SYNERGY IN COMPOSITES

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ABSTRACT

A well known definition of composite as “a heterogeneous mixture of two or more homogeneous phases which have been bonded together” (Kelly, 1994) does not stress at an important property aroused as a result of appropriate mixing phases in composites. Moreover, an overwhelming growth of application in the last decades of just one family of the composites - a family of fibre reinforced plastics (Kelly, 2009) - makes people to focusing on just one example of synergy in composites that is fracture toughness of the FRP, which are inherently strong due to the fibre. A purpose of the present paper is to draw attention, mainly of young researchers, to a number of the synergy effects arising in metal matrix composites.

Keywords: Composites, fibres, fracture, toughness, creep.

THE FIBRE AFFECTS MATRIX PROPERTIES.

An example of such effect can be observed in boron-aluminum composite. If the matrix contains magnesium then boron, which has a very low solubility in aluminum, goes out of aluminum to form borides, magnesium boride being an example (Mileiko, Sarkissyan et al., 1994a). This yields an essential increase in the matrix strength. Understanding the processes going on in the composite at enhanced and high temperatures allows developing a new and effective fabrication technology of composite structural elements. Details of the technology will be disclosed in the full text paper.

THE MATRIX AFFECTS FIBRE PROPERTIES.

A most impressive example of such effect can be seen in the structures of high temperatures composites based on oxide fibres produced by internal crystallisation method (Mileiko, 2005). The fibre surface carries a lot of the defects. Being tested separately the fibre occurs to be rather weak. However, if the matrix wets fibre material them the effective fibre strength in the matrix can be 3-5 times higher. This effect takes place in the case of using any fibre in a liquid matrix in the technological process (Mileiko, 2002; Mileiko, Sarkissyan et al., 2004;).

Again, understanding these mechanisms can be useful in developing fabrication technology of composites.

INTERACTIONS BETWEEN BRITTLE FIBRES AND DUCTILE MATRIX YIELDS AN INCREASE IN THE STRENGTH AND FRACTURE TOUGHNESS OF COMPOSITES.

Multiply fibre breaking at its weak points outside of the macrocrack plane makes a zone of energy dissipation in front of the crack tip large enough to produce a composite with fracture toughness larger than that of the ductile matrix. This makes a principal difference between
metal alloys and metal matrix composites (Mileiko, 1997). Unlike a case of the composites, strengthening the alloys yields a decrease in their fracture toughness.

**COOPERATION OF THE FIBRE AND A REFRACTORY MATRIX CAN YIELD COMPOSITES OF HIGH CREEP RESISTANCE AND ENHANCED OXIDATION RESISTANCE**

Reinforcing a molybdenum matrix with appropriate oxide fibers slows down oxidation of molybdenum at high temperatures. At the same time, oxide fibers crystallized from the melt determine high creep resistance of the composites at temperatures up to about 1300°C (Mileiko and Novokhatskaya, 2012; Mileiko and Novokhatskaya, 2015). An analysis of the experimental data on creep rupture and matrix oxidation yields a general idea of tailoring creep resistant refractory metal matrix composites of high fracture toughness and sufficiently high gas corrosion resistance. To develop such composites, it is necessary to reinforce a refractory metal with creep resistant fibers containing an element providing gas corrosion of the composite.

**REFERENCES**


