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Development of an RF-Driven Ion Source for the KSTAR Neutral Beam Injection System

The current ion sources employed in the KSTAR (Korea Superconducting Tokamak Advanced Research) neutral beam injection system utilize conventional filament-driven multicusp ion sources. However, the primary limitations of this source arise from the usage of 12 tungsten filaments, leading to complexities and maintenance issues. To overcome these drawbacks, the development of an RF-driven ion source has been initiated. In this study, a preliminary performance evaluation was conducted for an inductively coupled plasma source, employing a 5.5 kW RF power supply operating at 13.56 MHz.

To comprehensively characterize the plasmas, plasma diagnostics were conducted using an RF-compensated single Langmuir probe. Moreover, a 2-D plasma modeling utilizing COMSOL was performed, enabling a thorough analysis by comparing the modeling results with experimental data. The integration of experimental measurements and computational simulations offers crucial guidance for the development of the RF ion source, ensuring its compliance with the specific requirements for implementation in the KSTAR neutral beam injection system.

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