

Imaging Techniques: Tool for the quantification of oriented additives.

Tobias Schuster, Karsten Rode, Subin Damodaran, Robert Brüll

Fraunhofer LBF (Germany)

The rate of crystallization and the size of the resulting crystals have a strong impact on the mechanical and optical properties after conversion of the plastic, especially in polypropylene (PP). Therefore nucleating agents, such as the β nucleating agent N,N'-dicyclohexylnaphtalene-2,6-dicarboxamide (NU-100) are used to adjust the crystallization process. The direction of crystallite growth is highly dependent on the orientation of nucleating agent.[1] Figure 1 shows optical images of an extruded PP sample in the planes TD-ND and MD-ND and the respective IR absorptions.

NU-100 exhibits an intense IR absorption at 1628 cm^{-1} , which can be assigned to its two amide groups. Analyzing the perpendicular cuts of the extruded PP sample by IR, a strong influence of the cutting direction on the intensity of the band at 1628 cm^{-1} can be recognized. In contrast to the band at 1747 cm^{-1} , caused by the carbonyl group of an antioxidant, the band at 1628 cm^{-1} shows strong dichroism. The dichroic effect can be used to calculate the orientation of nucleating agents and polymer chains with regard to the three directions of the processed material from IR-spectroscopic measurements.[2-4]

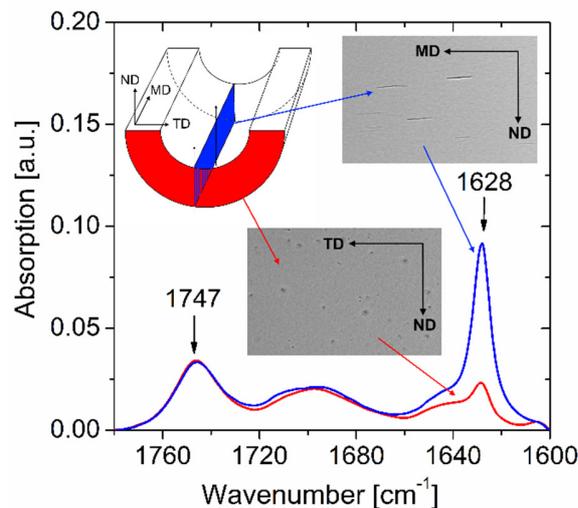


Figure 2: Optical images of orthogonal microtome cuts of an extruded pipe and enlargement of corresponding IR spectra in the range between 1780 and 1600 cm^{-1} .

References:

1. Yamaguchi, M.; Fukui, T.; Okamoto, K.; Sasaki, S.; Uchiyama, Y.; Ueoka, C. *Polymer* 2009, 50, (6), 1497-1504.
2. Brüll, R.; Maria, R.; Rode, K. *Macromolecular Chemistry and Physics* 2010, 211, (20), 2233-2239.
3. Schuster, T.; Rode, K.; Brüll, R.; Heinemann, J.; Haupt, H. *J Appl Polym Sci* 2013, 130, (6), 4182-4190.
4. Schuster, T.; Damodaran, S.; Rode, K.; Malz, F.; Brüll, R.; Gerets, B.; Wenzel, M.; Bastian, M. *Polymer* 2014, 55, (7), 1724-1736.