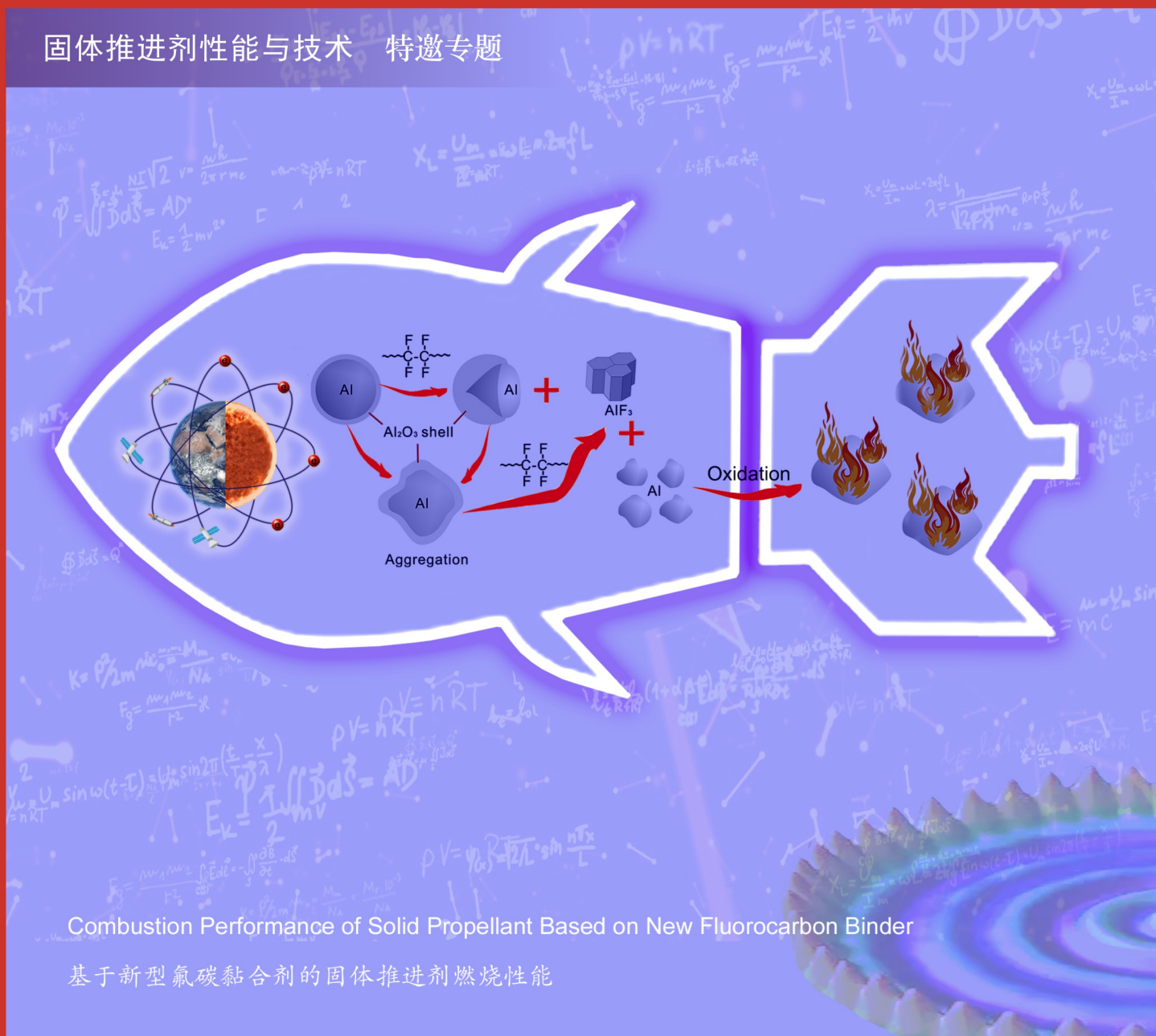


含能材料

CHINESE JOURNAL OF ENERGETIC MATERIALS

固体推进剂性能与技术 特邀专题



特邀 固体推进剂性能与技术 专题

(特邀★)

