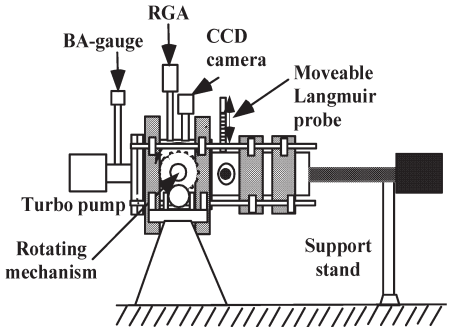
§8. A New Versatile PWI-experimental Device for the Evaluation of New Wall Concepts: VEHICLE-1

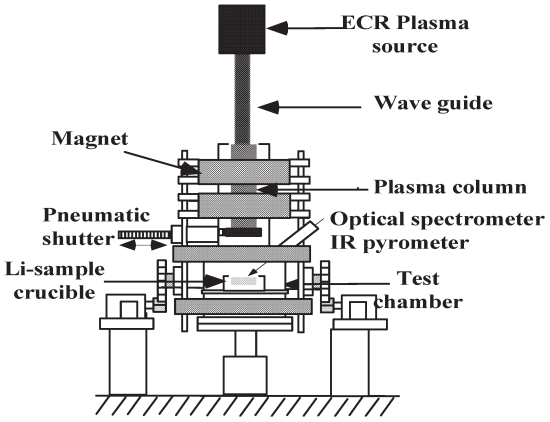
Hirooka, Y.

A versatile experimental facility has been put together for steady state edge plasma and surface component interactions research[1] and is currently in operation in the NIFS Plasma Heating Building. This facility is named VEHICLE-1 for a Vertical and Horizontal position Interchangeable test stand for Components and Liquids for fusion Experiments. A schematic diagram of VEHICLE-1 is shown in Fig. 1, where, as can be seen, two positions can be taken: (1) horizontal position similar to other laboratory-scale plasma facilities such as PISCES-B[2] ; and (2) vertical position like no other facility.

The VEHICLE-1 facility is equipped with a variety of diagnostics, including a linearly moveable Langmuir probe, differentially pumped residual gas analyzer, total pressure gauge, optical multi-channel analyzer, digital CCD camera, two thermocouples attached directly on both sides of the sample mounted on a graphite resistive heater. A 1kW ECR plasma source is employed, so that steady state plasmas of hydrogen, helium, nitrogen, oxygen, argon, etc. with densities of the order of 10^{10}cm^{-3} and electron temperatures typically 4~5eV. These plasma parameters are shown as a function of ECR power in Fig. 2.



(a) Horizontal position



(b) Vertical position

Fig. 1 The VEHICLE-1 facility shown in the horizontal position (a) and in the vertical position (b) is located in the Plasma Heating Building at NIFS.

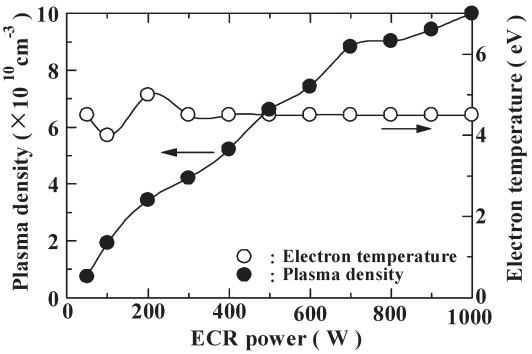


Fig. 2 Plasma parameters in VEHICLE-1 as a function of ECR power.

The vertical and horizontal positions interchanging mechanism of VEHICLE-1 is capable of swinging the whole device back and forth, including all the PWI-diagnostics, and this is meant to conduct proof-of-principle (POP) experiments on the innovative wall concept of liquid metal waterfall that can resolve all the PFC-associated issues including erosion, heat flux and particle control, etc. The preparation has been under way over the past year. Schematic illustration of the way this experimental setup works is shown in Fig. 3.

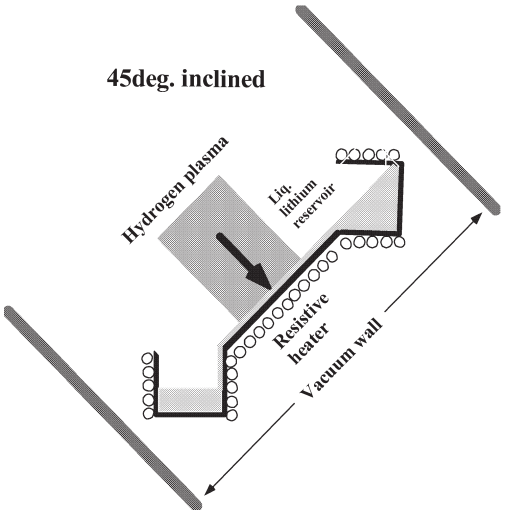


Fig. 3 Schematic illustration of a flowing liquid interacting with a steady state hydrogen plasma in VEHICLE-1.

Prior to flowing liquid experiments, standing liquid lithium has been bombarded with steady state hydrogen and helium plasmas. Results indicate that hydrogen recycling from liquid lithium is about 30% reduced, relative to that from solid lithium. Interestingly, opposite has been found for helium recycling, presumably due to the trapping effect by lattice imperfections[3]. These findings allow us to expect that flowing liquid lithium will also reduce hydrogen recycling even at steady state.

References

1) Hirooka, Y. et al., J. Nucl. Mater. **337-339**(2005)585.
2) Hirooka, Y. et al., J. Vac. Sci. & Technol.A **8** (1990) 1790.
3) Hirooka, Y. et al., Nucl Fusion **46** (2006)S56-S61.