含能快递

DOI: 10.3969/j.issn.1006-9941.2013.03.026

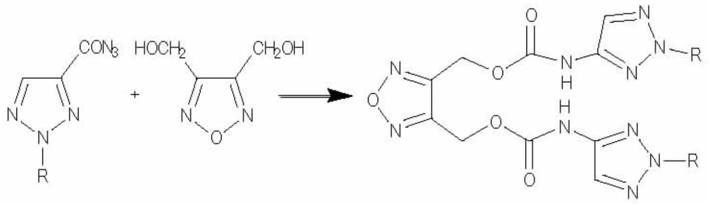
A brief review of publications of Russian scientists on energy materials and processes. Part 2.

Chemistry of Heterocyclic Compounds, **2011**, 47, N 4, 456-463
Published in Russian in *Khimiya Geterotsiklicheskikh Soedinenii*, 2011, N 4, pp. 557–565
Cite this: ***Chem. Heterocycl. Comps.***, 2011, **47**, 456-463 | DOI: 10.1007/s10593-011-0781-5

The Curtius Reaction in the Synthesis of Noncondensed Polynuclear Azoles

L.I. Vereshchagin, T.V. Golobokova, F.A. Pokatilov, A.G. Proidakov, O.N. Verkhozina, A.I. Smirnov, V.N. Kizhnyaev

Polynuclear linear systems in which the 1,2,3-triazole and furazan rings are bound by urethane or carbamide moieties have been synthesized by the reaction of 1,2,3-triazole carboxylic acid azides with hydroxymethyl azoles.

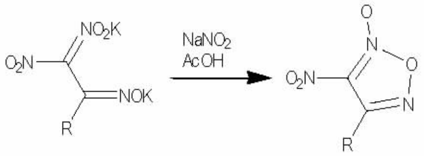


Russian Chemical Bulletin, **2011**, 60, N 5, 855-860
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 5, pp. 835–840
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 855-860 | DOI: 10.1007/s11172-011-0134-7

A Study of the Reaction Mechanism of 3-Nitro-4-R-furoxans Formation by Nitrosation of Dipotassium Salts of 1-Hydroxyimino-2,2-dinitro-1-R-ethanes

I. V. Ovchinnikov, Yu. A. Strelenko, N. A. Popov, A. O. Finogenov, and N. N. Makhova

The mechanism for the furoxan ring formation at the nitrosation of dipotassium salts of 1-hydroxyimino-2,2-dinitro-1-R-ethanes with NaNO$_2$/AcOH was confirmed experimentally by determining the ionization constants of the dinitromethyl and oxime fragments in the precursor and by ^{1}H, ^{13}C, ^{14}N, and ^{15}N NMR and MS of isomeric 3(4)-nitro-4(3)-R-furoxans with ^{15}N-labeled N(5) and N(2) ring atoms.

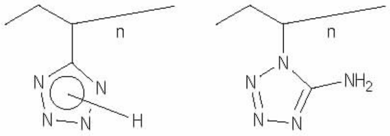


Russian Journal of Applied Chemistry, **2011**, 84, N 3, 497-503
Published in Russian in *Zhurnal Prikladnoi Khimii*, 2011, vol. 84, N 3, pp. 506–512
Cite this: ***Russ. J. Appl. Chem.***, 2011, **84**, 497-503 | DOI: 10.1134/S1070427211030281

Sorption Recovery of Mercury from Solutions with Vinyltetrazole (Co)polymers

V.A. Kruglova, L.P. Shaulina, V.N. Kizhnyaev, V.V. Annenkov

Sorption properties of homo- and copolymers based on 1- and 5-vinyltetrazoles in recovery of mercury(II) ions from acidic and neutral aqueous media under static conditions are described.

