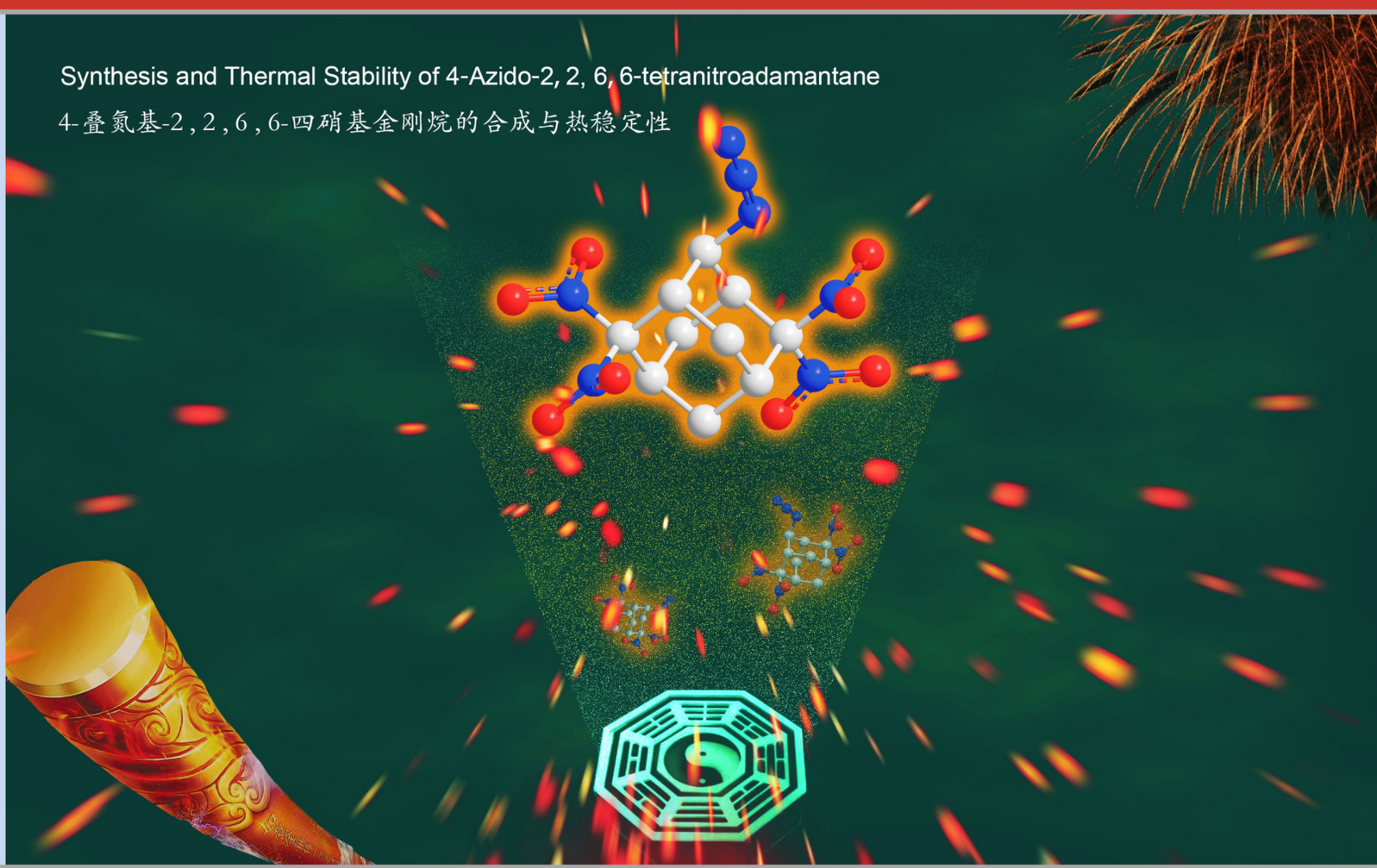
EI 收录期刊
中文核心期刊

ISSN 1006-9941
CODEN HACAFQ

含能材料

CHINESE JOURNAL OF ENERGETIC MATERIALS

含能材料 二〇二〇年 第二十八卷 第七期



新型含能材料的合成与性能 特邀专刊

2020 7
第28卷

HANNENG CAILIAO

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含能材料
CHINESE JOURNAL OF ENERGETIC MATERIALS

