Окисляющие вещества

Технические характеристики

По вопросам продаж и поддержки обращайтесь:

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-4159
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

Россия +7(495)268-04-70 Казахстан +7(7172)727-132 Киргизия +996(312)96-26-47

Адрес: https://tci.nt-rt.ru/ || эл.почта: tic@nt-rt.ru

Oxidizing Agents

Oxidation, which makes its target substance lose electrons, is one of the most basic reactions in organic chemistry and is exemplified by the combination with oxygen or a dehydrogenation reaction. In particular, oxidizing agents have often been used for the transformation of alcohols to the corresponding aldehydes, ketones or carboxylic acids. Heavy metal compounds, such as chromium(VI) oxide and potassium permanganate, have been exploited for many years. Later, less harmful oxidizing agents without heavy metals were developed, such as Dess-Martin periodinane, the Mukaiyama oxidizing agent and oxoammonium salts. Moreover, oxidation reactions employing inexpensive cooxidants have been reported in the presence of oxidation catalysts like tetrapropylammonium perruthenate (= TPAP) and TEMPO. In this way, oxidation reactions involving organic compounds have great diversity, and many books on oxidation have been published.[1)]

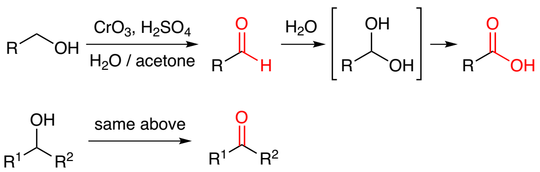
This brochure introduces a variety of oxidizing agents and catalysts for oxidation. We hope that it will be useful for your research in organic synthesis. In addition, we have prepared another brochure, “Reducing Agents”, which is the reverse reaction to oxidation.

Chromate Salts

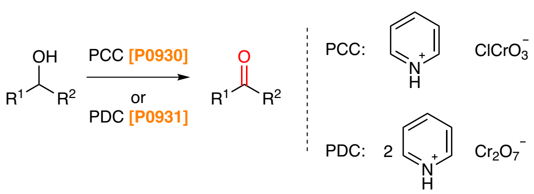
Jones *et al*. reported that a mixture of chromium oxide(VI) and diluted sulfuric acid was useful for the oxidation of alcohols, and this reaction is called Jones oxidation.[2)] It can convert primary and secondary alcohols into carboxylic acids and ketones, respectively. Since this report, chromium oxidants have been improved to develop the Sarett-Collins oxidation[3)] process using complex chromium(VI) oxide-2py, pyridinium chlorochromate (= PCC) **[P0930]**[4)] and pyridinium dichromate (= PDC) **[P0931]**.[5)] These reagents can oxidize primary alcohols to aldehydes without overreaction.

Caution: Chromium(VI) compounds and the chromium residue after the reaction are highly toxic, so they should be handled or discarded with consideration to the environment.

Jones oxidation

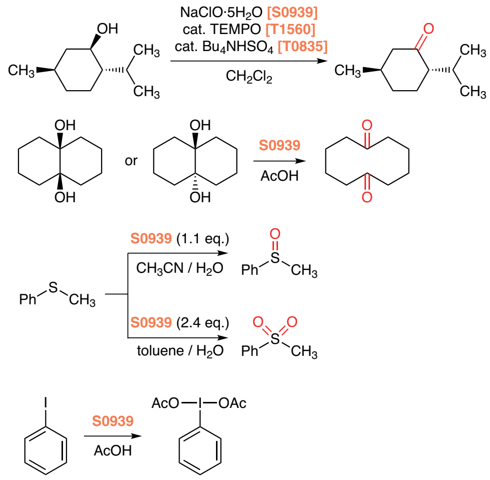


PCC and PDC oxidation



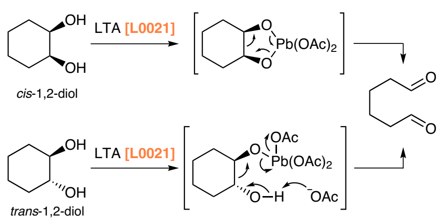
Sodium Hypochlorite

Sodium hypochlorite pentahydrate (= $NaClO·5H_2O$) **[S0939]** is a stable crystalline solid and effective for the oxidation of hydroxy and sulfide groups. For instance, **S0939** can oxidize secondary alcohols into ketones in the presence of a catalytic amount of TEMPO **[T1560]**.[6)] **S0939** is also utilized in the oxidative cleavage of 1,2-diols[7)] and oxidation of sulfides.[8)] Sulfoxides and sulfones can be synthesized in high yields by adjusting the equivalents of **S0939**. Furthermore, it has recently been reported that **S0939** is useful for the convenient synthesis of hypervalent iodine compounds.[9)]

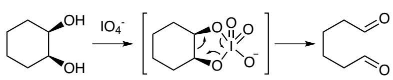


Criegee Oxidation

Criegee oxidation gives two ketones or aldehydes from 1,2-diols by using lead(IV) tetraacetate (= LTA) **[L0021]** as an oxidant.[10)] This reaction is different from the oxidative cleavage reaction using periodate salt (= Malprade reaction)[11)] and proceeds when applied to *trans*-1,2-diols, which would be difficult to pass through the five-membered intermediate. This indicates another reaction mechanism that does not pass through the cyclic transition state.

