

## Application of the Real-Time Sample Observation Thermal Analysis System

November 2014

**Nobuaki Okubo**

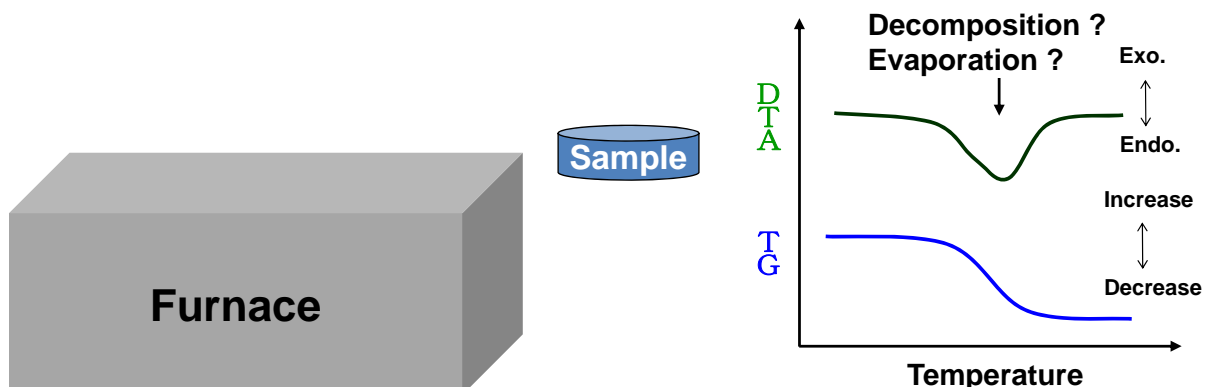
Analytical Application Engineering Department

Hitachi High-Tech Science Corporation

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

### Introduction - The Problem

- In conventional Thermal Analyzers, samples cannot be viewed directly because they are obscured by the furnace.
- So, Thermal Analyzer users are left to determine which phenomena occur by reviewing the curves obtained during the analysis.



We tried the development of the Thermal Analysis system which could observe a sample during the measurement.

So we completed this Real-Time Sample Observation system for DSC, STA, and DMA.



DSC System



STA System



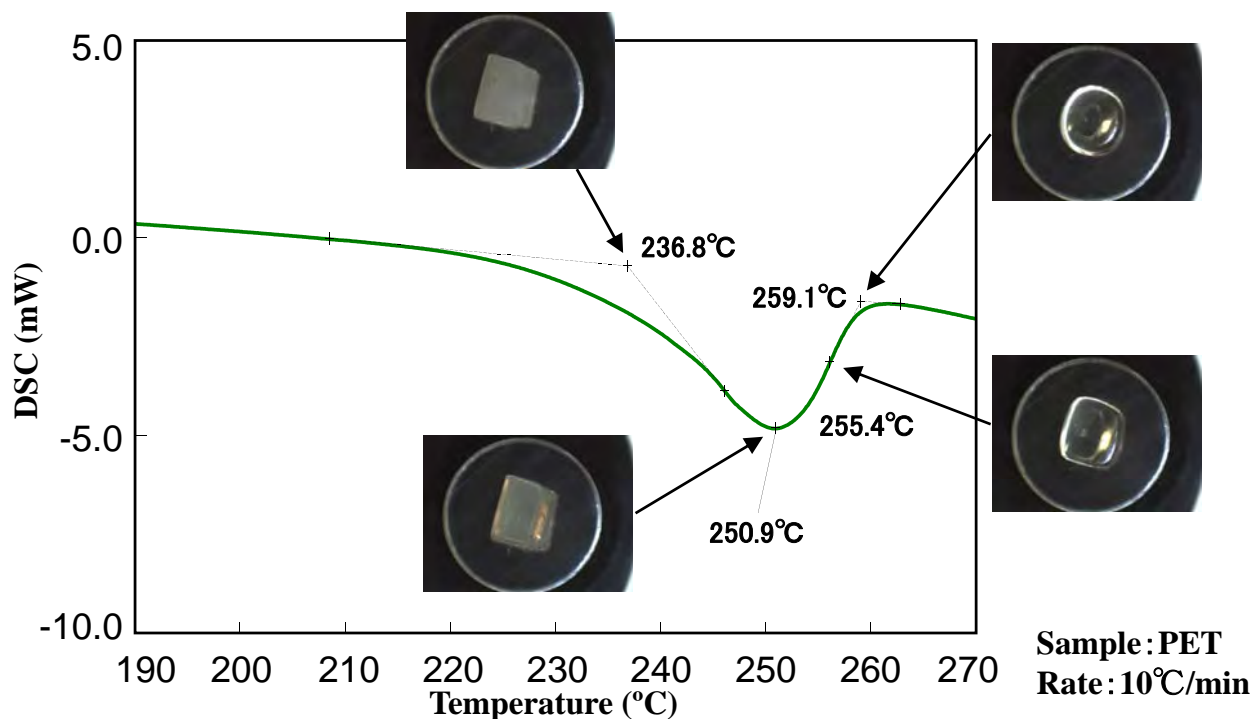
DMA System

*Hitachi High-Tech*

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

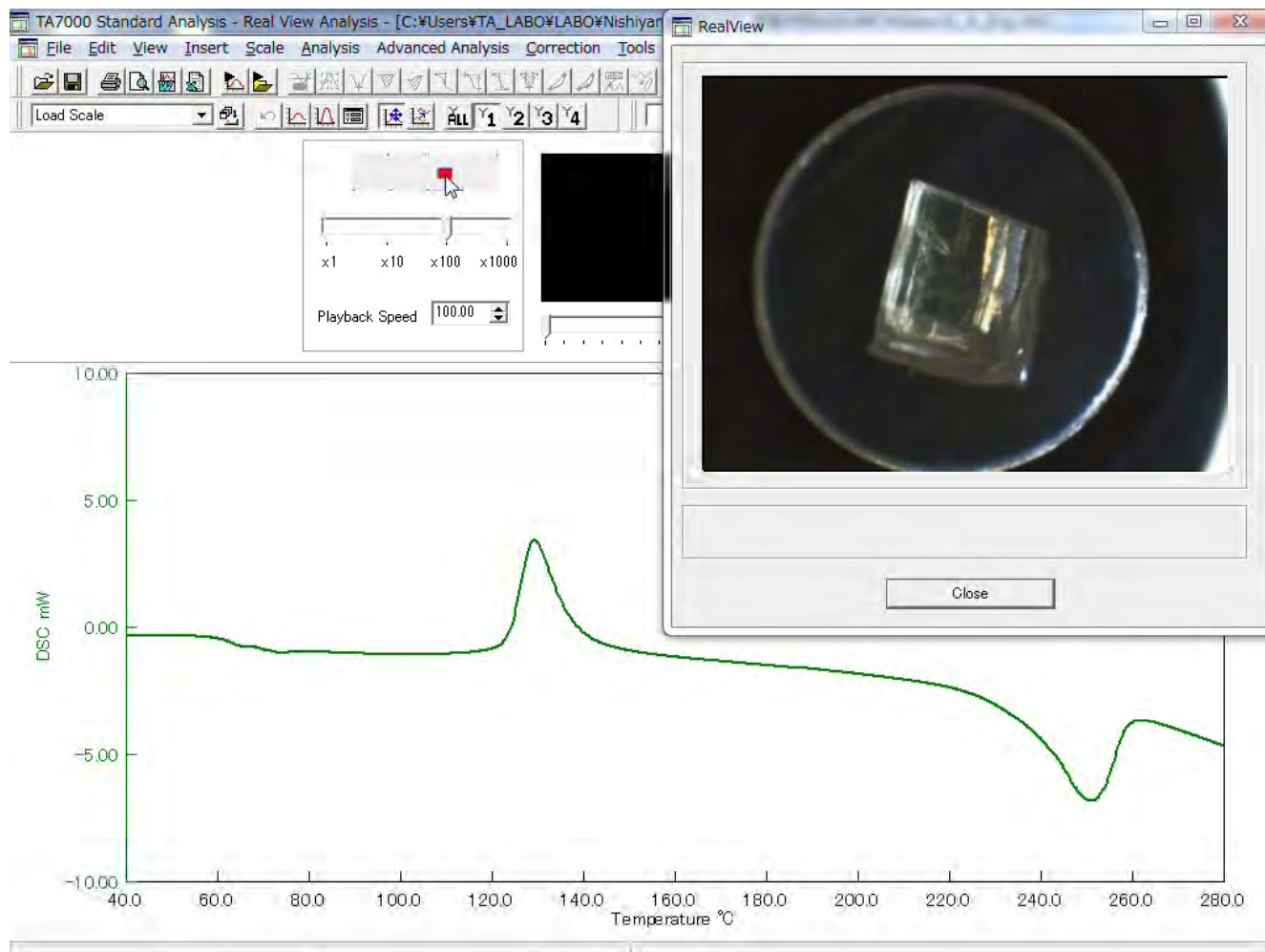
## Real-Time Sample Observing DSC Measurement

