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MECHANICS

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FINDING EFFECTIVE CHARACTERISTICS OF MULTICOMPONENT CHAOTIC REINFORCED KM

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Abstract

We calculate the effective mechanical properties of multicomponent random matrix reinforced composite materials, weakened by various defects - voids, pores, cracks ellipsoidal shape.

The relations obtained in [1] can be used to find effective mechanical properties of multicomponent random matrix reinforced composite materials, weakened by various defects - voids, pores, cracks ellipsoidal shape.

Let the pores have the shape of ellipsoids of rotation. Letting the parameter to zero, we obtain a composite material, a weakened circular uniformly oriented flat cracks.

Effective modules of this composite material is calculated according to the formulas:

$$\mu^* = \mu_m + \frac{\sum_{s=1}^{n} [\mu_s] c_s \alpha_s}{c_m + \sum_{s=1}^{n} c_s \alpha_s + c_0 \alpha_0} - \frac{\mu_m c_0 \alpha_0}{c_m + \sum_{s=1}^{n} c_s \alpha_s + c_0 \alpha_0}, \qquad (1)$$

$$K^{*}=K_{m}+\frac{\sum_{s=1}^{n}\left[K_{s}\right]c_{s}\gamma_{s}}{c_{m}+\sum_{s=1}^{n}c_{s}\gamma_{s}+c_{0}\gamma_{0}}-\frac{K_{m}c_{0}\gamma_{0}}{c_{m}+\sum_{s=1}^{n}c_{s}\gamma_{s}+c_{0}\gamma_{0}}.$$

Here c_0 - the concentration of cracks.

Hence, at low concentrations c_0 obtained formulas for determining effective body modules, attenuated non-interacting cracks

$$\frac{\mu^{*}}{\mu_{m}}=1-c_{0}\alpha_{0},\quad \frac{K^{*}}{K_{m}}=1-c_{0}\gamma_{0}. \tag{2}$$

Here

$$\alpha_{0}=\frac{8}{15\pi}\frac{(1-\nu_{m})(5-\nu_{m})}{2-\nu_{m}},$$

$$\gamma_{0}=\frac{4}{3\pi}\frac{1-\nu_{m}^{2}}{1-2\nu_{m}},$$

$$c_{0}=\frac{4}{3}\pi n a^{3},$$

n - numerical concentration of cracks.

With the degeneration of ellipsoids in the sphere of effective relations for the tensor plasticity correctly converted to the formula describing composite materials such as "matrix - spherical inclusions":

$$\mu^{*}=\mu\frac{(1-\alpha)\xi}{1-\alpha\xi},\qquad \xi=\sum_{s=1}^{n}\frac{c_{s}\mu_{s}(\Lambda_{s})}{\mu+\alpha\left(\left(\mu_{s}(\Lambda_{s})-\mu\right)\right)},$$

$$K^{*}=K\frac{(1-\gamma)\eta}{1-\gamma\eta},\qquad \eta=\sum_{s=1}^{n}\frac{c_{s}K_{s}}{K+\gamma(K_{s}-K)}. \tag{3}$$

Here

$$\alpha = \frac{2}{15}\frac{4-5\nu}{1-\nu}, \quad \gamma = \frac{1}{3}\frac{1+\nu}{1-\nu}, \quad \nu = \frac{3K_m - 2\mu_m}{6K_m + 2\mu_m}.$$

Linearization constants are found from the equations

$$\Lambda_s = \frac{(1-\alpha)\mu_m + \alpha\mu^*}{\mu_m + \alpha(\mu_s(\Lambda_s) - \mu_m)}\ e. \tag{4}$$

References:

[1] Khokhryakova Y. On the theory of nonlinear strengthening of multi-component chaotically reinforced composite weakened by various defects // Proceedings of the Sixth All-Russian Scientific Conference "Mathematical modeling and boundary problems" - Samara State Technical University - 2009. - C. 284-287.