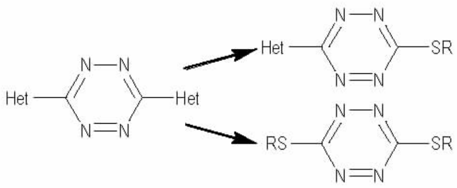


Russian Chemical Bulletin, **2011**, 60, N 5, 985-991
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*, 2011, No. 5, pp. 961–967
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 985-991 | DOI: 10.1007/s11172-011-0155-2

Reactions of 1,2,4,5-Tetrazines with *S*-nucleophiles

S. G. Tolshchina, R. I. Ishmetova, N. K. Ignatenko, A. V. Korotina, I. N. Ganebnykh, V. A. Ol'shevskaya, V. N. Kalinin, and G. L. Rusinov

The reactions of 1,2,4,5-tetrazines and azoloannulated 1,2,4,5-tetrazines containing heterocyclic leaving groups with S-nucleophiles were studied. It was established that instead of the leaving group replacement at the tetrazine ring, the attack of S-nucleophile at the unsubstituted carbon atom of imidazole subring occurs in the case of imidazo[1,2_*b*][1,2,4,5]tetrazines to form unusual products of nucleophilic substitution of the hydrogen atom.

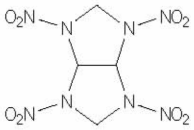


Russian Chemical Bulletin, **2011**, 60, N 6, 1138-1143
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*, 2011, No. 6, pp. 1113–1118
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1138-1143 | DOI: 10.1007/s11172-011-0178-8

Thermal Decomposition of *cis*-2,4,6,8-Tetranitro-1*H*,5*H*-2,4,6,8-tetraazabicyclo[3.3.0]octane

T. K. Goncharov, V. V. Dubikhin, G. M. Nazin, V. G. Prokudin, and Z. G. Aliev

The kinetics of *cis*-2,4,6,8-tetranitro-1*H*,5*H*-2,4,6,8-tetraazabicyclo[3.3.0]octane thermal decomposition was measured in various solvents and in the solid state by the manometric method. A correlation of the decomposition rate constants with N-N bond lengths in a set of secondary nitramines was analyzed.

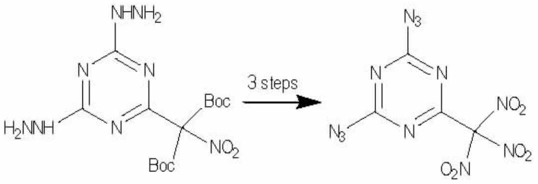


Russian Chemical Bulletin, **2011**, 60, N 6, 1220-1222
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*, 2011, No. 6, pp. 1194–1196
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1220-1222 | DOI: 10.1007/s11172-011-0191-y

A New Method for the Synthesis of 2,4-Diazido-6-trinitromethyl-1,3,5-triazine

A. V. Shastin, T. I. Godovikova, and B. L. Korsunskii

A new method for the synthesis of 2,4-diazido-6-trinitromethyl-1,3,5-triazine was described. The three steps method started with not dangerous precursor.

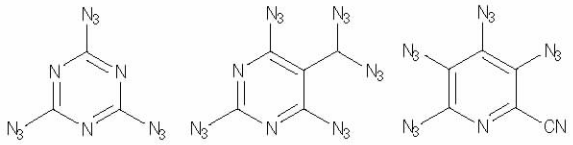


Russian Chemical Bulletin, **2011**, 60, N 7, 1274-1285
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 7, pp. 1250–1261
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1274-1285 | DOI: 10.1007/s11172-011-0195-7

Aromatic Polyazides and High-spin Nitrenes

S. V. Chapyshev

The review summarizes the results of recent studies of aromatic polyazides and high-spin nitrenes carried out at the Institute of Problems of Chemical Physics, Russian Academy of Sciences.



Russian Chemical Bulletin, **2011**, 60, N 7, 1301-1317
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 7, pp. 1278–1294
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1301-1317 | DOI: 10.1007/s11172-011-0198-4

Filtration Combustion of Solid Fuel in Countercurrent Reactions

G. B. Manelis, S. V. Glazov, D. B. Lempert and E. A. Salgansky

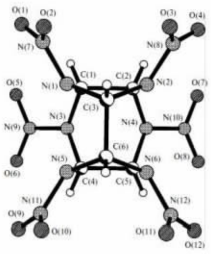
Data on filtration combustion of solid fuels in the countercurrent mode are reviewed. The phenomenon of super adiabatic overheating is described. The data of experimental and theoretical studies and some results of the development of technological processes of production of thermal or electric energy from substandard raw materials and extraction of valuable components (for example, rare metals) from unconventional sources (industrial wastes, poor ores, burrows, *etc.*) are presented. The processes of safe treatment of problematic wastes are considered.