**HITACHI**  
Inspire the Next



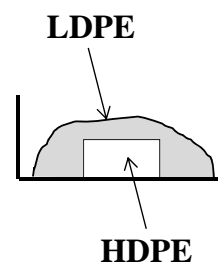
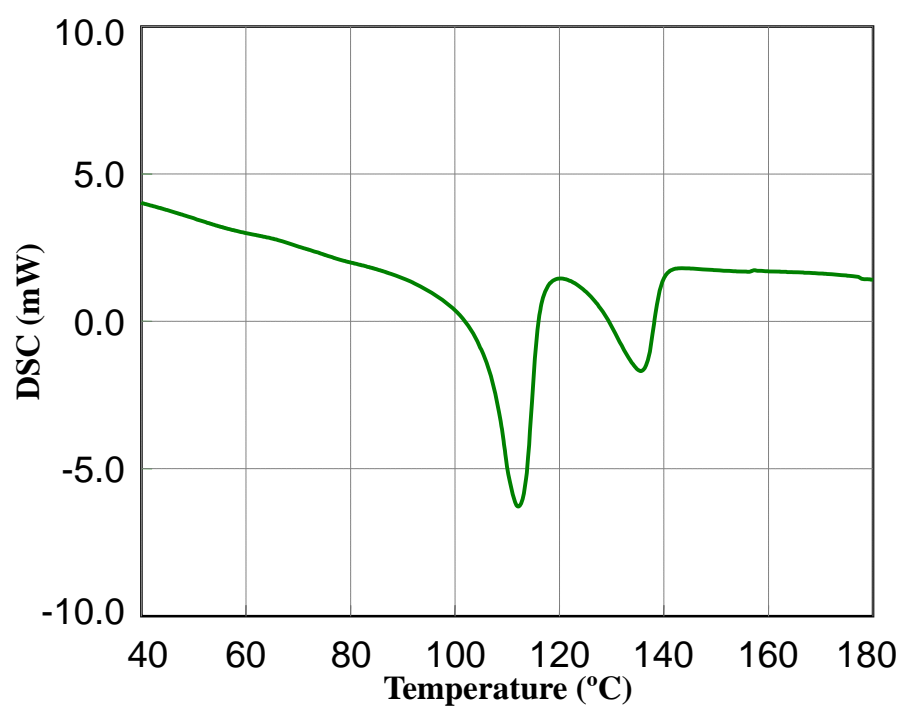
*Hitachi High-Tech*

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

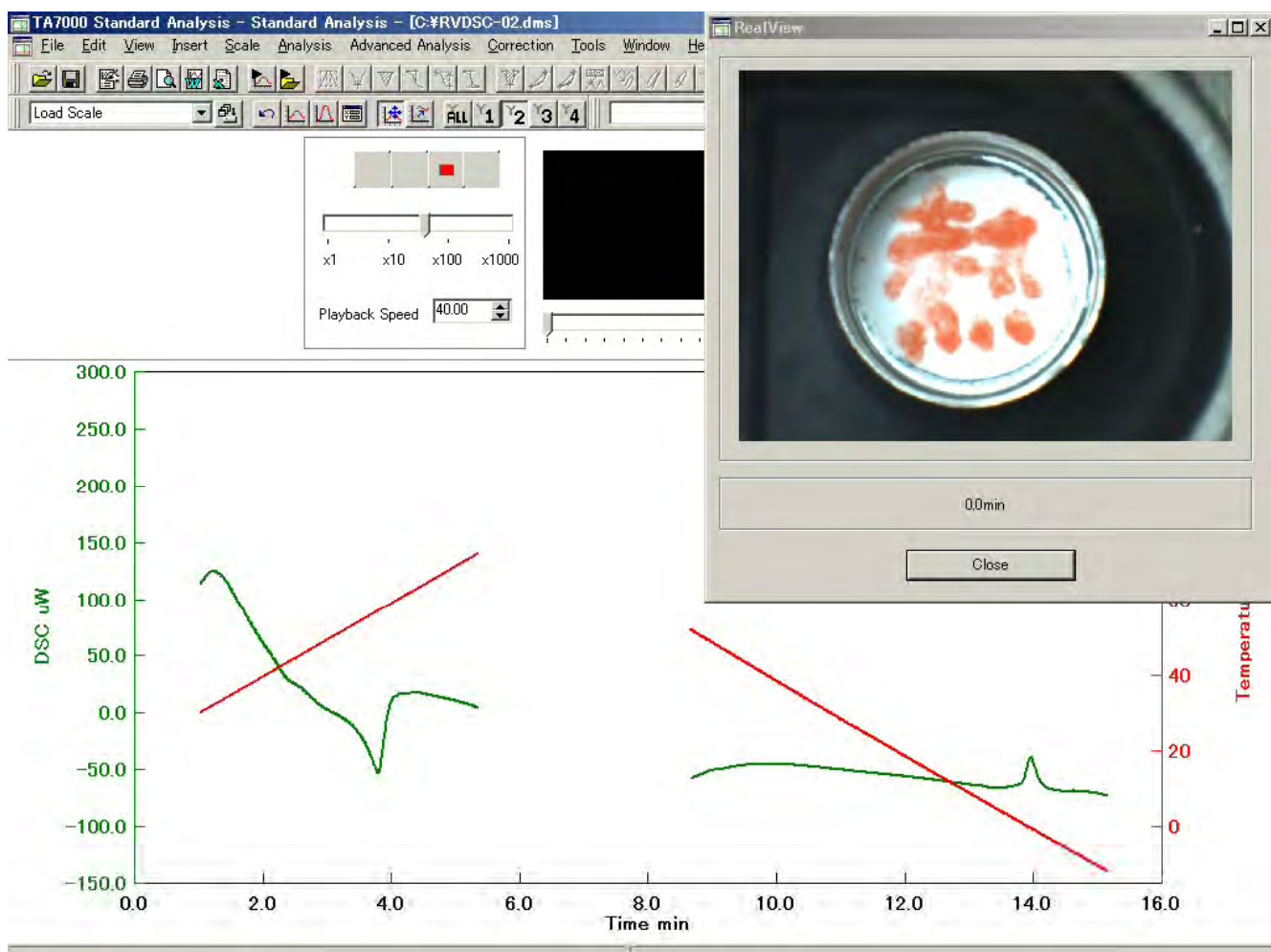
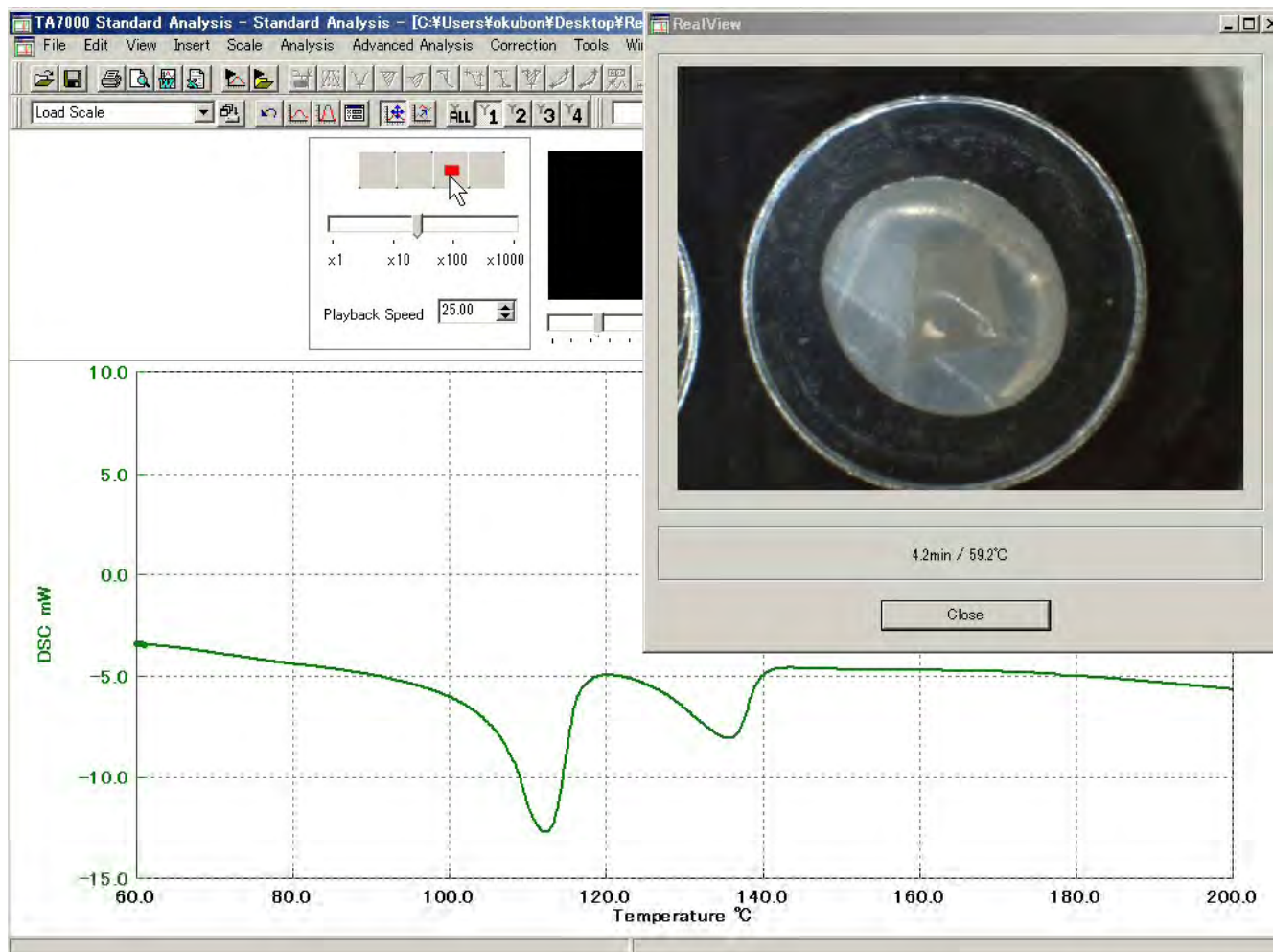


