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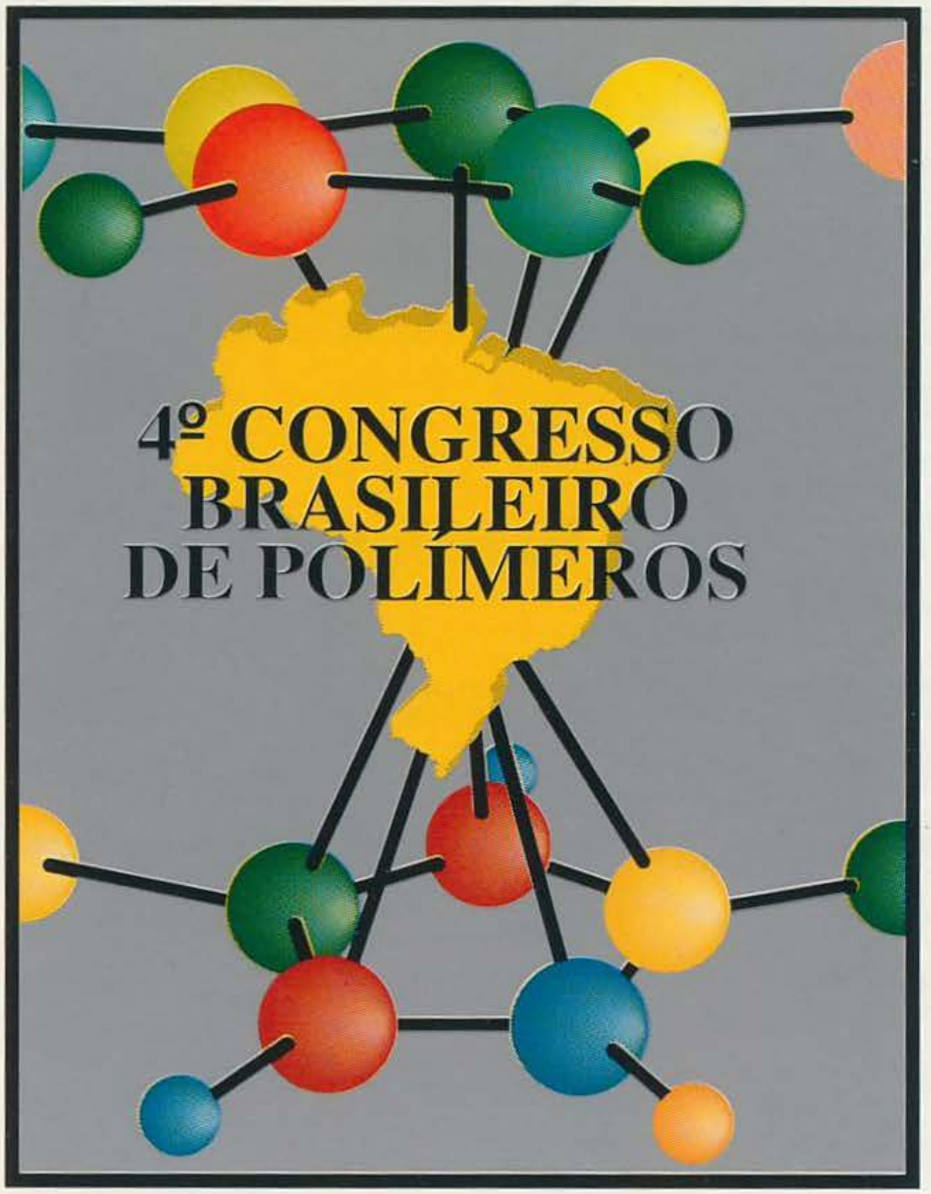

Promoção:

Associação Brasileira de Polímeros

THE EFFECT OF MORPHOLOGICAL ALTERATIONS INDUCED BY PLASTIC PLANE STRAIN COMPRESSION ON THE MELTING BEHAVIOUR OF ISOTACTIC POLYPROPYLENE (α FORM)

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1. Introduction

Morphological alterations induced by plane strain compression of isotactic polypropylene at room temperature were studied using wide-angle X-Ray diffraction and differential scanning calorimetry (DSC) techniques.

The properties of polymer products are known to be affected by their morphology. In particularly, the physical and mechanical properties of polymers are profoundly dependent on the degree of crystallinity and their changes under certain conditions. Often, morphological features can be deduced from the melting behaviour of the polymers[1].

Isotactic polypropylene (i-PP) is a semicrystalline polymer which may exhibit multiple peaks in its melting endotherm[2-4]. Earlier studies on the melting behaviour on i-PP samples, showing only the α-crystalline form, indicates that the DSC curve can have either two endothermal peaks or may be resolvable into two[5]. Their possible relation to structure has been widely discussed. We attempt in this work to investigate the modifications on the melting behaviour of i-PP samples, where only α-form is present, caused by plastic plane strain compression at room temperature[6,7].