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第 28 卷 第 7 期 2020 年 7 月 25 日

特邀 新型含能材料的合成与性能 专刊 （特邀*）

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综述

读者·作者·编者

期刊基本参数: CN 51-1489/TK ※ 1993 ※ m ※ A4 ※ 130 ※zh+en ※ P ※ ￥20.00 ※ 700 ※ 19 ※ 2020-07

CHINESE JOURNAL OF ENERGETIC MATERIALS Monthly

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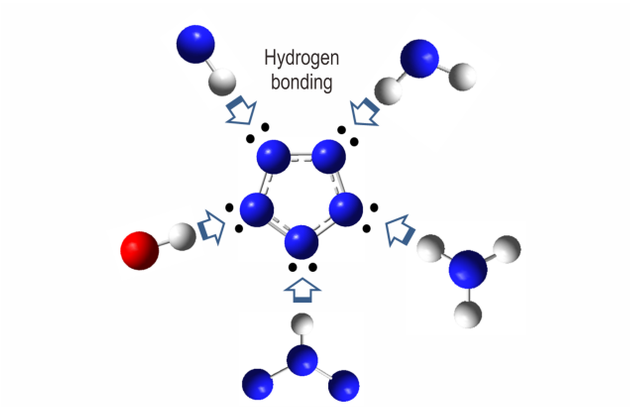
Invited Issue on Synthesis and Properties of Novel Energetic Materials

CHINESE JOURNAL OF ENERGETIC MATERIALS Monthly

CONTENTS Vol. 28 , No. 7 , 25 July , 2020

Reviews

Effect of Hydrogen Bonding in Pentazole Nonmetallic Salts

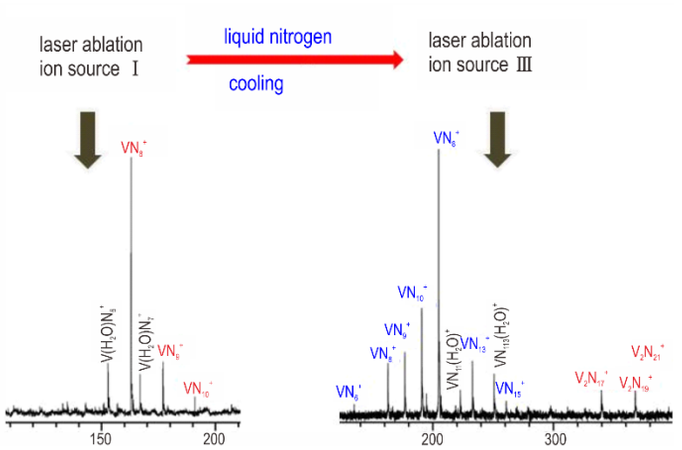


WANG Peng-cheng, JIANG Zhen-ming, ZHOU Xin-li, LIN Qiu-han, LU Ming

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):591−596**

Based on the analysis of hydrogen bond length, strength, number, and N—N bond length in non-metal salts of N_5^- anion, the thermal decomposition temperature is used as the basis for determining the stability. N_5^- anion is easy to form two major types of hydrogen bonds,N—H···N and O—H···N, with electropositive fragments. One of the key factors improving stability is maintaining good structural symmetry after being subjected to hydrogen bonding, the other is forming planar layered graphene-like structures through hydrogen bonding.

Generation of Metal-doped Nitrogen Clusters with High Nitrogen Content by Liquid Nitrogen Cooling-laser Ablation

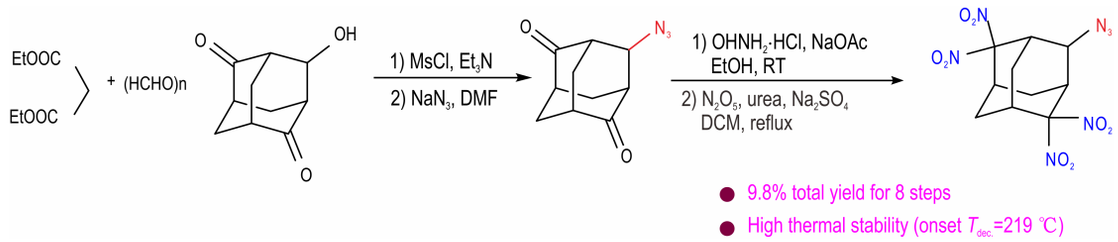


DING Ke-wei, LI Tao-qi, XU Hong-guang, BU Jian-hua, YANG bin, ZHENG Wei-jun, GE Zhong-xue

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):597−602**

The conventional laser ablation ion source was improved by adding liquid nitrogen cooling and its effect on generating metal doped nitrogen clusters with high nitrogen content was studied.

