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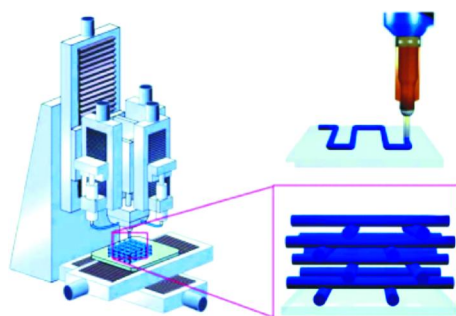
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## Direct Ink Writing Technology for Additive Manufacturing and Its Research Progress in Energetic Materials

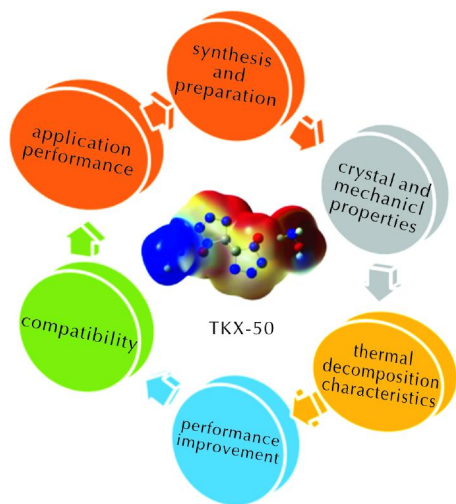


The basic characteristics of direct ink writing (DIW) technology and its application in energetic materials are systematically introduced. Recent research progresses for DIW technology used in metastable intermolecular composites (thermite, aluminum-fluorine polymer), propellants and explosives grains with complex structure, and explosive agents are mainly summarized. Moreover, the main challenges and the opportunities are also analyzed, which provide a guidance for the development and application of DIW in energetic materials.

JIANG Yi-fan, ZHAO Feng-qí, LI Hui, ZHANG Ming, JIANG Zhou-feng, HOU Xiao-ting, ZHANG Jian-kan, LI Na, DAI Ya-tang

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 1-19.

## Application and Research Progress of Dihydroxylammonium 5,5'-bistetrazole-1,1'-diolate (TKX-50) in Explosives & Propellants

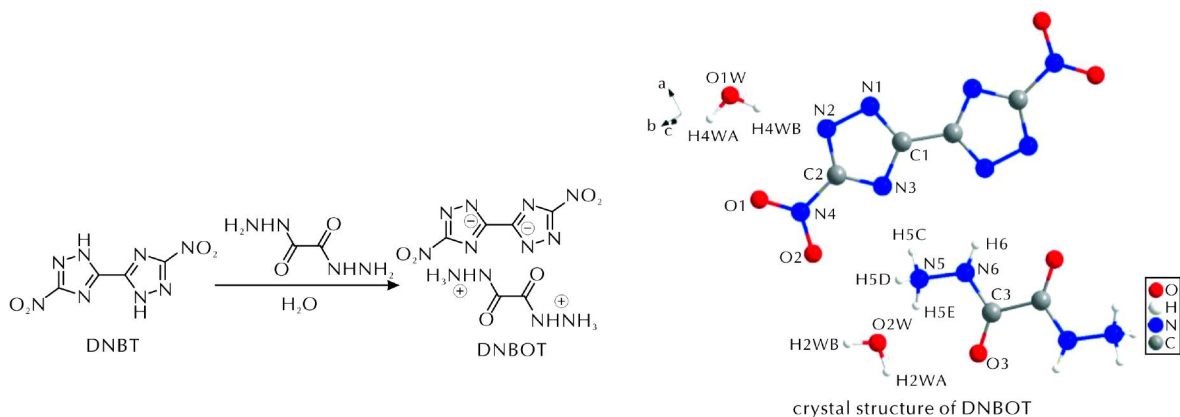


The current research status of dihydroxylammonium 5,5'-bistetrazole-1,1'-diolate (TKX-50) compound on its performance improvement, synthesis and preparation, crystal properties, mechanical properties compatibility, energy, and safety are summarized. The application advantages and existing problems of TKX-50 are pointed out, and the future development direction and research focus are prospected.

