

## Thermal History of Polymers

### 1. Introduction

Investigating the thermal history of polymers is crucial to understanding the relation between the internal structure and processing conditions of polymer material.

In this brief, an example of DSC measurement of polyethylene terephthalate (PET) is presented.

### 2. Measurements

#### 2-1 The effects of cooling rate on glass transition

PET samples were given a thermal history by cooling at various rates from a temperature higher than glass transition. The measurement results in Figure 1 show that there was very little difference in heat capacity before and after glass transition for all DSC curves. However, excluding the quenched PET sample, the curves showed unusual endothermic peaks at the end of glass transition. Furthermore, higher cooling rates resulted in smaller endothermic peaks. The thermal history near the glass transition of the sample can be inferred from the shape of these endothermic peaks.

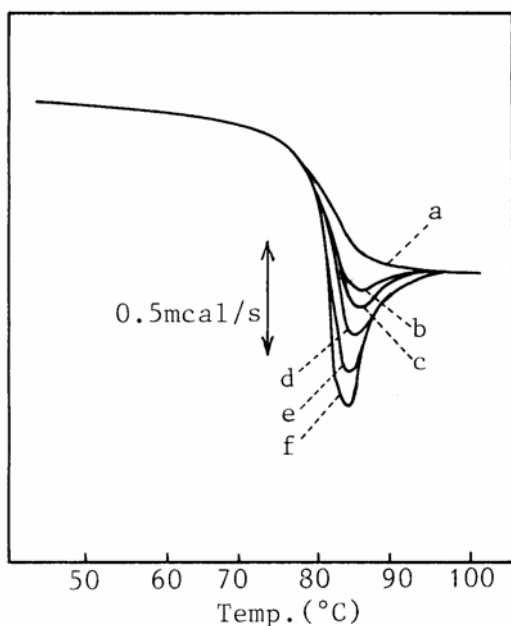


Figure 1 The Effects of Cooling Rate on Glass Transition

Sample weight : 18.3 mg  
Heating rate : 20°C/ min  
Cooled from 100°C  
a: Quenched  
b: Cooling rate: 10°C/ min  
c: Cooling rate: 5°C/ min  
d: Cooling rate: 2°C/ min  
e: Cooling rate: 1°C/ min  
f: Cooling rate: 0.5°C/ min

## 2-2 Changes in melting peaks by different thermal processing

PET samples were given thermal histories by being thermally processed at various temperatures while being cooled from a melted state. As the measurement results in Figure 2 show, excluding the quenched PET sample, the DSC curves showed small endothermic peaks before the melting peak at temperatures slightly higher than the processing temperatures. Furthermore, the endothermic peaks differed by thermal processing. The thermal history of samples can be inferred from the shapes of these melting peaks.

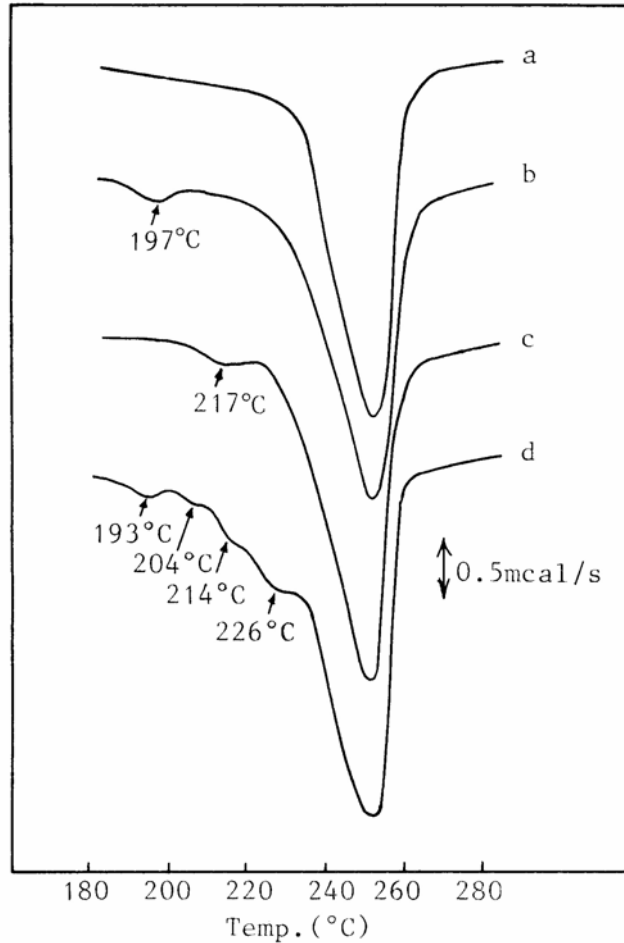


Figure 1 Changes In Melting Peaks by Different Thermal Processing

Sample weight : 18.3 mg

Heating rate : 20°C/ min

Cooled from 285°C

a: Quenched

b: Heat processed at 190°C for 3min

c: Heat processed at 210°C for 5min

d: Heat processed for 10min every 10°C until 185°C