MODEL OF THE THERMODYNAMIC PROPERTIES OF HIGH-ENTROPY ALLOYS IN THE REGION OF HIGH PRESSURES AND TEMPERATURES TO SIMULATE SHOCK-WAVE PROCESSES IN THESE MATERIALS

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High-entropy alloys are defined as alloys containing at least five main elements, the atomic fraction of each of which ranges from 0.05 to 0.35 [1–7]. To describe the thermodynamic properties of matter during numerical simulation of shock-wave processes, equations of state for materials are required, which closes the system of laws of conservation of mass, momentum and energy [8–10].

In this work, a model of the equation of state for the components of alloys is used in the following form:

$$E(V,T) = E_c(V) + E_a(V,T) + E_e(V,T),\ P(V,T) = P_c(V) + P_a(V,T) + P_e(V,T). \tag{1}$$

Here E is the specific internal energy; P is the pressure; V is the specific volume; T is the temperature; E_c and P_c are the cold components of E and P (at $T = 0$); E_a and P_a are the thermal contributions of atoms; E_e and P_e are the thermal contributions of electrons.

The model of thermodynamics of alloys is based on the assumption of equality of temperatures and pressures in its components:

$$V_{1N}(P,T) = \sum_{i=1}^{N} \alpha_i V_i(P,T),\ E_{1N}(P,T) = \sum_{i=1}^{N} \alpha_i E_i(P,T), \tag{2}$$

where V_{1N} and E_{1N} are the specific internal energy and specific volume of the alloy; V_i, E_i, and α_i are the specific volume, the specific internal energy and the mass fraction of the i-th component; N is the number of components.

Based on model (1) and (2) for alloys and their components, shock adiabats are calculated, which are in good agreement with the available data from shock-wave experiments in the region of high pressures and temperatures.

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