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Development of a Limiter-like Langmuir Probe System for the QUEST All-Metal Device

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QUEST (the Q-shu University Experiment with steady-state Spherical Tokamak) is a medium size all-metal spherical tokamak device in Kyushu University, and various unique fusion researches have been performed [1-8]. In particular, it is expected that experiments on active control of first wall surface temperature [8] under fully non-inductively driven steady state tokamak operations could clarify effect of the first wall temperature on steadiness of the tokamak operations.

Langmuir probes are typically useful for investigating plasma quantities in scrape-off layer (SOL) and in the vicinity of the first wall. There are mainly two restrictions in construction of Langmuir probes for QUEST. One is Langmuir probe material. To improve retention condition for hydrogen inside the first wall, the QUEST device is made of metals, and carbon is not used. Therefore, carbon can't be used as a material of Langmuir probes for QUEST. The other is endurance to high heat load in SOL plasmas in QUEST. In QUEST, steady state spherical tokamak operations have been performed using the radio frequency wave heating/current drive systems. The systems often excite high energy electrons which can reach SOL plasmas. The high energy electrons can be an origin of high heat load to the first walls and diagnostics in the SOL. Therefore, Langmuir probes in the SOL should withstand the high heat load.

To experimentally investigate plasma profiles over far-SOL region in QUEST, a limiter-like Langmuir probe system[9] was developed. The system is mainly made of tungsten to keep compatibility of the system with the all-metal condition of QUEST. The system includes water coolant systems to withstand high heat fluxes originated from high energy electrons during steady state tokamak operations. In this talk, preliminary experimental results of SOL plasma measurements using the system are presented. Information of equilibrium profiles and fluctuating quantities observed in the experiments will be introduced.

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