## Real-Time Sample Observing DSC Measurement

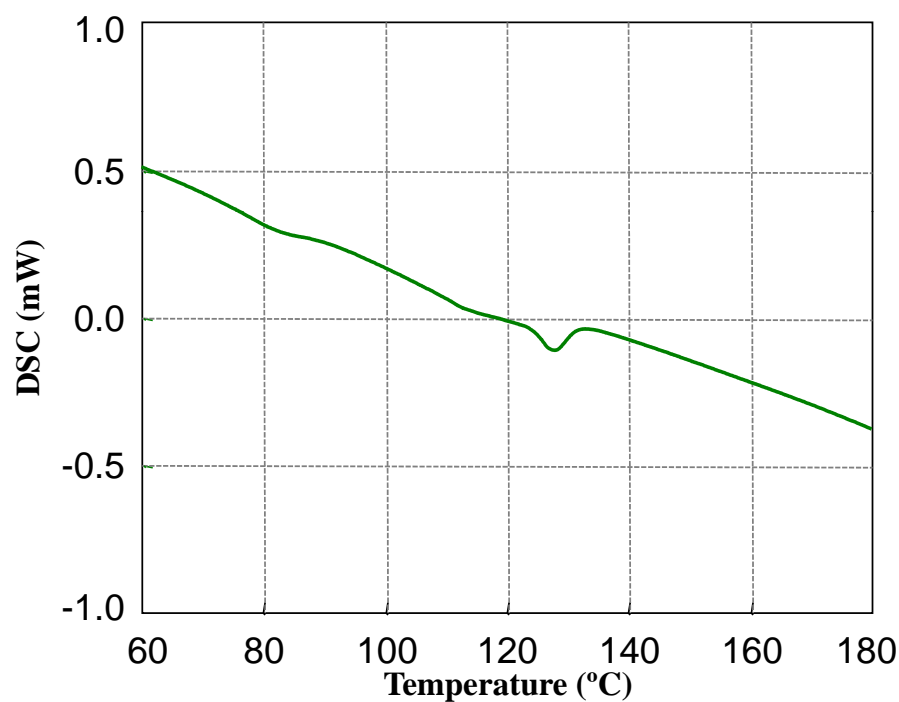
**HITACHI**  
Inspire the Next



**Sample: LDPE+HDPE**  
**Rate: 10°C/min**



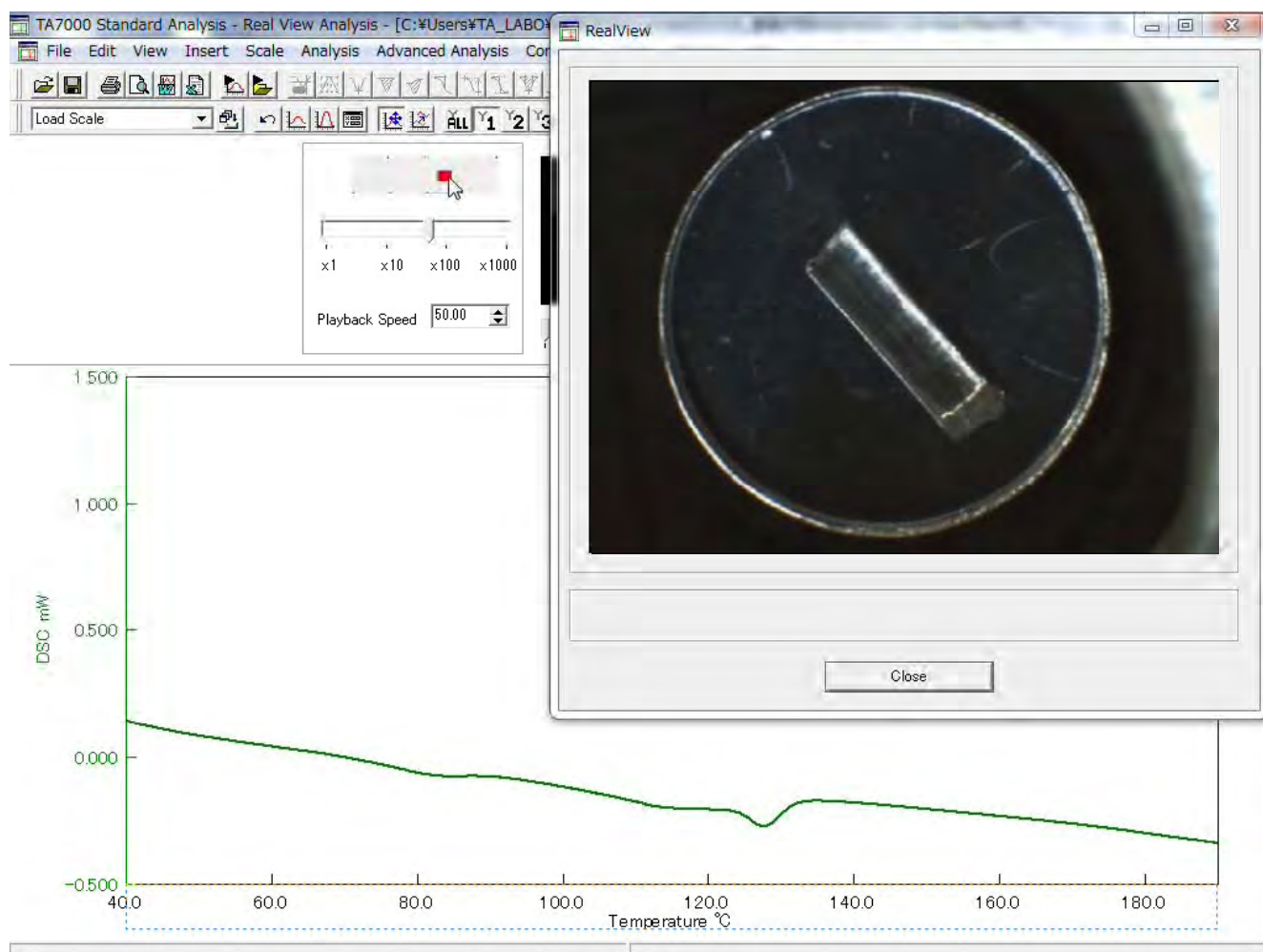


