Editorial

High Energy Density Physics

States of matter that correspond to an energy content of $10^{11}$ J/m$^3$ or equivalently 1 Mbar pressure, and above, are classified as High Energy Density (HED) states. The subject of HED physics spans over very wide areas of basic and applied physics including, for example, astrophysics, planetary sciences, geophysics, plasma physics, inertial fusion, fluid dynamics, radiation hydrodynamics, magnetohydrodynamics, material sciences, condensed matter physics, interaction of intense radiation with matter, atomic and molecular physics and many others. In addition to that, this field has great potential for numerous lucrative industrial applications. A study of the fundamental properties of HED matter, especially its thermophysical and transport properties, is therefore of considerable scientific importance as well as of great technological interest.

The traditional methods of generating HED states mainly involve shock compression of matter. Pressures in 10 Mbar range have been produced employing high power explosives, light gas guns and Z-pinchnes [1-5]. Much higher pressures in Gbar range have been generated using underground nuclear explosions [6] and powerful lasers [7-10]. Isobaric expansion (IEX) technique that involves explosion of thin metallic wires that are strongly heated by the passage of very high current [11], is an alternative approach. Compression of matter in diamond anvil cell (DAC) [12, 13] is another popular method to study this problem. A new technique that involves isochoric and uniform heating of a sample material using laser generated high energy proton beams [14] as well as accelerator generated intense heavy ion beams [15,16] has recently been proposed. Another novel proposal to study this field is to use future short-pulse tunable soft X-ray free electron laser based on self-amplified spontaneous emission [17].

In this special issue we present four specialized papers on selected topics in HED physics. The first paper by Deutsch et al. presents a comprehensive overview of the theory of stopping of energetic ions in dense targets to generate HED states in matter. This problem is specially of great importance to heavy ion driven inertial fusion. The second paper by Fortov and Lomonosov thoroughly deals with the Equation of State (EOS) of HED matter, which again, is an extremely important problem for inertial fusion and HED physics studies. The third paper by Lopez Cela et al. describes how the material properties like the yield strength of materials in HED state can be deduced from the experimental studies of the Rictmyer-Meshkov instability. The last paper presents experimental results on the measurement of the energy loss of energetic particles in laser-produced plasmas. This is a very valuable contribution to this filed as most of the available energy loss data so far has been measured in cold matter.

We believe that the papers presented in this special issue will provide a very good introduction to the field of HED physics and the large number of the references quoted therein would assist the readers to get more detailed information about the relevant problems.

REFERENCES


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