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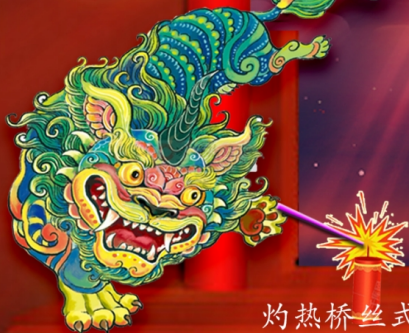
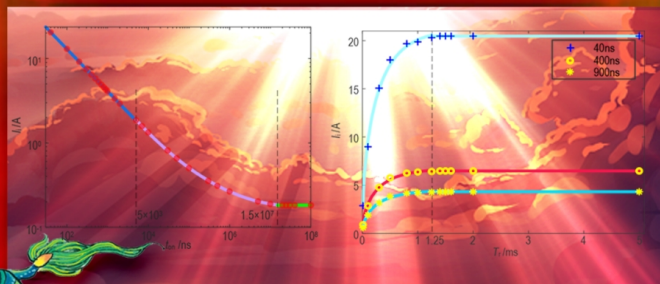
含能材料

CHINESE JOURNAL OF ENERGETIC MATERIALS

起爆与传爆技术 特邀专题

电龙火虎

Electric dragon & Fire tiger



灼热桥丝式电火工品脉冲电流激励发火规律分析

Analysis on Ignition Law of Hot Bridge Wire Electro Explosive Device Under Pulse Current Excitation

2023
第31卷 6

HANNENG CAILIAO

灼热桥丝式电火工品脉冲电流激励发火规律分析



近年来,科技工作者已对灼热桥丝式电火工品的发火规律及安全性等方面进行了一系列的积极探索与研究。然而,限于当时研究条件或认知的不同,在本领域内还存在亟待解决的问题。目前,特别是针对灼热桥丝式电火工品的发火规律的研究相对较少且不够全面。为此,来自陆军工程大学魏光辉等研究人员根据热传导理论,在考虑药剂放热和消耗等因素的前提下,建立了灼热桥丝式电火工品的温升模型,提出了其发火判据和临界参数仿真流程;并在此基础上分别研究了在单脉冲和脉冲串电流激励下,不同脉冲电流对灼热桥丝式电火工品临界发火电流的影响规律。结果表明,在单脉冲激励下,当脉冲宽度小于 $5\text{ }\mu\text{s}$ 时,灼热桥丝式电火工品的临界发火能量固定;而当脉冲宽度大于 15 ms 时,灼热桥丝式电火工品临界发火电流固定。在窄脉冲串电流激励下,临界发火电流随重复周期变化曲线的时间常数与脉宽无关,且当重复周期大于 1.25 ms 时,桥药系统无热累积效应,其临界发火电流与单脉冲电流作用情况一致;当重复周期小于 1.25 ms 时,桥药系统出现热累积效应,导致临界发火电流随着重复周期的降低而迅速衰减。

电龙火虎

封面整体以喜庆的朱红氛围色为主背景,红色大门表示灼热桥丝式电火工品安全性评估领域,缓缓打开的大门,表示该领域的研究已慢慢敞开,未来发展一片光明!封面底部的年兽分列两侧,分别代表两种不同的点火方式:单脉冲电流激励点火(左)和脉冲串电流激励点火(右);鞭炮串的繁疏程度与脉冲串的重复周期相对应(繁对应周期小)。左边的火苗相比于右边的大,代表脉冲串激励下,若重复周期小于一定值,则由于桥药系统有热累积效应,其点火电流要稍小一些。两只年兽上方的曲线图则分别对应在不同激励类型下的点火规律曲线,表示了单脉冲和脉冲串激励下的灼热桥丝式电火工品点火规律。

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◎ Initiation and Detonation Technology

