Effect of High Energy Electrons on H⁻ Production and Destruction in a High Current DC Negative Ion Source for Cyclotron

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In cyclotron used for medical application, negative hydrogen ions (H⁻) are commonly injected and accelerated to obtain higher extraction efficiently [1]. In such application of H⁻ ions, it is highly required to enhance the H⁻ production in ion sources and for obtaining high H⁻ beam current. In this study, we focus on the multi-cusp DC arc-discharge source [2]. A systematic study of the EEDF (Electron Energy Distribution Function) in the arc-discharge plasma has been conducted. Especially, the effect of the EEDF on the efficient H⁻ production has been studied by the KEIO-MARC code (Kinetic modeling of Electrons in the IOsource plasmas by the Multi-cusp ARC-discharge) [3].

By using the results of the EEDF from the code, H⁻ production rate/destruction rate is calculated by a system of zero-dimensional (0D) rate equations. Effects of 1) filter magnetic configuration, and 2) arc-discharge power, on the EEDF and on the resultant H⁻ production/destruction have been studied systematically. In addition, their optimizations are being carried out. Furthermore, some improvements of the KEIO-MARC code regarding neutral reactions and transport are being conducted. The results of those improvements will also be reported.

References