Transmission electron microscopy and X-ray diffraction studies of the detonation soot of high explosives

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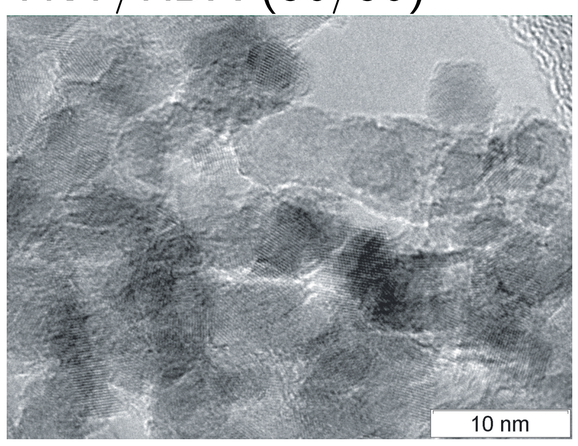
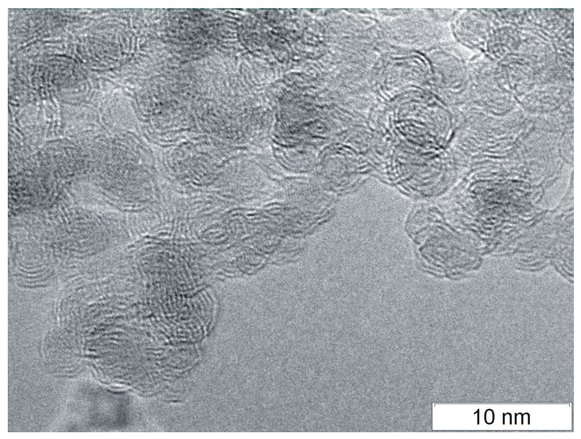
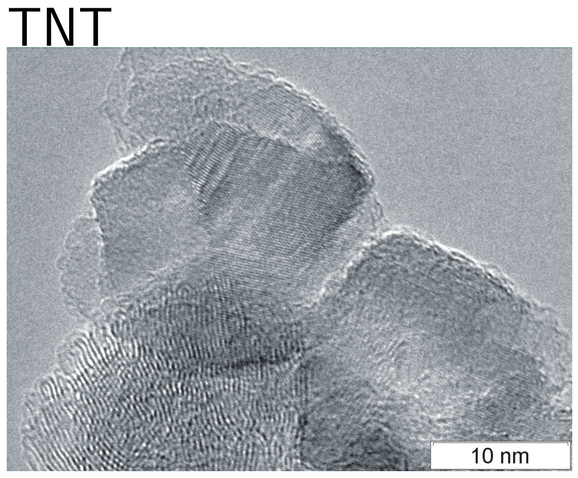
HRTEM

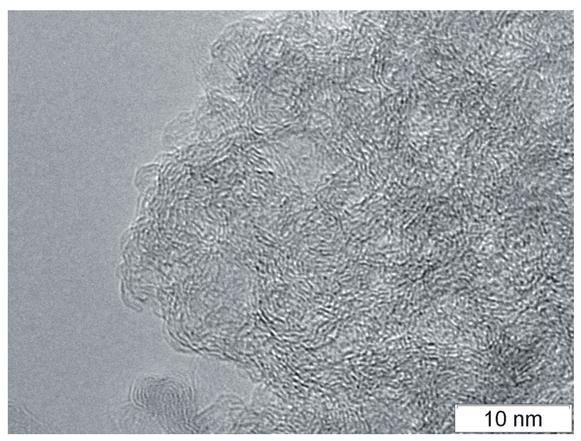
TNT/RDX (50/50)



