The sintering of TiH_2 and Fe by thermocycling at temperatures near the $\alpha \leftrightarrow \beta$ transformation of Fe did not give the desired result. The X-ray pattern showed the existence of two separate phases TiH_2 and Fe, which may indicate the stability of the TiH_2 hydride in the TiFe alloy.

Conclusion. TiFe alloys are attractive for their ability to absorb large amounts of hydrogen. Hydrogenation processes are accompanied by an order-disorder phase transformation. However, the use of TiFe hydrides is limited, because when the hydrogen concentration increases to 4.04 wt % H, the stable TiH_2 hydride is formed. Partial replacement of doped elements can improve hydrogenation kinetics without changing its ability to store hydrogen. Changing the pressure from 5 GPa to 10 GPa at temperature of 600 °C does not affect hydrogenation processes.

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DETERMINATION OF COMPOSITE MATERIALS WITH DISPERSIVE INCLUSIONS LONG-TERM STRENGTH

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The strength and durability of composite materials depend on cohesive bonds (interatomic and intermolecular interaction). and from the defectiveness of their structure. Real strength is formed by the structure of materials and defects of various kinds.

A flat macroelement of a composite material is considered – a homogeneous matrix in which elliptical inclusions of different sizes and orientations from another elastic material are evenly distributed. Inclusions of this form are often found in metals (oxidized layers, graphite inclusions in cast iron, etc.).

The macroelement is located in a flat biaxial field of normal stresses P and $Q = \eta P$. The elastic properties of the matrix and inclusions are specified. The modulus of elasticity of the inclusions is small compared to the modulus of elasticity of the matrix. The inclusions are flattened in shape and their defining parameters are length

$2a$ and angle of orientation α relative to the main axis [1]. We consider the case when the failure begins in the inclusions and the cracks dynamically spread along their entire length.

We accept as the criterion for the crack occurrence the condition of a Coulomb friction law with clutch type [2]^

$$\tau_{xy}^1 \le K^1 - \sigma_y^1 tg\rho^1, \quad (1)$$

where σ_y^1, τ_{xy}^1 are the stress in inclusion, K^1 is a clutch coefficient, $tg\rho^1$ is a coefficient of material inclusion internal friction. The stress in inclusion is determined as:

$$\sigma_y^1 = \frac{0,5P(\eta+1+(1-\eta)\cos 2\alpha)G_1(1+ш_1)(1+ш_2)}{G_1(1+ш_1)(1+ш_2)+2\delta G_2(ш_1-1)},\ \tau_{xy}^1 = \frac{0,5P(1-\eta)\sin 2\alpha\ G_1(1+ш_2)}{G_1(1+ш_2)+2\delta G_2},$$

where G_1, G_2 are the shear modules ($G_1/G_2<1$), $ш_1$, $ш_2$ are the elastic constants, which are expressed in terms of Poisson's coefficient ν [1].

Assume that the cracks grow, keeping their straight shape and orientation. Let the law of crack size growth under a given loading over time t have the form

$$a = a_0\Phi(t,P,\eta,\alpha), \quad (2)$$

where a_0 is the half-length of the crack at $t=0$.

According to expression (2), it is possible to find the time for the crack to reach the critical size a_* (the durability of the composite material) in the given stress field. Let this dependence have the form $t=\chi(a,P,\eta,\alpha)$, where t is a random variable.

The durability distribution function of a composite element with one inclusion can be found using the formula

$$F_1(t_*) = \iint\limits_{\chi(a,P,\eta,\alpha)\le t_*} f(a,\alpha)\,da\,d\alpha,\ t_{\min} \le t \le t_{\max}, \quad (3)$$

where $t_{\min}$ and $t_{\max}$ are the minimum and maximum value of durability.

Durability of the composite containing N inclusions

$t_* = \min(t_*^1, t_*^2, ..., t_*^N)$.

In this case, the durability distribution function of the composite with N inclusions is determined by the formula

$$F_N(t_*) = 1 - (1 - F_1(t_*))^N. \quad (4)$$

According to expression (4), the mean value, dispersion and other probabilistic characteristics of the composite material durability can be determined.

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ANALYSIS OF DIRECT REDUCTION OF IRON BY HYDROGEN

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Direct reduction of iron from oxides with hydrogen has a great advantage over reduction with carbon or in a water gas atmosphere. The advantage is that the emissions of dust, sulfur gases, oxide and carbon dioxide into the atmosphere by the metallurgical enterprise are sharply reduced due to the absence of blast furnace separation and agglomeration production. In addition, there is no need for solid fuel – coke. The sponge iron obtained after recovery practically does not contain sulfur and phosphorus. The possibility of increasing the productivity of the recovery process should be taken into account, since hydrogen has a higher diffusion coefficient in metals compared to other gases and carbon. These and other advantages have led to the fact that there are more and more studies of the technology of obtaining iron by reducing it from oxides with hydrogen.

Currently, iron recovery is carried out at so-called average temperatures. At temperatures below 843 K [1, 2, 3], a two-stage reduction (1) occurs, and above