“Fracture in PBX 9502 High Explosive: Effect of Loading Rate & Material Orientation”

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Abstract
Deformation, damage, cracking, and failure represent the sequence of what will happen when a high explosive (HE) component is subject to excessive external mechanical/thermal stimulants and insults. For ensuring the performance and assessing the safety of the energetic materials, we need an experimental technique to capture such a sequence and quantify some of the key parameters that characterize the processes. Fracture toughness is one of such key parameters for describing and predicting crack initiation and extension. In this talk, I will discuss a technique, based on the optical technique of digital image correlation (DIC), that quantitatively identifies the onset of damage in a brittle/quasi-brittle sample, identifies the boundaries of the damage and cracking regions and their evolution, and finally, extracts the stress intensity factor at the moving crack tip, i.e., fracture toughness $K_{IC}$. This technique is then applied to study the fracture in PBX 9502 high explosive, which is comprised of 95 weight percent (wt.%) triaminotrinitrobenzene (TATB) and 5wt.% Kel-F 800 polymeric binder. In this series of experimental measurements, we focus on the effect of the loading rate. We also consider two different material orientations, relative to the pressing direction when the high explosive was pressed.

Bio
Cheng Liu received his B.S. degree in mechanics and M.S. degree in solid mechanics from Peking University of China in 1984 and 1986, respectively, and Ph.D. degree in Applied Mechanics with minor study in Materials Science from California Institute of Technology (Caltech) in 1994. He joined Los Alamos National Laboratory (LANL) in 1994 as a Director Funded Postdoctoral Fellow and became a technical staff member in 1996. From 2001 to 2008, he served as the project leader of the “Thermal and Loading Dynamics of Energetic Materials” under the Joint DoD/DOE Munitions Technology Development Program (JMP). His research focuses on subjects of damage, fracture, and failure of different materials and material systems.

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