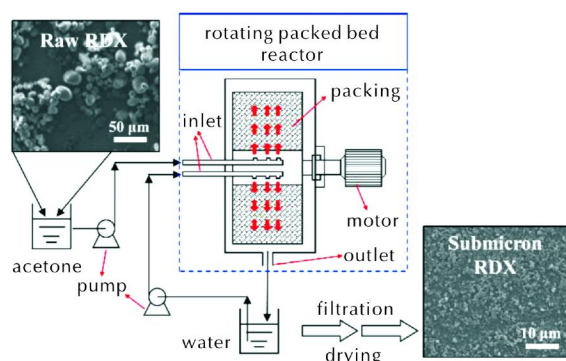
ZHANG Kun, WANG Jian, WANG Xiao-feng, FENG Xiao-jun

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 20-29.

## Synthesis , Characterization and Performance Prediction of Oxalohydrazidinium 5,5'-dinitro-3,3'-bi(1,2,4-triazolate)



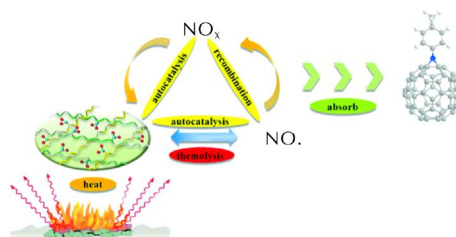
### Preparation of Submicron RDX Particles by High-gravity Assisted Solvent-Antisolvent Recrystallization Method



Submicron RDX was prepared through a high-gravity assisted solvent-antisolvent recrystallization method by using acetone-water medium as solvent-antisolvent system, and the polyvinylpyrrolidone (PVP) as surfactant. The effects of RDX solution concentration, PVP concentration and rotating speed of high-gravity reactor on the morphology and size of RDX were studied, and the optimal process conditions were obtained. The morphology, crystal structure and molecular structure of RDX were characterized by SEM, XRD and FT-IR, and the thermal decomposition process of RDX was studied by DSC.

CAO Shao-bo, ZHOU Lin-yu, ZHANG Liang-liang, CHEN Jian-feng  
*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 46-52.

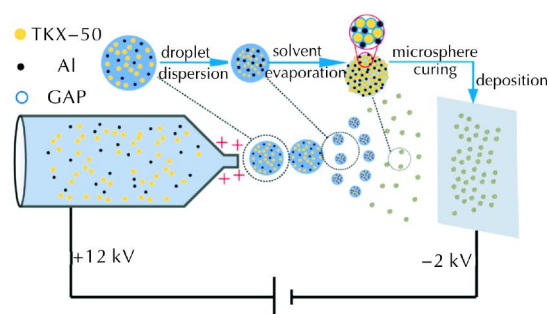
### Synthesis of Fullerene p-Methylaniline Derivative and Its Effect on the Stability of Nitrocellulose



Fullerene p-methylaniline derivative  $C_{60}(NC_6H_4CH_3)_n$  was synthesized via a two-step reaction by using fullerene,  $Br_2$ ,  $C_{60}Br_8$  and p-toluidine as raw materials. The structure of fullerene p-methylaniline derivative was characterized by nuclear magnetic resonance ( $^{13}C$  NMR), mass spectrometry (MS), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR) and ultraviolet-visible spectrophotometer (UV-Vis). Thermal analysis methods such as differential thermal analysis (DTA), vacuum stability test (VST), thermogravimetric analysis (TGA) and methyl violet test were used to study the interactive mechanism between fullerene p-methylaniline derivative and nitrocellulose.

XIONG Jie, JIN Zhi-yuan, YU Xue-mei, JIN Bo, PENG Ru-fang  
*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 53-59.