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含铝复合推进剂可提高复合固体推进剂的能量特性,因此,铝粉作为高热值燃料广泛应用于推进剂系统。然而,含铝复合推进剂在燃烧中易出现凝聚相团聚,降低推进剂的能量释放效率,从而降低实际比冲。为了解决推进剂燃烧过程中的凝聚相团聚,氟化物被引入到固体推进剂中。目前,推进剂引入含氟化合物的方式多样,但多存在相容性差、分散不均以及对推进剂其它性能产生未知影响等缺点。因此,北京理工大学姚启发博士、夏敏教授等研究人员通过引入一种具有端羟基结构且高氟含量的氟醇化合物(PFD),巧妙地利用推进剂的固化反应将含氟链段接入黏合剂主链,形成了基于新型氟碳黏合剂的新型固体推进剂。结果表明,加入PFD后推进剂的失重仍然包含三个主要阶段,但会使推进剂中RDX分解延后15~20℃,且在250℃前含氟链段完全分解失重;对比空白推进剂样品,含有PFD的推进剂在相同点火时间下具有更高的燃烧亮度;随着PFD的增加,推进剂样品燃烧火焰的密集程度显著增加,且火焰喷射更为剧烈;推进剂的凝聚相产物平均粒径由添加1%PFD时的5.13 μm逐渐减小至添加5%PFD时的1.04 μm。

氟碳燃烧

封面背景以数学和物理公式作为衬底,隐含所做研究涉及的关系复杂多变,同时又表明文章严谨的科学逻辑性;封面中心部为分割形的导弹弹体外形,指示本研究的应用领域主要为导弹用固体推进剂;导弹形状内部的圆球部分由左右两部分分割组成,导弹弹体左侧“地球原子模型”中,右边为原子,左边则为地球,表示微观机理研究与宏观性能及应用的有机统一;导弹弹体右侧则为本研究中涉及氟醇化合物在推进剂燃烧过程中的主要作用机理。整体设计简捷直观、色彩明快,重点突出、别出心裁。

封面效果 / @山鹰·翼筒设计

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◎ Properties and Technology of Solid Propellant

Energetic Express

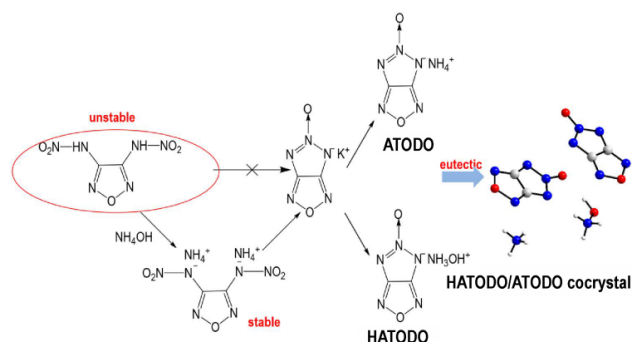
P763 ★

Preparation and Property

Synthesis and Characterization of 4H-[1,2,3]triazolo[4,5-c][1,2,5]oxadiazole 5-oxidehydroxylamine Salts / Amine Salts and their Energetic Cocystal

MA Ying-jie, MU Ping, YAN Yan, REN Xiao-ting, YAN Chao, HE Jin-xuan

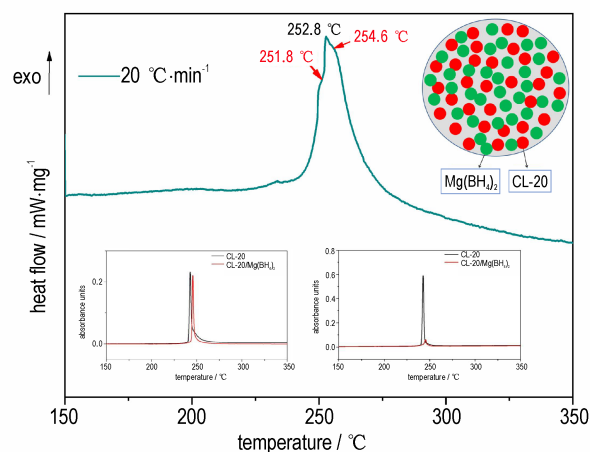
P764 ★ 4H-[1,2,3]Triazolo[4,5-c][1,2,5]oxadiazole 5-oxide (TODO) hydroxylamine salts and TODO amine salts were obtained through a three-step synthesis. These two energetic ionic salts were used to synthesize an energetic eutectic as raw materials. The energetic eutectic structure was characterized by SXRD, FT-IR and NMR, and its performance was study as well.



