed for the hollow cathode arcing and for effective H^- production on the discharge electrodes [2].

Magnetic field in the ion source is produced by external permanent NdFeB magnets with additional coils for field control. Since the H^- beam is deflected by this field, the second similar magnet system is used in order to direct it back coaxially. A built-in ohmic heater provides the cesium discharge start. Negative ions are extracted through the emission hole in the anode bottom cover. A triode ion-optical system is used for beam extraction at 4-5 keV and post-acceleration to 32 keV by the grounded accelerating electrode.

H^- beam with current 15-16 mA is produced with discharge voltage 80–90 V, current 8-9 A, hydrogen pressure 4–5 Pa, and magnetic field in discharge zone of about 0.1 T. An optimal anode temperature for beam production is 250–300°C. The total current in the extracted circuit (mainly consisted of H^- ions and co-extracted electrons) is <30 mA and it is about 3 times lower, than that in the experimental source [1]. The total current in the post-accelerated circuit is about 40 mA. Occasional breakdowns (several times per hour) stipulate the electrode conditioning and do not prevent the source from the normal operation. ”Unattended” runs were performed with discharge and beam control by a computer. No essential problems with electrode sputtering, erosion and flakes formation were recorded during and after $>10^2$ hours runs.

References

[1] *Yu. Belchenko, I.Gusev, A.Khilchenko et al.* Rev. Sci. Instrum. **77**, 03A527 (2006)
[2] *Yu. Belchenko and A.S. Kupriyanov*. Rev. Sci. Instrum. **65**, p.417 (1994)

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