A Bright Future for Thermal Methods

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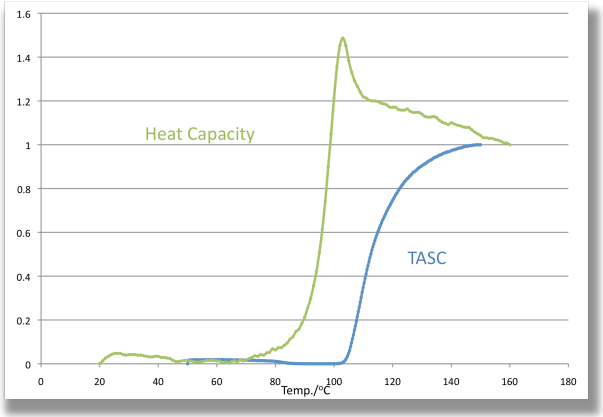
TASC Applications for Polymers

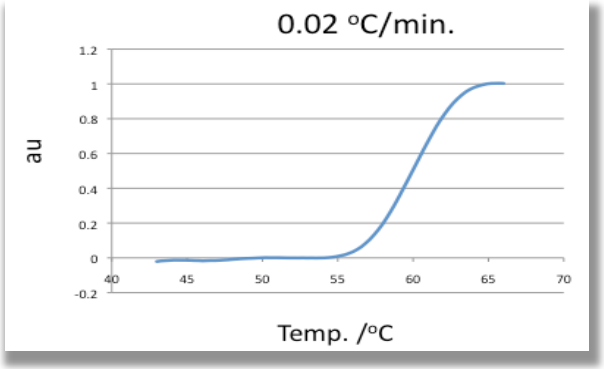
- Measuring Softening Points
- Measuring Glass Transitions in Very Small Samples
- Local Thermal Analysis
- Surface Measurements (Packaging)
- ThermoMechanical Analysis (TMA)

Measuring Softening Points

Right is an image showing a co-plot of DSC and TASC data. The flow event happens after the glass transition as measured by DSC as expected. The softening point as measured by TASC can serve as a means of inferring a glass transition in a wide range of materials including samples that are irregular in shape and not suitable for traditional TMA. It can also serve as a measure of relative viscosity for materials with similar chemical compositions.

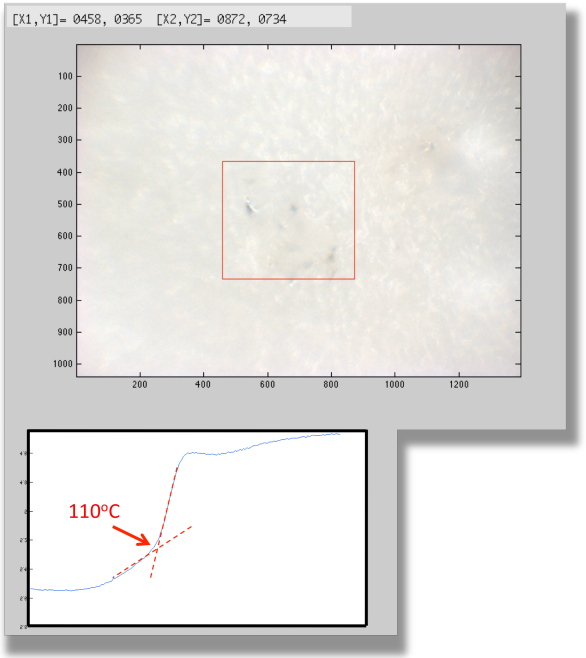


Right is a TASC experiment at a very slow heating rate. Unlike DSC the Signal/Noise of a TASC measurement does not degrade as the heating rate decreases. **Glass Transition Kinetics** can be studies over a very wide range of heating rates; see "TASC Applications to Pharmaceuticals"



Measuring Glass Transitions in Very Small Samples

Right is a TASC experiment made within the red square shown in the image. This corresponds to a sample mass of less than 10μg of a filled Polystyrene sample. In effect, the TASC measurement enables a glass transition to be determined with a limit of detection orders of magnitude better than DSC or any other conventional Thermal Analysis technique.