Russian Chemical Bulletin, **2011**, 60, N 7, 1394-1400
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 7, pp. 1372–1378
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1394-1400 | DOI: 10.1007/s11172-011-0209-5

New Conformer of 2,4,6,8,10,12-Hexanitro-2,4,6,8,10,12-hexaazaisowurtzitane (CL-20). Crystal and Molecular Structures of the CL-20 Solvate with Glyceryl Triacetate

S. M. Aldoshin, Z. G. Aliev, T. K. Goncharov, D. V. Korchagin, Yu. M. Milekhin and N. I. Shishov

Crystallization of CL-20 in different plasticizers (gyceryl triacetate and diethyleneglycol dinitrate) was studied. IR spectra of the crystals obtained under various conditions, as a rule, do not correspond to the spectra of known modifications. Crystal and molecular structures of the CL-20 solvate with glyceryl triacetate were studied. A new stable conformer of the CL-20 molecule was discovered.

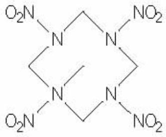


Russian Chemical Bulletin, **2011**, 60, N 7, 1436-1439
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 7, pp. 1413–1416
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1436-1439 | DOI: 10.1007/s11172-011-0214-8

Kinetics of the $\beta \to \delta$ Structural Reorganization in 1,3,5,7-Tetranitrooctahydro-1,3,5,7-tetrazocine

V. V. Zakharov and B. L. Korsunskii

Kinetics of the $\beta \to \delta$ thermal phase transition in the polycrystalline mono- and polydispersed samples of 1,3,5,7-tetranitrooctahydro-1,3,5,7-tetrazocine (octogen, HMX) was studied by the isothermal calorimetry. Effects of different factors on the transition kinetics were investigated.



Russian Chemical Bulletin, **2011**, 60, N 7, 1440-1447
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 7, pp. 1417–1424
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1440-1447 | DOI: 10.1007/s11172-011-0215-7

Models for Unimolecular Reactions in the Solid Phase and Stability Prediction of Energetic Compounds in the Condensed State

G. B. Manelis, G. M. Nazin and V. G. Prokudin

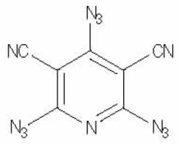
The results of analysis and refinement of phenomenological models for unimolecular reactions proceeding homogeneously in the bulk of undistorted crystal lattice or localized on the lattice defects are presented. It is shown that, within the framework of these models, the ratio of the rate constants for reactions in the liquid and solid phases, $K = k_l/k_s$, can be calculated with satisfactory accuracy and thus the known k_l values can be used to predict the rate constant k_s characterizing the stability of the materials.

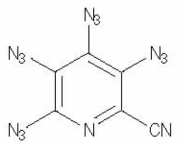
Russian Journal of Physical Chemistry B, *Focus on Physics*, **2011**, 5, N 2, 244-249
Published in Russian in *Khimicheskaya Fisika*, 2011, vol. 30, No. 3, pp. 57–62
Cite this: ***Russ.J. Phys. Chem. B,*** 2011, **5**, 244-249 | DOI: 10.1134/S1990793111020229

The Thermal Decomposition of Azidopyridines

V.V. Nedel'ko, B.L. Korsunskii, T.S. Larikova, Yu.M. Mikhailov, S.V. Chapyshev, and N.V. Chukanov

The thermal decomposition of 2,6-diazido-3,5-dicyanopyridine, 2,4,6-triazido-3,5-dicyanopyridine, and 2,3,4,5-tetraazido-6-cyanopyridine was studied by thermogravimetry, volumetry, mass-spectrometry, and IR spectroscopy. Reaction kinetic parameters were determined. The only gaseous product at the thermal decomposition of all these azides was nitrogen, its purity was 99.0–99.8 vol %.





