	Experiment title: Development of a specific oriented morphology in microinjection molding of thermoplastic polymers	Experiment number: 26-02 473
Beamline: BM26B	**Date(s) of experiment**: From 24 May 2009 at 08:00 to 27 May 2009	**Date of report**: *22/06/2009*
Shifts: 9	**Local contact(s)**: L. FERNANDEZ-BALLESTER, G. PORTALE	

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Report:

A previous study[i] dealing with the microinjection molding of a micropart (μpart: 150mm thick) concluded that the molding conditions lead to more oriented crystallites than for a conventional injection molded part (Macropart: 1.5mm thick). From that study, two possible explanations were given:

i) The microinjection molding process orients more the crystalline entities than injection molding.
ii) The crystals orientations are the same for the two processes, but the difference of orientation is due to a higher ratio of oriented structures for the μpart.

Thus, the beam time given by ESRF was used to probe locally the samples of High density polyethylene to compare thoroughly the orientation states of crystals. Local WAXD measurements were performed at the beamline DUBBLE-BM26B CRG, where a microfocus was set-up. The microfocused and highly brilliant beam allowed us to scan each morphological layer of the two samples. The step scans were 10μm for the μpart and the first 200μm of the macropart, and 50μm for the rest of the macropart thickness. The 2D WAXD pattern measured for the different positions in the samples are given in the following:

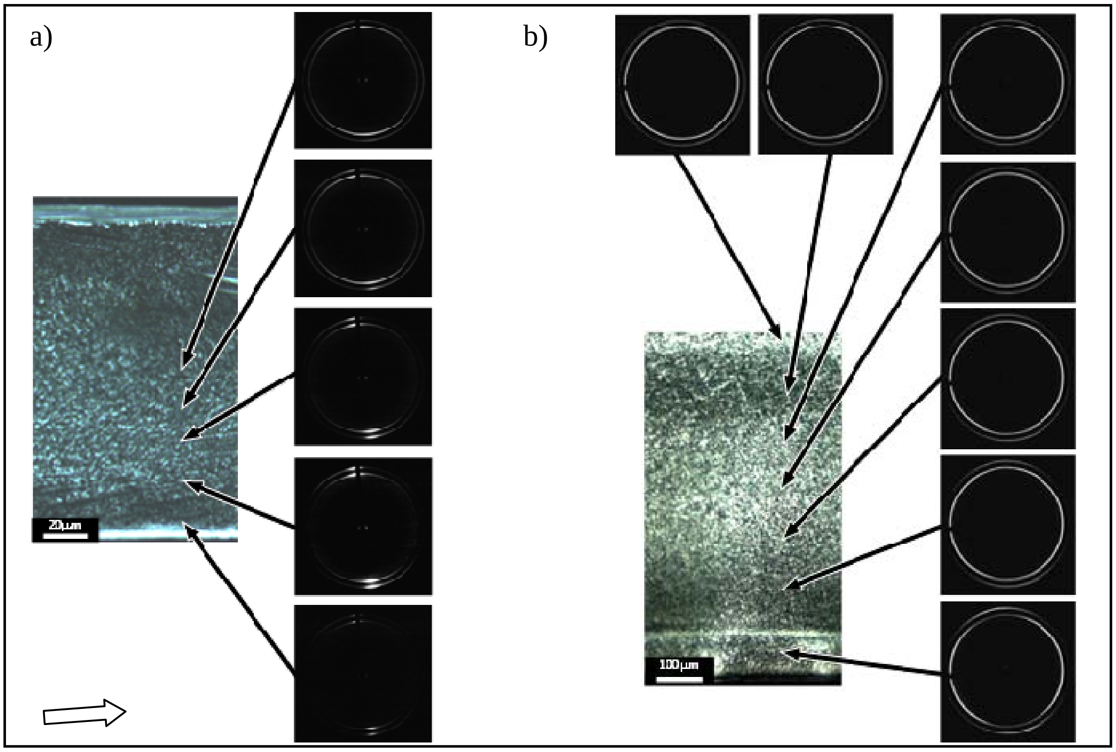

Figure 1: 2D WAXD patterns of the local morphology, indicated from the sample cross section for: a) µpart, b) Macropart. The arrow gives the flow direction.

The WAXD patterns are given for both the µpart (fig. 1a) and macropart (fig. 1b). The two diffraction rings presented in fig. 1 corresponds to the (110) and (200) diffraction planes. In the case of µpart (fig. 1a), the intensities of both diffraction rings show an equatorial maxima, regardless the position probed in the thickness. These diffraction patterns support that the morphology of the µpart is entirely compose by shish-kebabs with straight lamellae (KM-II[ii]).

In the case of the macropart (fig. 1b), the diffraction is a 4-arc maxima offset from the equator for the (110) plane, and a 2-arc meridian intensity maxima for the (200) plane for the external layer. The diffraction rings become gradually full when probing more and more in the inner layers, until reaching the middle of the thickness. The diffraction patterns found for the outer layer is due to the existence of row structures[ii] (shish-kebabs with twisted lamellae), corresponding to less oriented morphology than shish-kebabs with straight lamellae. The Herman's orientation function plotted from the diffraction patterns support this finding. Moreover, the crystallinity along part thickness is always lower for µpart, due to the specific processing conditions. Measurements were also performed for polyoxymethylene, but the data processing is not done yet. The final results will be reported in the PhD thesis of J. Giboz first, from which articles could be written.

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[i] Giboz J, Copponnex T and Mélé P 2009 "Microinjection molding of thermoplastic polymers: morphological comparison with conventional injection molding" *Journal of Micromechanics and Microengineering* **19** 025023

[ii] Keller A and Machin M J 1967 "Oriented crystallization in polymers" *Journal of Macromolecular Science Part B* **1** 41-91