SII NanoTechnology Inc.

DSC AS PROBLEM-SOLVING TOOL: TESTING FOR CRACKING IN PLASTIC HOUSINGS

Problem

A customer, working for a computer manufacturing company, was having difficulties with the housings used for the computers. The housings were made of a thermoplastic blend consisting of ABS (acrylonitrile butadiene styrene) and polycarbonate. Some of the housings performed satisfactory under normal usage while others would crack. The customer desired to have a straightforward test to examine the housing units to predict their relative impact resistance and their propensities to undergo cracking during usage.

Solution

Differential scanning calorimetry (DSC) provides a straightforward means of analyzing the thermoplastic housings. With DSC, a small portion of the housing may be cooled under subambient conditions to observe the glass transition event (Tg) associated with the butadiene component in the ABS-polycarbonate blend. The butadiene rubbery phase present in the blend provides the desired impact properties to the housing unit. The glass transition temperature of the rubbery phase is relatable to the impact properties of the blends containing ABS. Lower Tg values, for the rubbery transition, generally result in better impact properties for a given blend specimen.

The detection of the butadiene Tg by DSC can be difficult because of the low intensity of the transition since the butadiene component comprises only approximately 10% of the total weight of the ABS-polycarbonate blend. The Seiko Instruments DSC220C offers two key features necessary to obtain accurate and reproducible data on the butadiene transition of the blends:

- High sensitivity
- Extremely stable subambient performance.

The latter feature is important when analyzing the blends since it is critical that the low temperature DSC baseline does not shift significantly over time. A stable baseline is important when attempting to obtain reproducible Tg values.

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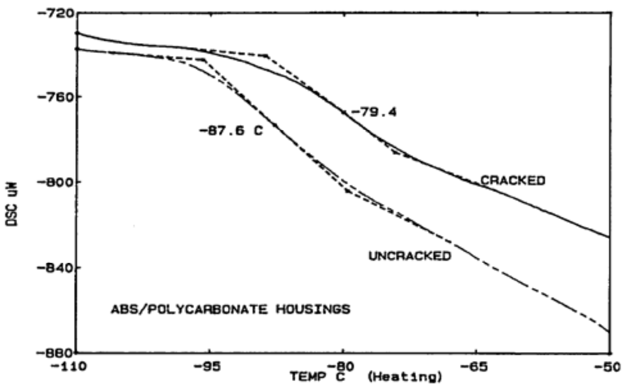

Figure 1

The 'Good' and 'Bad' ABS-polycarbonate blend specimens were analyzed using the DSC220C by heating from -130 to 0°C at a rate of l0°C/min. Shown in the Figure 1 is a direct comparison of the results obtained for the two samples (with the data normalized to a constant mass of 10.00 mg).

The glass transition event of the butadiene rubbery phase is observed as a step-wise change in the heat flow between -90 and -70°C. Below Tg, the butadiene component is a rigid solid, while above Tg, it converts to the flexible rubbery phase and gives the desired toughness characteristics to the blend. The results shown in the Figure demonstrate that the 'Good' uncracked material exhibits a mid-point Tg of -87.6°C while the 'Bad' cracked specimen has a significantly higher temperature of -79.4°C. The higher Tg of the 'Bad' sample is indicative of poorer toughness characteristics. The impact modifier may have been degraded as a result of internal cross-linking and/or as a result of degrafting from the copolymer matrix [1].

Summary

The Seiko Instruments DSC220C was used to examine two ABS-polycarbonate blends, one of which exhibited poor impact properties. The material which cracked had a significantly higher Tg of the rubber portion of the ABS impact modifier. The DSC220C provides the necessary high sensitivity and stable subambient performance required to detect the weak Tg of the butadiene component of the blend.

Reference

[1] F. J. Cama, J. Y. Chung, and J. E. Winiarski, Proceedings of the Nineteenth NATAS Conference, pages 586-591, Boston, 1990.

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