Method for studying the states of condensed matter near the cold compression curve at ultra-high pressures

Degtyarev A V[@], Arinin V A, Blikov A O, Georgievskaya A B, Gordeev A Yu, Davydov N B, Erunov S V, Knyazev V N, Korshunov S A, Kulakov E V, Manachkin S F, Profe A B, Pupkov A S, Tilkunov R V and Tyupanova O A

Federal State Unitary Enterprise "Russian Federal Nuclear Center—All-Russian Research Institute of Experimental Physics", Mira Avenue 37, Sarov, Nizhniy Novgorod Region 607188, Russia

[@] postmaster@ifv.vniief.ru

To develop equations of state for condensed matter in the region of ultra-high densities, data on "cold compression" are needed. Until now, "cold compression" of condensed materials has been studied under static compression conditions on powerful presses. The maximum pressure in such presses is limited by the strength of the structural components. The Institute of Experimental Gas Dynamics and Explosion Physics (IPE) FSUE RFNC-VNIIEF has developed a new unique method for studying the compression of condensed materials to extreme high densities in states located in close proximity to states on the "cold compression curve" of materials. Such states in materials cannot be achieved by exposure to shock waves. This method is based on the use of multi-frame radiography and explosive spherical loading devices. The physical design of such a loading device ensures compression of samples in a quasi-isentropic mode. This paper presents the results of the first experiment conducted to study the compression of a thin shell of lead (thickness 2 mm, mass 700 g) to a density 55 g/cm^3 in a quasi-isentropic mode. According to calculated estimates, the pressure at the moment of maximum compression was 3000 GPa (30 million atm). More than 90% of this value is due to the potential interaction of lead atoms.