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Thermal desorption spectrometry system for complementary hydrogen measurements of μ SR experiments

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Muon probing hydrogen study is based on the fact that the target material contains at least a small amount of hydrogen. Therefore, a high-sensitivity measurement of hydrogen abundance would be useful as a complementary measurement of μ SR experiments. We are developing a high-sensitivity thermal desorption spectrometry (TDS) system to perform such complementary measurements.

TDS is known as a method to evaluate the hydrogen abundance in a material¹. The principle is that a sample is heated in an ultra-high vacuum, the partial pressure of the released gas is measured with a quadrupole mass spectrometer, and the gas abundance is quantitatively evaluated by integrating the spectrum. Recently, the development of a TDS system that detects hydrogen with a high sensitivity of 10^{16} atoms cm^{-3} , the highly hydrogen sensitive TDS (HHS-TDS) system, was reported^{2,3}. Our system is a modified version of this HHS-TDS system suitable for complementary measurements of μ SR experiments.

While a conventional TDS system consists of a stainless steel UHV chamber, the HHS-TDS system consists of a chamber made of Be-Cu alloy. This alloy, which has a precise composition of $\text{Be}_{0.2}\text{Ni}_2\text{Ag}_{0.1}\text{Zr}_{0.2}\text{Cu}_{97.5}$, is suitable as a chamber material because of its good thermal conductivity, low hydrogen solubility, and hardness to form a vacuum flange⁴. In our system, the sample geometry was designed to allow measurement of thin-film substrates mounted on a flag-style sample holder, which is to make the measurement compatible with experiments using ultra-slow muons. We will report on the commissioning of the vacuum chamber and the infrared laser of the TDS system.

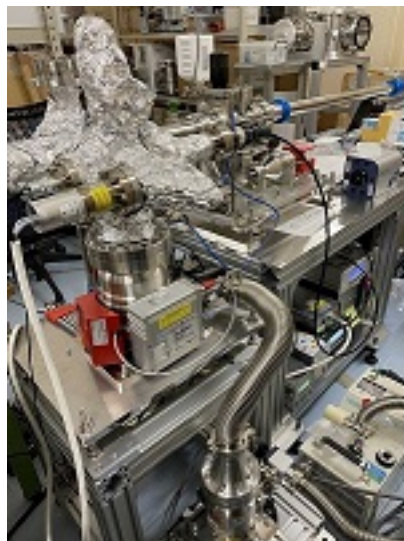


Figure 1: Snapshot of commissioning status of TDS system

- 1) J. B. Taylor and I. Langmuir, Phys. Rev. 44, 423 (1933).
- 2) T. Hanna et al., Rev. Sci. Instrum. 88, 053103 (2017).
- 3) K. Iwaya et al., Materials research meeting 2021, E5-O1-02, Yokohama, Japan, 2021.
- 4) <https://www.toel.co.jp/>

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