

§8. Direct Energy Conversion in LHD (LHD-DECX) - Thermoelectric Conversion -

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Application of thermoelectric conversion in LHD plasma is studied.^{1,2)} The energy conversion by use of thermoelectric element is one of the methods of direct energy conversion from thermal energy of plasma to electricity. This element is installed in divertor plates of LHD and also used to measure heat flux to divertor plate precisely, where the temperature increment of divertor is estimated around 500°C (locally 3000°C).

Several thermoelectric elements have been developed, such as BiTe, BiTe/PbTe, and SiGe. The working temperature of BiTe and BiTe/PbTe are about 200°C and 600°C, with conversion efficiency of around 5% and 10%, respectively. On the other hand, SiGe works well at the temperature around 1000°C with about 15% conversion efficiency. There, however, is no application of thermoelectric elements in vacuum except for application for space science.

In order to investigate the property of thermoelectric elements in vacuum and under high heat flux, the test bench was designed and constructed (Fig.1). The elements will be installed at the center with water cooling pipe and

tested the performance in vacuum and contents of heavy metals under high heat flow. The attainment degree of vacuum is less than 10^{-5} Pa by the turbo-molecular pump with 550 ℓ /sec. The maximum temperature is designed higher than 850°C at the center by the surrounded heaters. This test bench is able to measure a small amount of elements up to mass number of 200 by the mass analyzer. The thermoelectric elements are introduced in the high-temperature vacuum chamber by the sample holder. This test bench also is useful to investigate not only the thermoelectric element but also the properties of the semiconductor materials for the basic science in high temperature. Computer calculation by using the finite element method will be used to analyze the experimental data and to design the thermoelectric divertor.

In future property of thermoelectric elements and the effects of heavy metals in vacuum with high heat flux will be studied by using this test bench. The plasma irradiation experiments to the elements will be also carried out by using TPD plasma source.

Reference

- 1) Y. Tomita, et al., 15th Japan Soc. Plasma Sci. and Nucl. Fusion Research, 2aB-5 (1998).
- 2) S. Yamaguchi, et al., 15th Japan Soc. Plasma Sci. and Nucl. Fusion Research, 2aB-6 (1998).

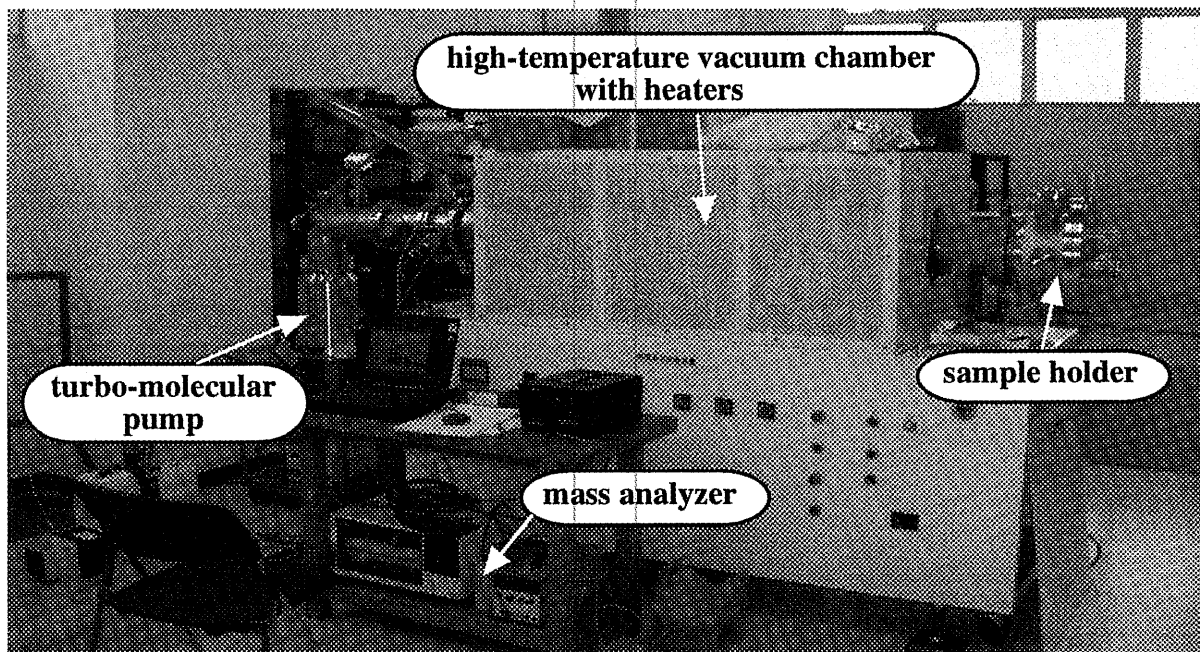


Fig.1. The test bench for investigation of property of thermoelectric elements. High vacuum and high temperature are obtainable by the turbo-molecular pump and the surrounded heaters.