Synthesis and Thermal Stability of 4-Azido-2,2,6,6-tetranitroadamantane

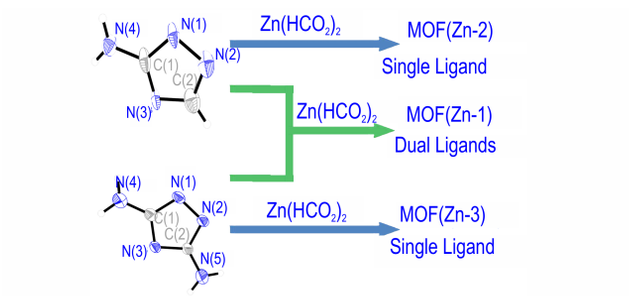


CAI Rong-bin, ZHANG Jian, LUO Jun

***Chinese Journal of Energetic Materials* (*Hanneng Cailiao*), 2020,28(7):603-608**

A high thermal stable and cage-like energetic compound 4-azido-2,2,6,6-tetranitroadamantane was synthesized from diethyl malonate and paraformaldehyde *via* 8 steps with a total yield of 9.8%.

Synthesis and Properties of a Heat-resistant Biligand Energetic Metal-organic Framework Material

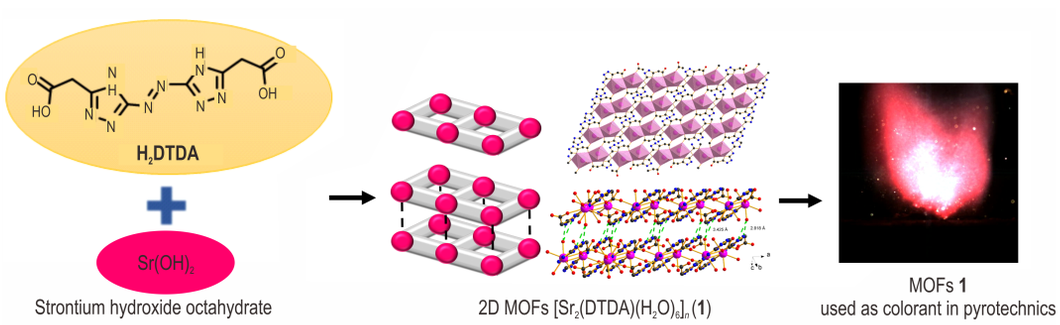


SHI Qing-rong, SU Hui, LI Ya-qiong, DING Ning, ZHAO Chao-feng, LI Sheng-hua, PANG Si-ping

***Chinese Journal of Energetic Materials* (*Hanneng Cailiao*), 2020,28(7):609-617**

The double ligand E-MOFs was prepared by co-coordination of the two ligands, and its crystal structure, decomposition temperature, sensitivity and detonation performances were tested or predicted. It was proved that the double ligand could improve the thermal stability of E-MOFs, and a new method for preparing heat-resistant energetic materials was developed.

Preparation and Properties of Red Pyrotechnic Colorant MOF $[Sr_2(DTDA)(H_2O)_6]_n$