Effect of $\text{Mg}(\text{BH}_4)_2$ on Thermal Decomposition of the Typical Nitramine Explosives

DU Fang, WANG Hui-si, LU Hui, YAN Jia-wei, LI Yi-heng, LIN Li-yun, LI Lei, TAO Bo-wei, GU Jian

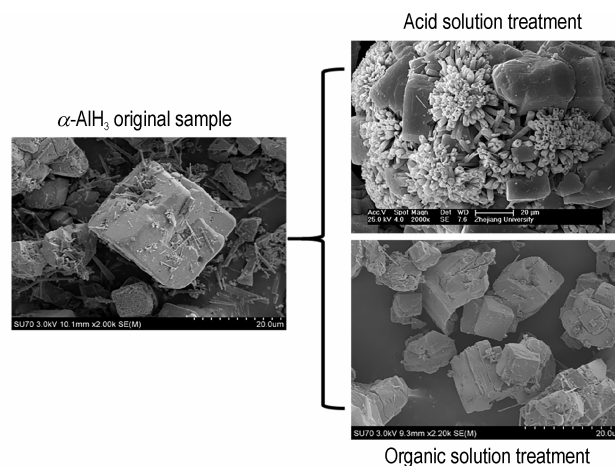
P771 ★ The thermal decomposition properties of $\text{Mg}(\text{BH}_4)_2/\text{RDX}$, $\text{Mg}(\text{BH}_4)_2/\text{HMX}$ and $\text{Mg}(\text{BH}_4)_2/\text{CL-20}$ were studied by differential scanning calorimetry (DSC). Thermal decomposition products of three mixtures were analyzed by Thermogravimetric analysis-Fourier transform infrared spectroscopy coupling technique (TG-FTIR).



Stabilizing Modifications of $\alpha\text{-AlH}_3$ by Acidic and Organic Solution Treatment

Yuan Xue-ling, Li He-ping, Pang Ai-min, Tang Gen, Xu Xing-xing, Liu Hui, Liu Jian-zhong

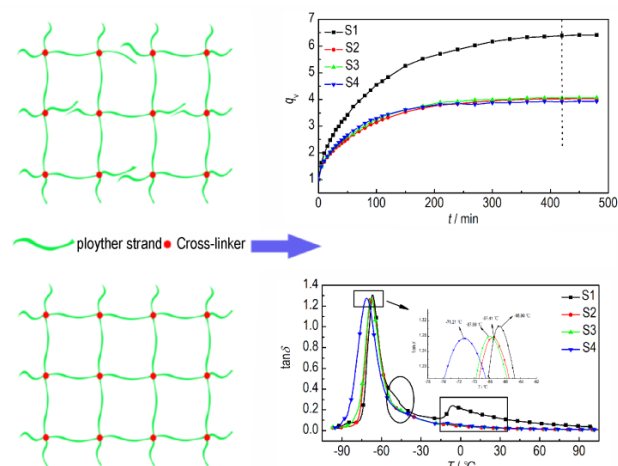
P779 Using acidic and organic solution as modifiers to treat $\alpha\text{-AlH}_3$ aiming to improve its stability, the samples before and after the treatment are compared and analyzed by structural characterization, stability test, and the mechanical sensitivity test. The hydrogen release performance and modification mechanism of the $\alpha\text{-AlH}_3$ after modification are discussed.



Effects of Crosslinking Catalyst on Properties of Polytriazole-crosslinked Solid Elastomer

ZHANG Yong-li, YANG Rong-jie, ZHANG Wei-hai, GAO Xi-fei,
JIANG En-zhou, ZHANG Yu-xuan

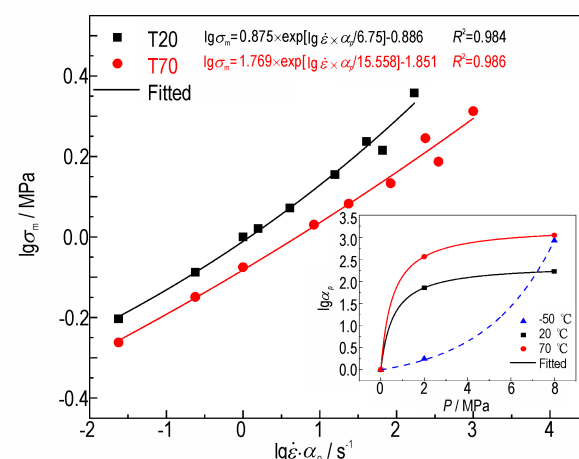
P787 In order to study the influence of crosslinking catalyst copper 2, 4-glutarate-cyclooctadiene complex dosage on the crosslinking network structure of polytriazole-crosslinked elastomer produced via click chemistry reaction, the elastomers with 0.01%, 0.02%, 0.05%, 0.10% mass content of catalyst relative to binder were evaluated by FTIR, TG, equilibrium swelling method and DMA.