A brief review of publications of Russian scientists on energy materials and processes.

Mendeleev Communications, **2011**, 21, N 3, 115-121

Cite this: ***Mendeleev Commun.***, 2011, **21**, 115-121 | DOI: 10.1016/j.mencom.2011.04.001

Reactions of Anodic and Chemical Aromatic Substitution

Author: V. A. Petrosyan

Review. Among anodic (electro-oxidative) aromatic substitution reactions there is a specific group of reactions involving direct nucleophilic replacement of hydrogen atom at the aromatic ring, or S_N^H(An) reactions. These reactions occurring *via* an intermediate σ+ complex represent a versatile type (the hydrogen atom that is easily removed as a proton) of S_N^H reactions, on the one hand, and are somewhat similar to aromatic electrophilic substitutions, on the other hand.

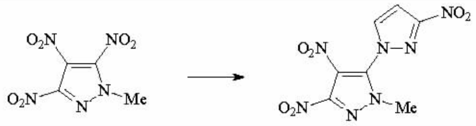
Mendeleev Communications, **2011**, 21, N 3, 149-150

Cite this: ***Mendeleev Commun.***, 2011, **21**, 149-150 | DOI: 10.1016/j.mencom.2011.04.012

Nucleophilic Substitution in 1-Methyl-3,4,5-trinitro-1*H*-pyrazole

Authors: I. L. Dalinger, I. A. Vatsadze, T. K. Shkineva, G. P. Popova, and S. A. Shevelev

1-Methyl-3,4,5-trinitropyrazole in reaction with thiols, phenols, oximes, ammonia, amines and NH-azoles gives substitution products of the 5-positioned nitro group.



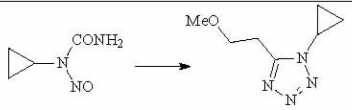
Mendeleev Communications, **2011**, 21, N 6, 302-304

Cite this: ***Mendeleev Commun.***, 2011, **21**, 302-304 | DOI: 10.1016/j.mencom.2011.11.002

Formation of Tetrazoles on Diazocyclopropane Generation

Authors: Y. V. Tomilov, I. V. Kostyuchenko, A. I. Novichkov, and E. V. Shulishov

Decomposition of *N*-cyclopropyl-*N*-nitrosourea with bases in the absence of agents for trapping of diazocyclopropane and cyclopropyldiazonium leads to 1,5- and 2,5-disubstituted tetrazoles.



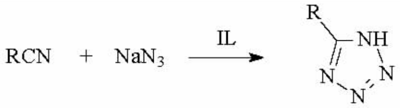
Mendeleev Communications, **2011**, 21, N 6, 334-336

Cite this: ***Mendeleev Commun.***, 2011, **21**, 334-336 | DOI: 10.1016/j.mencom.2011.11.014

Ionic Liquid-assisted Synthesis of 5-Mono- and 1,5-Disubstituted Tetrazoles

Authors: M. A. Epishina, A. S. Kulikov, N. V. Ignat'ev, M. Schulte, and N. N. Makhova

Reaction of aliphatic and (het)aromatic nitriles with NaN3 or activated nitriles with organic azides in ionic liquids (IL's) affords the corresponding 5-mono- and 1,5-disubstituted tetrazoles. IL is a reaction medium and a catalyst.



Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 9, 1933-1939
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 2, pp. 327–331
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1933-1939 | DOI: 10.1007/s11172-011-0291-8

Synthesis and Physicochemical Properties of Polyurethane Block Copolymers and Their Compositions with Plasticizers

Authors: Yu. M. Mikhailov, L. V. Ganina, V. V. Tereshatov, E. R. Badamshina, V. S. Smirnov, Yu. B. Kalmykov, Yu. M. Lotmentsev