Energetic Express

P525 ★

Prospective

Fundamentals, progress, and perspectives on pyrotechnics

CHU En-yi, CHEN Jian-hua, ZHANG Lei, LIU Wei

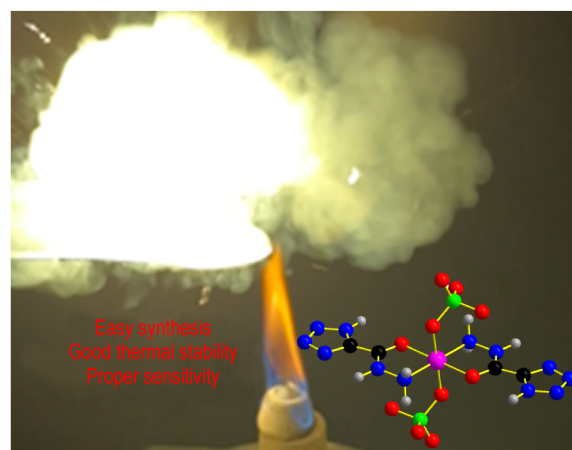
P527 ★

Pyrotechnics

Synthesis and properties of novel high nitrogen energetic complex of nickel perchlorate with tetrazole-5-formylhydrazine

KUANG Bao-long, WANG Ting-wei, LU Zu-jia, XIE Zhi-ming, ZHANG Han, ZHANG Jian-guo

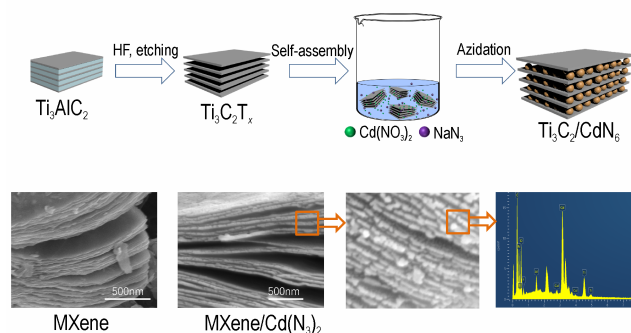
P531 ★ A novel tetrazole derivative ligand 1*H*-5-hydrazinyltetrazole (TZCA) was synthesized by using ethyl 1*H*-tetrazole-5-carboxylate as raw material through a one-step hydrazinolysis reaction, and its' energetic coordination compound $\text{Ni}(\text{TZCA})_2(\text{ClO}_4)_2$ (ECCs-1) was easily obtained under room temperature. The low sensitivities and good detonation properties of ECCs-1 suggesting its' potential application for lead free primary explosive.



Preparation and Performance of a novel film Primary Explosive of MXene/ $\text{Cd}(\text{N}_3)_2$

ZHANG Lei, WEI Chun-qiang, WANG Yan-lan, CHU En-yi, CHEN Jian-hua

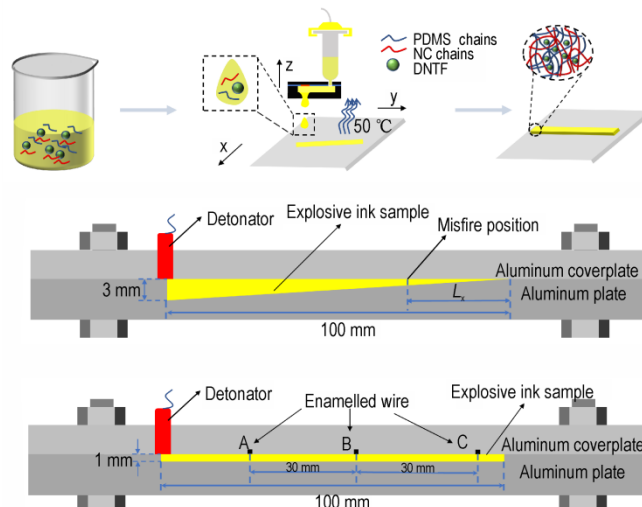
P539 ★ A high-temperature resistant primary explosive of MXene/ $\text{Cd}(\text{N}_3)_2$ composite film was prepared by surface self-assembly of electrostatic interaction. The morphology and thermal decomposition properties of MXene/ $\text{Cd}(\text{N}_3)_2$ composite film were studied by a series of characterization methods.