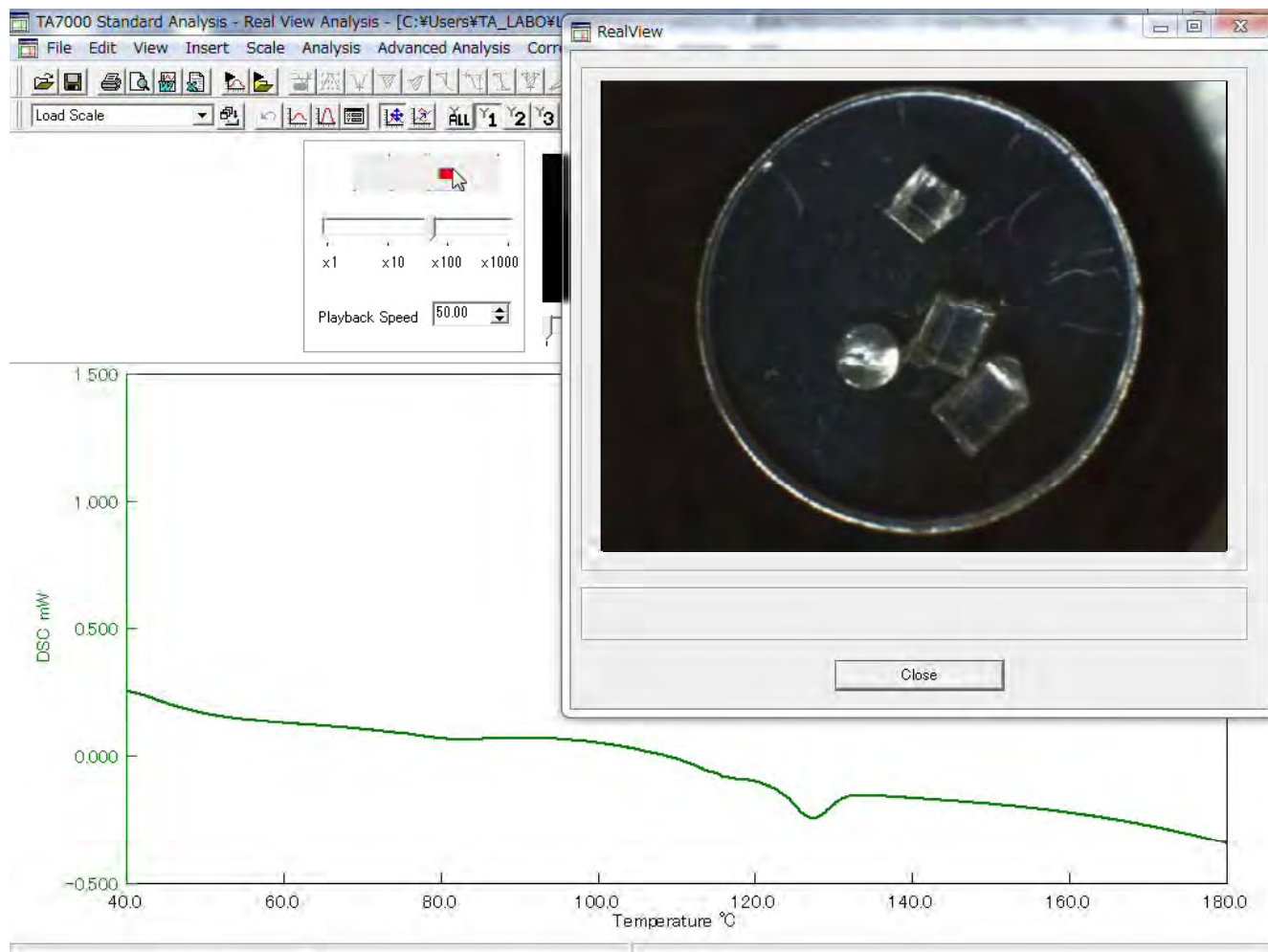


**Sample: Optical Fiber**  
**Rate: 10°C/min**

*Hitachi High-Tech*

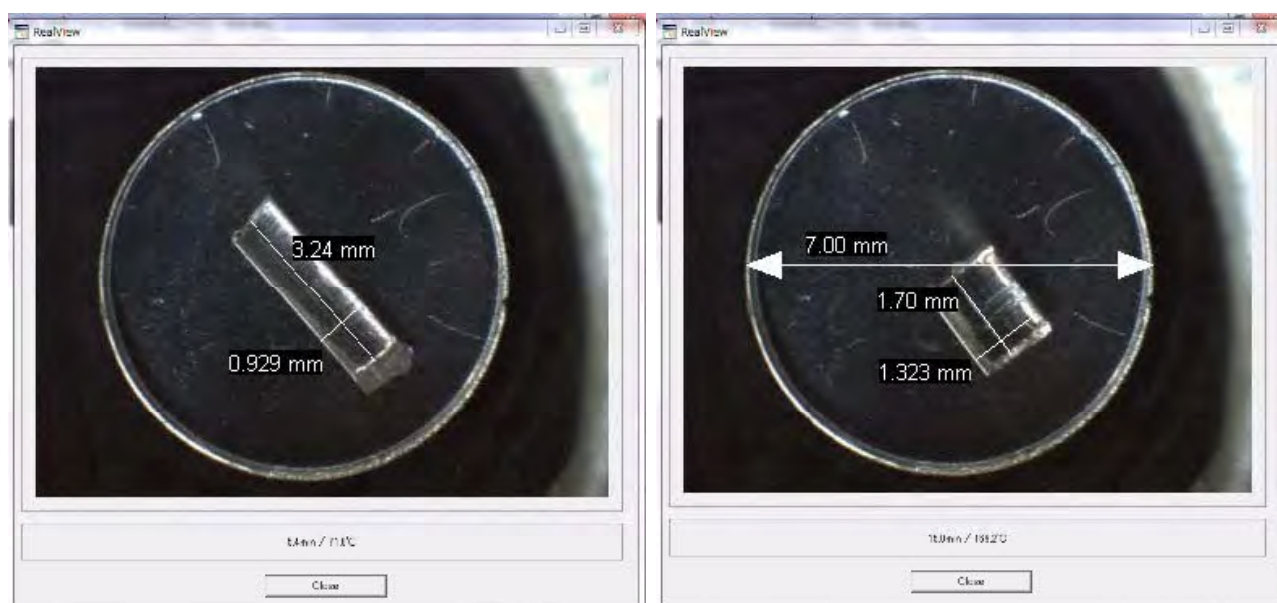
Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