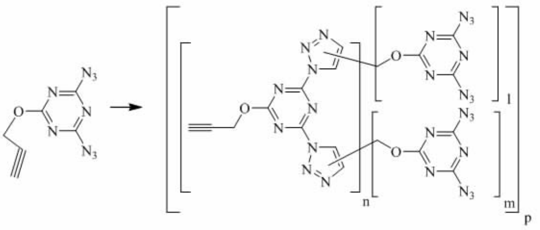
The synthesis of polyurethane copolymers based on oligoester diols, *viz.*, oligo-3,3'-bis(azidomethyl)oxetanediol and oligo-3-azidomethyl-3'-methyloxetanediol, and 4,4'-methylene-bis(phenylisocyanate) and various chain elongating agents was studied. A set of rheological and physicomechanical properties of the initial and plasticized copolymers was studied. Regularities of their deformation behavior were established. The process of mutual solubility was studied by the microinterference method for a wide range of systems block copolymers—plasticizers. On the basis of the data obtained, the phase diagrams were constructed for limitedly compatible systems.

Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 9, 1940-1943
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 9, pp. 1907–1910
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1940-1943 | DOI: 10.1007/s11172-011-0292-7

New Polynitrogen Hyperblanched Polymers

Authors: G. V. Malkov, A. V. Shastin, Ya. I. Estrin, E. R. Badamshina, and Yu. M. Mikhailov

The method for the preparation of new polynitrogen hyperbranched polymers of heterocyclic series was developed involving polymerization of monomeric 2,4-diazido-6-propynyloxy-1,3,5-triazine by 1,3-dipolar cycloaddition. Kinetics of the diazido acetylene monomer polymerization was compared with the kinetic data of polymerization of related compound, 2-azido-4,6-bis(propynyloxy)-1,3,5-triazine. Properties of hyperbranched poly(1,2,3-triazole-1,3,5-triazine)s with terminal azido groups and terminal triple bonds were compared.

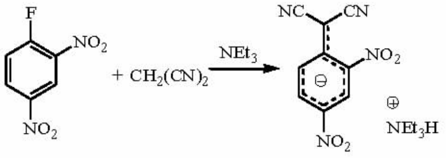


Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 10, 1995-1998
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 10, pp. 1960–1963
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 1995-1998 | DOI: 10.1007/s11172-011-0302-9

Triethylamine-assisted Reaction between 2,4-Dinitrofluorobenzene and Malononitrile

Authors: I. R. Golding, Z. A. Starikova, N. G. Senchenya, P. V. Petrovskii, I. A. Garbuzova, and Yu. G. Gololobov

The reaction of malononitrile with 2,4-dinitrofluorobenzene in the presence of triethylamine on silicon dioxide affords the triethylammonium salt of 2,4-dinitrophenylmalononitrile along with the related salt containing hexafluorosilicate anion.

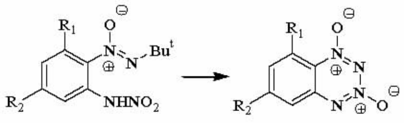


Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 10, 2040-2045
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 10, pp. 2003–2008
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 2040-2045 | DOI: 10.1007/s11172-011-0310-9

Generation of Oxodiazonium ions 2. Synthesis of Benzotetrazine-1,3-dioxides from 2-(*tert*-butyl-*NNO*-azoxy)-*N*-nitroanilines

Authors: M. S. Klenov, V. P. Zelenov, A. M. Churakov, Yu. A. Strelenko, and V. A. Tartakovsky

A new method for benzotetrazine-1,3-dioxides synthesis was developed, based on the reaction of 2-(*tert*-butyl-NNO-azoxy)-N-nitroanilines with Ac_2O/H_2SO_4. This method was also used for the synthesis of [1,2,5]oxadiazolo[3,4-c]cinnoline-5-oxide from 3-nitramino-4-phenylfurazan. The suggested mechanism of these reactions involves the formation of an oxodiazonium ion intermediate, resulting from *O*-acetylation of the nitramine group, followed by protonation and ionic dissociation. Then the oxodiazonium ion enters the intramolecular reaction with *tert*-butyl-NNO-azoxy or phenyl groups above heterocyclic systems have been obtained.