2. Experimental

Highly isotactic polypropylene (i-PP) samples (Mw=117400 g/mol; Mn=17300 g/mol) were supplied by OPP Petroquímica, Brazil. In order to provide reproducible and homogeneous specimens uninfluenced by the manufacturing process, a plate about 1mm thick was prepared from polymer granules by compression-moulding, by heating under pressure to 200 ^{o}C for 5 min. The pressure was released and the plates were slowly cooled in air to room temperature. Standard samples which 5.1 mm x 5.3 mm dimensions were cut from this plate to be further compressed in a channel die, at room temperature, at 3 different pressions: 363, 1088 and 2177 Mpa.

X-Ray diffractograms of the undeformed and deformed samples were obtained by using CuK_{α} radiation having a wavelength of 1.54 Å. The temperature was ambient and the scan range was 5-40^{o} with 2θ increments of 0.01^{o}.

The DSC scans were performed on the same samples analyzed by X-Ray diffraction. Each sample was heated from 30 ^{o}C up to 200 ^{o}C at a heating rate of 7.5 ^{o}C/min. Samples were kept for 10 min at this temperature, in order to erase any previous thermal history, and then cooled to room temperature at 7.5 ^{o}C/min. A subsequent heating was performed on each sample under the same conditions as the first heating. The melting curve obtained after reheating, under conditions previously described, is reproducible for all samples.

3. Results

A comparison of the X-Ray data obtained for the undeformed and deformed samples is shown in figure 1. These results show conclusively that only the α-crystalline form of i-PP is present in all the samples. It is clearly demonstrated a considerable increase of the

amorphous part, with a consequent decrease of the crystallinity degree, caused by the induced plastic deformation. The morphological alterations on the samples are reflected on their melting behaviour. Figure 2 shows the thermograms performed at the same conditions for the samples in the following situations: undeformed, deformed at 363, 1088 and 2177 MPa, and also for the reheated samples.

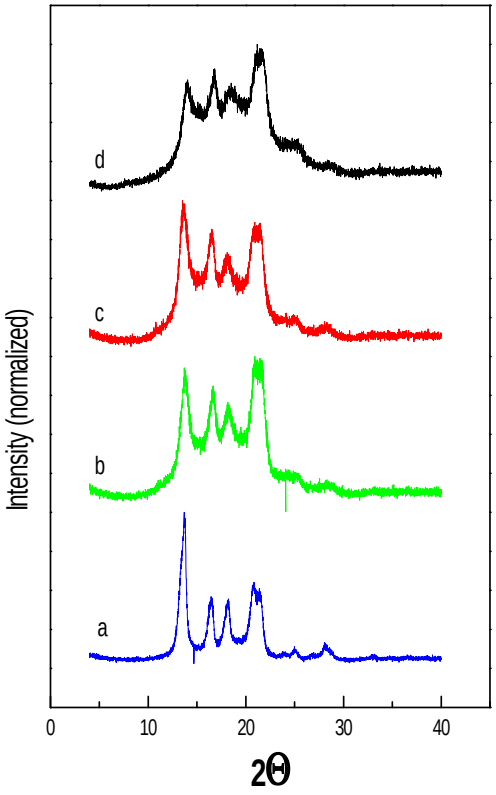

Fig. 1. X-Ray diffraction patterns from a) underformed sample and deformed at b) 363; c) 1088 and d) 2177 MPa.

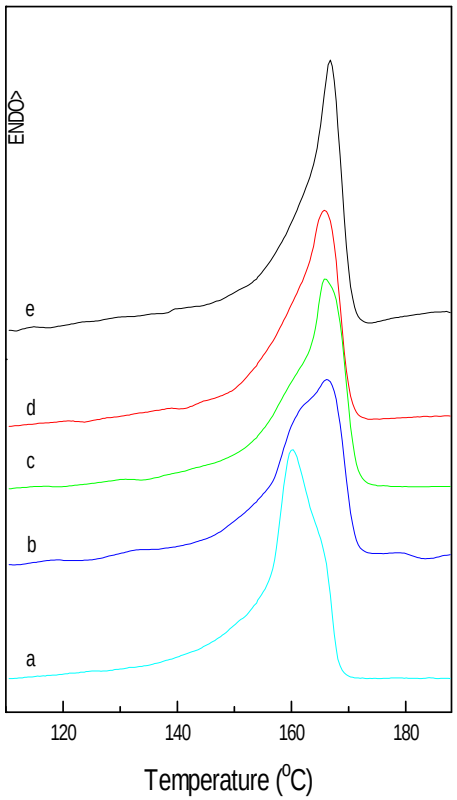

Fig 2: DSC thermograms from a) reheated samples; b) undeformed sample and deformed at c) 363; d)1088 and e) 2177 MPa.

4. References

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