Preparation and Performance of DNTF/PDMS/NC-based Energetic Ink

LIU Song-jin, GAO Lei, LIU Xiao-lei, LI Chun-yan, XIE Zhan-xiong, AN Chong-wei, WANG Jing-yu

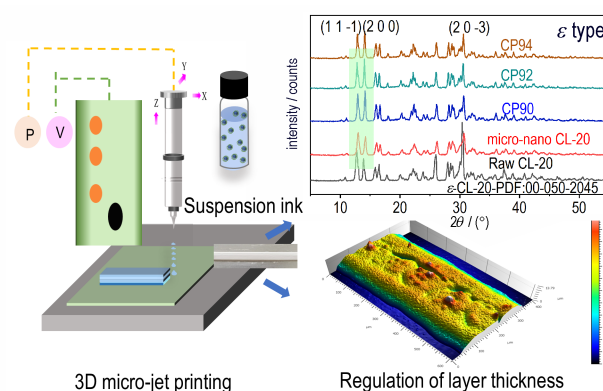
P546 ★ DNTF-based energetic ink matching with inkjet printing technology was designed. The formed samples were tested and characterized by microscopic morphology, mechanical properties, mechanical sensitivity, and detonation properties.



3D Microjet Printing and Properties of Micro-nano CL-20 Particle Suspended Explosive Ink

LI Chun-yan, CHEN Jiao, AN Chong-wei, YE Bao-yun, WANG Jing-yu

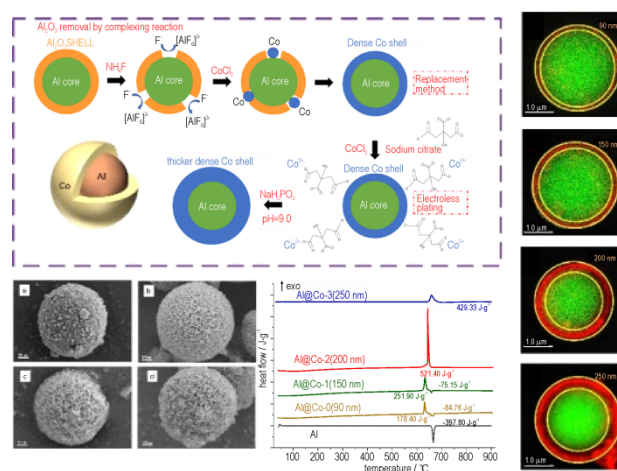
P552 ★ A micro-nano CL-20 particle suspended explosive ink suitable for 3D micro-jet printing was designed to explore the effect of the content of CL-20 in ink on the morphology, printing efficiency, packing density, crystal form of main explosive, mechanical sensitivity and detonation transmission properties of 3D micro-jet printing molding samples.



Controlled Preparation and Properties of Al@Co Micron Core-shell Energetic Particles

XU Xiang-yuan, GUO Ze-rong, XIANG Ning, CHEN Yong-peng, ZHANG Hui-chao, MA Xiao-xia, ZHOU Zun-ning

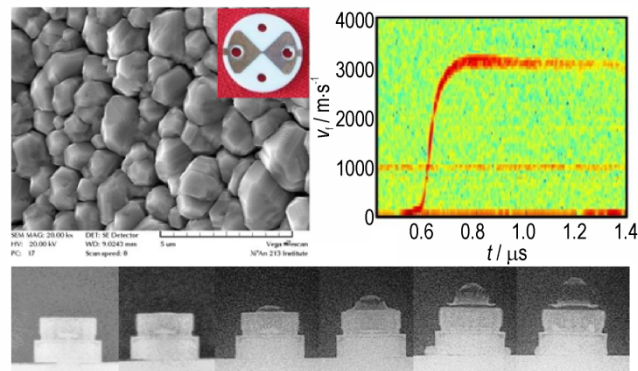
P561 ★ A series of Al@Co core-shell energetic particles with uniform coating and tunable shell thickness were synthesized combining the replacement and electroless plating methods. The cobalt shell thickness was respectively confirmed as 90, 150, 200 nm and 250 nm. To investigate the influence of shell thickness on the self-propagation high-temperature synthesis (SHS), the DSC measurements in argon atmosphere were conducted and the Al@Co-2 with 200 nm cobalt coating shows the best exothermic performance with 521.40 J·g⁻¹. The as-prepared Al@Co core-shell particles provide a promising selection for fuel component in novel green primary explosives.