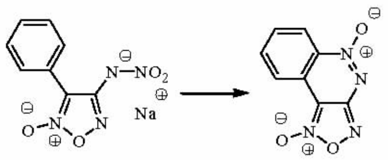


Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 10, 2046-2050
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 10, pp. 2009–2013
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 2046-2050 | DOI: 10.1007/s11172-011-0311-8

Generation of Oxodiazonium Ions. 3. Synthesis of [1,2,5]Oxadiazolo[3,4-c]cinnoline-1,5-dioxides

Authors: V. P. Zelenov, A. A. Voronin, A. M. Churakov, M. S. Klenov, Yu. A. Strelenko, and V. A. Tartakovsky

A reaction of 4-(*N*-nitramino)-3-phenylfuroxan with the Ac_2O/H_2SO_4 leads to formation of [1,2,5]oxadiazolo[3,4-*c*]cinnoline-1,5-dioxide. The reaction presumably proceeds through an oxodiazonium cation [N=N=O]+. Furoxanocinnoline was also prepared at reaction of the 4-(*N*-nitramino)-3-phenylfuroxan *O*-methyl derivative with H_2SO_4. 7-Nitro derivative is formed when furoxanocinnoline is nitrated with HNO_3/H_2SO_4 mixture.

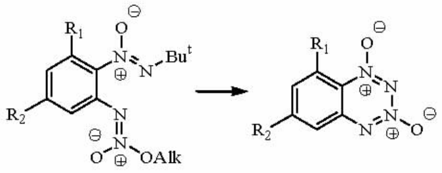


Russian Chemical Bulletin, Int. Ed., **2011**, 60, N 10, 2051-2056
Published in Russian in *Izvestiya Akademii Nauk. Seriya Khimicheskaya*,2011, No. 10, pp. 2014–2019
Cite this: ***Russ. Chem. Bull.***, 2011, **60**, 2051-2056 | DOI: 10.1007/s11172-011-0312-7

Generation of Oxodiazonium Ions. 4. Nitramine *O*-alkyl Derivatives in the Synthesis of Benzotetrazine-1,3-dioxides

Authors: M. S. Klenov, A. M. Churakov, Yu. A. Strelenko, and V. A. Tartakovsky

A new method for the synthesis of benzotetrazine-1,3-dioxides was developed from the 2-(*tert*-butyl-*NNO*-azoxy)-*N*-nitroaniline *O*-alkyl derivatives upon the action of strong acids. A mechanism suggested for these reactions includes transformation of the N=N(O)OR group to the oxodiazonium ion (N=N=O)+, which intramolecularly reacts with the neighboring *tert*-butyl-*NNO*-azoxy group, furnishing the tetrazine-1,3-dioxide ring.



（以上信息由俄罗斯 N. D. Zelinsky Institute of Organic Chemistry 的 Aleksei B. Sheremetev 博士供稿）

法开发低成本制备 TATB

2012 年，法国 CEA-Le Ripault 报道了一种低成本制备 TATB 的方法，他们采用三氯苯（TCB）为原料，在 DMSO 中与 MeONa 在 62 ℃反应 3 h 制得二氯苯甲醚（DCA）后经硝化再胺化制备 TATB，成本能节约 30%。以前也有文献报道 DCA 合成，反应温度为 120 ℃，反应时间 1 h，但所用溶剂具有致癌性，并且反应后产物处理困难。

（*Wuillaume A，Pasquinet E，Grech E，et al. Towards low-cost TATB-based formulations. Insensitive Munitions and Energetic Materials Technology Symposium，Las Vegas，NV May 14 –17，2012.*）

美 ATK 评估 TEX 作为下一代 IM 炸药组分可靠性

2012 年，美国 ATK 对 TEX 作为钝感炸药成分进行了全方位评估。以乙二醛和甲酰胺为原材料制备 TEX 无须特殊设备，安全可行，对环境不产生危害性的排放，是低成本、可放大制备的钝感炸药，目前已用 4 L 无盖的夹套反应釜进行小规模生成，同时对 TEX 进行相容性、感度、热稳定性、爆轰性能等评估，有理由认为 TEX 是下一代钝感弹药的炸药组分。

