Development of defining equations for unidirectional carbon fiber

Ostrik A V[@], Nikolaev D N, Utkin A V and Mochalova V M

Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry of the Russian Academy of Sciences, Academician Semenov Avenue 1, Chernogolovka, Moscow Region 142432, Russia

[@] ostrik@ficp.ac.ru

As is known, the traditional decomposition of stress and strain tensors on the ball and deviator parts in relation to anisotropic materials is inconvenient, since the hydrostatic stress in this case depends not only on the temperature and relative change in volume (density), but also on the components of the strain tensor deviator. Therefore, the decomposition introduces the generalized orthotropic pressure given by the diagonal tensor [1]. Decomposition [1] allows you to use the normal equation of state (EOS) to construct defining equations of an anisotropic composite.

To determine the elastic constants of unidirectional carbon plastic, data on measurements of the speed of ultrasound in the material in various directions are used [2]. The carbon fiber equations are constructed as for the equilibrium mixture by the known EOS of its components (carbon and epoxy-polyamide composition) [3]. The calculated Hugoniot adiabate of such mixture is compared with experimental data [4].

The constructed defining equations are used in numerical modeling of a shock-wave experiment with samples of unidirectional carbon fiber plastic cut at different angles to the direction of reinforcement. Satisfactory agreement of the calculated and experimental data was obtained.

[1] Lukyanov A 2008 *Int. J. Plast.* **28** 140–167
[2] Chu Y, Degtyar A and Rokhlin S 1994 *J. Acoust. Soc. Am.* **95** 3191–3203
[3] Ostrik A 2020 *Konstrukcii iz kompozicionnyh materialov* **1(157)** 43–47
[4] Mochalova V, Utkin A and Nikolaev D 2023 *J. Appl. Phys.* **133(24)** 245902