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Investigation on the radio-frequency power transfer efficiency in an inductively coupled hydrogen plasma source with an expansion region[1]

HONG LI, FEI GAO, DE-QI WEN, WEI YANG, PENG-CHENG DU, YOU-NIAN WANG, Dalian University of Technology, PLASMA SIMULATION AND EXPERIMENT GROUP (PSEG) TEAM — The radio-frequency (RF) power transfer efficiency is experimentally and numerically investigated in an inductively coupled hydrogen plasma source with an expansion region. The fundamental plasma properties are obtained by means of a Langmuir probe. The effect of the antenna coil turns, N, is also studied in a range of 3 - 9 turns. It is found that more coil turns can significantly enhance the power transfer efficiency. Moreover, the experimental results show that the power transfer efficiency first increases and then reaches the maximum with increasing the applied power. The peak of the power transfer efficiency shifts consistently from 1 Pa to higher pressures with increasing the applied power and N. In order to reproduce the experimental results and give a comprehensive knowledge of the power absorption mechanism, a self-consist hybrid model is carried out. The numerical results and the analytic solutions in the limit cases can well explain the various trends of the power transfer efficiency obtained in the experiment.

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