（*Steve Velarde，Gene Johnston，Aaron Bertholfl. Tex：a rational，next-generation IM explosive component. Insensitive Munitions and Energetic Materials Technology Symposium，Las Vegas，NV May 14 –17，2012.*）

法采用新工艺规模化制备高纯度 ADN

与肼相比，ADN 更稳定、无毒、对人和环境几乎无危害性，ADN 是一种绿色的氧化剂和炸药。EURENCO 从 2006 年开始研究高纯度 ADN 的制备，从实验室规模开始，经历小批量制备，到 2011 年已经达到了 10kg/day 的小规模生成。他们所制得的高纯度 ADN 已成功用于液体单基推进剂 LMP-1035。

（*Henrik Skifs，Helen Stenmark. New process for production of high purity ADN-development and scale-up. Insensitive Munitions and Energetic Materials Technology Symposium，Las Vegas，NV May 14 –17，2012.*）

法研制出能降低熔铸炸药加工粘度的高品质 NTO

近年，NTO 已经广泛用于熔铸炸药配方的装药。在熔铸炸药加工时，当普通标准的 NTO 含量超过 60% 时，熔融相的粘度都很高，不利于加工。2012 年，法国 SNPE 的附属单位 EURENCO 研制出一种高品质 NTO（他们命名为（NTO CF），当它用于熔铸炸药装药时能明显降低加工时的粘度，这种高品质的熔铸炸药也适用于 TNT 为基的熔铸炸药。

（*Eck G，Songy C，Minguet L. NTO insensitive compositions. Insensitive Munitions and Energetic Materials Technology Symposium，Las Vegas，NV May 14 –17，2012.*）

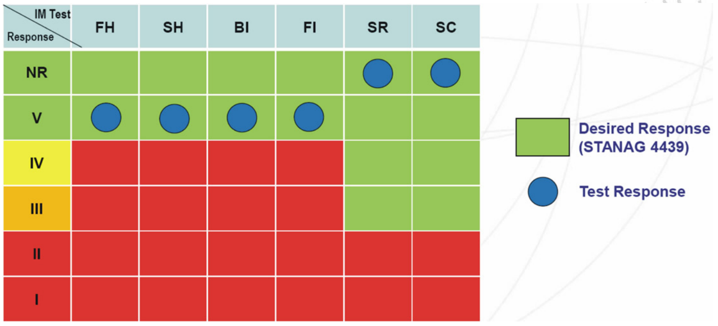
美评估用 DEMN 代替 Octol 炸药中 TNT 的可行性

Octol 是由 HMX 和 TNT 不同比例构成的熔铸炸药，然而这种炸药不能满足 IM 要求，为此美陆军正研制用 DEMN 代替其中的 TNT，设计了试验配方 DEMN-III J、DEMN-IX F 和 DEMN-IX H，装弹于 155 mm 口径 M795 和 120 mm 迫击炮对其进行 IM 评估，结果显示 6 种 IM 试验通过了 4 种。通过调整和配方优化以及添加其它高能炸药和蜡，得到了试验配方 ARLX-2106-B、ARLX-2107-A 和 ARLX-2107-B，初期放大到 1gal 的试验结果显示成分的相容性、三种感度（撞击、摩擦和静电）、真空安定性和加工安全性全都通过，大隔板试验的冲击波感度比 FGO（HMX/TNT =65/35）炸药分别降低 40%、54% 和 54%。三种配方的临界直径都比 Octol 大，爆速与 Octol 相当，爆压略低于 Octol，进一步的装弹 IM 试验将在初期评估试验后进行。

（*Neelam Mehta，Brian D. Roos，Eric J.，Assessment of DEMN based IM Formulations for Octol Replacement*［*C*］*// Insensitive Munitions and Energetic Materials Technology Symposium，Las Vegas，NV May 14 – 17，2012.*）

