Modeling the characteristics of shock-wave flow in copper samples, accounting for melting

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Information on the thermodynamic characteristics of materials at high pressures and temperatures is required to solve a wide range of problems in physics and energy. Equations of state, which express the functional relationship between thermodynamic quantities, make it possible to generalize the results of experimental studies on the state parameters of matter at high energy densities, thereby enabling the modeling of physical processes that occur at high pressures and temperatures.

This work is devoted to modeling the thermodynamic characteristics of shock-compressed copper samples with varying initial densities. Two thermodynamically complete equations of state for copper are considered, one of which is constructed for the liquid phase, and the other for the solid and liquid phases, as well as their thermodynamically equilibrium mixtures. Based on these two equations of state, calculations were performed for the kinematic and dynamic characteristics of copper under shock-wave conditions. In addition, the temperature dependence of copper density during isobaric heating was calculated. The results of all these calculations are compared with experimental data obtained at high temperatures. Based on the results of comparison of calculation results with experimental information, the areas of applicability of the considered equations of state were established.

The results of this work can be used in the mathematical modeling of physical processes in copper at high pressures and temperatures.