南京理工大学

NANJING UNIVERSITY OF SCIENCE & TECHNOLOGY
200 Xiaolingwei Street, Nanjing 210094
P.R.China

Feedback from a foreign scientific consultant, professor of the Nanjing University of Science and Technology (China) Ruiqi Shen, on the dissertation of Zh. Yelemessova, doctoral candidate of the specialty 6D073400 – Chemical technology of explosives and pyrotechnic products on the topic of "New nano metal-organic framework energy materials for pyrotechnics"

Currently, metal–organic frameworks (MOFs) have attracted great attention due to their intriguing molecular topologies and potential applications in chemical separation, gas storage, drug delivery, catalysis, chemical sensor technology etc. Particularly, MOFs could also be potential energetic materials because of their high densities and high detonation heats. The porous crystalline structure attracts attention due to its high specific surface characteristics and the possibility of changing their physicochemical properties by introducing metal centers.

However, the process for preparing the bulk polymers is expensive and multistage. Therefore, the search and study of new, less harmful and more high-energy materials is an important task. In this connection, it is of interest to search for alternative methods for obtaining bulk materials, one of which are structures based on graphene oxide frameworks and activated carbon (AC) materials. The growing popularity of multilayer graphene's is due to the uniqueness of their physical and chemical properties. A promising, simple and cost-effective method is the production of activated carbon materials based on plant wastes such as rice husk.

The PhD student, Zh. Yelemessova investigated the burning rate enhancement mechanism by AC using thermal analysis (DTA-TG). Under the effect of AC-CuO, the behavior of AN/Mg/NC mixture decomposition changed from the three–stage character into two–stage. After AC–CuO adding, the heat release was increased from 1.2 to 7.2 mW. The addition of AC in energetic mixture shifts exothermic peaks to low temperatures side and decrease the onset decomposition temperature in range from 262 to 209°C. The activation energy E_a for the AN/Mg/NC composite, determined by the Kissinger DSC-TG method, was about 90.1 kJ/mol with a pre-exponential coefficient A of 1.5 × 10.9, while Ea for AN/Mg/NC/C was about 82.9 kJ / mol with A 1.6 × 10.9. In the presence of an AC-CuO additive, the value of E_a decreased by 2 kJ/mol. In particular, the E_a of decomposition of AN/Mg/NC by AC-CuO was 81.5 kJ/mol, which was very close to the value for the AN/Mg/NC/C composite. The addition of AC and AC-CuO can lower the energy barrier of thermal decomposition of the AN/Mg/NC composite by more than 8 kJ/mol.

The research work of Zh. Yelemessova in terms of relevance, scientific level, novelty, significance of the results and the total volume of research, meets all the criteria for PhD dissertations and can be recommended for defense in the dissertation council by the specialty 6D073400 – "Chemical technology of explosives and pyrotechnics"

Truly yours,

11 NOV 2019

Ruiqi SHEN
Professor, Ph.D.
Deputy Dean of School of Chemical Engineering
Nanjing Univeristy of Science and Technology
200 Xiaolingwei, Xuanwu District, Nanjing 210094, Jiangsu Province, China
Phone: +86-25-84315076
E-mail: rqshen@njust.edu.cn