The crystallization and processing properties of PP/Tackifier blend

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Introduction

Biaxial stretching polyolefin films are widely used in the fields of packaging, porous separator and protective wrapping. Properties of the final products are largely dependent on the processing parameters, for example, stretching rate, temperature and stretching ratio.

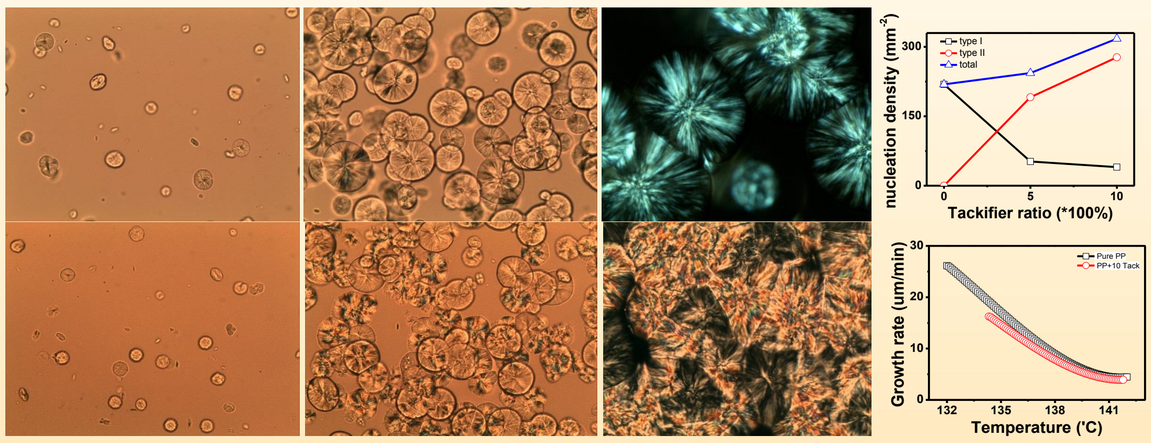
At the same time, the competitively power among products is mainly determined by the productivity and the yeild ratio. Aiming to solve the problems of the high breakage ratio of BOPE, which is still under development, we add Tackifier in the system to modify the high temperature performance during the stretching.

Under the above background, we designed a series of experiments to investigate the effects of Tackifier on the polyolefin based films. the experiments include SAXS/WAXS in-situ observation on the stretching of the films, the static crystallization of PP/Tackifier blends by Polarized optical microscope(POM), differential scanning calorimeter(DSC), and small angle oscillation shear (SAOS) experiments.

Experiments and data

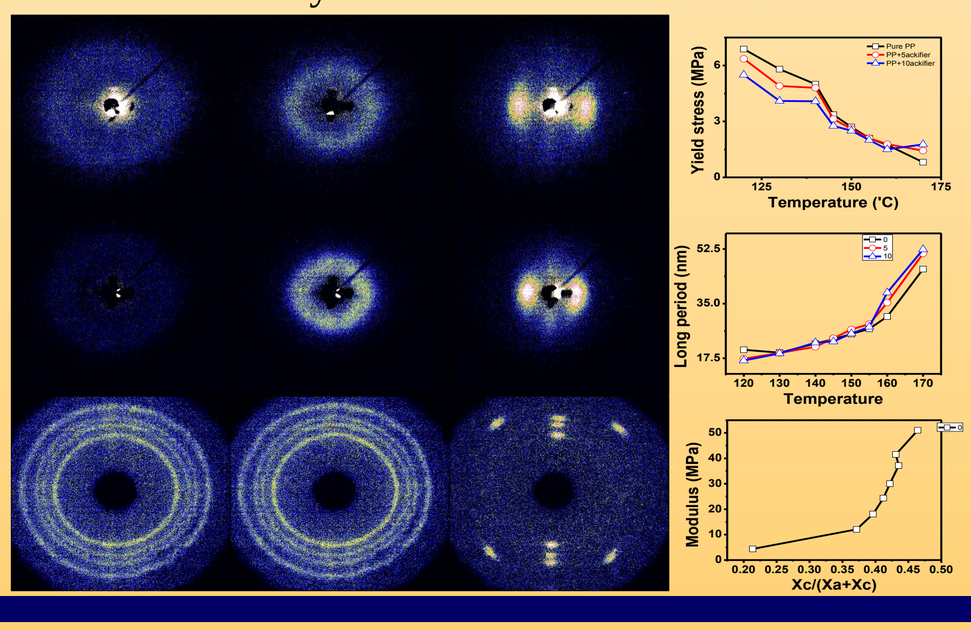
1. Static crystallization.

The POM with CCD recorded the crystallization procedure during a 2℃/min cooling. We founded that the addition of Tackifier induced a new crystal phase(Type II), which has no Maltase in it. Nucleation density is increased while linear growth velocity of spherulite decreased.



2. In-situ X-ray stretching experiments.

The stretching experiments are conducted with the combination of SAXS/WAXS device and the stretching device. through this we have found that with the addition of Tackifier, the yield stress decreased. At the same time long period increased. By WAXS we have found the correlation between crystallization and modulus.



Methods

1. Non-isothermal observation of static crystallization of PP/Tackifier blend.

With the CCD recording the image of the spherulite together with the cooling of a constant rate(2℃/min, in my experiments), we can get the radius of the spherulite all the way along the whole cooling procedure. With the time-radius curve, according to the constant cooling rate, the Temperature-Radius curve can be drawn, which can be simulate with polynomials. The differential of the above-mentioned polynomials is the Time-Growth rate relationship.

Compared with the isothermal experiments, through this method we can get the growth rate of a whole range of temperature, at the same time, this method is very time-saving and the repeatability is pretty high.

2. Combination of SAXS/WAXS with stretching device.

Three points are obtained in this experiment: before heating, after heating and after stretching, meanwhile, the stress-strain curve is followed. Through these three points, the structure-processing relationship can be investigated.

Discussion and Conclusion

1. Static crystallization.

– The addition of Tackifier may have some effects like preventer to the original Maltase spherulite, disabling some of the Maltase nuclei, at the same time inducing the new crystal phase.

– The decreasing of the linear radius growth rate may be due to the tack effect of Tackifier to the polyolefin basement, slowing down the movement of chains, which lead to the smaller growth rate.

2. In-situ X-ray stretching experiments.

—The increase of the long period: may be due to the melting of lamellar, combined with the decreasing of crystallinity

—Difference trends in the orientation of SAXS and WAXS: may be due to the formation of Fibrillar crystal, whose scattering pattern is streak, this acts as a summation to the original patterns and the FWHM of azimuthal angle intensity integration smaller.

Plan

1. Experiment:

–increase the repeatability, which contains the adjustment of the extensional rheometer with temperature jump.

–optimize parameters, enabling to illustrate the mechanisms of crystal deformation(melt recrystallization or lamellar slippage) and the processing-structure relationship.

2. Devices:

—Maintain the X-ray scattering device: regas the detector, some optimization affairs.

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