UCRL-86843
PREPRINT

CENT - 810684 - - 52

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THE LAWRENCE LIVERMORE NATIONAL LABORATORY
TWO-STAGE LIGHT-GAS GUN

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This paper was prepared for presentation at
American Physical Society 1981 Topical Conf.
on Shock Waves in Condensed Matter,
Menlo Park, California
June 23-25, 1981

October 23, 1981

Lawrence
Livermore
Laboratory

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TWO-STAGE LIGHT-GAS GUN*

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ABSTRACT

The diagnostics and experimental program of our facility are described.

DESCRIPTION

This facility is used to study condensed matter at high pressures. The gun launches a planar impactor plate at a velocity up to 8 km/s. The operation of the gun is described and illustrated elsewhere in these proceedings.¹ When the impactor strikes a target specimen, shock pressures up to several Mbars and temperatures up to a few tens of thousands of Kelvins are generated. Maximum compression factors of 1.5-6 over initial specimen density are achieved, depending on the specimen material.

The duration of the experiments is a few hundred nanoseconds. The facility has a fast diagnostic system² with nanosecond or less time resolution to measure material properties. Shock velocity and impactor velocity are measured to obtain equation-of-state data in solids³ and liquids.⁴ A fast optical pyrometer was developed to measure temperature in initially transparent materials.^{5,6} Electrical conductivity has been measured.⁷ Flash x-ray diffraction has been performed in crystals at shock pressures up to about 1 Mbar.^{8,9}

In the past few years many materials have been studied including Al, Cu, Ta³ and liquid H₂, D₂,¹⁰ N₂, O₂, Ar,^{4,11} CO, CH₄,¹² Xe,¹³ NH₃, H₂O,^{6,7} CH₂ (polybutene) C₆H₆ (benzene),¹⁴ I₂,¹⁵ graphite,^{16,17} BN,¹⁸ steel,¹⁹ and UO₂.²⁰ We are now planning experiments on liquid He and the alkali metals.

The facility is summarized in Table I.

*Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract #W-7405-Eng-48.

Table I. The LLNL Two-Stage Light-Gas Gun Facility

Facility:	Launch velocities of 1-8 km/s; launch tube inner diameter of 22, 28, 38, 51, or 64 mm.
Diagnostics:	Pulsed x-ray shadowgraphy for impactor velocity; shorting, self-shorting, and piezoelectric shock-wave detectors with 300 psec time resolution; 6-channel optical pyrometer with 5 ns time resolution; electrical conductivity with 2 ns time resolution; flash x-ray diffraction; rotating mirror framing and streak camera. Tektronix 519 and 7903 oscilloscopes and 7912 transient digitizers in development.
Experiments:	Equation of state Pyrometric temperature Electrical conductivity Flash x-ray diffraction High explosive response to high-velocity impact
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