SMALL-ANGLE X-RAY SCATTERING OF COMPOSITE POLYPROPYLENE FILMS

D.E. Temnov[1], E.E. Fomicheva[1], B.A. Fedorov[2], A.V. Smirnov[2]
[1]Herzen State Pedagogical University, Saint-Petersburg, Russia
[2]St. Petersburg State University of Information Technologies, Mechanics and Optics, Russia

Composite polypropylene (PP) films with aluminium (Al) particles were investigated by small-angle X-ray scattering (SAX). Results for pure PP and PP with 2% and 4% aluminium powder are shown in Fig.1.

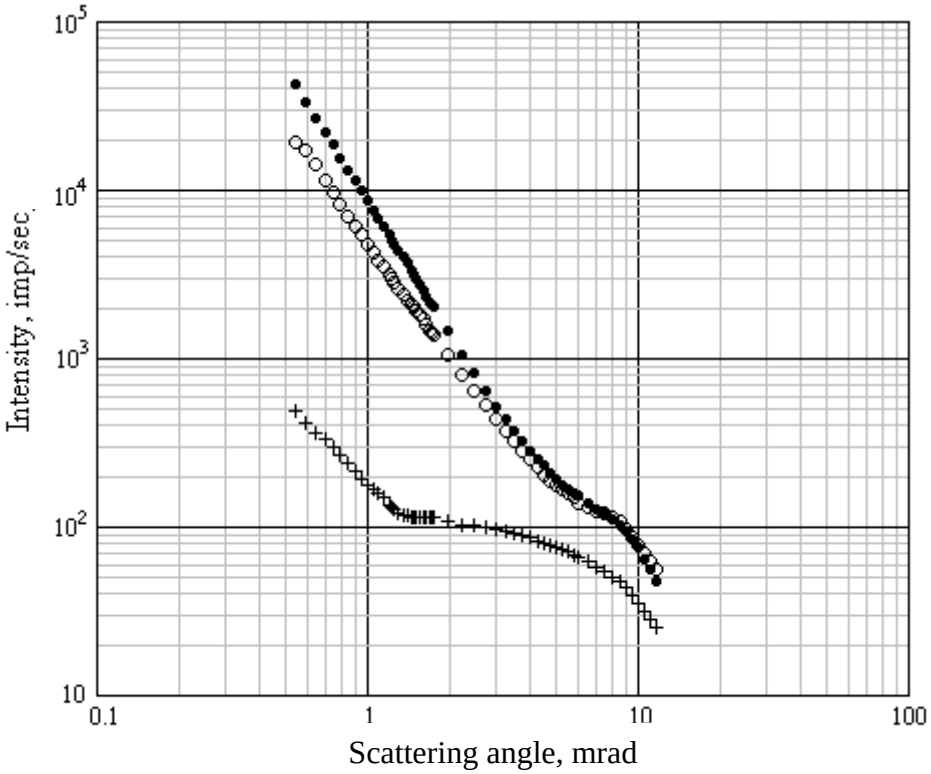

Fig.1 Experimental SAX curves: +++ pure PP; ○○○ PP + 2 vol. % Al ; ••• PP + 4 vol. % Al.

Apparently, presence of Al particles essentially changes a profile of PP dispersion curve. Moreover, dispersion from aluminum becomes defining, especially in the region of small angles in which (in double logarithmic scale) strongly pronounced rectilinear dependence of intensity on a dispersion angle is observed. According to the theory SAX developed in work by Bejla and Schmidt [1], intensity of X-ray dispersion on the homogeneous particles possessing fractal surface, submits to law

$$I(q) \sim q^{-(6-D_s)}$$

The inclination $k = \dfrac{\Delta(\lg I)}{\Delta(\lg q)}$ of a linear part of the specified dependence directly defines fractal dimension D_s of investigated samples. If to accept that observed fractal concerns properties of an interface of phases in the investigated sample it is possible to estimate degree of its "roughness" (scale of a relief of a surface) which is defined by size fractal dimensions.

As appears from Fig.1 PP with 2 vol. % Al possesses higher fractal dimension (D_s = 2,490 ± 0,025) in comparison with PP with 4 vol. % Al (D_s = 2,250 ± 0,016). It is possible to put forward the assumption that Al particles have sites of different "roughness", and at transition from 2 % to 4 % occurs conglomerate of these particles on "rougher" sites of their surface therefore fractal dimension of bound together particles decreases.

1. Bale H.D., Schmidt P.W. The theory of small-angle X-ray scattering by the fractal surfaces.// Phys.Rev.Lett. 1984, Vol.53, P.596-603.