

# Recent Progress on the Preparation Methods and Properties of Nano-energetic Composites

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## Abstract

Nano-energetic composites offer the potential of extremely high rates of heat release, substantial combustion efficiency, regulating energy release efficiency and pronounced decrease of sensitivity. In this paper, in order to explore recent progress in nano-energetic composites, a review on the preparation method including electro spray method, sol-gel method, spray drying method, solution method and some other methods were investigated and compared. What's more, nano-energetic composites and their properties and sensitivity were summarized. Finally, based on research in recent five years, the development direction and problems that need attention of nano-energetic composites were proposed.

## Preparation method of nano energetic compound

### Electrospray method

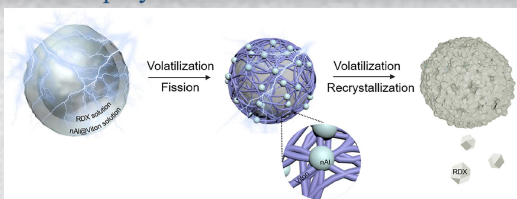


Fig.1 Preparation of nAl@RDX@Viton composites

### Sol-gel method

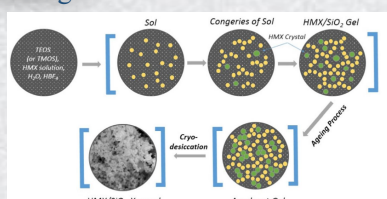


Fig.2 Preparation of HMX/SiO<sub>2</sub> nanocomposite with sol-gel method

### Other methods

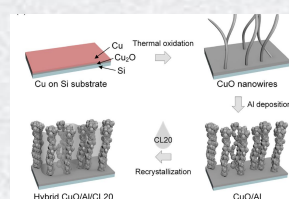


Fig.6 CuO/Al/CL-20 nanoenergetic composite arrays

### Solution method

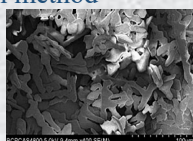


Fig.3 Cellulose/RDX composite aerogel

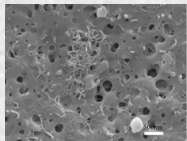


Fig.4 CL-20/CNT; and f CL-20/rGO + CNT

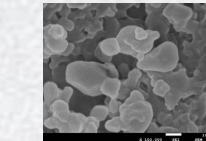
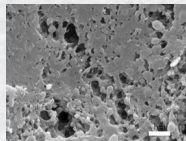


Fig.5 RDX/PMMA nano-composites

## Properties of nano-energetic composites

At present, researchers are devoting to reduce the sensitivity of energetic materials by common methods such as ultrafine processing, spheroidization, and composite technology. However, only one or two of the above ways have been reported, and the obtained sensitivity was unsatisfactory.

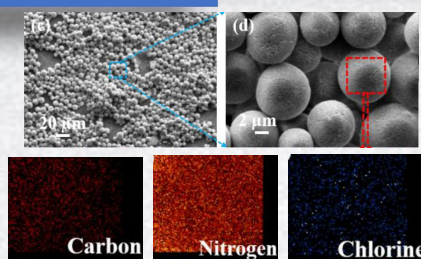


Fig.7 Micro-sized spherical CL-20/PNCB composite and EDX maps of the C, N, Cl distribution.

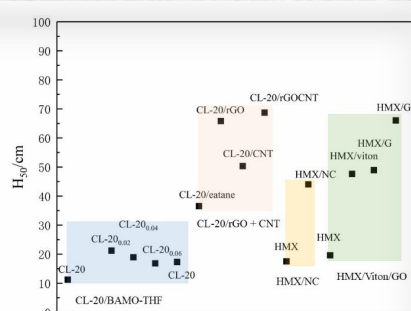


Fig.8 H<sub>50</sub> of the nano-energy composites

## Conclusions

The study of nano-energetic composites should pay more attention to problems in the three following three aspects.

1. Strengthen the research on the basic characteristics of nano-energy composite materials, pay attention to the improvement of the safety performance of materials and design materials with higher energy and maintaining the safety at the same time.

2. At the micro and nano scale, attach importance to the surface interface and reaction mechanism of materials and explosive components. Use simulation methods to design optimal parameters suitable for nano-energetic composite materials to improve the overall performance of the system.

3. Through the method of material modification and material combination, the reaction energy and safety of the material system are further improved. While focusing on scientific research, it also of great significance on the material's scale-up production capacity, so that nano-energy composite materials can be used in explosives and propellants systems.