Preface

This book is unique compared to others on shock wave physics of condensed matter in that Chaps. 1, 2, and 3 are designed to quickly get a physical scientist or engineer to understand how shocks interact with material boundaries and other shock waves by presenting the steady one-dimensional (1-D) strain conservation laws. The specific key technique presented is shock wave impedance matching, which insures conservation of mass, momentum, and energy. Early emphasis is given on the meaning of shock wave and mass velocities in a laboratory coordinate system. An overview of basic experimental techniques is presented in Chap. 4 on how to measure pressure, shock velocity, mass velocity, compression, and internal energy of steady 1-D shock waves. These first four chapters allow the reader to understand much of the shock wave literature, perform basic data analysis techniques, and design simple 1-D shock wave experiments. The rest of the book will then treat thermodynamics, liquids and solids compression under shock loading, wave propagation and stability, phase transitions, detonation of energetic materials, time-dependent flow, and a few selected topics. Advanced treatments of condensed matter under dynamic loading can be addressed by the reader once the first-order approaches presented in this book are understood.

This book is a continuum mechanics approach treating liquids and isotropic solids. The book primarily treats one-dimensional uniaxial compression to illustrate key features of condensed matter response to shock wave loading. For materials in equilibrium, a review of thermodynamics is done showing how the Hugoniot pressure–volume (P-v) points fit on the thermodynamic surface and how it relates to other processes such as isothermal and isentropic compression. The first-order Maxwell solid model will be used to show first-order features of time-dependent behavior. Detonation shock waves in explosives is treated as a special overviewed subject. Detonation physics is primarily based on experimental data so the experimental properties of detonating explosives are emphasized. A unique summary description of nonideal cylindrically shaped explosives is included. Finally, a few selected subjects in shock wave physics are overviewed in the last chapter.

This text is not meant to be a historical account of shock wave physics but rather it is put together from 20 years of teaching primer shock physics courses.

The material is from the authors experience in presenting to students a cohesive course of the subject so they can read the literature and look into more advanced treatments on their own. It is inevitable that some of the organization is due to how and when the author learned specific subjects. It is assumed that the reader has taken undergraduate physics, mechanics, thermodynamics, advanced calculus, matrix theory, and at least one other physical science course such as mechanical engineering, chemistry, material science, or numerical computations.

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