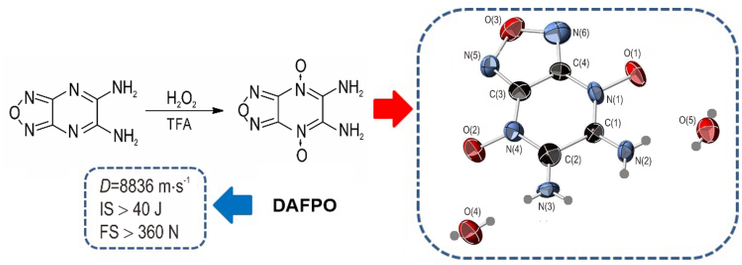


ZHOU Jin-yang, HE Liu, WANG Ting-wei, ZHU Shun-guan, ZHANG Qi

***Chinese Journal of Energetic Materials* (*Hanneng Cailiao*), 2020,28(7):618-624**

A novel two-dimensional energetic MOF $[Sr_2(DTDA)(H_2O)_6]_n$ (**1**) with high thermal stability and insensitivity was designed and synthesized by using the novel mixed ligand of high-nitrogen content and carboxylic acid H_2DTDA 2, 2′-(3, 3′-azo-bis(1*H*-1, 2, 4-triazol-5-yl)) diacetic acid and strontium hydroxide octahydrate under hydrothermal condition.

Synthesis, Structure and Properties of 5,6-Diaminofurazano[3,4-b]pyrazine-4,7-dioxide

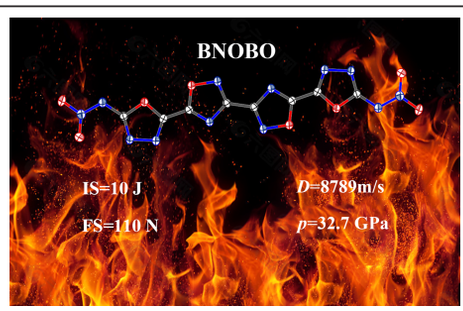


LIU Ning, DUAN Bing-hui, LU Xian-ming, ZHANG Qian, WANG Bo-zhou

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):625−631**

A novel insensitive energetic material, 5,6-diaminofurazano [3,4-b]pyrazine-4,7-dioxide (DAFPO) was synthesized and fully characterized. The impact and friction sensitivities were measured by BAM method. The detonation velocity and pressure were calculated by EXPLO5 code.

Synthesis and Properties of 3, 3′-Bis (2-nitroamino-1, 3, 4-oxadiazol-4-yl)-5,5′-linked-1,2,4-oxadiazole and Its Energetic Salts

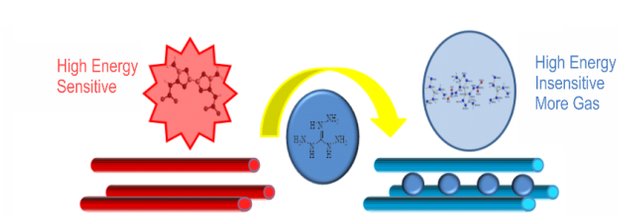


LIAO Si-cheng, DENG Mu-cong, SONG Si-wei, JIN Yun-he, LIU Tian-lin, ZHANG Qing-hua

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):632−637**

Guided by the idea of these multicyclic compounds with a 1,2,4-oxadiazole core will have good thermal stability and high density because of their 3,5-substitution pattern and the possibility of achieving a planar conformation. Synthesis and characterization of new multicyclic oxadiazoles, 3,3′-bis(2-nitroamino-1,3,4-oxadiazol-4-yl)-5,5′-linked-1,2,4-oxadiazole (BNOBO).

Crystal Structure and Detonation Performance of 5,5′-Diamino-4,4′-dinitroamino-3,3′-bi-1,2,4-triazole Triaminoguanidinium Salt (TAGAT)