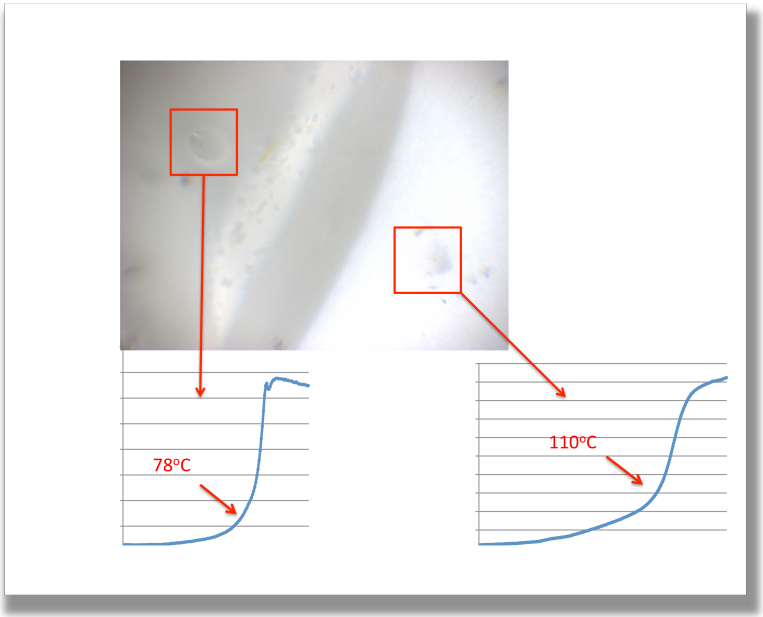


The fact that the measurement is localized means that **Local Thermal Analysis** can be performed (see below). An extension of this called **T-Map** enables images to be created on the basis of transition temperatures (see below and "TASC Applications for Pharmaceuticals").

Local Thermal Analysis (LTA)

Right shows two TASC measurements made at different points on the sample shown in the image. The locations are indicated by the red squares. It can be seen that the transition temperatures at the different locations are different thereby demonstrating that these are different materials. The scale of scrutiny depends on the magnification and the size of the indentations made in the sample.

An extension of this called **T-Map** enables images to be created on the basis of transition temperatures.

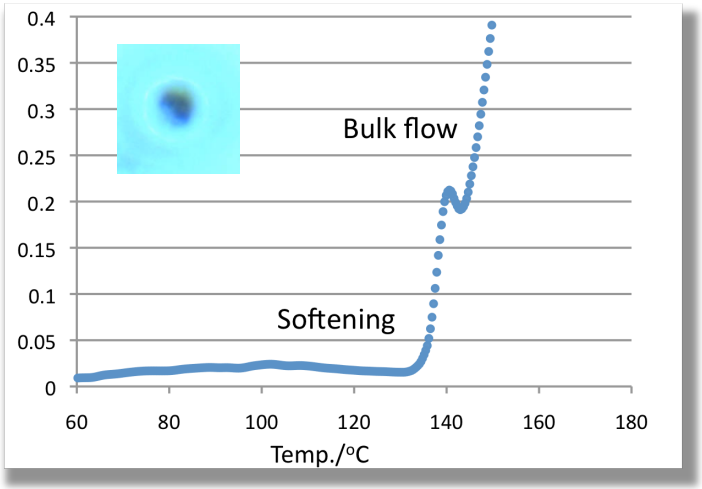


The TASC method for LTA uses a uniform temperature field, this means that all parts of the sample have the same temperature. This ensures that the thermal history of the sample during the experiment is known and that all temperature measurements are accurate. This is an advance over the first generation LTA approach which uses **a heated probe because this imposes a highly non-uniform temperature fiel**d on the sample. This difference means that TASC can achieve better accuracy for transition temperatures and interpretation is easier because the thermal history at each location is known.

Surface Measurements (Packaging)

Right, a packet used for confectionary is shown. The inset shows that there are different materials on each side, yellow on the exterior and white on the interior.

Right, the results of a TASC measurement are shown on the indentation (inset) In the white surface. There is a softening point where the indentation begins to relax then bulk flow is observed.



ThermoMechanical Analysis – TASC-TMA

Right, there are two images of the components used for TASC-TMA, first they are not assembled in the second they are. The crucible is a standard 6mm diameter aluminum DSC pan. The sample is a white strip of filled Polystyrene. The probe is placed on the crucible and the sample. These are then placed within the field of view of the Hot Stage Microscope.

The TASC algorithm can follow the movement of the Probe as the sample softens as shown **right**, thus this is a form of Thermomechnical Analysis (TMA). In this example a 3-point bend measurement is made. An alternative is to use a point that impinges on the sample so that a penetration measurement is made.