Differential Scanning Calorimetry (DSC)

- **Introduction**

Differential scanning calorimetry (DSC) is one of the most popular thermal analysis techniques. At constant heating or cooling rate, many characterized parameters of the material like the heat capacity, the melting and crystallization temperatures, the heat of fusion or the various thermal parameters of chemical reactions can be determined. According to these parameters, what the material is could be identified [9].

- **Principle**

In the heat-flux-type DSC system, there are two crucibles subjected to the same temperature program, one with a sample, another with a reference. There is a heater that will heat the crucible which has a lower temperature to keep the sample and reference crucibles at the same temperature. Due to the different thermal capacities, their responses to the ambient temperature are different [7]. The temperatures and the heat flow associated with transitions in materials are measured and plotted as functions of time and temperature [10].

- **Resolution**

DSC is characterized by its high resolution compared to DTA. This is because DTA can only detect and control the temperature difference (ΔT) between the sample but cannot establish the relationship between ΔH and T, while DSC can achieve this.

When testing different materials with widely varied thermal sensitivity. Controlling the heating rate and the amount of sample are two key factors to improve resolution or sensitivity.

Increase the heating rate and increase the sample quantity can improve the detection sensitivity of weak thermal effect substances.

Increase the sample quantity can improve the detection sensitivity of trace components.

Slow down the heating rate, small sample quantity can improve the resolution of adjacent peaks.

- **Result**

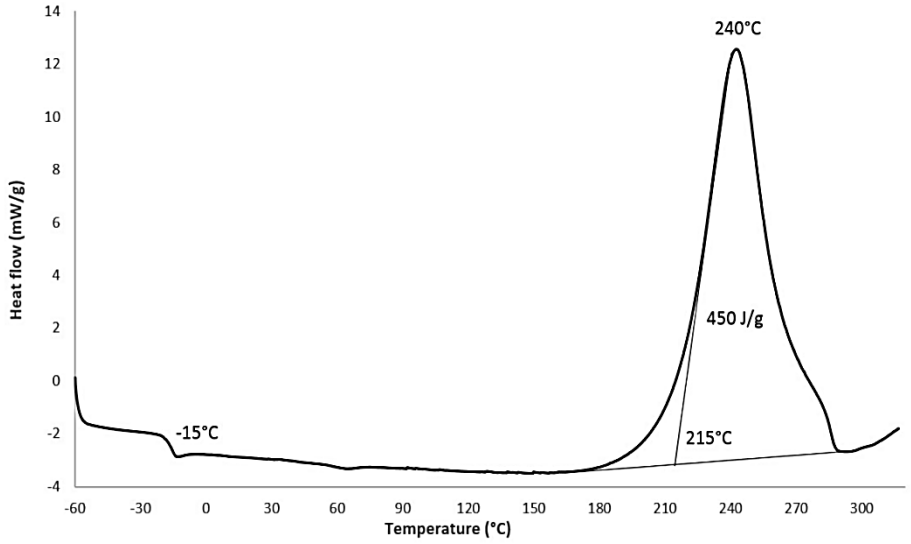

Fig.1 Standard DSC HexFlow® RTM6 resin

It can be seen from the graph [11] that T_g is -15℃, T_{onset} is 215℃ and T_{peak} is 240℃. The area enclosed by the baseline, the tangent of onset temperature and DSC curve is melting enthalpy and is calculated as 450J/g.