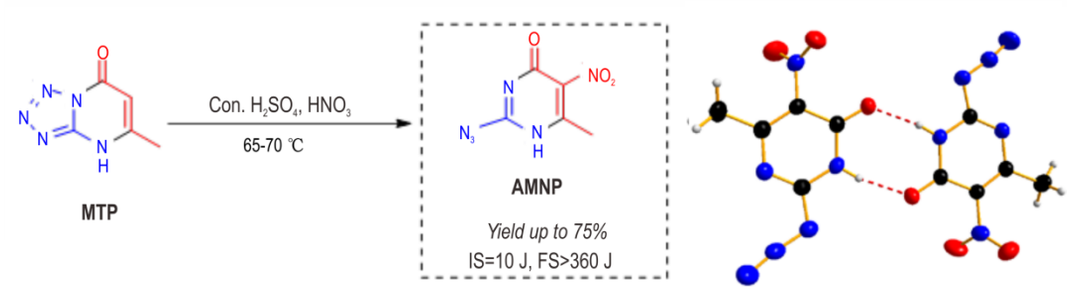


XUE Yu-bing, CHENG Guang-bin, YANG Hong-wei

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):638−643**

A new energetic ionic salt of 5,5′-diamino-4,4′-dinitroamino-3,3′-bi-1,2,4-triazole triaminoguanidinium salt (TAGAT) was obtained through a three-step synthesis with its crystal structure fully characterized by X-ray diffraction analysis. The thermal behaviors and detonation properties were investigated. TAGAT exhibits excellent gas-generating capability, average venting rate and good detonation performances, making it a potential gas generating compound and a promising candidate of insensitive energetic material.

Synthesis, Crystal Structure and Properties of 2-Azido-6-methyl-5-nitro-pyrimidin-4(3H)-one(AMNP)

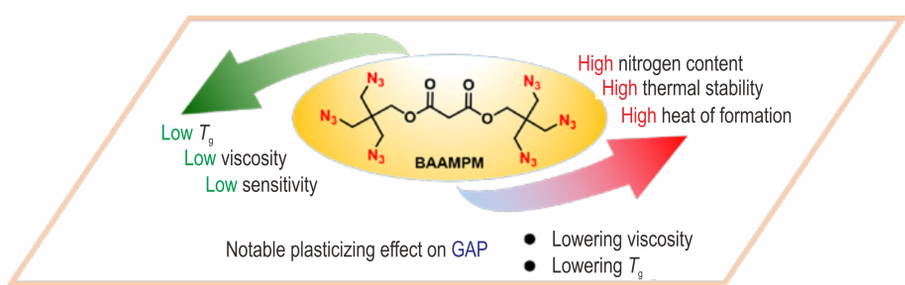


HU Yong, YANG Jun-qing, ZHANG Jian-guo

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):644-649**

2-Azido-6-methyl-5-nitro-pyrimidin-4(3H)-one was synthesized via cyclization and nitration reactions by using 5-amino-1*H*-tetrazole and ethyl acetoacetate as raw material. Its structure was confirmed by elemental analysis, X-ray analysis and ^{13}C NMR. Its thermal stability and decomposition process were investigated by TG and DSC method.

Synthesis and Properties of Energetic Plasticizer Bis(3-azido-2,2-bis(azidomethyl) propyl) malonate

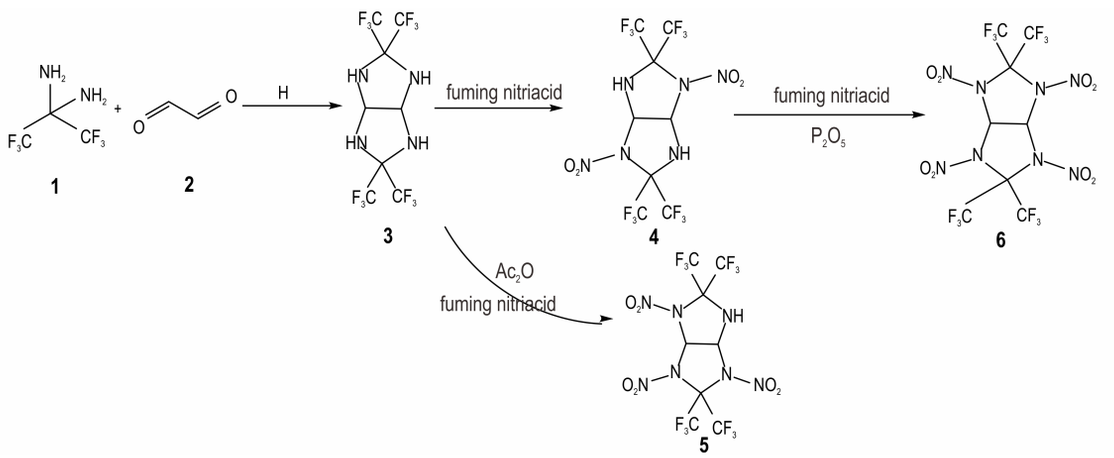


ZHAO Bao-dong, JIN Guo-liang, LIU Ya-jing, GAO Fu-lei, CHEN Bin, WANG Ying-lei, GE Zhong-xue

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):650-656**

A novel multi-azido energetic plasticizer bis(3-azido-2,2-bis(azidomethyl) propyl) malonate was designed and synthesized. As the DSC results shown, BAAMPM has a rather low glass transition temperature (-58.3 ℃) and good thermal stability as well as low mechanical sensitivities. Moreover, the viscosity and glass transition temperature of BAAMPM/GAP mixtures are considerably lower than that of GAP, showing that BAAMPM has notable plasticizing effect on GAP.

