Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Microstructural Characterization of Plastic Bonded Explosives
JOHN YEAGER, DANIEL HOOKS, Los Alamos National Laboratory, DAVID BAHR, Washington State University — Plastic bonded explosives (PBX), a mixture of hard, anisotropic grains in a compliant matrix, represent an interesting case for understanding composite mechanical response and failure. PBX 9501 (0.95 cyclotetramethylene tetranitramine [HMX], 0.05 polymer binder) is relatively safe formulation of HMX, which is thought to be due to the high compliance of the binder. Crack formation between the crystals and the binder has been observed in this and many other systems and is usually the failure mechanism of PBX materials under mechanical strain. Thus the properties of the crystal-binder interface are important for development of failure models. The interfacial properties of PBX 9501 as well as an inert simulant have been characterized using several methods. Surface energies of several polymer binders and various crystallographic faces of HMX have been determined with a contact angle measurement technique, allowing for thermodynamic work of adhesion at the interface to be calculated. Surface roughness of the crystal faces has been measured with atomic force microscopy (AFM). PBX formulation methods are suspected to lead to a diffuse interface, but the nature of this interface has not previously been characterized in detail. Here, the coherence of the interface has been studied using tapping mode AFM for modulus contrast, and these findings are correlated with results from diffraction techniques.

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Date submitted: 19 Nov 2009 Electronic form version 1.4