Effect of Micro Morphology and Crystal Structure of Copper Foil on the Performance of Exploding Foil Initiator

HAN Ke-hua, ZENG Xin, ZHAO Wan-jun, CHU En-yi, JIAO Qing-jie

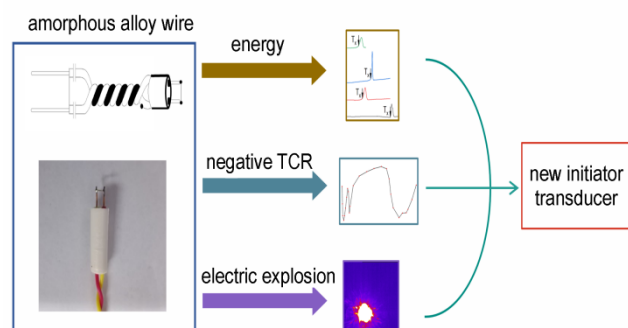
P568 ★ Based on closed-field non-equilibrium magnetron sputtering ion plating technology and Lift-Off etching method, Cu foils with three different crystal morphologies were prepared under the sputtering power of 150, 450 W and 800 W. Electrical explosion performance, flyer velocity of the corresponding exploding foil, and the firing performance of the integrated exploding foil initiator were carried out subsequently, providing technical support and theoretical basis for the development of reliable and low-energy exploding foil initiators.



A Preliminary Research on the Properties of Amorphous Alloy as New Microheater Material of Initiator

NING Jue-yong, JIAN Hao-tian, ZHU Zheng-wang, ZHENG Guo-qiang, LI Hong-gao, ZHU Peng, SHEN Rui-qi

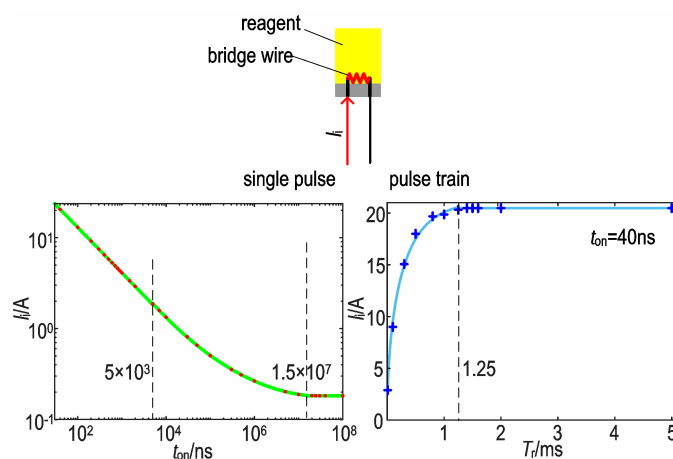
P577 ★ A type of amorphous alloy bridge wire micro-heater was designed and fabricated. The energetic property, negative temperature coefficient of resistance, and electric explosion characteristics of the amorphous alloy bridge wire micro-heater are better than conventional Ni-Cr wire micro-heater, and the amorphous alloy is supposed to be a promising micro-heater material of initiator.



