

## MICROSTRUCTURE OF PLASTIC BONDED EXPLOSIVES PBX

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Plastic bonded explosives (PBX) are highly filled polymers containing up to 90 % high energy solid load. The high loads are reached using bi- or polymodal particle size distributions, where smaller particles fit into the gaps of the larger ones. In recent years the microstructure of the solid ingredients shifted into the scope of actual research, as it was shown that incorporating carefully recrystallized particles reduce the shock sensitivity of PBXs. As a result so called reduced sensitivity variants of crystalline high explosives became available on the market. In this context particle size, shape, surface morphology, voids, inclusions, impurities, dislocations and twins are discussed to influence the mechanical sensitivity and the creation of hot spots during shock loading, and the crystallite size and microstrain of the powdery high explosives were investigated by means of laboratory and synchrotron X-ray diffraction. The investigations revealed anisotropic diffraction peak broadening and correlate the size/strain broadening with particle processing and shock sensitivities [1, 2]. While investigating microstructure parameter of the isolated powders the question arises, how these parameters would be affected by processing steps, on mechanical loading or even ageing of the PBX.

The simultaneous characterization of the ingredients in such a composite is still a challenging task, as it includes a very coarse beside a fine crystalline fraction of the same species and the amorphous binder. In order to reveal separate information of each ingredient or fractions different measuring and evaluation techniques were applied to an untreated and a strongly loaded PBX. The coarse fractions were probed by rocking curves combined with a statistical evaluation [1, 2] and the fine fractions by 2Theta scans and a size/strain analysis incorporated into a whole pattern fit of the program TOPAS. Besides, the degree of crystallinity was determined from single peak fits. The investigations revealed significant changes of the microstructure of the crystalline fractions and of the amorphous content. Further investigations will include different defect mechanisms (cleavage vs. twinning) and molecular simulation which may help understanding changes of the binder and binder particle interaction. Figure 1 shows a PBX sample as measured, Figure 2 the peak width distribution before and after loading. The shift of the curve to higher peak widths indicates a poorer crystal quality of the coarse fraction after loading.



Figure 1: PBX-sample as measured.  
Cut surface about 1 cm x 1 cm.

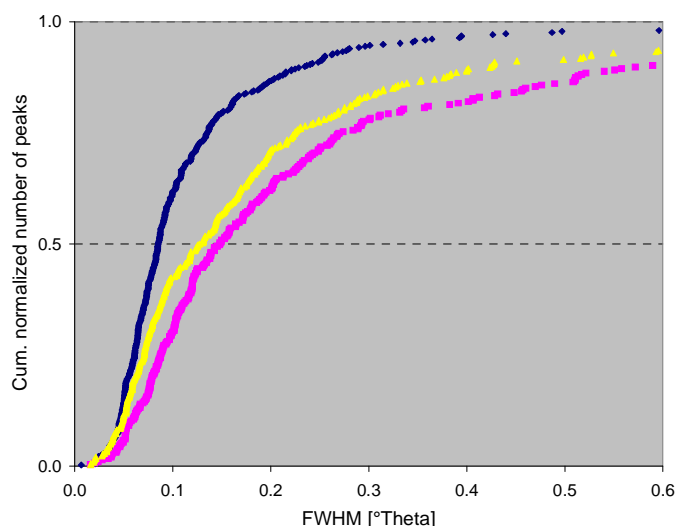


Figure 2: Peak width distribution of PBX before (upper curve) and after loading (middle and lower curve). The data from rocking curves represent the coarse crystalline fraction only.

(1) M. Herrmann, *Part. Part. Syst. Charact.* 22, 401-406, 2005

(2) M. Herrmann, P. B. Kempa, S. Doyle, *Z. Kristallogr. Suppl.* 26, 557-562, 2007