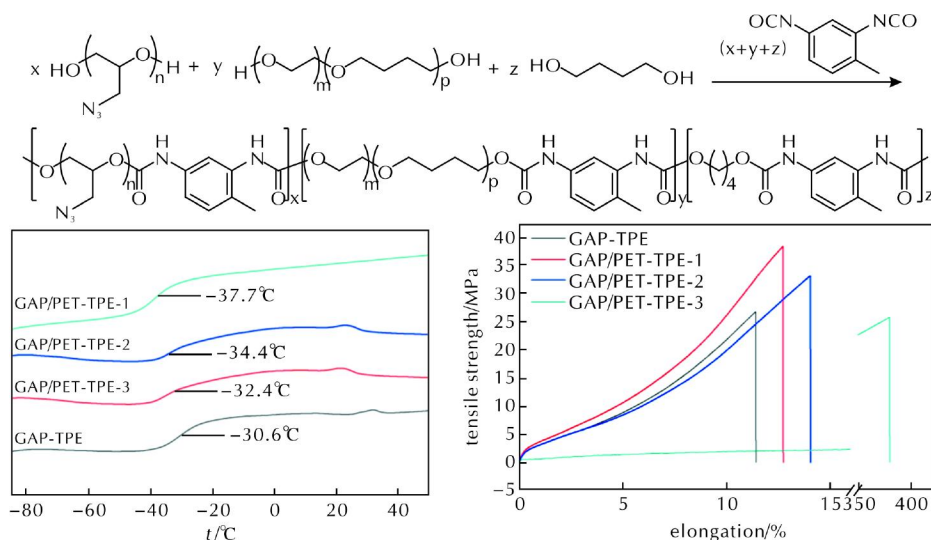
### Preparation of TKX-50/Al/GAP Energetic Micro-units by Electrostatic Spraying Method and Its Performance



TKX-50/Al/GAP composite microspheres were prepared by electrostatic spraying. The morphology, structure and thermal decomposition properties of the microspheres were studied by SEM, XRD, FT-IR and DSC. The mechanical sensitivities of the microspheres were also tested.

YE Bao-yun, FENG Chen-he, AN Chong-wei, WANG Jing-yu, ZHAO Feng-qi, ZHAO Jia-jing  
*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 60-66.

## Cryogenic Mechanical Properties of GAP/PET Block Thermoplastic Elastomers

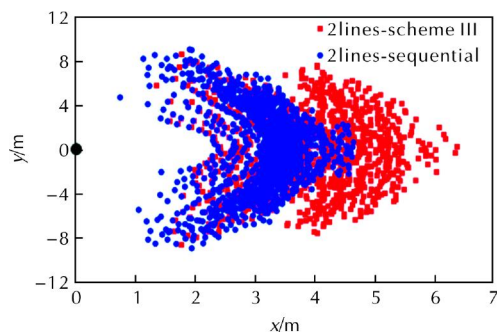


The GAP/PET block thermoplastic elastomers were synthesized using GAP and PET as soft segments, and TDI extended BDO as hard segments to enhance their cryogenic mechanical properties. The thermoplastic elastomers have a low  $T_g$  of  $-37.7^\circ\text{C}$  and exhibit ductile rupture under the low temperature of  $-40^\circ\text{C}$ .

XU Ming-hui, YANG Wei-tao, LU Xian-ming, MO Hong-chang, GE Zhong-xue

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 67-72.

## Effect of In-line Asynchronous Initiation on Warhead Damage Efficiency

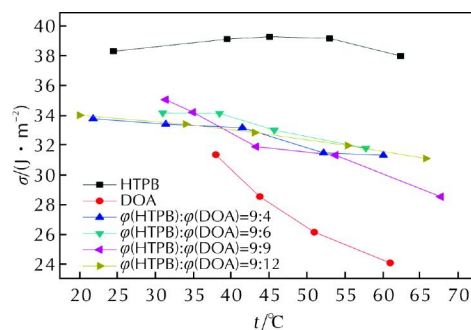


Four kinds of in-line asynchronous initiation schemes are proposed based on the sequential initiation mode. By LS-DYNA simulation and solving the fragment exterior ballistic equation, the effects of the in-line initiation sequence, delay and the number of initiation lines on the damage efficiency of military vehicles are studied.

ZHANG Shu-kai, WANG Ke-wei, XIE Jia-liang, LI Xiao-gang, ZHANG Hao-yu, CHENG Li

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 73-84.

## Study on the Surface Free Energy of HTPB/Plasticizers



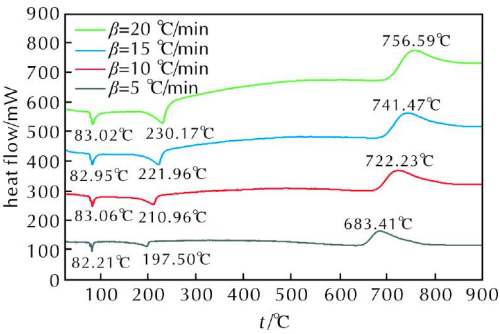
The effect of the volume ratio of HTPB with plasticizers, the type of plasticizers, the type of plasticizers and temperature on the surface free energy of HTPB/plasticizer was analyzed. The surface free energy of HTPB bonding system was measured by surface energy measuring apparatus.

