Application Note B-TA1044

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B-TA1044 - Vaporization rate of H_2O below room temperature

Introduction

STA(TG-DSC) can measure the evaporation, sublimation, dehydration, and decomposition behavior of substances by measuring the mass change during heating, but in the case of substances that evaporate, sublimate, or dehydrate under room temperature conditions, STA measurement from below room temperature is often necessary. The Low temperature STA with refrigerated cooling attachment can be cooled down to -40°C, making it possible to measure the mass change of samples below room temperatures. In this study, we evaluated the mass change of distilled water below room temperature by continuously measuring the cooling and heating processes of the distilled water.

Measurement and analysis example

The figure below shows the results of low-temperature STA in which approximately 5 mg of distilled water was used as a sample and cooled down to -40°C in helium atmosphere and then heated up to 100°C. The results show that mass loss due to evaporation of H_2O is observed during the cooling process immediately after the start of measurement, but the rate of mass loss decreases as cooling is continued. At -20°C, an exothermic peak due to crystallization is observed, H_2O becomes solid, and the subsequent mass loss is due to sublimation. At -40°C, the TG curve shows almost flat, and the sublimation rate of H_2O is very slow at -40°C. After that, the sublimation rate increases with increasing the heating, and after the endothermic peak due to melting is observed at 0°C, H_2O is 100% vaporized at around 40°C.The derivative TG, DTG curve corresponds to the rate of mass change of the sample; from the DTG curve, we can read that the rate of mass loss at 0°C is -2%/min and at 20°C is 7%/min, indicating that the volatilization rate at 0°C is decreased than 30% lower than that of room temperature (20°C).

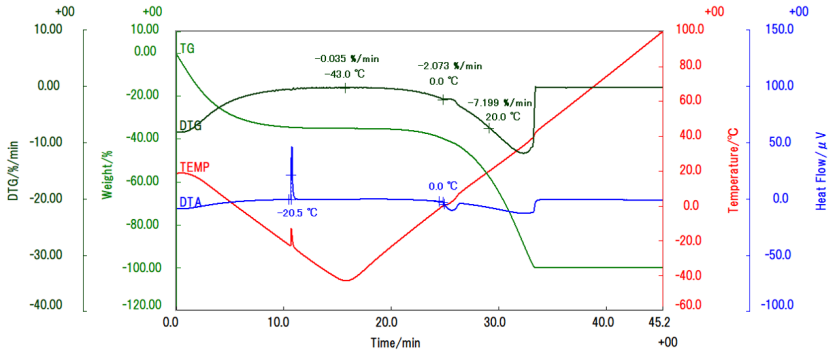

Figure 1: Low-temperature STA results of distilled water

Although STA is usually only used for temperatures above room temperature, using low-temperature STA makes it possible to evaluate the rate of mass change (such as volatilization rate) below room temperature.

Recommended equipment and software

- STA8122 + refrigerated cooling unit
- Vullios measurement and analysis software