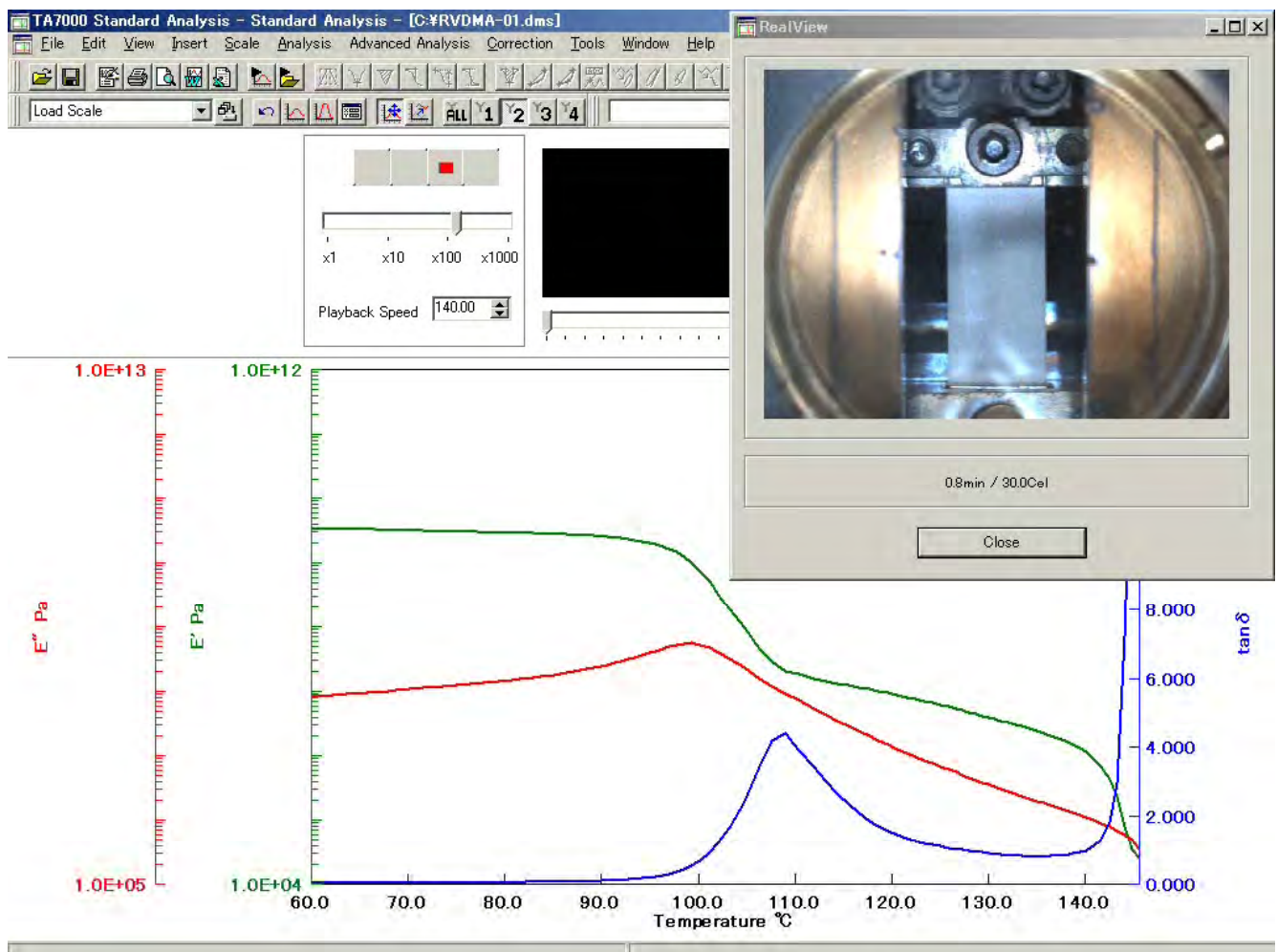
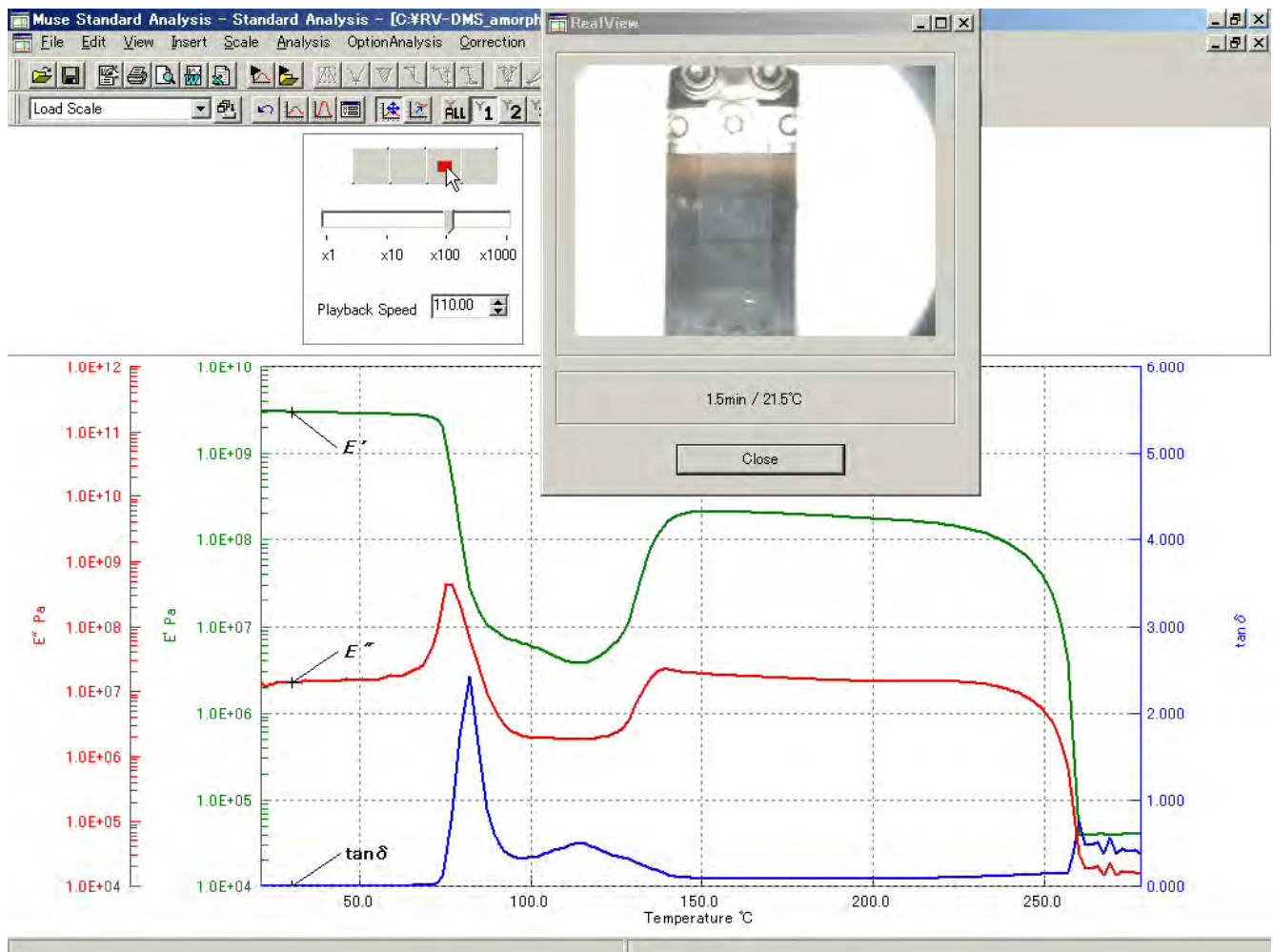




## Real-Time Sample Observing DSC Measurement

**HITACHI**  
Inspire the Next









STA7200RV+RV-2TG



Top view of furnace

*Hitachi High-Tech*

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.



Balance Beams



Cut-away image of furnace

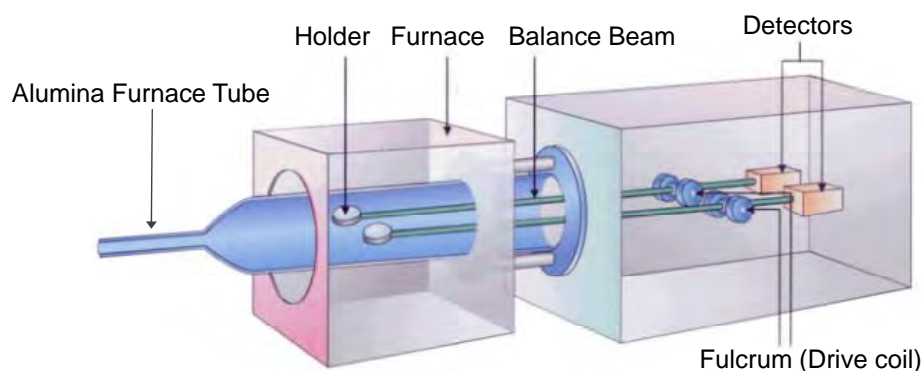
*Hitachi High-Tech*

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.



It is necessary to meet the following conditions to observe sample in the furnace during the measurement.

- Temperature up to 1000°C
- Temperature uniformity
- Maintain sensitivity and baseline stability
- Controlled performance of atmosphere (gas tightness and flow rate)



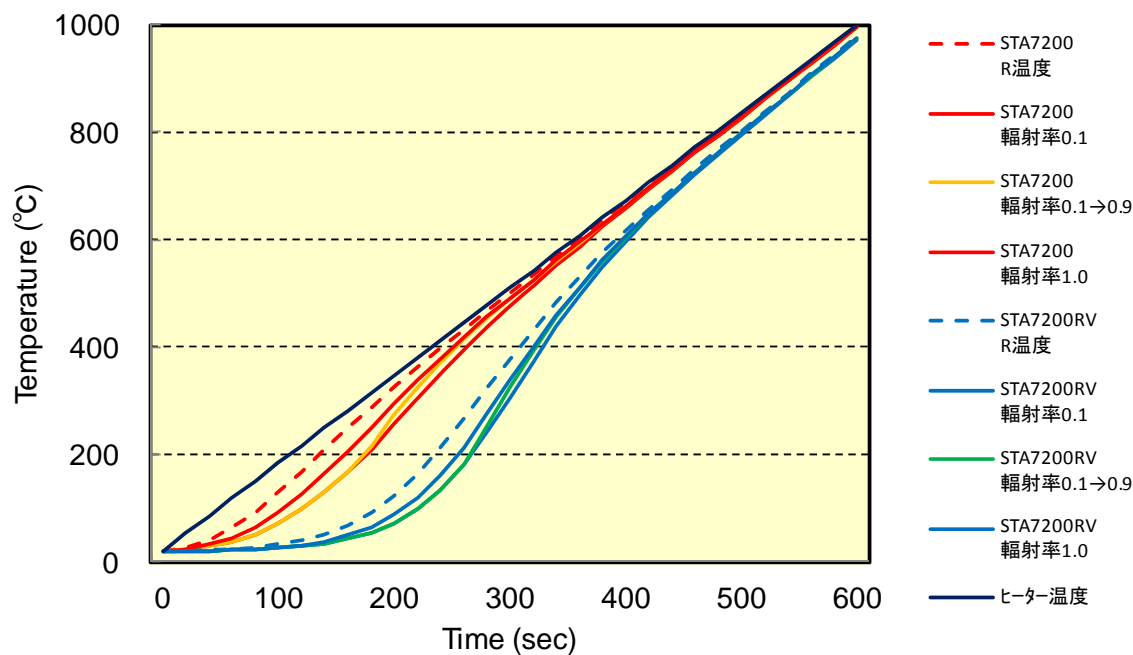
### Horizontal Differential Dual Beam Type STA (TG/DTA/DSC)

