

Synthesis, Properties and Applications of Ammonium Dinitramide

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Abstract: Ammonium dinitramide (ADN) has been proved to be a very promising oxidizer in propellant, and has caused people extra attentions in the field of high energy density materials. In this paper, synthesis, properties and application of ADN in propellants are reviewed and discussed in some detail. The data in literature show that ADN possesses advantages of high energy, low signature, and friendly to environment. In comparison with the flake ADN, the prilled ADN is much better in some aspects, such as thermal stability, hygroscopicity and mechanical sensitivity.

Key words: organic chemistry; review; ammonium dinitramide; energetic oxidizer; propellant

* 资料编译 *

纳米铝粉对 RDX、PBX 和 TNT 为基炸药爆轰性能的影响

法国的 French Ministry of Defense 采用传统的速度测量技术研究了含纳米铝粉 RDX/AP 复合炸药的爆轰性能, 且将其与含微米铝粉炸药的爆轰性能进行了比较^[1]。他们还利用传统的压力测量技术进行了空气冲击波实验。通过对含有 100 nm 铝粉和 5 μm 铝粉的 RDX/AP 复合物的感度评估, 他们认为: 在弹道效应、冲击波效应和水下实验效应三方面有所改进; 落锤感度实验证明, 含 100 nm 铝粉的 RDX/AP/Al 复合物感度更高; 含 25% 的 100 nm 铝粉的复合物的爆速略有降低, 而含有较少 100 nm 铝粉的复合物的爆速呈上升趋势。对于含有纳米铝粉的给定复合物, 爆轰曲线的曲率随着纳米铝粉含量的增加而增加。将 LiF 替换为铝粉, 并且将含有惰性 LiF 添加剂的给定复合物作为参照对比, 含铝复合物爆轰曲线的曲率与爆轰前沿中铝的氧化速率有关。铝粒子的直径越小, 爆轰产物的温度越高, 铝粉的氧化速率也越高。

加拿大的 Defense Research Establishment 和 Defense Science and Technology Organization 组织合作评估了含有纳米铝粉的炸药复合物的潜在威力^[2]。他们对添加纳米铝粉和微米铝粉的各种塑料粘结炸药 (PBX) 和 TNT 为基炸药配方的爆轰性能进行了研究, 通过测试爆速、钢板爆痕深度实验、以及测爆热和放出气体组成的爆炸量热实验来表征炸药的爆轰性能。该项研究还通过空中爆炸实验来评估在远声场中能量释放的差异。对于 PBX 炸药, 在含有微米铝粉和纳米铝粉时, 没有观测到很大的差异。对于含 TNT 和 Al 的混合炸药, 用纳米铝粉, 爆速明显提高, 钢板爆痕深度增大, 而爆炸量热实验几乎没有测得多余的能量释放。为了解释这种情况, 他们测试了不同铝粉填充量、各种直径的炸药样品, 结果显示, 添加铝粉时, TNT/Al 混合炸药的临界直径减小, 可见装药直径对性能有一定的影响。TNT 和 Al 混合炸药进一步的水箱实验证实了这个现象。

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(高晓敏, 张光全, 李秉仁编译)
