ТЕЗИСЫ ДОКЛАДОВ

INTERNATIONAL WORKSHOP

«Multiscale Biomechanics and Tribology of Inorganic and Organic Systems»

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ

«Перспективные материалы с иерархической структурой для новых технологий и надежных конструкций»

VIII ВСЕРОССИЙСКАЯ НАУЧНО-ПРАКТИЧЕСКАЯ КОНФЕРЕНЦИЯ С МЕЖДУНАРОДНЫМ УЧАСТИЕМ, ПОСВЯЩЕННАЯ 50-ЛЕТИЮ ОСНОВАНИЯ ИНСТИТУТА ХИМИИ НЕФТИ

«Добыча, подготовка, транспорт нефти и газа»

Томск
Издательский Дом ТГУ
2019

DOI: 10.17223/9785946218412/196

THERMODYNAMIC PARAMETERS OF SHOCK WAVE LOADING OF CARBIDES WITH VARIOUS STOICHIOMETRIC COMPOSITIONS

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Shock wave synthesis and compaction using powder mixtures are a promising direction of new materials creation. In this direction intensive research of materials compressibility are carried out to create mixtures with required properties. Mixtures with carbides as a component are of great interest.

The results of numerical experiments on modeling of shock wave loading of solid and porous carbides with various stochiometric composition are presented. The model is based on the assumption that all the components of the mixture, including gas, have similar pressure, velocity and temperature. Equations of state of Mi-Grüneisen is used for describing behavior of condensed phases. The coefficient of Grüneisen depends explicitly only temperature for model TEC. The modified equation of state is proposed for the calculation of model TEC2 to improve the reliability of the description of thermodynamic parameters of shock-wave loading of pure materials and heterogeneous mixtures of different porosity. The coefficient depends temperature and volume for model TEC2 in this case.

This model allowed to describe behavior of porous materials and mixes in a wide range of porosity and pressures with precision experiment. On the basis of these results, it was proposed to describe this model the behavior of complex materials such as carbides, considering the chemical compound as mixture. Interest in the research on carbides compressibility is related, in particular, to problems of explosive compaction of powders of carbides, i.e. with the microsampl of these compounds with properties (hardness, fragility) of initial grains of specimens. Porous carbide was viewed as porous mixture with the components of the relevant elements of the carbide. Correlation of volumetric fraction of the condensed component was determined, as well as for solid samples by stoichiometric ratio, but the value decreased proportionally to the porosity of the sample.

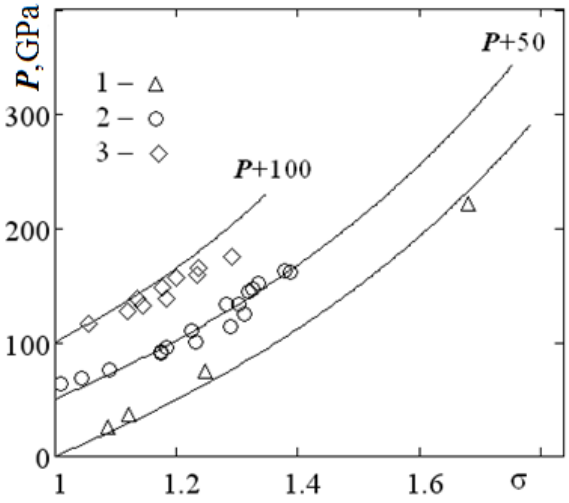

Figure 1. Calculation and experimental data for porous boron carbide in the variables pressure P – compression ratio σ. m 1-1, 2–1.04, 3–1.29 (porosity m is ratio of density of solid substance to the density of sample).

Assumption about the possibility of determining the volume of components based on stoichiometric ratio, has allowed not only to describe accurately the behavior of carbides with equal shares of the components such as WC, TiC, TaC, NbC, but also the behavior of boron carbide B_4C.

This material has a high hardness value, yielding to this indicator only diamond that causes the increased interest. The availability of experimental data made it possible to compare the calculated and experimental data, taking into account the assumptions used in the model. For volumetric proportion of boron carbide was determined by a ratio of 4: 1 respectively, chemical composition.

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