Development and present status of divertor plasma simulator NAGDIS-II

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Linear plasma devices are being used around the world to solve various problems related to plasma-wall interactions and edge/divertor plasmas in fusion devices. The linear divertor simulator NAGDIS-II, which is located at Nagoya University, Japan, was developed more than 20 years ago, but it is still being updated and producing results. This device is approximately 2.5 meters long and steady-state plasma can be generated through direct current discharge.

Over the past decade, a set of discharge equipment has been improved. The intermediate electrode located between the cathode and anode was electrically divided for realizing the cascade arc discharge, and a stable power supply for the discharge and flexible gas piping system have been installed. Using this high-particle-flux plasma, numerous researches have been conducted on metal nanostructures, such as fuzz, nano-tendril bundles (NTBs), and large-scale fiberform nanostructure (LFN) [1].

Furthermore, many measuring instruments have been applied particularly for investigating the plasma detachment phenomenon. Downstream and upstream Thomson scattering measurement systems revealed a decrease in plasma parameters over long distances along magnetic field lines in helium plasma [2] and hydrogen-isotope plasmas [3]. Two-dimensional (2D) movable electrostatic-probe [4] and spectroscopy systems clarified the 2D spatial structure of the detached plasma. In high-speed camera measurements that included multiple windows in the field of view, statistical analysis methods were combined to clarify the spatiotemporal plasma transport behavior [5]. This year we introduced a new upstream chamber equipped with numerous ports that are advantageous for observation and measurements.

To understand physics at NAGDIS-II, DISCOVER, which is an integrated transport code consisting of a plasma fluid code, a neutral transport code, and a collisional radiative code, has recently been developed [6]. We will explore and propose physical models that contribute to improving the accuracy of detached plasma simulations, thereby contributing to the predictive simulation of fusion reactors.

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