Study of the Molecular Weight Influence on the Formation of the β-polymorph in Metallocenic Isotactic Polypropylene

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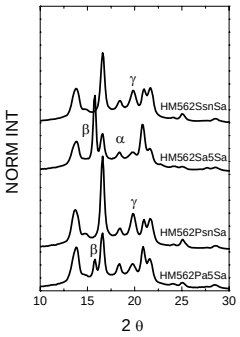
Isotactic polypropylene, iPP, is one of the most important thermoplastic polymers due to its low manufacturing cost and rather versatile properties. iPP exhibits a very interesting polymorphic behavior depending on the polymerization procedure, thermal history and use of different nucleating agents. Recently, studies on different aspects of the iPP β-polymorph have been published [1, 2]. This paper completes these previous works by analyzing the formation of the β-polymorph starting from samples of metallocenic iPP of different molecular weight. We also consider the effect of the cooling rate in the appearance of β-polymorph in the iPP samples that were studied.

In order to carry out this study, we used two commercial iPP resins supplied by Bassel, of different molecular weight: the melt flow index values are 15 and 30 gr/10 min, respectively. As β nucleating agent we use a mixture of pimelic acid and calcium stereate (in a 1:2 proportion), supplied by Fluka. Note that this is known to be a highly selective β nucleator. The iPP resins were blended with contents in nucleating agent of 0.3 wt % by using a Haake Rheocord 9000 internal mixer at 190 ºC and 40 rpm during 10 minutes.

Two different thermal treatments were applied. The former, Qa, consists of a fast cooling (around 100 ºC/min). To do this process, we melt the material in a press, and then we use refrigerated plates with cold water in order to obtain the sample. The latter, named Sa, consists of a slow cooling at the inherent cooling rate of the press (around 1.5 ºC/min) after switching off the power.

The structural characterization and thermal properties have been analyzed by X-Ray diffraction and Differential Scanning Calorimetry (DSC). Moreover, stress-strain analyses and measurements of dynamic-mechanical properties have been carried out in order to obtain accurate characterization of the different polymers synthesized.

As a small example of our work, Figure 1 shows the X-Ray diffractograms corresponding to the samples with and without β nucleating agent and thermal treatment of slow cooling. It is evident that both the molecular weight of the sample and the thermal treatment applied have an important influence on the content of the different crystalline modifications. From these diffractograms, we have determined the proportions of the different polymorphs, α, β and γ phases, respectively.



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References:

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