Differential Scanning Calorimetry (DSC)



Cold-stage DSC

Primary Glass Transition Temperature (Tg')

What is *primary glass transition temperature (*Tg')?
Tg' is the glass transition temperature that is measured when a frozen liquid is warmed and the concentrated glass is undergoing transition from the glassy to a rubbery state as it is shown in Fig.1.

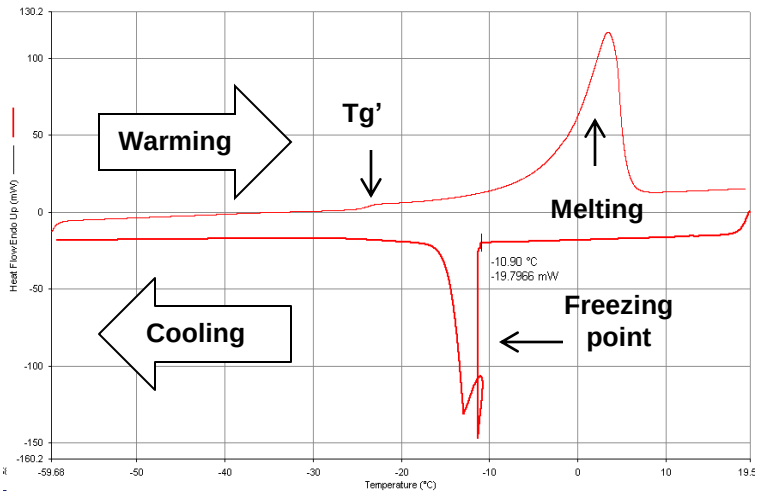

Fig. 1. Warming and cooling scans of a solution

Why is it important to know Tg'?
During primary drying, the product temperature should not exceed the collapse temperature which is theoretically identical to Tg'. If product temperature exceeds Tg', the solid might collapse because mobility in the solid is increased and the solid will lose its structure. Therefore knowledge of Tg' is important for development of a good freeze drying cycle.

Determination of (Tg')
In order to characterize the thermal behavior of a liquid, sample is loaded into a 50µL Aluminum DSC pans and sealed hermetically. The sample is then scanned for example from 20°C to -60°C and warmed to 20°C at a rate of 5°C/min. The freezing point of the bulk solution and any thermal events during the freezing are identified. Thermal events such as the primary glass transition temperature, eutectic crystallization (exothermic peak), eutectic melt (endothermic peak) of the excipients are characterized as well.

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HTD

BIOSYSTEMS INC.

High Throughput Development



Differential Scanning Calorimetry

Glass transition temperature (Tg)

Amorphous solids are disordered structures such as glasses, rubber and plastics. Many liquids can be supercooled, that is, brought to temperatures below their freezing points, without crystallizing. The obtained solid will have the structural characteristics of a liquid, but with a much greater viscosity. This amorphous state is also called the "rubbery state". As the temperature decreases further, the molecular mobility of the material is reduced and the material increases in rigidity, but its internal structure lacks the definite arrangement of atoms, ions, or molecules that characterises a crystalline solid. This will continue until the material has undergone a phase transition from the rubbery state to the glassy state. The temperature at which this occurs is the glass transition temperature, T_g. Generally, the glassy state is expressed as a frozen liquid.

It is important to measure Tg of an amorphous solid because the storage temperature of such solid should not exceed its Tg to achieve optimal storage condition. In addition to this, it is important to prevent moisture absorption by the amorphous solid, as it is known it might plasticize the solid and lead to increase mobility and recrystallization.

At HTD we utilize a Diamond DSC from Perkin Elmer to measure Tg of amorphous compounds. This technique enables us to identify Tg of a formulation in 1/10th of the standard analytical time, at higher sensitivity and using small quantities of material (2-3 mg). In Fig.2 glass transition temperature of trehalose is measured at 100 ºC/min.

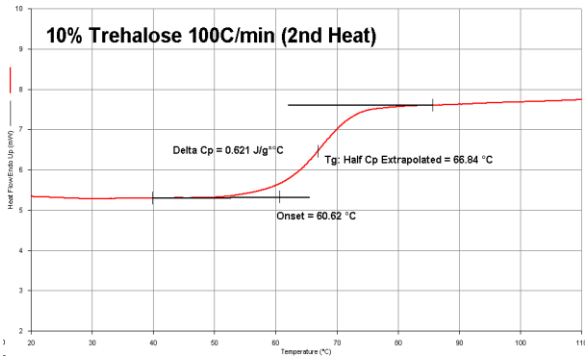

Fig.2. *Determination of Tg of trehalose when scanned at 100 ºC/min*

Fig.3. *Diamond DSC (Perkin Elmer)*

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