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Title: THE EFFECT OF PRESSING INTENSITY ON THE MICROSTRUCTURE OF PBX 9501

Author(s): Paul D. Peterson
Joseph T. Mang
Michael A. Fletcher

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Los Alamos
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INTRODUCTION

In the preparation of PBX 9501 samples, pressing conditions are often varied in order to achieve nominal density. Although density is met, differences in pressing intensity can lead to variations in microstructure between samples. To evaluate the effect of pressing intensity on the microstructure, three cylinders (1" ϕ x 1" long) of PBX 9501 (HOL Lot 89C730-010 MT 345) have been pressed at 5,000 psi, 15,000 psi, and 30,000 psi, respectively, using a 50 Ton press. Following pressing, the entire profile of each cylinder was examined for microstructural changes due to the different pressing conditions. As differences in material microstructure can occur across a wide range of length scales (from nanometers to millimeters) both polarized light microscopy and small-angle x-ray scattering (SAXS) have been used to probe the particle morphology, porosity, crystal size and size distribution of each cylinder.

EXPERIMENTAL

Three cylinders (1" ϕ x 1" long) of PBX 9501 (HOL Lot 89C730-010 MT 345) were pressed to 5,000 psi, 15,000 psi, and 30,000 psi, respectively, using the 50 Ton press at LANL. After pressing, each of the three cylinders was sectioned twice, along the centerline, using a diamond anvil saw. A total of 18 specimens were then cut from the two resulting pieces as shown below (Figure 1).

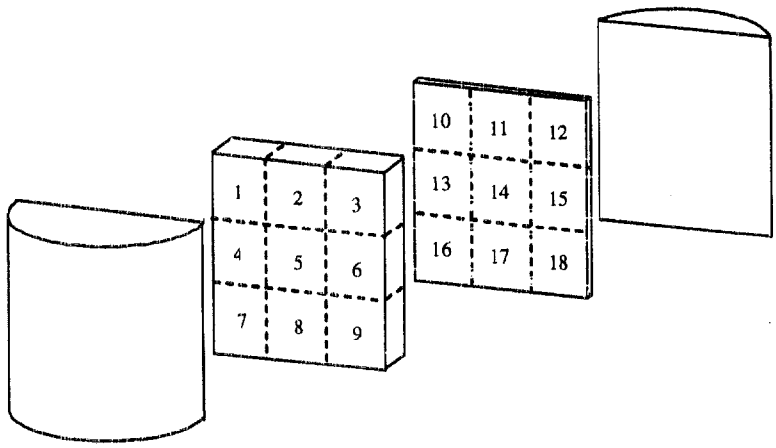

Figure 1) Specimen preparation and orientation

For each cylinder, specimens 1-9 were analyzed for microstructural differences using polarized light microscopy. These specimens had approximate dimensions of 0.3" x 0.3" x 0.15". Each specimen was potted in epoxy under vacuum and then allowed to dry overnight under 500 lbs pressure. They were then removed from the pressure cell and the face of each specimen was polished to a smooth finish using a series of SiC polishing papers (1200 grit, 2400 grit, 4000 grit), Al_2O_3 polishing powders (1μm and 0.3μm), and an OP-S suspension (0.03μm). Each of the nine specimens from each sample was then examined for microstructural differences using polarized light microscopy.

Specimens 10-18 from each sample were analyzed using SANS. These specimens had approximate original dimensions of 0.3" x 0.3" x 0.05" and were polished to a thickness of 0.03" using the Al_2O_3 polishing powders.

RESULTS AND DISCUSSION

Photomicrographs of the center of specimen 5 of each of the samples are shown in Figures 2-4 respectively.

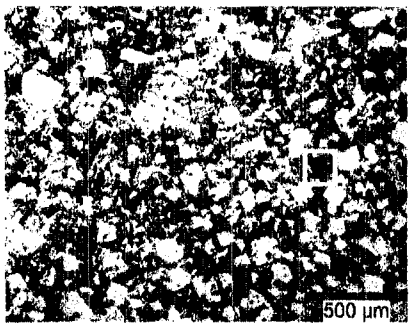

Figure 2) PBX 9501
5,000 psi, 1.7976 g/cc

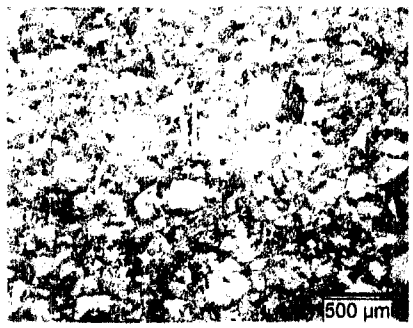

Figure 3) PBX 9501
15,000 psi, 1.8294 g/cc

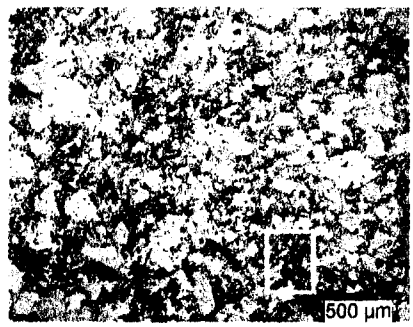

Figure 4) PBX 9501
30,000 psi, 1.8342 g/cc

Figure 5) Binder contains relatively few crystals

Figure 6) Crystal rubblization at point of contact

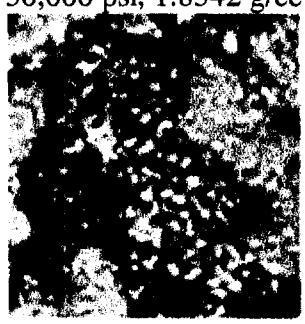

Figure 7) Increased number of fine crystals in binder rich areas

The qualitative differences in microstructure are obvious across the three images. At 5,000 psi (Figure 2), in general, the crystals appear to be well segregated from each other by binder. This cushioning effect protects the crystals from fracturing due to crystal-crystal contact forces. Some fine crystals can be seen within the binder, however even these appear to be fairly dispersed (Figure 5). At 15,000 psi (Figure 3) many of the crystals in the image have been pressed into contact with each other. At the points of contact, crystal fracture and rubblization has occurred (Figure 6). In addition, much of the binder material appears lighter due to the generation of more fine crystals. At 30,000 psi, increased rubblization due to crystal contact and fracture has occurred and more fine crystals are visible in the binder rich regions (Figure 7).

Similar differences in material microstructure are expected at the smaller length scales probed by SAXS. Results from the SAXS studies were not available at the submittal of this paper. However, these results as well as further analysis of microstructural differences across the entire specimen using both PLM and SAXS will be presented at the conference.

CONCLUSIONS

Preliminary analysis of PBX 9501 pressed at different intensities indicates that variations in pressing intensity will result in microstructural differences. Fracture of contacting crystals may lead to an increase in the number of fine crystals within the binder matrix.