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Properties of Insensitive Octogen

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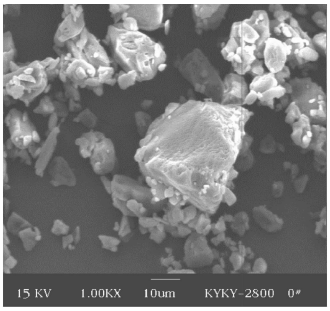
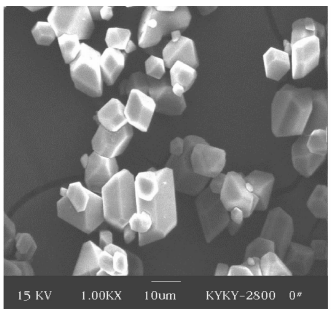
Crystal quality and morphology can greatly influence the sensitivity and other properties of energetic crystals. Researches show improving crystal quality of RDX/HMX can reduce their sensitivities. So we prepared a kind of insensitive Beta-octogen fine particle (FD-HMX) by a special crystallization process. In this paper, the crystal qualities and properties of FD-HMX were characterized by scanning electron microscope (SEM), laser light scattering, density gradient technique, differential scanning calorimetry (DSC), impact sensitivity test and gap test. Meanwhile FD-HMX was compared with reference commercial grade HMX.

The results show that FD-HMX is much regular and very smooth(Figure 1). It is very transparent and nearly no internal defects as shown in the optical images in a fluid of matching refractive index (Figure 2). The purity of FD-HMX is 99.6% ±0.5% measured by high performance liquid chromatography (HPLC), and the mean particle size is 14 to 20 microns with narrow size distribution and the particle density of different batches FD-HMX is 1.9012 – 1.9020 g · cm^{-3} which shown in Table 1. And DSC curve of FD-HMX shows that there are two main thermal effects: solid-phase transition and decomposition. FD-HMX decomposition temperature is same as that of commercial grade HMX, while the solid-phase transition temperature is 202.33 ℃, which is higher than 196.31 ℃ of commercial HMX. So it can be concluded that thermal property of FD-HMX is better than that of commercial HMX.

At the final of the experiment, the sensitivities of FD-HMX were measured by GJB772A – 97 standard test methods of method 601.1 Initiation Probability Test, method 601.2 Drop-height Test and method 605.1 GAP Test. The results (Table 2) indicate FD-HMX has greater drop heights of 72.2 cm with 2 kg dropping weight and lower initiation probabilities of 24% with 10 kg dropping weight than 16.8 cm and 88% of commercial grade HMX. The aluminium gap thickness of PBX based on FD-HMX is 15 mm, which reduces 2 mm comparing with commercial HMX.



(a) commercial HMX



(b) insensitive HMX(FD-HMX)

Fig. 1 SEM photographs of two HMX particles

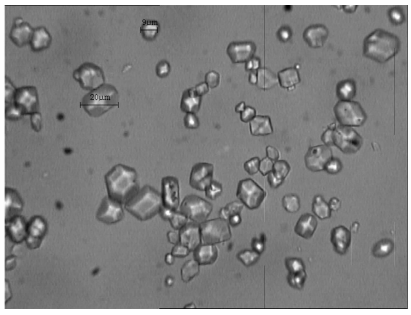


Fig. 2 Optical microscopy of FD-HMX in a fluid of matching refractive index

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Table 1 Particle size and density of two HMX particles

		different batches FD-HMX						commercial HMX
		1	2	3	6	7	8	
particle size/μm	size distribution	4 – 40	4 – 40	4 – 40	4 – 40	4 – 40	4 – 40	1 – 100
	d_{50}	14	13	18	15	16	17	19
	d_{90}	23	21	36	33	33	29	62
particle density /g · cm^{-3}	density distribution	1.9012 ~	1.9013 ~	1.9011 ~	1.9008 ~	1.9012 ~	1.9018 ~	1.8979 ~
	mean	1.9020	1.9018	1.9017	1.9015	1.9019	1.9022	1.8994
	density(±0.0005)	1.9018	1.9015	1.9014	1.9012	1.9018	1.9020	1.8994

Note: d_{50} is the particle size of 50% of total volume, d_{90} is the particle size of 90% of total volume.

Table 2 Sensitivities of two HMX particles

	commercial HMX	FD-HMX	remarks
explosive probability 0.95 (Pi,Pu)	88(0.69,0.98)	32(0.15,0.54) batch 1 24(0.09,0.45) batch 2	sample 50 mg hammer 10 kg drop 25 cm
drop height H_{50}/cm	16.8 ±0.1	72.2 ±0.1 batch 1 * 46 ±0.1 batch 2	sample 35 mg hammer 2 kg * hammer 5 kg
gap thickness/mm	17.0 ±0.5	15.0 ±0.5	aluminium gap Φ20 mm charge HMX/binder 88/12

Note: 0.95 (Pi,Pu) is confidence interval at 0.95 confidence level.

Key words: analytical chemistry; insensitive HMX; crystal quality; sensitivity

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In conclusion, a liquid smoke composition which can effectively attenuate IR radiation in 3 – 5 μm and 8 – 14 μm bands is developed. Chamber test results show that the developed composition can effectively attenuate IR radiation. The transmittance of formed smoke is 11.7% in 3 – 5 μm bands and 3.9% in 8 – 14 μm bandsrespectively. It can also totally obscure IR thermal imaging system as long as 30 s.

Key words: pyrotechnic; liquid; infrared countermeasure; smoke composition; smokescreen

CLC number: TQ567.5

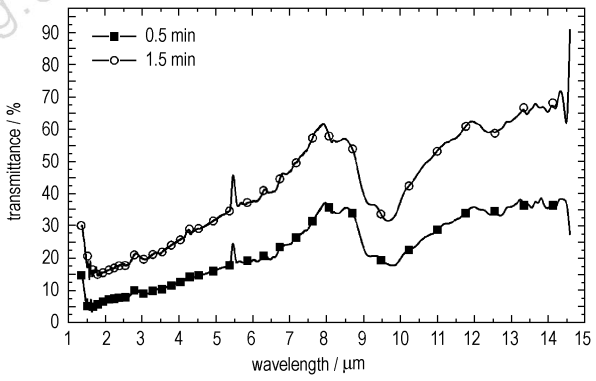

Fig. 1 Curves of IR spectrum transmittance at 0.5 min and 1.5 min

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