Synthesis and Properties of Polynitro 3,3,7,7-Tetra(trifluoromethyl)-2,4,6,8-tetraazabicyclo [3.3.0]octane

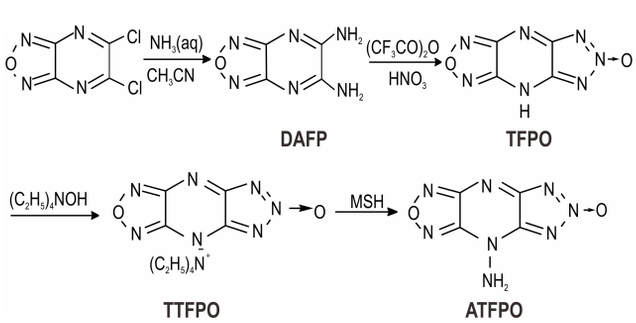


YANG Tong-tong, LIU Yang, HOU Xiao-wen, MENG Zi-hui, XU Zhi-bin

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):657−663**

Three polynitro 3,3,7,7-tetra (trifluoromethyl) -2,4,6,8-tetraazabicyclo [3.3.0] octanes were prepared and fully characterized. All compounds show good detonation performance and low mechanical sensitivity.

Synthesis and Properties of 4-Amino-1,2,3-triazolo[4,5-e]furazano[3,4-b]pyrazine 6-oxide

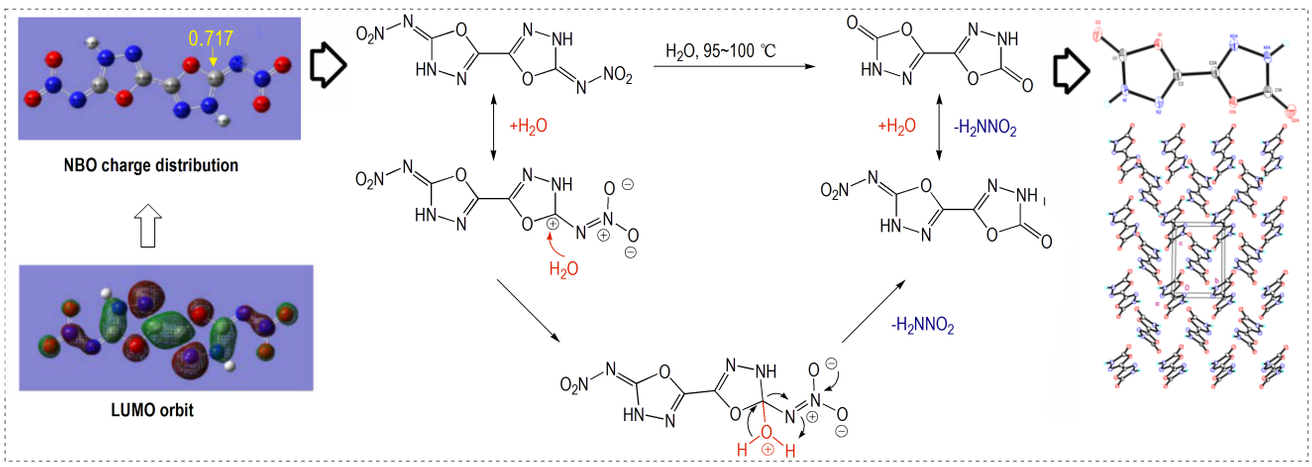


LI Ya-nan, HU Jian-jian, CHEN Tao, WANG Bin, CHANG Pei, WANG Bo-zhou

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):664−669**

A novel high energy density material, 4-amino-1,2,3-triazolo [4, 5-e]furazano[3, 4-b]pyrazine 6-oxide(ATFPO), was designed and synthesized by the reactions of substitution, nitrification-cyclization, neutralization and *N*-amination. The thermal stability of ATFPO was tested by differential scanning calorimetry(DSC) method. The detonation properties of ATFPO were predicted.

