SHAPE-MEMORY MATERIALS: DEVELOPMENT ALTERNATIVE THERMOSHRINCABLE COMPOSITES BASED ON NON-LINEAR ELASTIC SPRINGS

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Development of non linear elasticity of spiral springs leads us to creature of novel thermoshrinkable composites .This polymer matrix composites are reinforced by the extremely straightened non-linear metallic springs.

At present, the consensus regarding to the most prominent shape-memory materials are shape-memory alloys and shape-memory polymers. Beside advantages, the shape-memory alloys have disadvantages that limit their engineering applications, Among disadvantages of shape-memory alloys it should be emphasized the limited recoverable strain, inherently high stiffness, high cost and comparatively high inflexibility of the phase transition temperature. [1, 2].
Beside advantage, shape-memory polymers also have disadvantages that limit their engineering application. The low reconstruction stresses should first of all disadvantages of shape-memory polymers. Such limitations of recoverable strains and reconstruction stresses are attractive for use as motive for development of novel alternative shape-memory materials.
The main goal of our work is development of alternative composites with high reconstruction stresses and large recoverable strains. In accordance with non-linear elasticity of spring [3, 4], springs with high index J (J = D/d, where d and D are diameters of wire and spring, respectively) can be extremely straightened in linear area of material elasticity.
Let us suppose, that limit of linearity is equal 1%. In accordance with this hypotheses, a draw ratios λ of the extremely straightened spring are corresponding to the every value of spring index J. The relation between draw λ and spring index J can be calculated as follows

$$\lambda = [\sin 0{,}5\,\pi(1-0{,}005\,J)]^{-1}$$

An accordance with this equation, if spring index J is equal 200, then value of draw ratio λ is not limited. If spring index J decreases from 150 to 100 (or from 50 to 25), then draw ratio λ decreases from 2.6 to 1.415 (or from 1.08 to 1.02), respectively.
Reinforcement of the polymer matrix composites by the extremely straightened metallic spring leads to increase of reconstruction stresses and recovery strains in process of the stress-free thermally induced shrinkage.

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