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

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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)