MEASUREMENT OF EXPLOSION TIME AS A FUNCTION OF IMPACT PRESSURE FOR PBX 9501

Author(s): B. Henson, CST-6, B. Asay, DX-2, P. M. Dickson, DX-2, C. Fugard, and D. J. Funk, DX-2
Los Alamos National Laboratory, MS J567, Los Alamos, NM 87545

Submitted to:
11TH Detonation Symposium, Snowmass, CO, August, 1998 (DoD has not yet scheduled the dates)

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
Measurement of Explosion Time as a Function of Impact Pressure For PBX 9501

Subject to Weak Planar Shocks

B. Henson, B. W Asay, P. M. Dickson, C. Fugard and D. J. Funk

Los Alamos National Laboratory, Los Alamos, NM 87545

Recent calculations of the ignition of energetic material subject to weak shock indicate three characteristic regimes of response as a function of impact pressure [D. L. Bonnett and P. B. Butler, J. Prop. and Power 12, 680 (1996); C. M. Tarver, S. K. Chidester and A. L. Nichols III, J. Phys. Chem. 100, 5794 (1996)]. At low pressures, the mechanical heating of the material is insufficient to generate ignition. At high pressures, prompt ignition is observed. At intermediate pressures, between ~0.75 to 2.0 GPa, mechanical heating is calculated to achieve sufficient heating to generate ignition after a variable induction time, equivalent to the induction time observed in purely thermal ignition experiments. These calculations depend on the calculation of at least two complex physical mechanisms in the material, mechanical heating and thermal decomposition.

We present measurements of the surface temperature of confined PBX 9501 subject to weak planar shock with pressures spanning the range from moderate heating to prompt ignition. The measurements of temperature is based on IR radiometry with InSb detection from 1 to 5 μm. The measurement of temperature is performed with a temporal resolution of 1 μs and sensitivity from 30°C to 1000°C. This range is sufficient to quantify the degree of mechanical heating in the explosive and the variable time to ignition. A low
A sensitivity example of such an experiment is shown in Figure 1. In this experiment a confined sample of PBX 9501 is impacted at a calculated pressure of 1 GPa by a narrow steel plunger. The data show the temperature as a function of time after impact at t=0. The sensitivity was not sufficient to record bulk heating in this experiment, but the transient at ignition (t=60μs) is clear. Subsequent cooling in the data result from the loss of sample confinement during ignition.

![Figure 1. Radiometric surface temperature from a confined sample of PBX 9501 subsequent to impact at 1 GPa (calculated). The thermal ignition transient at t=60μs is clear. Subsequent cooling results from loss of sample confinement.](image)

These data qualitatively verify the inductive nature of ignition in regimes of intermediate pressure predicted by recent calculations. We will present a full experimental parameterization of this effect throughout the pressure regime of interest in PBX 9501. These experiments will provide severe constraints on both the mechanical heating and thermal decomposition mechanisms used in current models.