Explosive experiments for studying dynamic properties of transition metals, some actinides, and alloys on their basis

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Abstract

In this article, we give brief overview of some earlier published data demonstrating how mechanical behavior of some transition and 5f-metals, as well as alloys depend on the content of impurities and alloying elements, the blank fabrication technology, aging, pressure, temperature, low, and high strain-rate-deformations. Control over stability of mechanical properties, particularly the shear and spall strength of the material, is demonstrated to be of critical importance. Effect of phase transitions on the features of spherical shells behavior under explosive loading is shown to be possible.

Keywords: data storage materials (A), shock-wave loading (B), mechanical properties (C), strain, high pressure (D), spherical shock-wave recovery experiments (E).

1. Introduction. The transition 3d-, 4d-, and 5d-metals, as well as metals with f-electron shells, i.e. lanthanides and actinides, have complex phase diagrams and regular significant changes in physical, mechanical, and thermodynamic properties of each phase.

Plutonium shows the highest sensitivity to changes in pressure, temperature, content of alloying elements and impurity elements (metallurgical and/or radioactive nuclear decay products). Due to substantial, sometimes anomaly, changes in the properties of different phases of Pu and its practical significance, this actinide was studied most comprehensively. In particular, one investigated and analyzed:

- its phase diagram in the wide range of pressures and temperatures (P,T) using high static pressure methods and techniques;
- changes in mechanical (strength and plastic) properties at quasi-static and dynamic loading in the region of existence of each phase, both in the initial state before aging, and after long-term self-irradiation;
- isothermal, isentropic, and shock compressibility;
- sound velocities at atmospheric pressure and different temperatures, as well as in the shock-compressed states, etc.

The purpose of this work is to discuss the earlier published data on the behavior and properties of some transition and 5f-metals being of interest from the standpoint of fundamental research into actinides, as well as verification and validation of modern strength models, as well as 2D- and 3D- numerical codes.

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