NIU Guo-tao, NAN Hai, NIU Yu-lei

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 81-84.



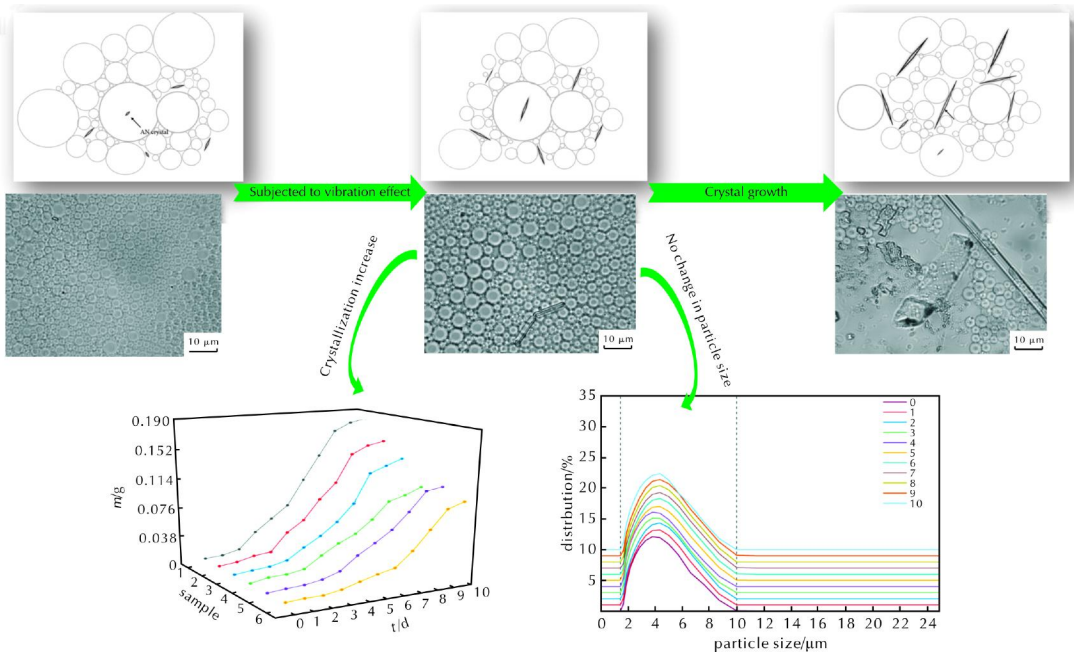
Thermal Decomposition Behavior and Compatibility of DFT-NAN/B



The thermal decomposition behavior of 3,5-difluoro-2,4,6-trinitroanisole (DFTNAN) and micro-sized boron powder mixture was studied by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). With the increase of the heating rate, the reaction between DFTNAN and boron powder is more intense, which is more helpful to remove the oxides on the surface of boron particles.

ZHU Yu ,WANG Jian-hua ,LIU Yu-cun ,JING Su-ming ,ZHAI Si-yuan ,WEN Xu  
*Chinese Journal of Explosives & Propellants* ,2022 ,45(1) : 85-89 .