**Hitachi High-Tech**

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

## Modeling of Furnace by CAE

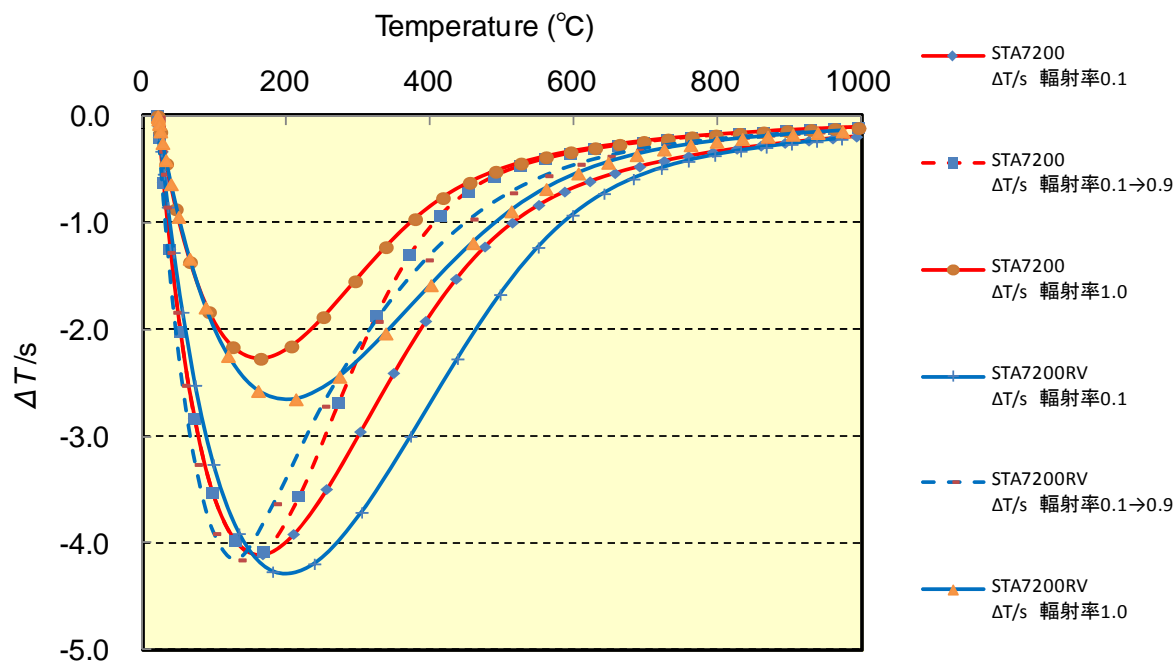
### Influence on sample temperature of radiation factor



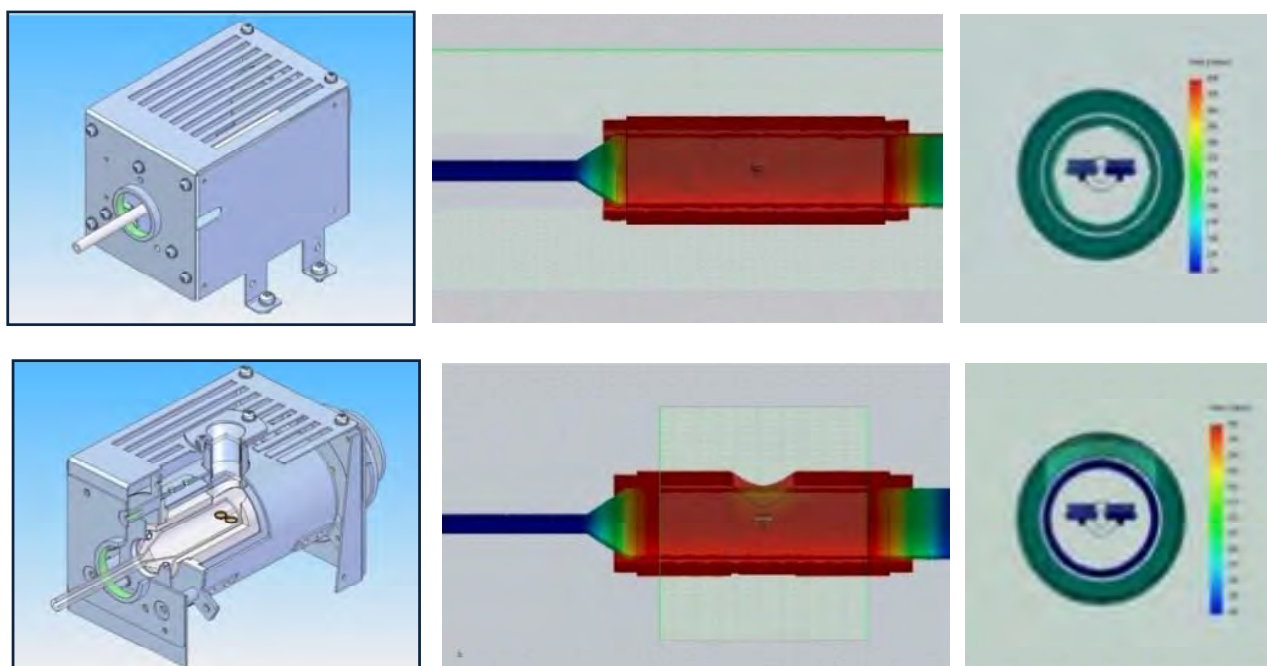
**Hitachi High-Tech**

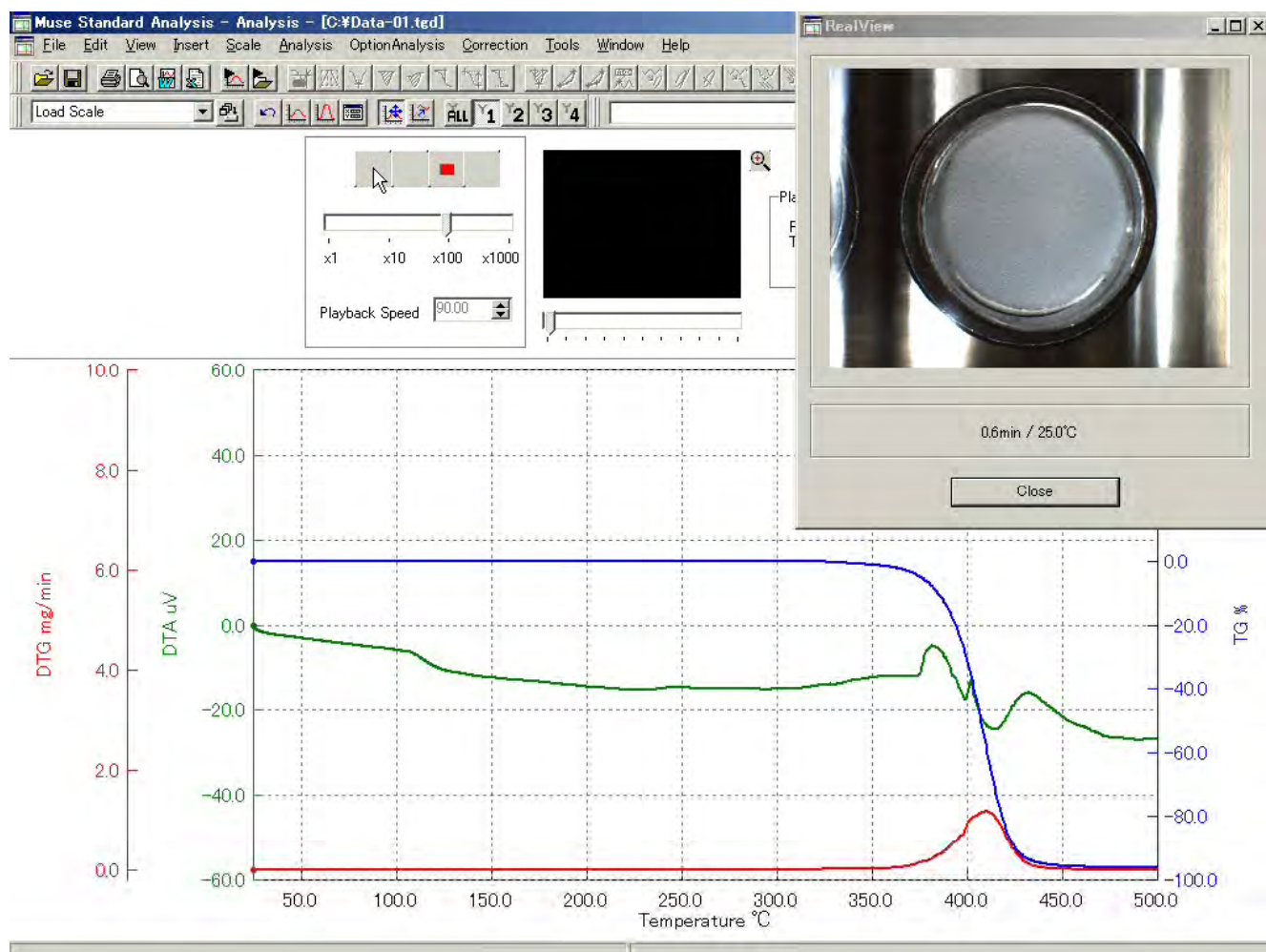
Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