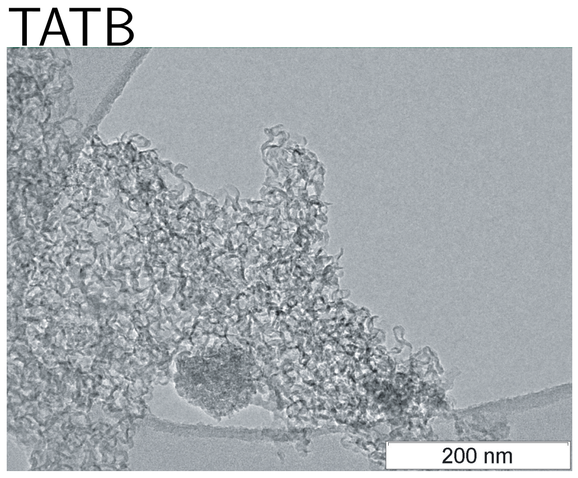


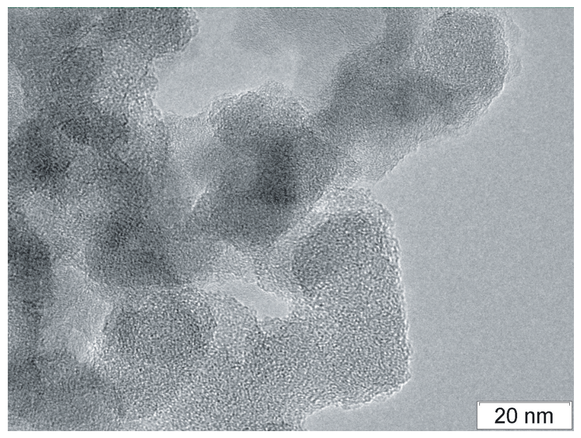
TNT



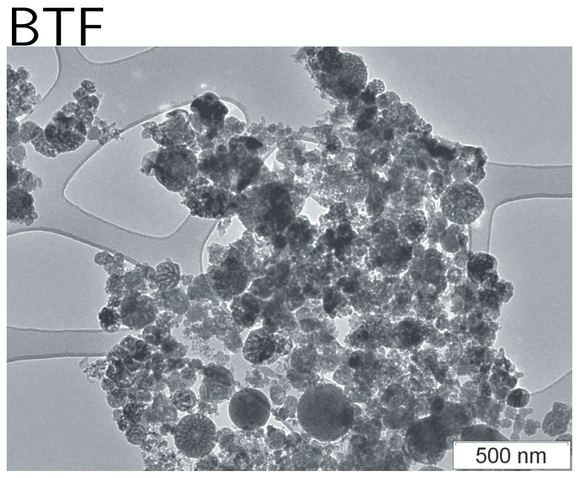


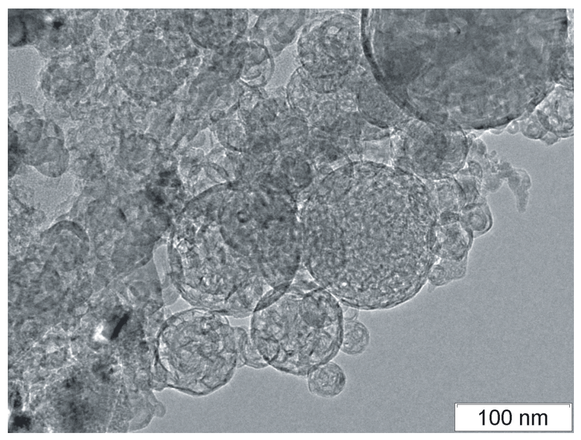
TATB