Influence of Vibration on the Stability of On-site Mixed Emulsion Explosive

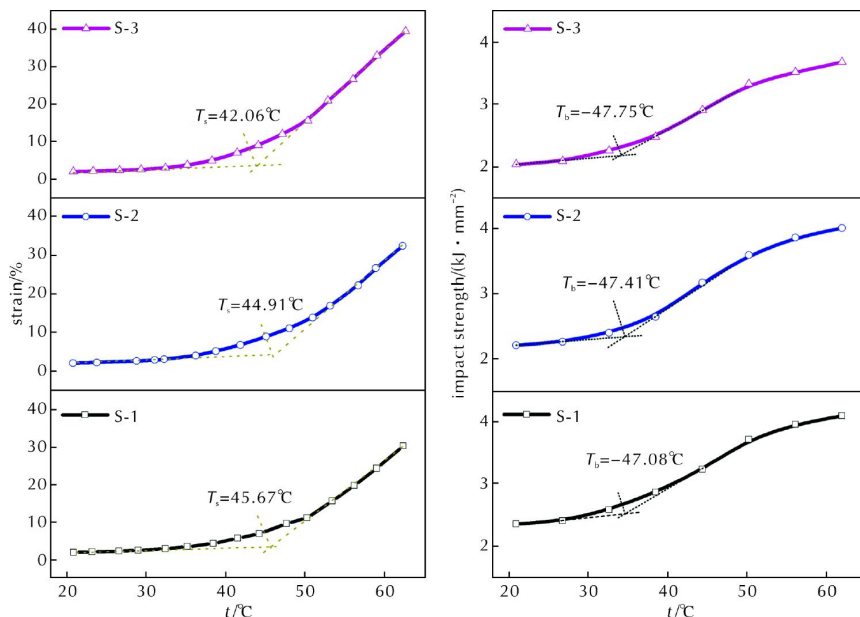


The average particle size, viscosity, crystallinity and conductivity of emulsion matrix were measured by laser particle size analyzer, digital viscometer, titration and conductivity method before and after vibration test.

WEI Guo ,LIU Feng ,WU Pan-yu ,WANG Xi-dong  
*Chinese Journal of Explosives & Propellants* ,2022 ,45(1) : 90-96 .



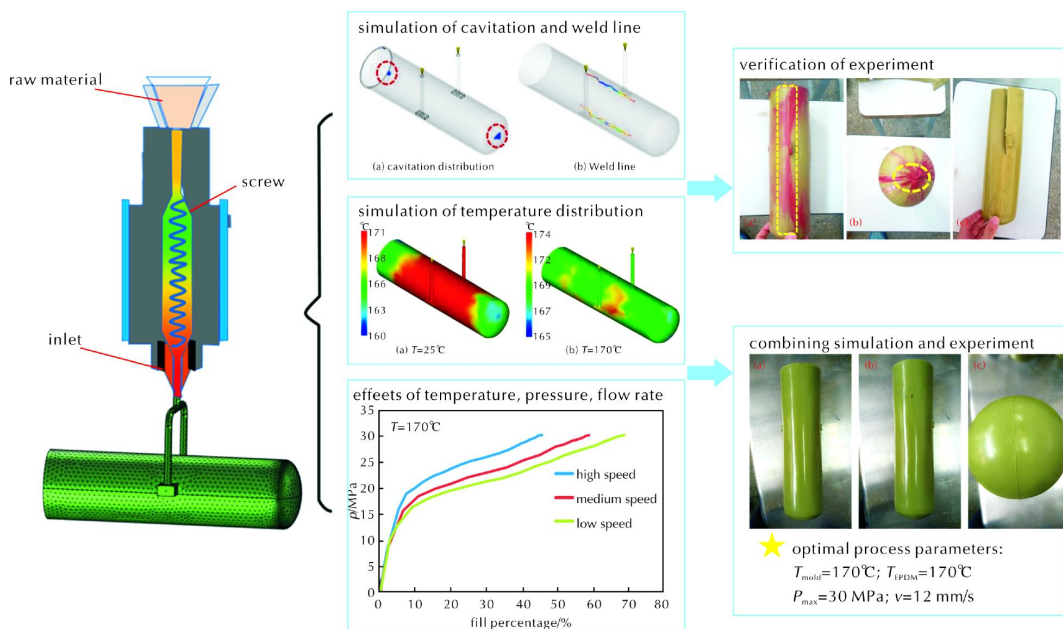
## Mechanical Critical Transition Characteristics of CL-20/CM-DB Propellants over a Wide Range of Temperature



To investigate the mechanical characteristic over a wide range of temperature, the mechanical performance of CL-20/composite modified double base propellant (CL-20/CMDB) was investigated by tensile test and dynamic mechanical analyzer. The mechanical critical transition characteristics at high and low temperatures were studied by thermal deformation test and impact loading test, respectively.

HU Yi-wen, WANG Jiang-ning, ZHANG Jun, YUAN Zhi-feng, CHEN Jun-bo, CHEN Tai-jun, SONG Xiu-duo, PEI Jiang-feng, GENG Chao-hui  
*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 97-102.