Uniaxial Tensile Properties of Butadiol Quaternary Propellant under Confining Pressure and Wide Temperature

LI Chun-tao, LI Wei, PANG Ai-min, CAO Cheng-shuo, SUN Xin-ke,
ZHOU Wei-jie

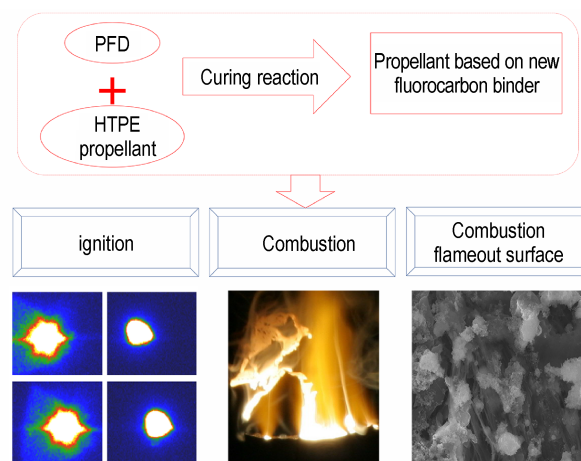
P793 ★ The macroscopic mechanical response and mesoscopic damage mechanism of butyl tetrad propellant under wide temperature confining pressure and different tensile rates were studied. Based on the typical mechanical properties of propellants under different working conditions, the applicability of time-confining pressure equivalent superposition principle (TPSP) was analyzed, and the main curves of maximum tensile strength of propellants at 20 °C and 70 °C were constructed.



Combustion Performance of Solid Propellant Based on New Fluorocarbon Binder

YAO Qi-fa, MAO Chao-chao, SHAO Yu-ling, XIA Min, LUO Yun-jun

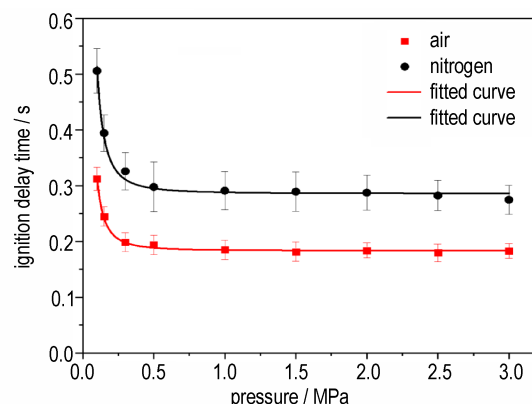
P804 ★ A fluoroalcohol compound (PFD) is added to the HTPE propellant, and its hydroxyl end structure can be connected to the binder main chain in the propellant curing reaction to form a new solid propellant based on fluorocarbon binder. The thermal decomposition, laser ignition and combustion tests of the new propellant were carried out to study the effects of PFD on the thermal decomposition, combustion particle size and energy release efficiency of the propellant.



Ignition and Combustion Characteristics of NEPE Propellant in Nitrogen and Air

TU Cheng-yin, CHEN Xiong, ZHOU Chang-sheng, ZHANG Bei-chen, LI Lian-bo

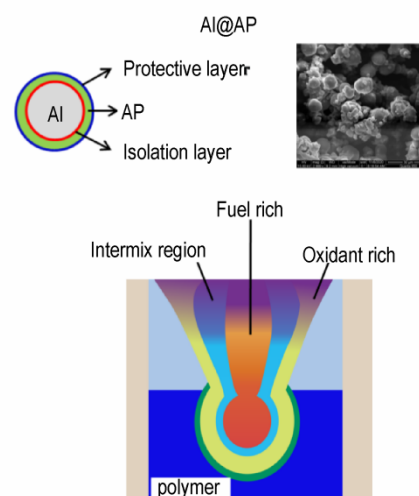
P811 In order to comprehensively study the ignition and combustion characteristics of NEPE propellant, the combustion processes of NEPE propellant were monitored and compared for different experimental conditions through a high-speed camera. In particular, the ignition delay time and combustion rate of NEPE propellant were measured at pressures in the range of 0.1–3.0 MPa under nitrogen and air respectively, and the effects of ambient pressure and gas environment on the ignition delay time and combustion velocity of NEPE propellant were investigated.



