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DSC Measurements of Polyethylene

Correlation between Density and Melting

1. Introduction

Polyethylene (PE) is the most inexpensive among various common polymer materials and has excellent moldability, making it easy to mass produce. It is used in a wide range of fields, including industrial parts, office supplies, and daily goods. PE is classified into low density and high density (0.92 to 0.96 g/cm3) depending on the polymerization method. Depending on the density, mechanical properties such as stiffness, thermal properties such as deformation temperature, and optical properties such as birefringence will change. And the density also affects to the formability and processability. Therefore, it is important to know the density of PE accurately in order to select a PE with an optimum density according to the properties required for the final product.

We introduce DSC measurement results of the melting for low-density polyethylene (LDPE) and high-density polyethylene (HDPE), both of which have known densities. We will also show the results of investigation for the correlation between melting and density.

2. Measurements

Two types of LDPE and three types of HDPE with different densities were used. These PEs were once melted and then quenched to room temperature as thermal treatment to adjust the heat history.

Melting behavior of PE was measured on the NEXTA® DSC600 high-sensitivity differential scanning calorimeter. Measurements were taken over a temperature range of -20～160 ℃ at a heating rate of 10 ℃/min using a sample weight approximately 10 mg.

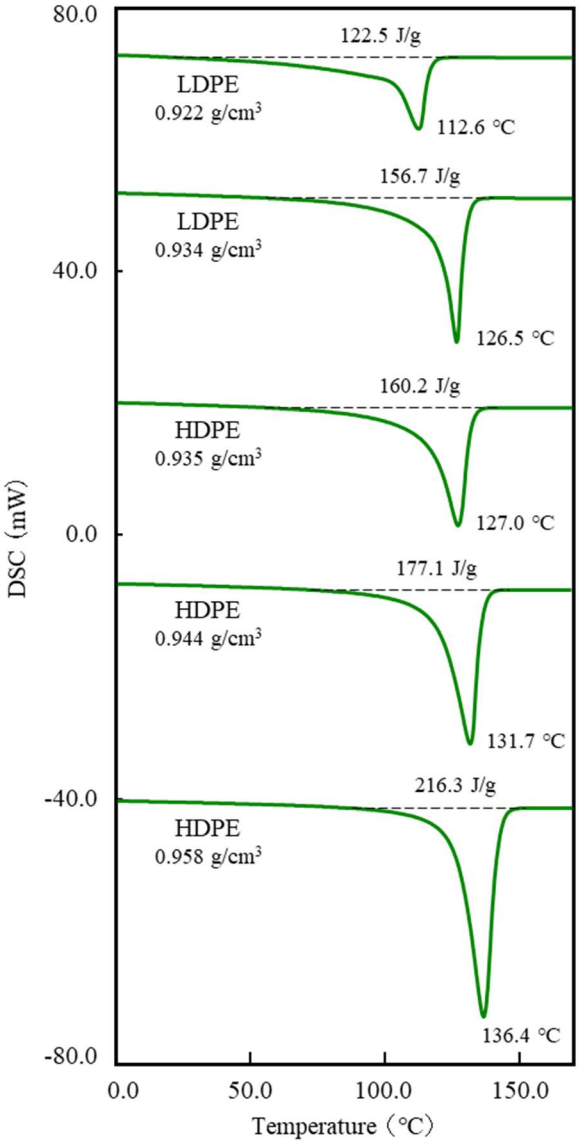

Figure 1 DSC curves of LDPE and HDPE

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The temperature of the melting peak and the heat of melting from Figure 1 plotted against the density of each PE are shown in Figure 2. Both the peak temperature and the heat of melting correlated with the density. In particular, a good linear relationship was obtained for the heat of melting. From this relationship between density and heat of melting, unknown density of other PE material can be estimated by measuring its heat of melting. However, since the density of PE varies depending on the manufacturing method, it is necessary to conduct a thorough study using PE with known density.

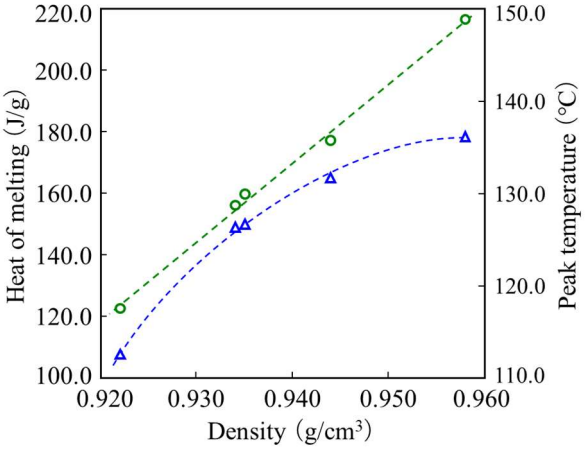

Figure 2 Relationship between the heat of melting, the peak temperature, and density for PE.

Heat of melting

Peak temperature

Science for a better tomorrow

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