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Mechanical properties of AlSiMg/SiC and AlSiMgTiB/SiC produced by semi-solid stir casting and high pressure die casting

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Abstract

Mechanical properties of the AlSiMg/SiC and AlSiMgTiB/SiC composites produced by high pressure die casting (HPDC) are investigated. The mixture of ADC 11, master alloy AlMg, master alloy AlTiB and 99 % aluminium were used as metal matrix. A reinforcement particle was represented by high purity silicon carbide with an average particle size mesh 400. Aluminium matrix and SiC particle with the content: 5 %, 7.5 %, and 10 % wt were mixed by the semi-solid stir casting method. The stirring process was performed by 45° degree carbide impeller at a rotation of 600 rpm and temperature of 570°C for 15 minutes. The mixture of AlSiMg/SiC and AlSiMgTiB/SiC were shaped into the specimen by HPDC. Mechanical characterizations of composite specimens were done in hardness, tensile and impact tests. The density of the composites was also determined. The results have shown that adding SiC improves the hardness, tensile strength of the AlSiMg/SiC and AlSiMgTiB/SiC. The increase of % wt SiC decreases the impact resistance of the composites tested. The addition of TiB increases the hardness and ultimate tensile strength and ductility. A higher of % wt of SiC porosity of composite increases. This physical quantity was lower at the composite with TiB than without this type of ingredient. TiB caused grain refining of the matrix and enhances the mechanical properties of composites. © 2021, Peter the Great St. Petersburg Polytechnic University

Author keywords

Aluminium Matrix Composite; HPDC; Mechanical properties

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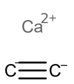
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REFLECTION AND TRANSMISSION AT THE INTERFACE OF AN ELASTIC AND TWO-TEMPERATURE GENERALIZED THERMOELASTIC HALF-SPACE WITH FRACTIONAL ORDER DERIVATIVE

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Abstract. The present investigation is concerned with the reflection and transmission at elastic half-space and a two-temperature generalized thermoelastic half-space with fractional order derivative. The governing equations in the context of the theory of two-temperature generalized thermoelasticity using the methodology of fractional calculus are used to investigate the problem. The incident wave is assumed to be striking at the plane interface after propagating through the elastic solid half-space. It is found that the amplitude ratios of various reflected and refracted waves are functions of the angle of incidence and frequency of the incident wave. These amplitude ratios are influenced by the fractional-order thermoelastic properties of media. The expressions of amplitude ratios and energy ratios have been computed numerically for a particular model. The variations of energy ratios with the angle of incidence are shown graphically. The conservation of energy at the interface is verified.
Keywords: fractional, temperature, elastic, reflection, transmission

1. Introduction

In recent years, several interesting models have been developed by using fractional calculus to study the physical processes particularly in the area of heat conduction, diffusion, viscoelasticity, mechanics of solids, control theory, electricity, etc. It has been realized that the use of fractional order derivatives and integrals leads to the formulation of certain physical problems which is more economical and useful than the classical approach. There exist many materials and physical situations like amorphous media, colloids, glassy and porous materials, manmade and biological materials/polymers, transient loading, etc., where the classical thermoelasticity is based on Fourier type heat conduction breaks down. In such cases, one needs to use a generalized thermoelasticity theory based on an anomalous heat conduction model involving time-fractional (non-integer order) derivatives.

The first application of fractional derivatives was given by Abel [1] who applied fractional calculus in the solution of an integral equation that arises in the formulation of the tautochrone problem. Caputo [2] gave the definition of fractional derivatives of order of absolutely continuous function. Caputo and Mainardi [3], Caputo and Mainardi [4], and Caputo [5] found good agreement with experimental results when using fractional derivatives

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MECHANICAL PROPERTIES OF EPOXY RESIN WITH ADDITIVES SOOT AND NANOTUBES

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Abstract. The article presents the results of a study of a composite material based on epoxy-diano resins containing a nanocarbon dispersed filler. The effect of small soot and carbon nanotube inclusions on the change in the mechanical characteristics of the cured epoxy resin ED-20 depending on the degree of filling was investigated. Measurements of the ultimate strength, effective modulus $E^* = d\sigma/d\varepsilon$ and maximum deformation before specimen fracture were performed during tensile tests, compression, and bending. The study of the mechanical properties of the specimens was carried out on an AG-X Autograph Series Shimadzu universal testing machine under typical conditions, i.e. room temperature. Found a significant increase in the ultimate strength and plastic deformation of the cured resin with the introduction of the addition of carbon black and nanotubes. The change in the effective modulus during the deformation up to the destruction of the material was determined. Two stages of deformation with a different character of modulus change are revealed: its monotonous decrease and its almost constant value. On this basis, it was concluded that the process of deforming epoxy composites with a consistent change in the deformation mechanisms is complex.

Keywords: epoxy composites, soot, nanotubes, strength, plasticity

1. Introduction. The development of composite materials (CM) is one of the most promising areas of physical, chemical, and technical materials science. The uniqueness of the properties of these materials is due to the presence and interaction of two or more phases in them, which differ significantly in their properties. The most common practice is to create composites in order to improve the stress-strain characteristics of known materials, in particular, polymers. Composite materials based on polymers are widely used in various industries, due to the extremely wide range of their physical, chemical, and other properties [1-14]

In the construction industry, thermosetting polymers based on low molecular weight epoxy and diano resins are the most common [15-23]

Of particular interest are polymeric materials with carbon fillers [24-25]. The first of them – carbon fibers – in the second half of the last century began to be used for the production of carbon plastics, which have found wide application in aerospace and other industries.

As dispersed (powdered) plastic fillers, furnace soot (carbon black) is the most common [1-3,13] In [14], high-density polyethylene was used as the polymer matrix, and the technical carbon (CB) was used as the filler. It was shown, in particular, that the effective modulus of

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