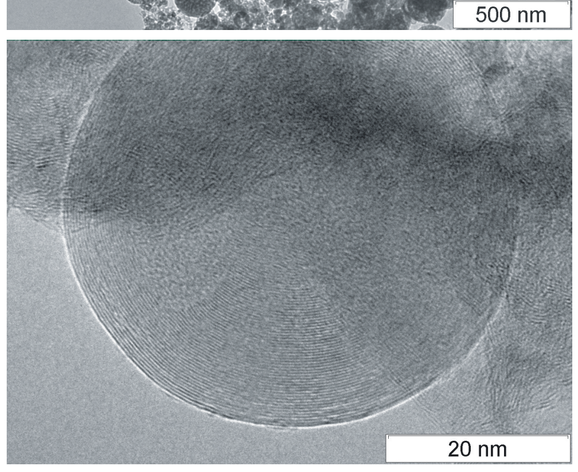


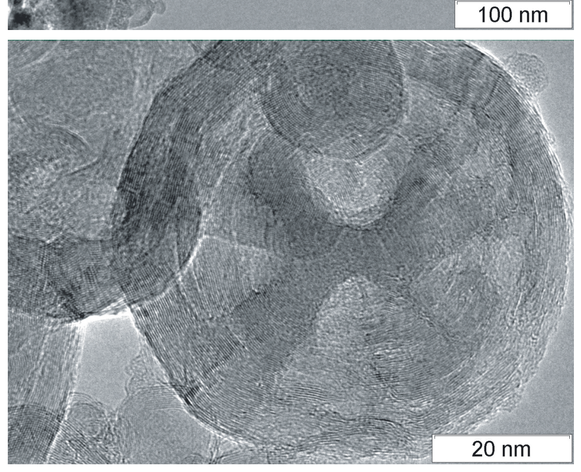


BTF

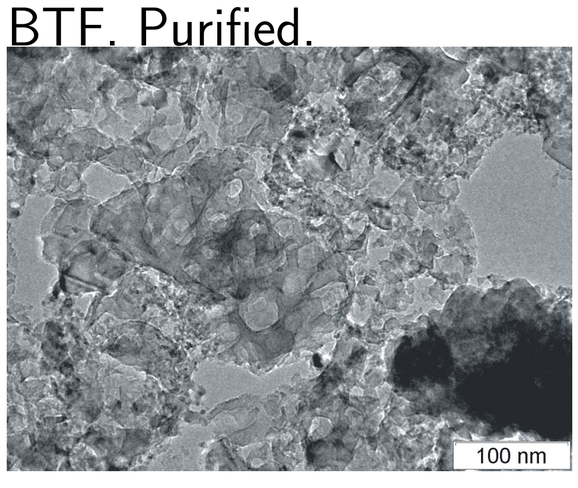


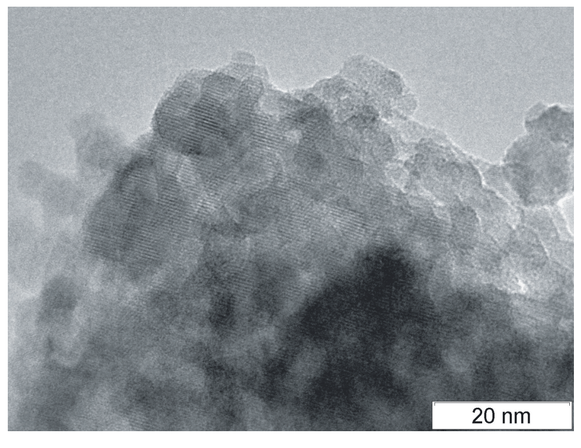






BTF. Purified.



