

DSC Measurement of Polyethylene

- The correlation of polyethylene density and melting -

1. Introduction

Polyethylene is used in products such as containers, tapes, and stationary. Polyethylene is classified as high density or low density by this polymerization method (ranging from 0.92 to 0.96g/cm³).

In this brief, manufacturer-supplied low (LDPE) and high-density polyethylene (HDPE) with known densities are measured using DSC to investigate the relationship between melting and density.

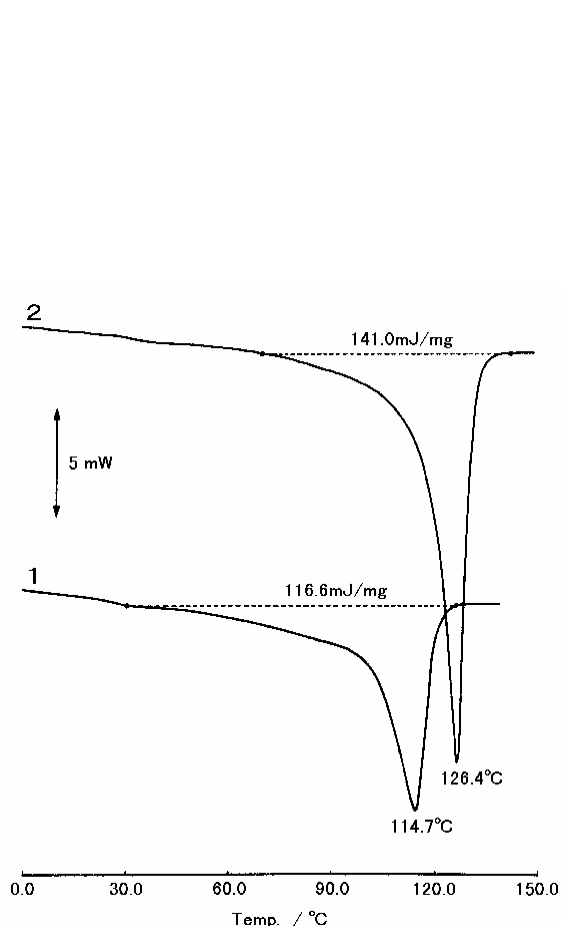


Figure 1 DSC curves for LDPE

Density

1: 0.922g/cm³

2: 0.934g/cm³

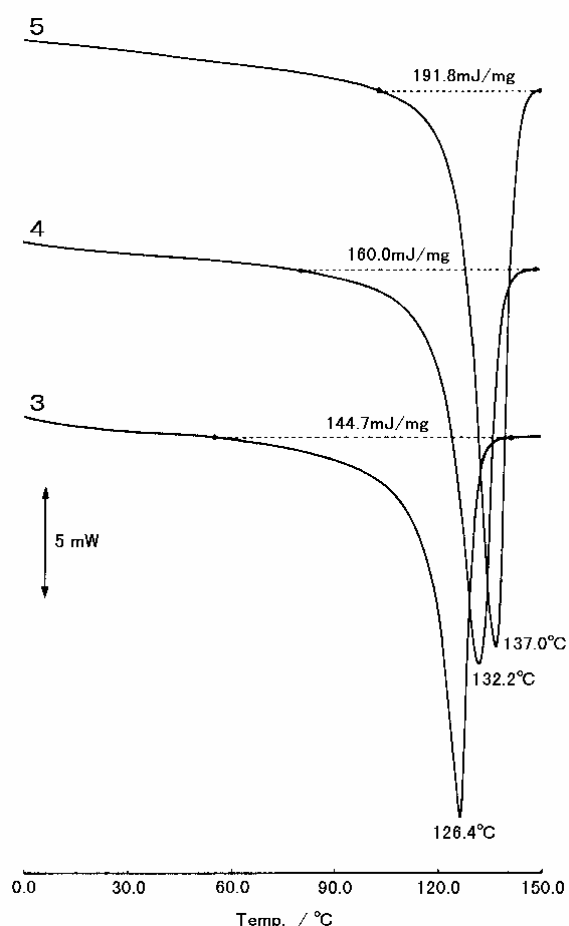


Figure 2 DSC curves for HDPE

Density

3: 0.935g/cm³

4: 0.944g/cm³

5: 0.958g/cm³

2. Measurements

Figures 1 and 2 show the DSC measurement results for LDPE and HDPE. For these measurements, samples weighting about 10mg were heated at 10°C/min. All samples were melted and then quenched to room temperature.

The endothermic peak temperature and melting heat were acquired from Figures 1 and 2. Figure 3 shows this data plotted versus the known densities.

Figure 3 clearly shows that the higher the density, the higher the peak temperature and the larger the melting heat. In particular, the melting heat showed a good linear relationship. These results show that the density of an unknown polyethylene sample can be estimated from this melting heat value. However, densities differ by manufacturing method so such investigations require a sample with a known density.

A melting point of 142°C and a melting heat of 286.7J/g have been reported for completely crystallized polyethylene. The ratio of the melting heat of the samples and the melting heat of the completely crystallized polyethylene was used to calculate the degree of crystallization. These results are presented in Table 1.

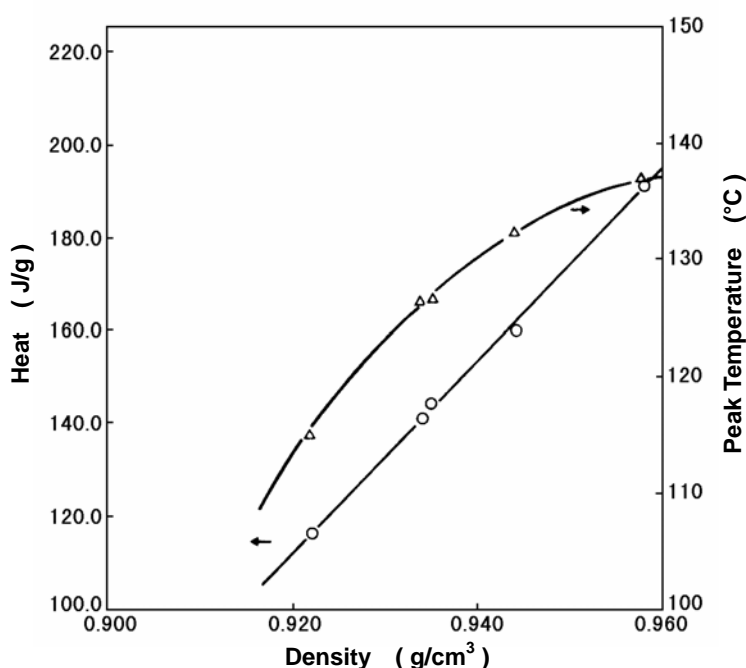


Figure 3 The Relation of Melting Heat and Peak Temperature with Density in Polyethylene

Table 1 Degree of Crystallization of Polyethylene

Density (g/cm ³)	Peak Temperature (°C)	Melting Heat (J/g)	Degree of Crystallization (%)
0.922	114.7	116.6	40.7
0.934	126.4	141.0	49.2
0.935	126.4	144.7	50.5
0.944	132.2	160.0	55.8
0.958	137.0	191.8	66.9