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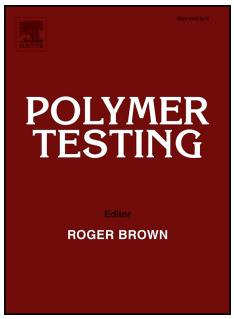

Evaluation of effective density of the molecular network and concentration of the stress transmitters in amorphous layers of semicrystalline polyethylene

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Material Properties

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Summary

A method of evaluation of the molecular network density in semicrystalline polymers and the concentration of stress transmitters, i.e. the molecular elements transferring load between neighboring lamellae, is presented. It is based on measurements of the residual elastic stress left after arresting the strain. The network properties were derived on the ground of rubber elasticity.

This approach was applied to several polyethylenes of different chain length and architecture. The molecular network in these materials was additionally altered by blending with low molecular wax or by annealing. For all samples, the stress transmitter concentration was estimated and compared with theoretical predictions, including the Huang-Brown model for tie molecules. It was found that both molecular weight and chain architecture deeply influence the network properties in solidified material since short and linear chains can disentangle relatively easy during crystallization, while large length and chain irregularities impede disentangling, which leads to higher network density. The chain architecture rather than chain length is a primary factor controlling the network properties.

The method allowed determination of the concentration of stress transmitters quite precisely. This seems important for computer modeling and predicting the long-term performance of semicrystalline polymers.

Keywords: polyethylene; amorphous phase; molecular network; entanglements; tie molecules; stress transmitters