Stability of Oxadiazole Nitramide Compounds in Water and Its Hydrolysis Mechanism

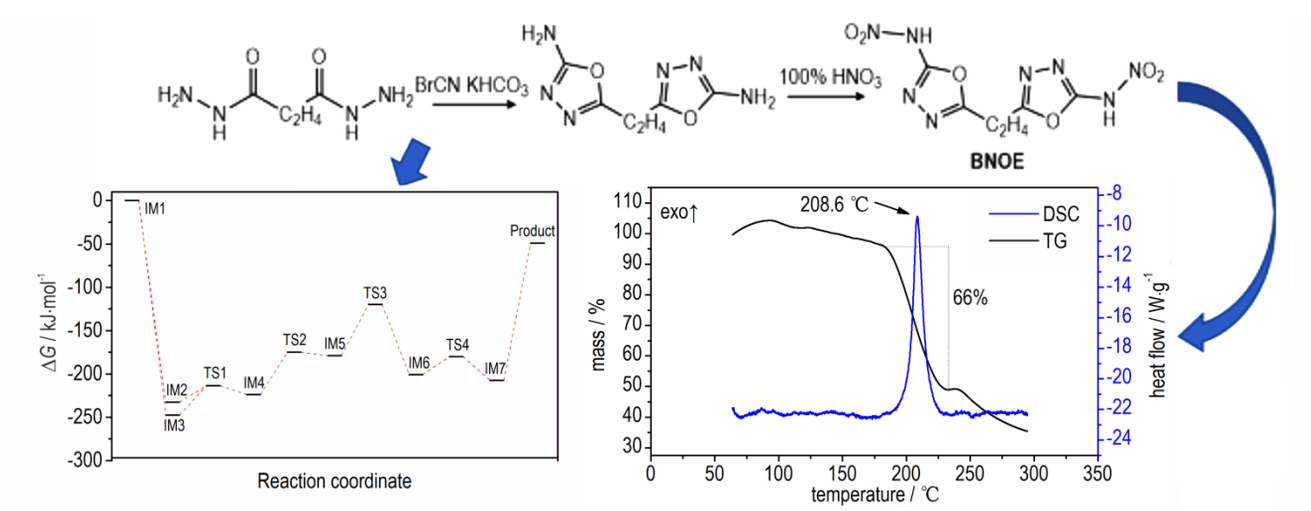


ZHANG Zhen-qi, MA Qing, LU Huan-chang, LIAO Long-yu, FAN Gui-juan

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):670-677**

Through the theoretical calculation of NBO charge distribution and LUMO orbital distribution of oxadiazole nitramide compounds and the experimental verification of the hydrolysis reaction, the mechanism and internal rule of the hydrolysis reaction of oxadiazole nitramide compounds were revealed.

Synthesis and Properties of 1,2-Bis(5,5′-dinitramino-1,3,4-oxadiazol-2-)ethane

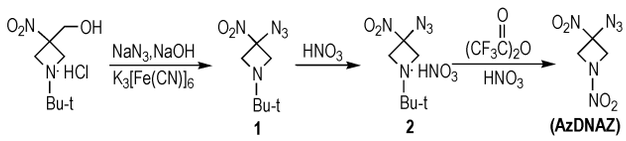


MA Ying-jie, LU Yan-hua, CAO Yi-lin, HE Jin-xuan

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):678-684**

A new energetic compound of 1,2-bis(5,5′-dinitramino-1,3,4-oxadiazol-2-)ethane was obtained through a three-step reaction. The mechanism of cyclization reaction was studied by quantum chemical calculation method. The thermal behaviors and detonation properties were investigated.

