YOUNG'S MODULUS AND INTERNAL FRICTION OF BIOMORPHIC SiC/Si COMPOSITE ON THE BASE OF EUCALYPTUS

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It is for the last ten years that physical and mechanical properties of biomorphic SiC/Si composites are under study. They are the new kind of ceramics (ecoceramics – environment conscious ceramics) with a channel structure. The present work deals with their acoustic properties (Young's modulus E and logarithmic decrement δ) measured at 116-296 K in a wide strain amplitude range which allows one to investigate both linear and non-linear material behaviour under vibrational stresses.

Bio-SiC/Si composites were prepared by a technique of the melted Si infiltration in vacuum into a porous carbonized wood (white eucalyptus) after its pyrolisis in the Ar atmosphere at 1000°C. The material had a cellular structure stretched along the tree upgrowth. The cells contained a residual carbon and pores of about 100 μm partially filled with Si. The samples for the acoustic tests were rods of a rectangular cross-section (~16 mm^2) and ~50 mm length. The orientation of the rods was along the cells stretching (tree height). Acoustic measurements were made by a resonant composite oscillator technique using longitudinal vibrations at frequencies of ~100 kHz.

Some unexpected effects have been revealed during vibrational loading of the samples in air and vacuum environments. It has been found that the effective modulus E becomes higher and decrement δ becomes lower at continuously increasing strain amplitude ε when the measurement is made in air at room temperature. The changes are mainly irreversible: after ε decreasing the Young's modulus E at low amplitudes reveals higher value as compared with the initial one and the decrement δ decreases by about 50%. Some time later, the curves E(ε) and δ(ε) show the recovery effect if the sample is kept in the air after the first measurement. In vacuum, during the pumping, the values of E and δ increase and decrease, respectively, that is similar to the above mentioned high amplitude excitation effect. Besides, the curves E(ε) and δ(ε) obtained in vacuum are qualitatively the same as in the air. One notices the similar behavior of E(ε) and δ(ε) at low temperatures as well.

One can conclude from the available results that, in bio-SiC composites, there exist at least two mechanisms which influence on their elastic and anelastic properties. The first one is due to an adsorption and/or desorption of gases which are in the air (presumably because of the pores and residual carbon). The second one is associated with microplastic deformation that arises due to dislocations or any other structural entities which can make an oscillatory movement under ultrasonic stresses and, in this way, can increase both the damping and non-linear anelastic strain.

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