新加坡 **ST Kinetics** 有限公司研制 **40nm** 增强抗爆钝感弹药的新型装药

为了能研制出满足钝感性能要求的下一代 40 nm 增强抗爆弹药，新加坡 ST Kinetics 有限公司研制出压制配方 MX-09 来代替 Comp A5 配方。新配方的密度为 1.87 g · cm^{-3}，临界直径小于 5.3 mm，爆速达到了 7800 m · s^{-1}，可以不用改变加工工艺，直接取代 Comp A5 装药。这种新型装药的 40 nm 增强抗爆钝感弹药钝感测试如下图，快速烤燃（FH）、慢速烤燃（SH）、枪击试验（BI）、破片撞击试验（FI）、殉爆试验（SR）和聚能射流试验（SC）基本上都满足了 IM 的要求。



IM Test / Response	FH	SH	BI	FI	SR	SC
NR	🟩	🟩	🟩	🟩	🟩●	🟩●
V	🟩●	🟩●	🟩●	🟩●	🟩	🟩
IV	🟥	🟥	🟥	🟥	🟩	🟩
III	🟥	🟥	🟥	🟥	🟩	🟩
II	🟥	🟥	🟥	🟥	🟥	🟥
I	🟥	🟥	🟥	🟥	🟥	🟥

🟩 Desired Response (STANAG 4439)

● Test Response

(Aw Cheng Hok. 40mm enhanced blast insensitive explosive munitionscInsensitive Munitions and Energetic Materials Technology Symposium, Las Vegas, NV May 14 – 17, 2012.)

美 **ATK** 用温和的硝化方法制备如 **TEGDN**、**PETN**、**TMETN** 等常见硝酸酯化合物

近来，美国 ATK 报道一种用硝酸盐/硫酸的硝化试剂在最高反应温度为室温的温和条件下硝化多元醇烷烃化合物的新方法，得到如二缩三乙二醇二硝酸酯（TEGDN）、太安（PETN）、双甘油四硝酸酯（DGTN）、三羟甲基乙烷三硝酸酯（TMETN））、丁三醇三硝酸酯（BTTN）、丙三醇三硝酸酯（NG）等多元醇硝酸酯含能化合物。硝酸盐与硫酸的混合是温和的放热反应，有利于反应的控制，同时也限制了废物流中硝酸和硝酸酯产物的含量。该硝化方法不仅能用于大批次的连续工艺合成这些硝酸酯，还可能用于其它含能材料的硝化。

(Nicholas Straessler, Alexander Paraskos, Michael Kramer. Preparation of common nitrate esters by mild nitration of polyols[C]// Insensitive Munitions and Energetic Materials Technology Symposium, Las Vegas, NV May 14 – 17, 2012.)

美陆军研制出实验室规模表征含能含能材料爆轰性能的测试技术

当前，含能材料爆轰性能测试表征技术都采用飞片或水隔板试验，需要千克级含能材料。近来美陆军开发出一种只需要几克量级含能材料的实验室规模测试其爆轰性能的测试技术，他们根据能量转换原理、材料 Hugoniots 关系和经验关系，采用条纹相机捕获含能材料-空气界面处冲击波扩散速度，进而得到爆轰波性能数据和冲击波性能数据。通过与 35 种已知含能材料的历史数据对比，测试的误差在 3.5% 以内。该方法不仅测试成本低，而且测试只需要克量级含能材料，这样就可以避免为表征其爆轰性能参数需要的放大合成制备工艺。

(Matthew M. Biss. Removing Full-Scale Testing Barriers: A Fundamental Detonation Characterization Technique for Novel Energetic Formulations at the Laboratory Scale[C]// Insensitive Munitions and Energetic Materials Technology Symposium, Las Vegas, NV May 14 – 17, 2012.)

美陆军优化 **NTO** 工艺

NTO 是常用炸药之一，每年仅 IMX 配方就需要 2.1 M lbs 的 NTO，现在的造价是 $15/bl。为了降低 NTO 的成本，美国 Army research development and engineering command 对 NTO 的制备（包括重结晶）进行了优化，他们发现重结晶温度降到 5 ℃收率能提高 10% 而不会影响 NTO 的质量。

(Timothy E Dawag, Jacob Morris. Nitrotriazolone process optimization. Insensitive Munitions and Energetic Materials Technology Symposium, Las Vegas, NV May 14 – 17, 2012.)

（张光全　编译）