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Investigation of Shock Wave Properties of Porous Materials for Experiments at PRIOR

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Research on shock wave processes provides information on thermodynamic and rheological properties of materials in a wide range of pressures and temperatures under conditions of high strain rates. Investigation of shock compression features of porous materials is of particular interest, since the experimental study of the same material at different densities can significantly expand the area of thermodynamic states accessible by pulse loading.

The objects of the study were inert porous media. Shock jump is blurred in them, thus allowing us to observe density distribution in the front of the compression wave. For an inert porous media, we selected silicone rubber with glass microspheres, this silicon rubber featuring different concentration of microspheres. These microspheres have various diameters. In the first case, the average size of microspheres was 80 microns, while in the second case the microsphere size varied within the range 20-150 microns.

One of the methods of creating a shock wave in a material is to use a light-gas gun. Several of certain advantages of such gas guns are the possibility of smooth adjustment of impact velocity, a controlled minimal tilt of a flyer plate in all of the experiments and high uniformity of the region of 1D flow behind a shock front in a target.

A compact device which fits the requirements at the plasma physics Cave of FAIR is currently designed and constructed at TU Darmstadt (Germany) in the frame of the PRIOR project. With this device flyer plates could be accelerated to velocities up to 3 km/s. (Michael Endres, Serban Udrea, Yana Hitzel and D.H.H. Hoffmann "A light gas driver for matter properties studies at FAIR").

The substances which we are planning to test with the light gas gun are still being explored during the experiments with explosives to determine the detailed picture that should be expected during future proton-radiography experiments. Free surface velocity profiles of samples were registered with VISAR laser Doppler interferometer.

Was obtained some new experimental data on the properties of porous materials under shock wave loading for silicon rubber with microspheres of different diameter. The velocity profiles have rather complex structure of the shock-wave front, this structure being created by the pores collapse kinetics in the investigated heterogeneous samples.

A rather complex structure of the shock wave front is a specific feature of the investigated samples. The heterogeneous structure of the investigated samples causes considerable oscillation of the velocity profiles after the shock jump.

Was obtained the Hugoniots of the materials at high pressures and some data on the isentropes of the substances at low pressures.

It determined that the rubber with microspheres is a material with a low value of a damage threshold.

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