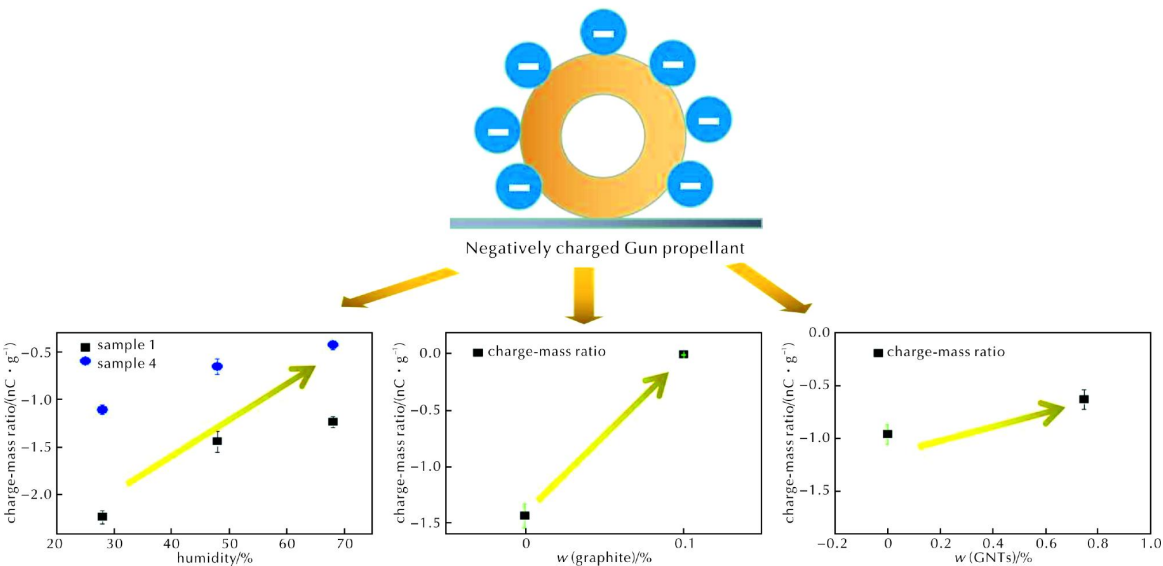
## Research on Injection Molding Simulation and Process Parameters of EPDM Coating



To improve the development efficiency of ethylene propylene diene monomer (EPDM) rubber coating injection molding process, the flow law of EPDM was studied by combination of numerical simulation and experimental verification and appropriate process parameters were optimized. The rheological properties of EPDM were modeled using the Carreau mode, which was introduced into Moldflow software to simulate the injection molding process of EPDM coating.

LIU Ben-ben, ZHANG Hui, LI Jun-qiang, CHEN Guo-hui, YANG Shi-shan, PENG Jiong, HE Ji-yu, LI Xiang-mei, YANG Rong-jie  
*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 103-108.

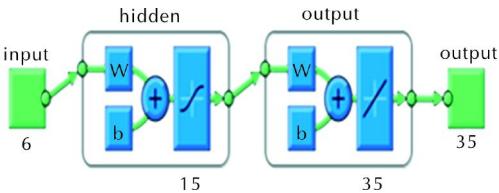
Frictional Static Electricity Characteristics of Typical High Energy Nitramine Gun Propellant



The flume method was adopted to simulate the electrostatic electrification by friction of high-energy nitramine gun propellant in the process of manufacture and application , and a Faraday cylinder was used to measure the frictional electrostatic charge . The influence of the flume length , contact medium , humidity , morphology and propellant formulation on the electrostatic accumulation characteristics of the propellants were systematically studied .

SHI Xian-rui ,XU Can-qí ,JIA Yong-jie ,LI Xiao-dong  
*Chinese Journal of Explosives & Propellants* ,2022 ,45(1) : 109-114 .

