ISSN NO: 2770-0003
Date of Publication: 24-10-2022

Investigation of Transformation in the Amorphous Phase of Polyaramid as a Result of Heat Treatment

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Abstract: This article examined how polyacrylamide changes under the influence of temperature. As a result of this, the conclusions of the results of the formation of the amorphous phase and its application in several ways are given.

Keywords: Nitroxyl radicals, EPR, 2,2,6,6-tetramethylpiperidine-1, PKA.

In recent years, spin tags and probes – stable nitroxyl radicals covalently bound to a macromolecule (spin tags) or introduced into the studied systems in small quantities (spin probes) - have become very popular and widespread in the study of liquids, polymers and biological systems. [1]They act as molecular sensors. And they allow us to obtain unique information about the structure and dynamics of the systems under study.[2]

The use of spin labels and probes is based on the fact that the EPR spectra of nitroxyl radicals depend on their rotational and translational dynamics and the nature of distribution in polymers; these factors, in turn, are determined by the structure and mobility of the medium in which the probe or label is located.[3]

We investigated the rotational diffusion of the 2,2,6,6-tetramethylpiperidine-1osil radical in the initial and heat-treated samples in order to identify changes occurring during heat treatment in amorphous sections of the PCA obtained by various methods.

Signals of both fast and slow components of rotational mobility of radicals are observed on each spectrum of the initial samples. [2]From the obtained EPR spectra of heat-treated PC samples, it can be noticed that the signals of the rotating component either weaken (2- samples obtained by hydrolytic polymerization of caprolactam, produced in Germany), or disappear altogether (1,3-samples obtained by anionic polymerization of caprolactam and hydrolytic polymerization of caprolactam, produced in China). This suggests that after heat treatment, the large pores that occur in the amorphous phase of the PCA either decrease to the size of a radical (fast-rotating radicals are inhibited), or they are displaced from the volume of the polymer.

Heat treatment also affects the signals of a slowly rotating component. The slowly rotating component on the spectra in all the studied samples of polycaproamide shifts towards a slow rotation speed and an increase in the intensity of these signals occurs. It follows from this that the rapidly rotating radical particles are pumped into a slowly rotating component.[5]

Thus, the study of the amorphous structure of PCAs obtained by various polymerization methods showed that an amorphous structure differing in uniformity is formed from the method of preparation and the preliminary conditions of crystallization.[4] In the samples obtained by anionic polymerization, the structure is more homogeneous compared to the samples obtained by hydrolytic polymerization of PCAs. Heat treatment leads to the transition of the amorphous structure from a heterogeneous state to a relatively homogeneous one.

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