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Preliminary design of tungsten wire calorimeter for CRAFT NNBI

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As one of effective means for plasma heating and current driving, neutral beam injector have been installed in most of nuclear fusion experimental devices in the world. High power neutral beam long pulses are required for continuous heating was required according to the development and research of magnetic controlled fusion energy. Large area high current ion source is the key equipment of neutral beam implantation system, in order realize efficient plasma heating, it is necessary to tune and optimize the ion source. As a common ion source diagnostic technology, tungsten wire calorimeter has been widely used in foreign neutral beam test platforms. In this paper, a tungsten wire calorimeter for beam source diagnosis is preliminarily designed. The relationship between temperature distribution of tungsten wire and heat conduction and radiation is explored by heating tungsten wire in vacuum environment, the diameter of tungsten wire and the time to reach thermal equilibrium, the temperature distribution of tungsten wire under different beam energy and influence of beam current with different divergence angle on the temperature distribution of tungsten wire are simulated and analyzed by finite element method. It also designs the frame of tungsten wire calorimeter, analyzes the fixing mode of tungsten wire and frame, the insulation isolation between tungsten wire and frame, tests the spring tension used for fixing tungsten wire, and determines the connection mode between spring and tungsten wire. Finally, the preliminary design of the tungsten wire calorimeter is completed. The operation of the calorimeter will provide a method for studying the spatial and temporal resolution of the beam, and provide a powerful technical means for the exercise and test of the exercise and test of the ion source.

Primary authors: Mrs YU, ling (institute of plasma physics, chinese academy of science); Mr XU, yizhen (institute of plasma physics, chinese academy of science)

Co-authors: Dr XU, yongjian (institute of plasma physics, chinese academy of science); Ms CHEN, liping (institute of plasma physics, chinese academy of science); Mr PENG, xufeng (institute of plasma physics, chinese academy of science)

Presenter: Mrs YU, ling (institute of plasma physics, chinese academy of science)

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