



Soviet-era science, translated into English

Reports of the Academy of Sciences of the USSR

Corresponding Member of the Academy of Sciences of the USSR V. V. KORSHAK, D. Ya. TSVANKIN,

1962

SovietRxiv

View the original and related papers at <https://sovietsrxiv.org/items/ru-196201.71222>

Source: Math-Net.Ru and CyberLeninka. Machine translation. Verify with the original.

Abstract

Full Text

Reports of the Academy of Sciences of the USSR

1962. Volume 146, No. 6

CHEMISTRY

Corresponding Member of the Academy of Sciences of the USSR V. V. KORSHAK, D. Ya. TSVANKIN,
S. P. KRUKOVSKII

STUDY OF POLYETHYLENE TEREPHTHALATE (LAVSAN) FILMS WITH GRAFTED POLYSTYRENE

The properties of grafted films are determined, first of all, by the structure and properties of the original film. It is therefore of interest to determine in what way grafting affects the structure of the film onto which another polymer is grafted. A polyethylene terephthalate film was chosen as the initial film, since it is the most suitable object for X-ray study. This film has a crystalline structure and a high degree of orientation. Thus, with the aid of X-ray patterns we can judge both changes in the structure of the crystals and changes in orientation, i.e., in the mutual arrangement of the crystallites in the film.

Polystyrene was grafted onto the original polyethylene terephthalate films. The latter, as is known, has an amorphous structure, which facilitates the study of X-ray patterns of the grafted films. In addition to the X-ray investigation, photographs of transverse sections of these films were obtained.

The grafting of polystyrene onto polyethylene terephthalate film was carried out by the method described earlier ⁽¹⁾. After washing in boiling benzene and drying in a vacuum oven at 60° to constant weight, the original polyethylene terephthalate film had a thickness of 28 μ . After brief heating at 100° in an air atmosphere, the original polyethylene terephthalate films were heated with styrene in a stream of purified nitrogen at 80° for 3 and 8 hours. The samples were then boiled in benzene to remove homopolystyrene and dried to constant weight. After heating for three hours, a film 46 μ thick was obtained with a yield of grafted polystyrene of 20.95% (relative to the weight of the original film). After eight hours of heating, the film had a thickness of 143 μ with a yield of the grafted layer of 195%. Samples of such films were then studied by X-ray diffraction. For comparison with the grafted films, two packets were prepared from superposed films of polyethylene terephthalate and polystyrene. For this purpose, films about 50 μ thick were cast from polystyrene. In the first

packet, one polystyrene film (50μ) was used for 7 polyethylene terephthalate films (28μ), which corresponds to $\sim 21\%$ polystyrene by weight of polyethylene terephthalate. In the second packet, 7 polystyrene films were used for 5 polyethylene terephthalate films, which corresponded to $\sim 195\%$ polystyrene by weight of polyethylene terephthalate.

Thus, four samples were prepared for the X-ray study. Two of them were grafted films, and two samples consisted of separate films of polyethylene terephthalate and polystyrene in the same weight ratio as in the grafted films. The X-ray patterns were taken with copper radiation with a filter, on a flat film. The X-ray patterns were obtained at different positions of the incident beam of rays relative to the plane of the film. Because the film has an axial-planar texture (²), different X-ray patterns are obtained when exposures are made at different angles. The most suitable arrangement for our purposes proved to be that in which the incident ray passed parallel to the plane of the film and perpendicular to the direction of the macro-

To the article by V. V. Korshak, D. Ya. Tsvankin, S. P. Krukovskii, p. 1347

Fig. 1. X-ray diffraction pattern of grafted films with 20.95% (a) and 195% (b) polystyrene

To the article by G. Paspalevs, V. K. Dokova et al., p. 1460

Fig. 2. Multiple inclusions of rickettsia-like microorganisms in granuloma cells. Oc. 10, obj. 90 \times

molecules. The X-ray diffraction patterns shown in Fig. 1 were obtained precisely in this way. Photographs of transverse sections of polyethylene terephthalate films with grafted polystyrene were taken in a polarization microscope with crossed nicols.

The X-ray diffraction pattern in Fig. 1a corresponds to a specimen containing 20.95% polystyrene. It contains the principal reflections of polyethylene terephthalate, which should appear for the given orientation of the specimen relative to the incident beam of rays, and is almost completely identical to the X-ray diffraction pattern of the original film. In addition to the crystalline reflections, the X-ray diffraction pattern in Fig. 1a contains a weak amorphous halo of polystyrene, which is poorly visible in the photograph. In the X-ray diffraction pattern in Fig. 1b, of the polyethylene terephthalate reflections only the most intense reflection, 100, remains. The other reflections are hidden beneath the very intense amorphous halo of polystyrene.

Fig. 2. Transverse section of a grafted film. 500 \times . The white region at the bottom of the photograph is paraffin, in which the film was embedded before preparation of the section

X-ray diffraction patterns of packets consisting of polystyrene and polyethylene terephthalate films proved to be identical to the X-ray diffraction patterns of polyethylene terephthalate films with grafted polystyrene. Thus it was found

Fig. 2. Transverse section of a grafted film. 500 \times . The white region at the bottom of the photograph is paraffin, in which the film was embedded before preparation of the section

Figure 1: Fig. 2. Transverse section of a grafted film. 500 \times . The white region at the bottom of the photograph is paraffin, in which the film was embedded before preparation of the section

that grafting of polystyrene causes no change in the X-ray diffraction pattern of the base polyethylene terephthalate film. This is demonstrated both by the character of the X-ray diffraction patterns of films with grafted polystyrene and by the fact that the X-ray diffraction patterns of films with grafted polystyrene are identical to the X-ray diffraction patterns of packets made up of polyethylene terephthalate and polystyrene films. From this it may be concluded that the main mass of crystals of the original film is not affected in the grafting process. The constancy of the X-ray diffraction pattern indicates that the structure of the crystallites is not changed or destroyed, and at the same time that the mutual orientation of the crystallites in the film is not changed.

Let us now consider the photograph of a transverse section of a polyethylene terephthalate film with grafted polystyrene in a polarization microscope (Fig. 2). Polyethylene terephthalate and polystyrene differ in their birefringence and therefore, in crossed nicols, exhibit different coloration. Because of the different coloration, contrast is produced in the black-and-white photograph (Fig. 2). As can be seen, the grafted layer of polystyrene is separated from the original film comparatively clearly. The transition zone is very narrow—at least, its thickness is considerably less than the thickness of the grafted layer. From the facts presented it may be concluded that the grafting process occurs in a very thin surface layer and does not affect the structure of the entire film. At the same time, the increase in the thickness of the grafted layer is also, evidently, not connected with a deeper penetration of the grafted polymer into the base film.

The authors express their gratitude to E. M. Belavtseva for preparing the film sections.

Received
5 VI 1962

REFERENCES CITED

1. V. V. Korshak, K. K. Mozgova, S. P. Krukovskii. *Vysokomolekulyarnye soedineniya*, **4**, No. 11 (1962).
2. D. Ya. Tsankin, *Vysokomolekulyarnye soedineniya* (in press).

Note: Figure translations are in progress. See original paper for figures.

Source: Math-Net.Ru and CyberLeninka. Machine translation. Verify with the original.