## Influence on $\Delta T/s$ of radiation factor



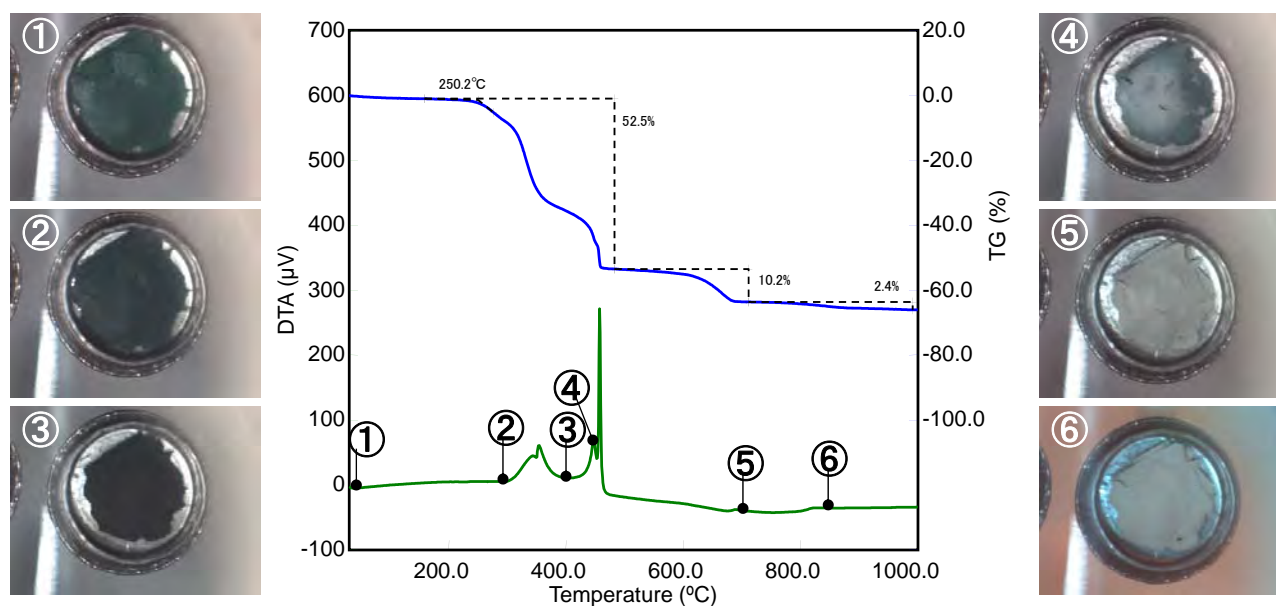
## Computer simulation of the radiant heat





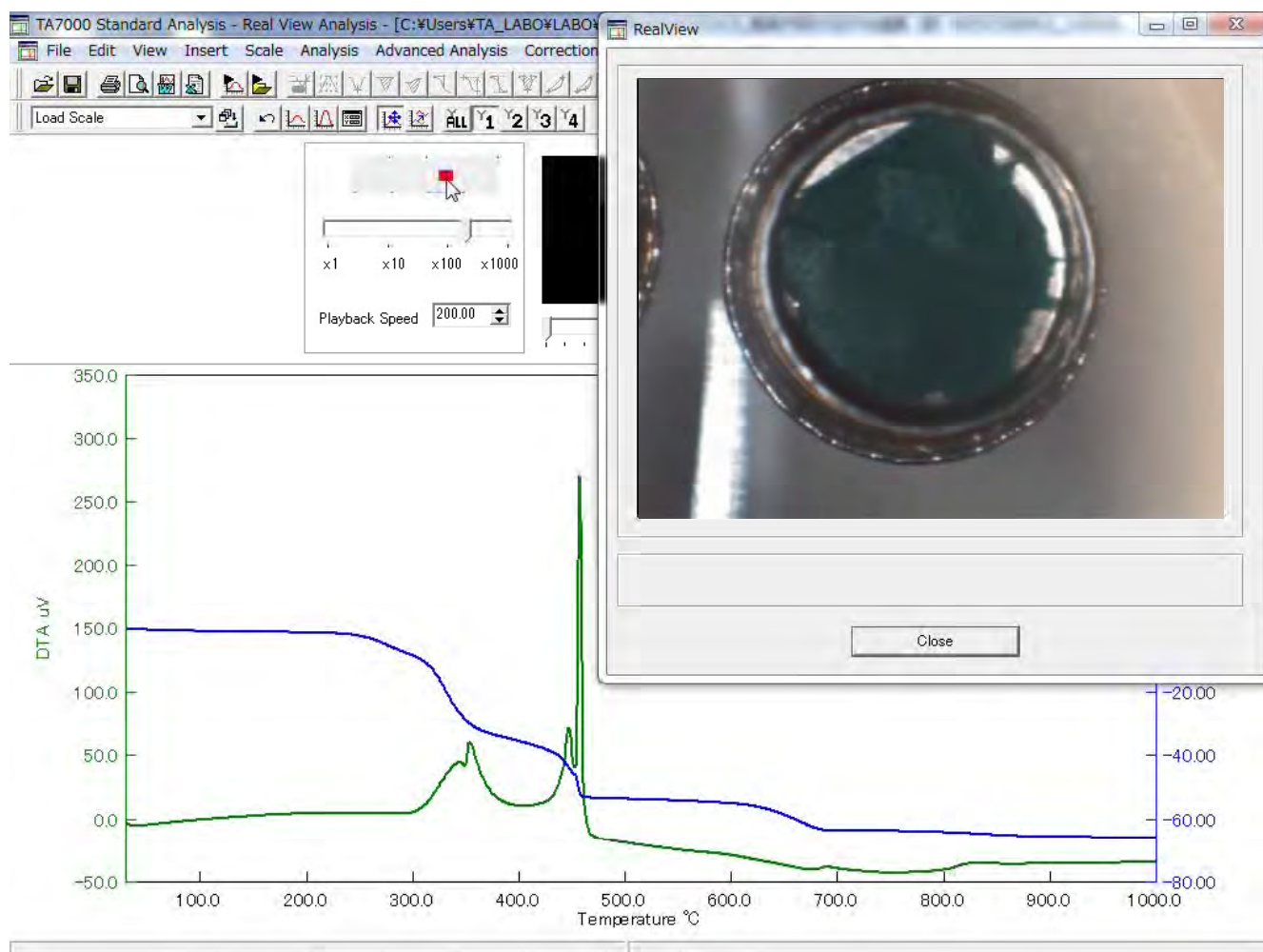
## Real-Time Sample Observing STA Measurement

**HITACHI**  
Inspire the Next



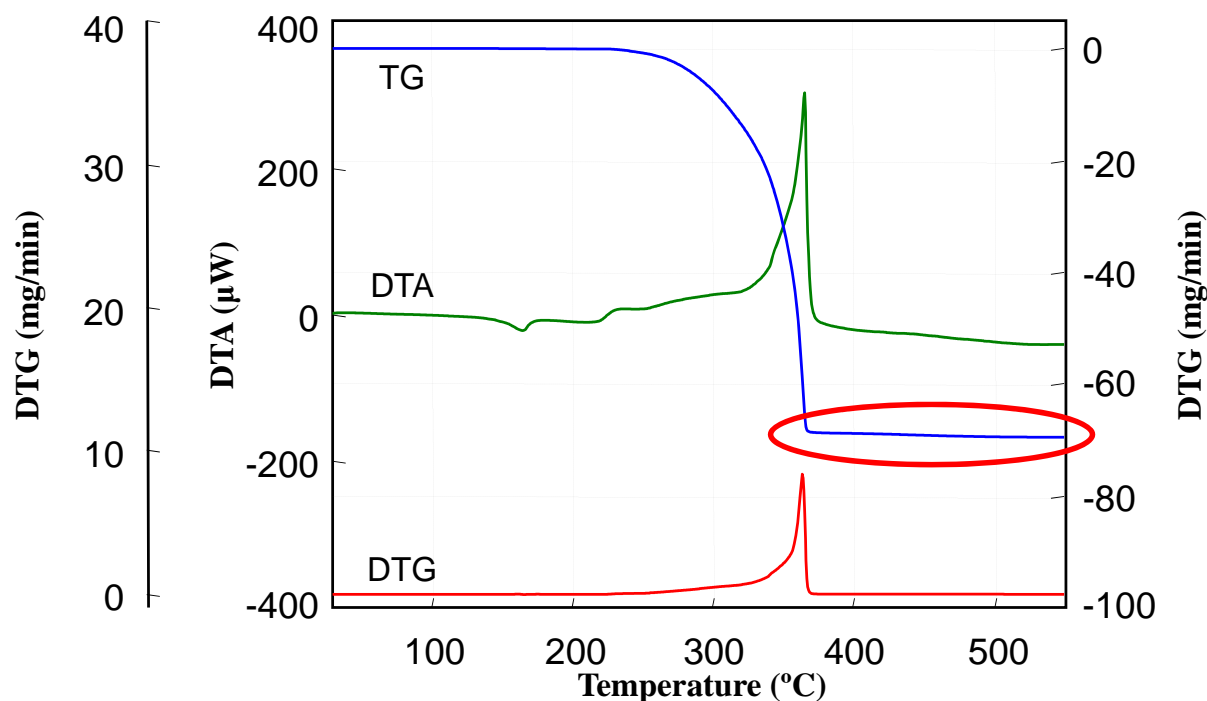
**Sample : Paint film**  
**Rate : 10°C/min**  
**Gas : Air 200mL/min**