Application of Aluminum-based Composite Fuel in NEPE Solid Propellant

WANG Hui-si, ZHANG Xing, WANG Yan-wei, DU Fang, LI Lei, GU Jian, Li Wei, TAO Bo-wen

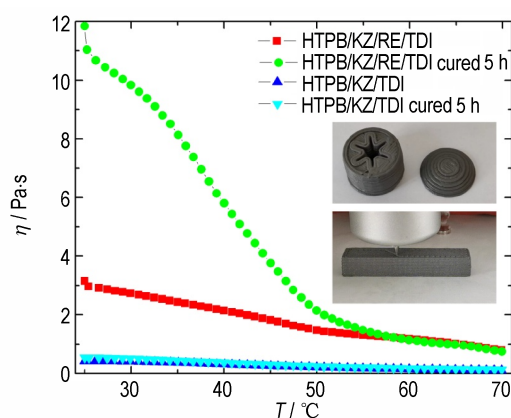
P819 ★ The influence of Al@AP on the combustion, mechanical and process performance of NEPE propellant was studied, and the combustion mechanism of Al@AP in NEPE propellant was derived.



Rheological Properties and 3D Printing of a Modified-HTPB Solid Propellant

SHI Yu, REN Quan-bin, HUANG Pu, WANG Kai, WANG Wei, CAO Cheng-shuo, SHI Ke, FU Xiao-meng, WANG Fang, LI Wei, WANG Yan-wei

P826 ★ The method of blending and modification is used to modify the hydroxyl-terminated polybutadiene (HTPB) by adding a small amount of styling aids. At the same time, there are no special requirements for the curing parameters and plasticization ratio of propellant formula. It can be well adapted to the performance control means of HTPB solid propellant. Theoretically, this method can be used in 3D printing of various HTPB solid propellants.

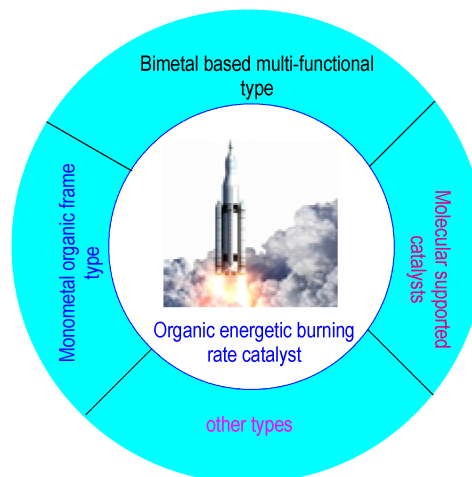


Reviews

Research Progress on Organic Energetic Burning Rate Catalysts for Solid Propellants

TAN Bo-jun, DUAN Bing-hui, REN Jia-tong, LU Xian-ming,
MO Hong-chang, LIU Ning

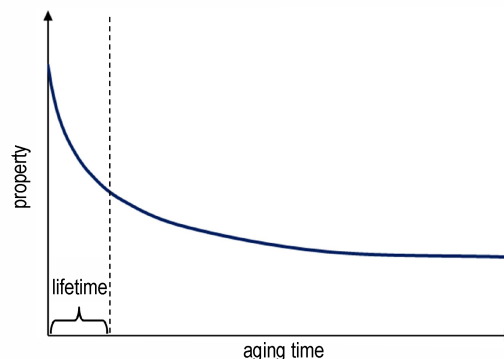
P833 ★ This review summarized the research progress of energetic burning rate catalyst, including monometal-organic framework type, bimetal based multi-functional type, molecular supported type and other types.



Theories and Methodology of High Temperature Accelerated Test for Composite Solid Propellants (I) : The Applicability of Arrhenius Equation

CHI Xu-hui, PENG Song, ZHAO Cheng-yuan, YANG Gen,
ZHANG Feng-tao, CAO Rong

P853 ★ Application history of Arrhenius equation on aging of composite solid propellants has been reviewed. Physical meanings of the equation parameters have been clarified. The parameters can be regarded as constants to solid propellants aged at normal acceleration temperatures.



Research Progress on Bonding Interface Creep Damage in Solid Rocket Motors

LI Kang-jia, QIANG Hong-fu, WANG Zhe-jun, WANG Xue-ren,
WANG Jia-xiang

P861 ★ This paper shows that in order to evaluate the performance changes of the bonding interface of solid rocket motor after vertical storage, it is necessary to study the creep damage of the bonding interface. According to the load characteristics of vertical storage of engine, which points out the shortcomings of the current research on creep damage of bonding interface, and puts forward the ideas and methods of creep damage experimental research and simulation analysis. It provides a reference for follow-up research.