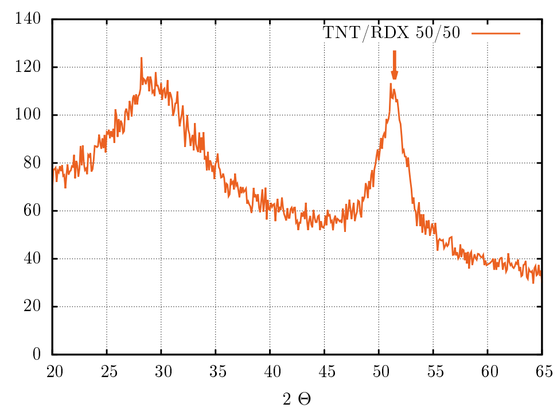


Abstract

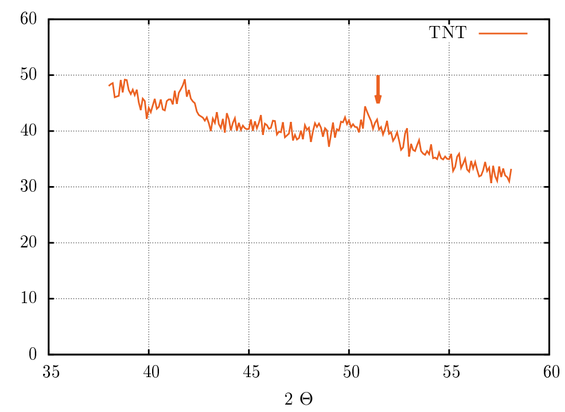
This poster presents the results of high-resolution transmission electron microscopy and X-ray diffraction studies of the recovered carbonaceous residue (soot) from the detonation of some high explosives: TNT, a mixture of TNT and RDX (50/50), triaminotrinitrobenzene and benzotrifuroxane. The use of the same experimental setup allowed a qualitative and quantitative comparison of the detonation products formed under similar conditions: detonators based on bulk PETN in an icy body, cylindrical charges of 20 mm diameter weighing about 20 g, experimental assembly was frozen in ice with a total mass of about 1 kg. The results clearly show differences in the morphology of graphite-like and diamond inclusions and in the quantitative content of nanodiamonds for the explosives used in this study.

XRD

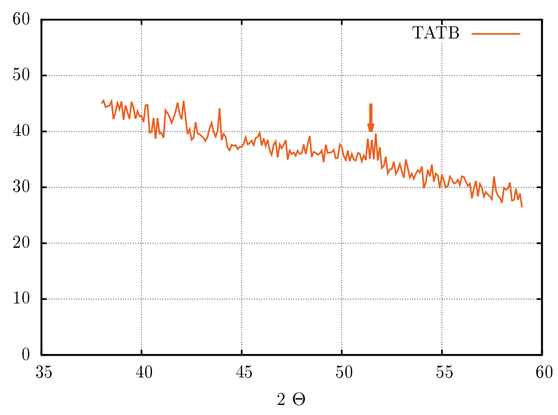
TNT/RDX (50/50)



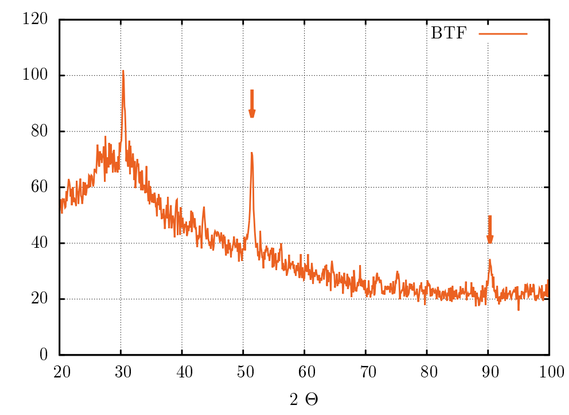
TNT



TATB



BTF



Nanodiamons in Detonation Soot

HEs	XRD d, nm	HRTEM d, nm	* SAXS d, nm
TNT/RDX (50/50)	3	5	6
TNT	3	10	4
TATB	< 2?	< 2?	< 2?
BTF	15	up to 100	70

Conclusions

The detonation soot of pure TNT is characterized by the presence of nanodiamonds of polyhedral shape with a size of about 10 nm and carbon fibers up to tens of nanometers which, based on the measured interplanar spacing, correspond to the graphite modification of carbon. The detonation products of the 50/50 TNT/RDX mixture contain smaller nanodiamonds of quasi-spherical shape with a diameter of a few nanometers, onion-like carbon of the same size, and carbon fibers up to several tens of nm long. The TATB detonation carbon consists mainly of carbon fibers up to tens of nm long and slightly separated particles of amorphous carbon with sizes up to tens of nm. The BTF charges are characterized by the presence of large spherical carbon particles up to several hundred nm in diameter. These particles were initially composed of a liquid carbon phase, but their condensation followed different pathways, resulting in both perfect and considerably inhomogeneous onion-like particles up to 100 nm in diameter and porous diamonds.

References

* Carbon condensation in detonation of high explosives. K.A. Ten, V.M. Titov, E.R. Pruuel et al. Proc. 15th Int. Det. Symp. July 13-18, 2014. ONR-43-280-15. (2015). Pp. 369-374.
Carbon Photoalbum `http://ancient.hydro.nsc.ru/srexpl/detcarbon/`