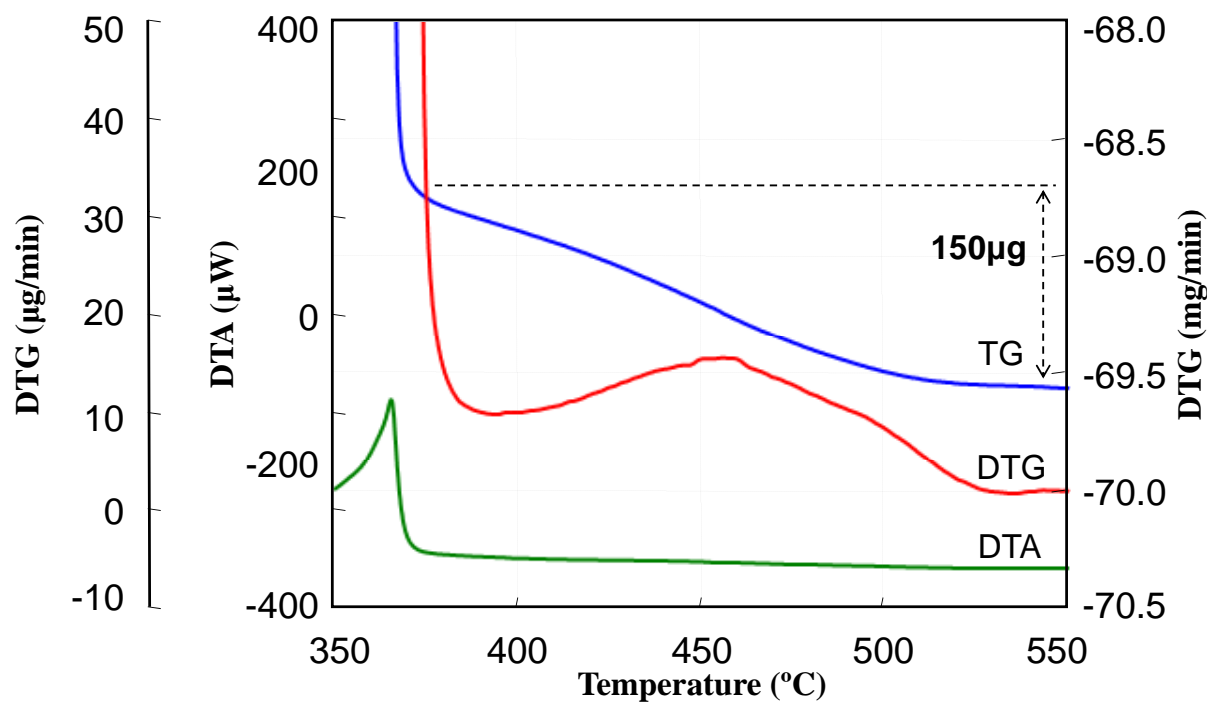


## Real-Time Sample Observing STA Measurement

**HITACHI**  
Inspire the Next



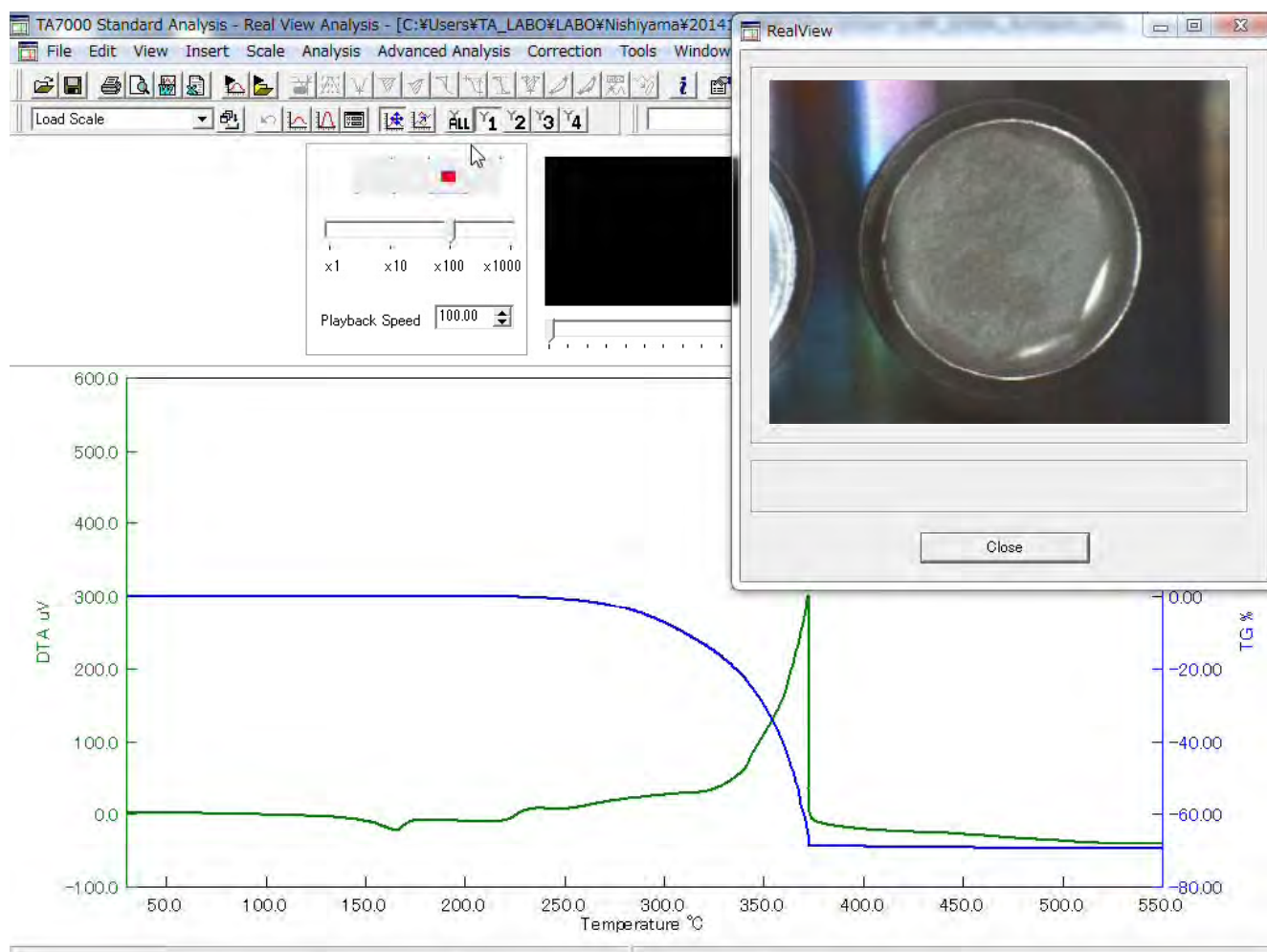
Sample : Glass Fiber Reinforced PP, Rate : 10 $^{\circ}\text{C}/\text{min}$ , Gas : Air 200mL/min



Sample : Glass Fiber Reinforced PP, Rate : 10°C/min, Gas : Air 200mL/min

**Hitachi High-Tech**

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.



**We developed the Real-Time Sample Observation system for DSC, STA, and DMA.**

**Particularly, the furnace of the STA system was enabled by the measurement up to 1000°C by using the computer simulation technique.**

**We will thereby obtain more detailed information by this systems.**



**DSC System**



**STA System**



**DMA System**

**Hitachi High-Tech**

Copyright ©2014 Hitachi High-Tech Science Corporation All Rights Reserved.

**HITACHI**  
Inspire the Next

***Thank you for your Attention***