Analysis on Ignition Law of Hot Bridge Wire Electro Explosive Device Under Pulse Current Excitation

LYU Xu-xu, WEI Guang-hui, DU Xue, LU Xin-fu, SUN Jiang-ning

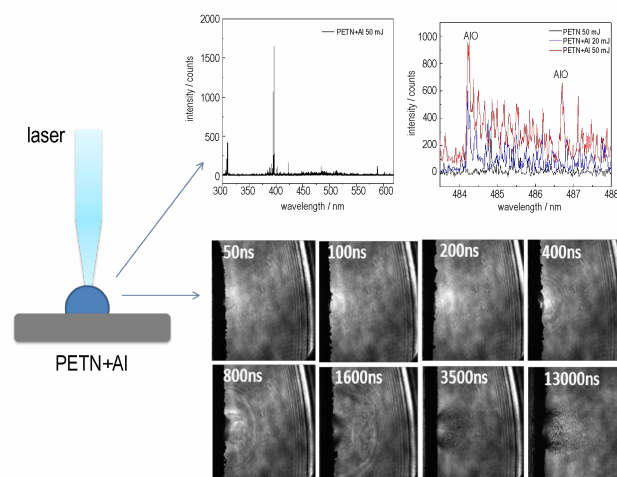
P589 In order to study the safety of hot bridge wire EED under pulse current excitation, the calculation process of critical ignition current of hot bridge wire EED was designed, and the effect law of pulse current parameters on critical ignition current was revealed. Firstly, the temperature rise model of hot bridge wire EED was established by theoretical analysis, and the solution method was given. Then, the sensitive criterion of hot bridge wire EED was given, and the calculation process of critical ignition current was designed. Finally, the effect of pulse parameters on the critical ignition current of hot bridge wire EED under single pulse current and pulse train current excitation were analyzed separately.



Laser Ablation Characteristics of PETN Explosive Doped With Nano-aluminum Powder

Ji Xiang-bo, TANG Duo, QIN Wen-zhi, GAO Yuan, PIAO Jun-yu

P598 In this paper, a single pulse 1064 nm laser was used to ablate PETN explosive doped with nano-aluminum powder. The influence of nano-aluminum powder on the shock wave and characteristic spectrum of explosive was studied. The plume expansion and material ejection characteristics of PETN doped with nano-aluminum powder under the action of pulse laser were observed by shadow measurement system, and the spectra of explosive after laser ablation were detected by laser induced breakdown spectroscopy.

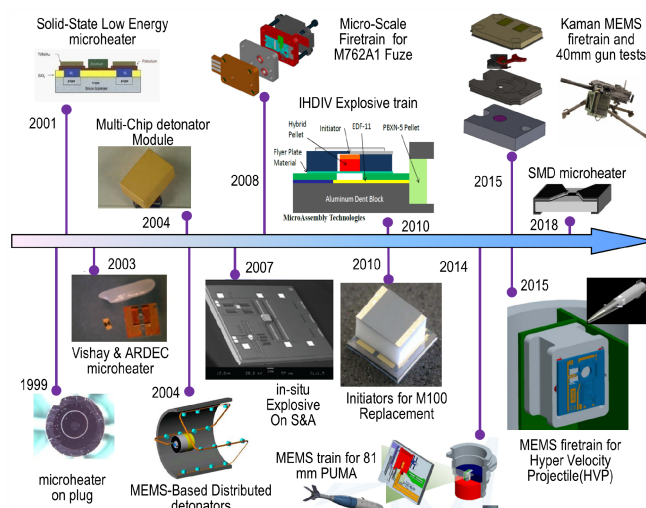


Reviews

Review on Micro Fire-train based on Flyer Impact Initiation

LIU Wei, CHU En-yi, LIU Lan, REN Xiao-ming, XIE Rui-zhen, REN Wei, LI Jiao

P606 ★ The micro fire-train based on initiation detonation mechanism of the flyer impacting the secondary explosive is a kind of system-level MEMS initiator. The state-of-art of the micro fire-train was reviewed from five aspects, including micro-heater design and energy control, detonation energy propagation control and device, energy transmission and control, micro fire-train design and integration, and reliability evaluation of the fire-train. Based on the analysis of the micro fire-train, some suggestions were proposed.



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