AMORPHOUS PHASE OF POLYPROPYLENE-PHYSICAL STATE AND ITS ROLE IN SELECTED PROPERTIES

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ABSTRACT

Intensive research concerning semicrystalline polymers have been conducted for many years. Unabated interest in this class of materials results mainly from their unique properties but also from exceptionally complicated structure. Full description of plastic deformation of such materials requires considering the presence of lamellar crystals “immersed” in disordered regions and supermolecular structures. Most of papers analyze the influence of parameters of crystalline phase such as the degree of crystallinity, thickness of lamellae or orientation of crystals, on the properties of semicrystalline polymers and only few papers analyze the influence of the amorphous phase-its structure, physical state.

In the paper [1] we have presented the way of modification of the amorphous phase by introducing the molecules of low molecular weight modifier. The presence of a modifier resulted in changing the physical state of disordered regions. However, due to instability of the polymer-modifier systems (i.e. polypropylene-chloroform) caused by desorption of modifier in laboratory conditions, an attempt of obtaining a new system characterized by higher stability has been taken on. An aliphatic hydrocarbon–nonadecane proved to be a good modifier.

For the polypropylene-nonadecane system we have estimated the influence of the presence of the modifier on the structure and physical state of the amorphous areas (change of glass transition temperature (DMTA), change of interlamellar spacing (SAXS), change of distribution of the size of free volume pores (PALS) and then we have analyzed the influence of the modification process on several parameters or phenomena accompanying its uniaxial stretching:

-intensity of cavitation phenomenon,

-the value of Young modulus and stress at yield point,

-intensity of the lamellae fragmentation process.

We have proved that the presence of the modifier leads to substantial decrease of the intensity of cavitation phenomenon as a result of filling of free volume pores of the amorphous phase. Additionally, we have observed a decrease of the yield stress in case of modified samples. Similar effect has been observed and explained in case of polypropylene-chloroform system [2]. The presence of nonadecane molecules in the polypropylene amorphous phase area caused also decrease of the intensity of lamellae fragmentation process, probably due to decrease of intensity of the cavitation phenomenon [3].

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References:

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