Application Note B-TA1042

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B-TA1042 - Evaluation of the adsorption amount of MOF

Introduction

MOFs, Metal Organic Frameworks are three-dimensional microporous materials with pore properties formed by metal ions and bridging ligands, and have a high-surface area far exceeding that of activated carbon or zeolite. The adsorption separation method, which separates and captures CO_2 by reacting it with MOFs, is expected to have various applications, such as efficient gas storage, separation, and ion transport.

In this study, the amount of H_2O and CO_2 adsorbed at room temperature and the color change of the sample for HKUST-1 were measured and evaluated using a sample observation type of humidity controlled STA.

Measurement and analysis examples

In the pretreatment, the sample was heated to 180°C in He atmosphere (Figure 1(a)) and in dry N_2 atmosphere (Figure 1(b)), and after desorbing the adsorbed materials, it was cooled to room temperature. In Figure 1(a), when the measurement atmosphere was subsequently changed to CO_2 atmosphere, a 11.7% mass increase due to CO_2 adsorption was observed. Furthermore, by changing the atmosphere back to He, the adsorbed CO_2 was quickly released, resulting in a mass loss.

In Figure 1(b), a 33.2% mass increase due to H_2O adsorption was observed when the atmosphere was changed from dry N_2 to humidity controlled N_2 (25°C, 80% RH). A subsequent change to the dry atmosphere resulted in the mass loss due to dehydration, but the mass loss was gradual. Furthermore, comparing sample images during the measurements, the sample was dark blue after pretreatment, but no color change was observed upon CO_2 adsorption, turning light blue upon H_2O adsorption. This change to light blue is presumably due to hydration of the Cu^{2+} sites upon H_2O adsorption. Thus, it is clear that the amount of adsorption, adsorption/desorption rate, and sample color of HKUST-1 vary depending on the type of atmospheric gases being adsorbed.

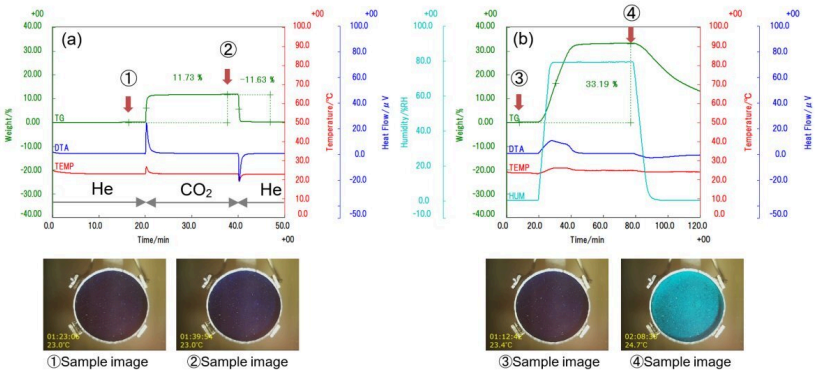


Figure 1: Sample observation STA results after sample pretreatment

(a) Measurement atmosphere: He → CO_2 → He,
(b) Measurement atmosphere: Dry → Humidity-controlled 25°C 80% RH → Dry (base gas: N_2)

Supervised by Prof. Ryotaro Matsuda of Nagoya University

Samples provided by Prof. Ryotaro Matsuda and Prof. Shinpei Kusaka of Nagoya University

Recommended instrument and software

- Sample Observation STA8122 and HUM-1
- Measurement and analysis software Vullios

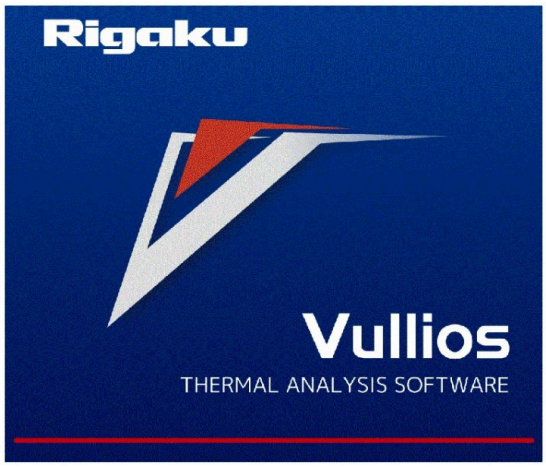
Related products

HUM

Water vapor generator: Thermal analysis of humid atmosph eres is possible simply by setting the relative humidity

Sample Observation STAvesta

Sample observation STA
TG-DSC system that allows real-time observation and recor ding of sample changes during thermal analysis



Vullios

Measurement and analysis software for Rigaku Thermal An alysis instruments