EFFICIENCY INVESTIGATION OF A NEGATIVE HYDROGEN ION BEAM PRODUCTION WITH THE USE OF ECR PLASMA SOURCE [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.134

1Lapin R.L., 1,2Skalyga V.A., 1Izotov I.V., 1Golubev S.V., 1Razin S.V., 1Bokhanov A.F., 1Kazakov M.Yu., 1Shaposhnikov R.A., 3,4Tarvainen O.

1Institute of Applied Physics Russian Academy of Sciences, Nizhny Novgorod, Russia
2Lobachevsky State University, Nizhny Novgorod, Russia
3Rutherford Appleton Laboratory, Harwell, OX11 0QX, UK
4University of Jyvaskyla, Department of Physics, FI-40014 Jyvaskyla, Finland

Negative hydrogen ion sources are of great demand in modern physics as injectors into accelerators and as drivers for neutral beam injectors for fusion devices [1]. In the previous work it was shown that the use of gasdynamic ECR plasma could be prospective for volume negative hydrogen ion production and gives a possibility to obtain H- beams with current density up to 80 mA/cm2 [2]. Some processes in low-temperature hydrogen plasmas, which are important for negative ion generation and dissociation, are accompanied by the radiation in vacuum ultraviolet (VUV) range [3]. Investigations of VUV emission provides an opportunity to obtain key plasma parameters and volumetric rates of plasma-chemical processes and thus to optimize H- ion source.

We investigated negative ion production n a two-stage volume generation mechanism based on the gasdynamic ECR plasma discharge. At the first stage, vibrationally excited hydrogen molecule at high states are produced through B and C singlet states as a result of collision with “hot” (50 – 100 eV) electrons, at the second one H- are generated as a result of dissociative attachment of “cold” (≤ several eV) electrons to the excited molecules. Experiments were performed with the plasma sustained by pulsed 37 GHz / 100 kW gyrotron radiation in a two-stage magnetic system, consisting of two identical simple mirror traps, connected to each other. Volume negative ion production was implemented in the following way: ECR discharge took place in the first trap, while dense hydrogen plasma flowed into the second chamber through a perforated plate. It prevents the passing of microwaves into second chamber and presumably helps to produce “cold” electronic fraction there as a result of neutral gas ionization.

We studied ECR plasma emission in three ranges corresponding to the lines of atomic (122±10 nm - Lyα line) and molecular emission (160±10 nm – Lyman band, and 180±20 nm – molecular continuum) of hydrogen in both traps with the use of appropriate filters and calibrated diode in a wide varying range of system parameters. The dependencies of VUV emission power on system parameters were measured near optima for H- production. It was shown that molecular continuum emission prevails in the first chamber and Lyα emission has the highest value in the second trap. As a final result, we have suggested some modifications of the experimental scheme for further optimization of negative hydrogen ion production.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/FJ-Lapin.docx) [↑](#footnote-ref-1)