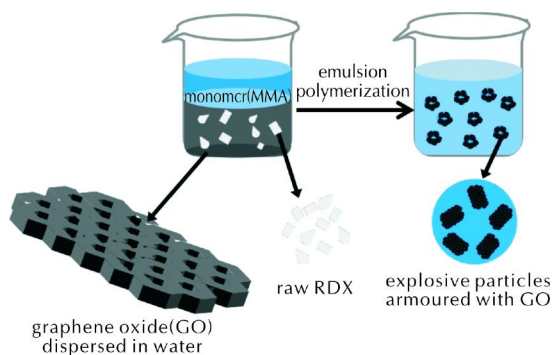
Prediction of Desensitizer Concentration Distribution in Gun Propellant Based on Artificial Neural Network Algorithm



A method for quickly predicting the concentration distribution of desensitizer in 5/7 modified single-base gun propellant was proposed , and a simple neural network model based on artificial neural network algorithm was established , and the experimental data of desensitizer concentration profile of 5/7 modified single-base propellant was used to train the model .

GOU Yong-liang , LIU Bo , LI Zi-chao , WEI Lun , MA Fang-sheng , YAO Yue-juan , YU Hui-fang , LI Qiang  
*Chinese Journal of Explosives & Propellants* ,2022 ,45(1) : 115-119 .

## Effect of Graphene Oxide on Safety Performance and Mechanical Properties of RDX /PMMA

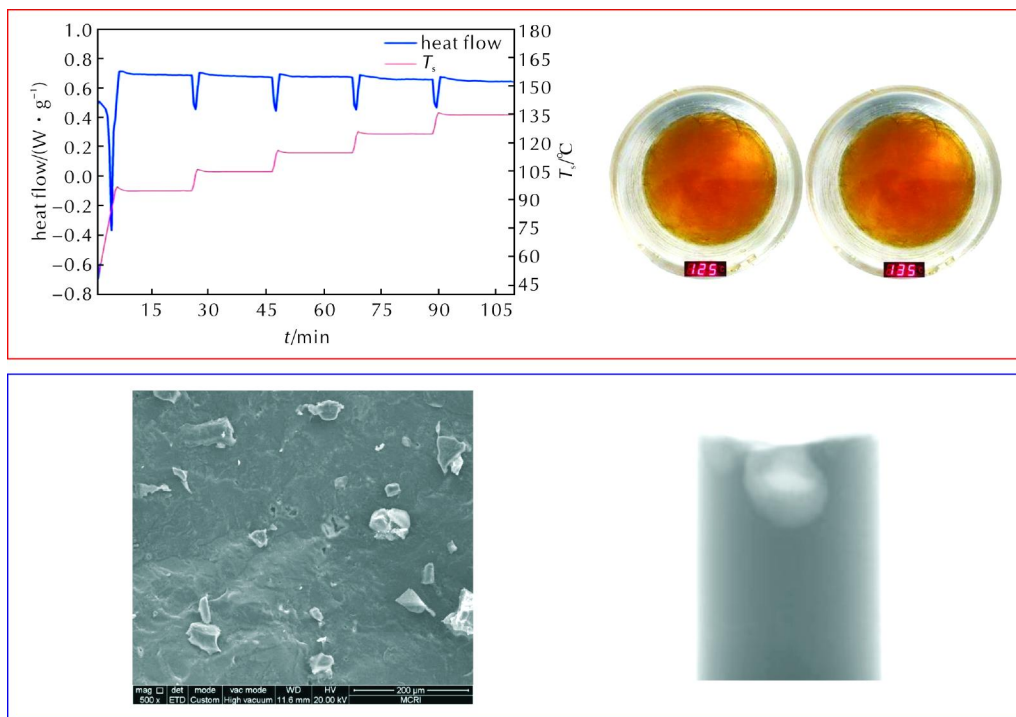


HOU Cong-hua, ZHANG Xin, MA Jing-jing, ZHANG Shi-min, WU Nan, LI Ze-rui, DU Yu-xing

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 120-125.

RDX /PMMA /GO particles were prepared by emulsion polymerization method, and compared with those of RDX /PMMA prepared by the same method.

## Thermal Safety and Solidification Characteristics of BFFO



JU Rong-hui, LUO Yi-ming, WANG Hao, JIANG Qiu-li, ZHANG Meng-meng, YANG Fei, ZHAI Lian-jie, WANG Xi-jie

*Chinese Journal of Explosives & Propellants*, 2022, 45(1): 126-132.

The thermal safety of BFFO was studied by DSC test and long-term constant temperature test, and the solidification properties were studied by X-ray transmission imaging, SEM morphology analysis and DSC controlled solidification test, which were also compared with 3, 4-bis (3-nitrofurazan-4-yl) furoxan (DNTF).