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FROM THE EDITOR

Energetic materials derived from heterocycles

Due to the high energy content in a unit of volume, energetic materials are widely used in military munitions, for mining of minerals, in construction industry, in metal processing, pyrotechnics, as well as in aerospace technology. The majority of energetic materials typically include several components, which can be formally classified as oxidizers, fuels, binders, catalysts, and technological additives. Depending on the ratio of carbon, hydrogen, nitrogen, and oxygen atoms in the molecule, energetic compounds can play the role of oxidizer or fuel, or function as monopropellants at a balanced oxygen content (intramolecular oxidation of all hydrogen atoms to H_2O, and carbon atoms to CO_2). For stoichiometrically balanced mixtures, the weight percent of oxidizer is typically from 70 to 95%. The properties of oxidizer, especially the enthalpy of formation, have a dominant effect on the energetic capabilities of the system, compared to the properties of other components. Nevertheless, all components of composite energetic materials are important and each must perform well in its role. By replacing components, their number and proportions in the composition, specialists achieve the desired effect, producing explosive compositions, rocket propellants, fireworks, etc.

Traditionally, the solution of a new technical problem realized with the using of energetic material requires the selection of energetic and auxiliary components that possess the necessary set of properties. Obviously, the more such compounds are synthesized and investigated, and the more diverse and wider the range of measured properties, the more likely that this problem will be successfully solved. Moreover, the possibility of solving certain technical challenges appears only as a result of the synthesis of compounds with an unusual set of properties that was not previously encountered. When gathering the information about new energetic compounds, it is highly important to accurately determine their experimental characteristics (first of all, the enthalpy of formation), since computationally estimated properties are often quite far from the actual values.

Energetic materials are substantially different from natural fuels. First of all, they can produce energy without consuming air oxygen, and are instead oxidized in intra- and intermolecular redox reactions with oxygen (fluorine, chlorine, etc.) that is part of their structure. Second, such materials exhibit an unusually wide range of possible rates of transformation. For example, the detonation of an explosive may be complete in as little as 10^{-5} s. Multiton blocks of rocket propellant burn in propulsion system in a few tens of seconds. In contrast, in a special source of current, the reaction between energetic components lasts for hours. Thirdly, the power generated by the energetic system can range from millions of kilowatts to a part of watt. Fourth, it is possible to adjust the composition and volume of gaseous and condensed products created in the combustion (or explosion) of energetic materials. These remarkable advantages continue to attract the attention of researchers, providing further development of the energetic materials science.

Despite the more than hundred years of search for new energetic compounds, their range is not large. Energetic compounds must meet many strict requirements, which are often contradictory. Recently, environmental requirements are also imposed on energetic compositions. Satisfying all requirements is exstremely difficult, and maybe not possible. All of the currently used energetic compounds also have drawbacks. This forces the leading world countries to invest in the search for new and more advanced components for energetic materials. It is also important to further optimize the processes used for the synthesis of known energetic compounds, in order to reduce the risks of manufacturing, to simplify and streamline the relevant industrial technologies.

It should be noted that in this field of research not all results obtained are published in open literature. Nevertheless, even a survey of the openly available sources show the increasing role of heterocyclic motifs as building blocks used in the design of new energetic compounds. This thematic issue of "Chemistry of Heterocyclic Compounds" contains papers and reviews covering various types of energetic heterocyclic compounds, procedures for their synthesis, as well as theoretical and experimental evaluation of their properties.

Hopefully, the combined efforts of authors, reviewers, and the members of editorial team have resulted in the preparation of valuable material, and this thematic issue will be interesting and useful both for the specialists in the field of energetic compounds and for those who are involved in studying other aspects of chemistry and the application of heterocycles.

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