FLEXIBILITY OF POLYMERS AND POLYMER-BASED COMPOSITES

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For a long time the term "brittleness" was used when discussing polymers, polymer-based composites and other materials – in a 'hand-waving' way, without a definition. The situation changes when an equation defining brittleness B was formulated [1]:

$$B = 1/[E' \cdot \varepsilon_b] \quad (1)$$

Here E' is the storage modulus determined by dynamic mechanical analysis at the frequency 1.0 Hz and ε_b is the tensile elongation at break. Since the original definition, B became connected to impact strength [2] and a number of other mechanical and also tribological properties [3].

A similar situation exists with "flexibility" – a quantity mentioned often but in hand-waving arguments. Therefore, we would like to develop an equation defining flexibility Y. At this time we have several candidate equations. One of them is:

$$Y_\alpha = \eta \cdot \alpha_l / [B \cdot \Sigma_i^n u_{bi}] \quad (2)$$

Here η is the number of bonds in a monomer, $\Sigma_i^n u_{bi}$ is the sum of the strengths of bonds in the monomer, while the linear isobaric thermal expansivity α_l is

$$\alpha_l = l^{-1}(\partial l/dT)_P \quad (3)$$

where l is the length (or height) determined by thermal mechanical analysis.

We shall present relationships involving Y, B, α_l and also other properties. Thus, we are connecting Y to mechanical (tensile modulus, tensile elongation at break, tribological (dynamic friction, wear) and thermophysical (density, linear thermal expansivity) properties.

References:
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