A Melt-cast Explosive 3-Azido-1,3-dinitroazetidine (AzDNAZ) with Gem-azidonitro of Novel Energetic Group: Synthesis and Performance

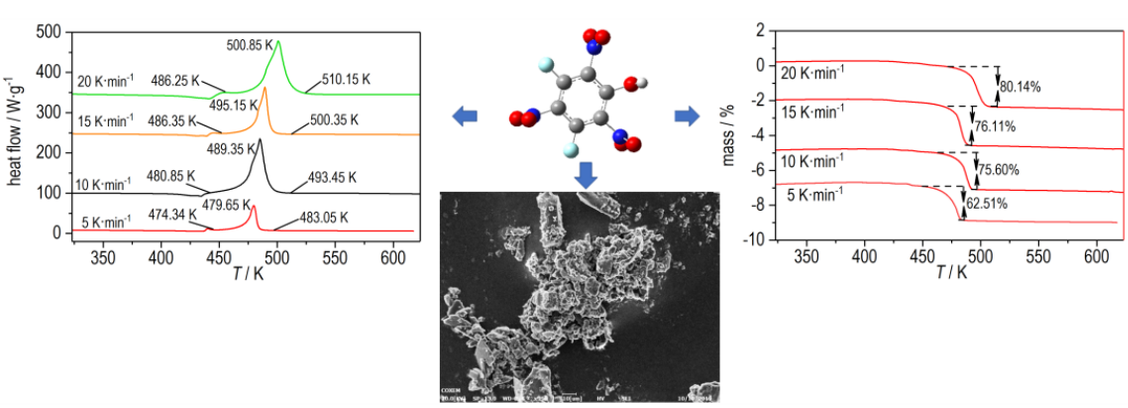


Using (1-tert-butyl-3-nitroazetidin-3-yl)methanol as starting material, a melt-cast explosive of 3-azido-1,3-dinitroazetidine (AzDNAZ) with novel gem-azidonitro energetic group was obtained through an improved azidation-salinization-nitration strategy. Structures of the intermediates and AzDNAZ were characterized. One of the intermediates, 1-tert-butyl-3-azido-3-nitro-azetidinium nitrate (compound 2), was obtained for the first time with the single crystal determined by X-ray single crystal diffraction. Performance of AzDNAZ was studied using DSC-TG and quantum chemical calculations.

JIA Si-yuan, ZHANG Hai-hao, ZHANG Jia-rong, LIU Qian, LUAN Jie-yu, BI Fu-qiang, WANG Bo-zhou

***Chinese Journal of Energetic Materials* (*Hanneng Cailiao*), 2020,28(7):685-689**

Kinetics of Thermal Decomposition of 2,4,6-Trinitro-3,5-Difluorophenol

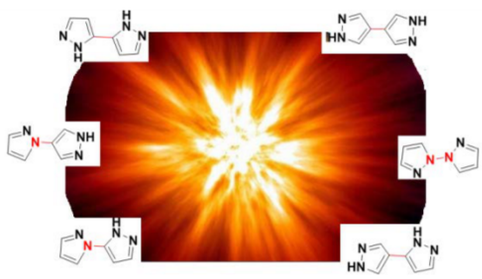


The thermal decomposition kinetics of 2,4,6-trinitro-3,5-difluorophenol was studied by TG-DTA method. The pre-exponential factor and apparent activation energy were calculated, and the related thermodynamic parameters were obtained.

YANG Lei, LIU Yu-cun, JING Su-ming

***Chinese Journal of Energetic Materials* (*Hanneng Cailiao*), 2020,28(7):690-694**

Review on Energetic Compounds Based on Bipyrazoles: Synthesis and Property



LUO Yi-fen, XIAO Chuan, BI Fu-qiang, LI Xiang-zhi, WANG Zi-jun, WANG Bo-zhou

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):695−706**

Advances in the construction of bipyrazole energetic compounds were reviewed. The reported bipyrazole energetic compounds were divided by different bonding modes.

Review on Preparation of Boron-based Energetic Compounds

Five categories of boron-based energetic compounds were introduced and the research progress was reviewed towards their structural characteristics, synthesis routes and basic properties. It can be considered as a new way to improve the combustion performance of fuel-rich propellants by replacing boron particles. As a non-chlorine energetic material, it can also be explored to replace ammonium perchlorate.

WANG Guo-dong, LIU Yu-cun, JING Su-ming, LIU Guo-qing, HAN Rui-lian

Chinese Journal of Energetic Materials **(*Hanneng Cailiao*), 2020,28(7):707−716**