A.V. Voznyak, Yu.V. Voznyak, S.V. Prokhorenko, L.A. Novokshonova, V.G. Grinyov, E.V. Kuvardina, P.S. Didenko, V.G. Krasheninnikov

EQUAL-CHANNEL MULTIPLE-ANGULAR EXTRUSION OF POLYOLEFIN COMPOSITES

Abilities of equal-channel multiple-angular extrusion (ECMAE) to enhance physical and mechanical properties of polymeric composites and effect of the type of polymeric matrix on the strengthening ability of extrudates are studied by the example of compositions of polyethylene of high density, isotactic polypropylene and graphite nanoplates xGnP(5). ECMAE was realized at the plastic deformation intensity $\Delta\Gamma = 0.83$, the value of accumulated strain $\varepsilon = 8.5$, the extrusion speed $0.6 \cdot 10^{-3}$ m/s. The deformation route included pairs of oblique deforming channels located in the planes rotated through the angle of 90° clockwise and separated by vertical deforming channels.

It is demonstrated that ECMAE results in microhardness multiplied by factor of 1.3–1.5 and homogeneous distribution of microhardness over the cross-section of the extrudates. The effect depends on the type of the polymeric matrix. The highest increase in microhardness is achieved when polyethylene matrix is used because of better ability of molecular orientation, not polypropylene one. It was registered that ECMAE provides 95–96% reduction of the coefficient of linear thermal expansion of the tested polymeric composites in two perpendicular directions (aligned and perpendicular to the axis of the sample).

Keywords: severe plastic deformation, equal-channel multiple-angular extrusion, polyolefin composites, graphite nanoplates, microhardness, coefficient of linear thermal expansion

Fig. 1. Scheme of ECMAE process (*а*) and route (*б*): *1* – die, *2* – punch, *3* – polymeric billet, *4* – sacrified billets

Fig. 2. Temperature dependences of the elongation of PP (*1*, *3*) and PP + 5% xGnP(5) (*2*, *4*) samples: *1*, *2* – $\varepsilon = 0$; *3*, *4* – $\varepsilon = 8.5$