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The High Power-Beam Efficiency Investigation of Miniaturized ECR Ion Source

A miniaturized 2.45GHz microwave ion source (MIS) with plasma chamber of 30 mm x 40 mm and has the ability to produce more than 20 mA CW hydrogen ion beam with 180 W microwave power has been built at Peking University(PKU)[1]. To understand the plasma evolution mechanism of MIS, a hybrid discharge heating (HDH) mode that contains a surface wave plasma (SWP) ignition discharge process and an electron cyclotron resonance(ECR) ionization was proposed, and the power-beam efficiency is increased to 25 mA/100 W[2]. The power-beam efficiency is a key parameter to evaluate an ECR ion source, and many factors can affect it. Under the structure of this MIS, factors such as input power, pressure, magnetic field configuration, and the wall material and the size of plasma chamber has been investigated. Based on this research, a more compact 2.45GHz microwave ion source with inner diameter of 24mm has been developed. A 32.5 mA hydrogen ion beam was obtained with only 100 W microwave power. RF power efficiency of this one is increased from 25 mA/100 W to 32.5 mA/100 W.

[1] J.M. Wen, S. X. Peng, H. T. Ren, et al., Chin Phys B. 27, 055204 (2018).

[2] W. B. Wu, S. X. Peng, A. L. Zhang, et al., J. Appl. Phys. 132, 083305 (2022).

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NSFC 11975036

Email Address

sxpeng@pku.edu.cn

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Presenter if not the submitter of this abstract

Shixiang Peng

Primary authors: Mr MA, Tenghao (Peking University); Mr CUI, Bujian (Peking University); Dr WU, Wenbin (Institute of Applied Physics and Computational Mathematics); Mr JIANG, Yaoxiang (Peking University); Prof. GUO, Zhiyu (Peking University); Prof. CHEN, Jiaer (Peking University); PENG, Shixiang (Peking University)

Presenter: PENG, Shixiang (Peking University)

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