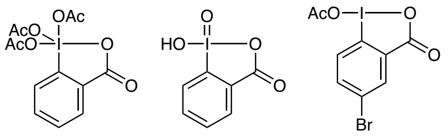


cf) Malaprade reaction

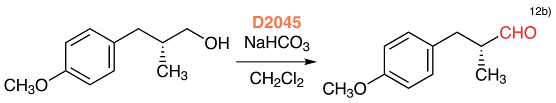


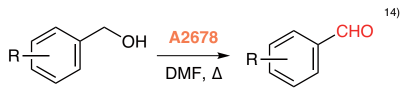
Oxidation using Hypervalent Iodine Compounds

Dess-Martin periodinane (= DMP)[12] [D2045] [D4477] can oxidize primary and secondary alcohols into aldehydes and ketones, respectively. DMP has some advantages compared with chromate(VI) compounds: the reaction using DMP proceeds under mild conditions; the generality of reactive substrates is wide; the environmental impact is lower; and the treatment after the reaction is easy. 2-Iodoxybenzoic acid (= IBX)[13] [I0791] and 1-acetoxy-5-bromo-1,2-benziodoxol-3(1*H*)-one (= ABBX)[14] [A2678], which was developed by Togo, are also utilized as oxidants of alcohols as well as other hypervalent iodine compounds.[15] These compounds are introduced in our brochure "Hypervalent Iodine Compounds".



DMP [D2045] [D4477] IBX [I0791] ABBX [A2678]

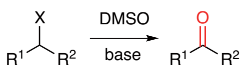




DMSO Oxidations and Odorless Swern Oxidants

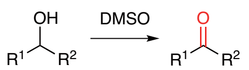
Kornblum *et al*. found that the carbonyl group was produced from benzyl halides and tosylates by the treatment of DMSO [D0798] in the presence of a base.[16] After this report, various types of oxidations using DMSO have been reported as follows: Pfitzner-Moffatt oxidation[17] using DCC [D0436]; Albright-Goldman oxidation[18] using acetic anhydride [A2036]; Parikh-Doering oxidation[19] using SO_3-pyridine complex [P0998]; and Swern oxidation[20] using oxalyl chloride [O0082]. These reactions are utilized widely from the laboratory scale to the industrial scale.

Kornbrum oxidation



X = halogen, TsO

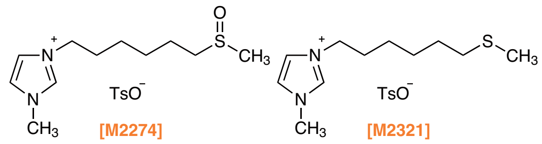
Various DMSO oxidations

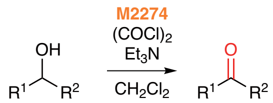


R^1 = alkyl, aryl
R^2 = H, alkyl, aryl

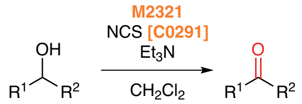
named reactions	reagents
Pfitzner-Moffatt oxid.	DCC [D0436] [D4876] TFA [T0431]
Albright-Goldman oxid.	Ac_2O [A2036]
Parikh-Doering oxid.	SO_3·py [P0998], Et_3N [T0424]
Swern oxid.	$(COCl)_2$ [O0082] or TFAA [T0433] Et_3N [T0424]

One problem with DMSO oxidation is the odor of the byproduct dimethyl sulfide. To solve this problem, Togo *et al*. developed the odorless and recyclable imidazolium salts [M2274] and [M2321] for use in Swern oxidation[21a)] and Corey-Kim oxidation,[21b)] respectively.





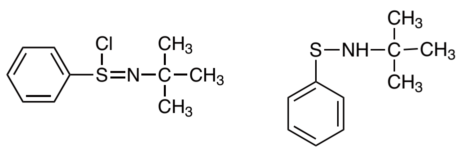
R^1 = alkyl, aryl
R^2 = H, alkyl, aryl



R^1 = alkyl, aryl
R^2 = H, alkyl, aryl

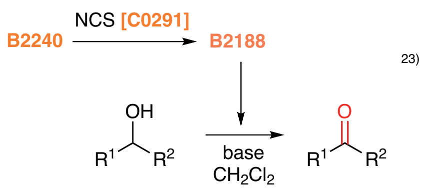
Mukaiyama Oxidation Reaction

Mukaiyama's group reported two new oxidation reactions using *N*-*tert*-butylbenzenesulfinimidoyl chloride [B2188],[22] and catalytic amounts of *N*-*tert*-butylbenzenesulfenamide [B2240] and NCS [C0291],[23] respectively. It is considered that B2188 is generated *in situ* by the reaction of B2240 and NCS, and turns into B2240 after the reaction; thus B2240 works as a catalyst. B2188 is a stable solid and can give α,β-unsaturated ketones from an enolate by deprotonation at the α-position or 1,4-addition.[24] In addition, the new method has been reported to afford a ketone from an aldehyde, an alkyllithium and B2188 in one pot.[25]



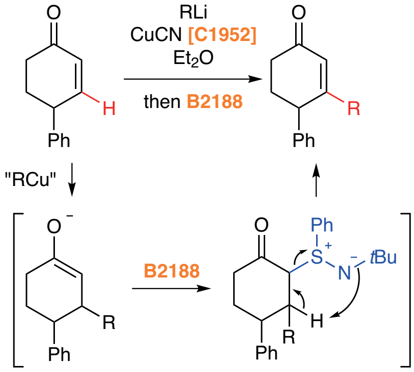
[B2188] [B2240]

Oxidation of alcohols



R^1 = alkyl, aryl
R^2 = H, alkyl, aryl

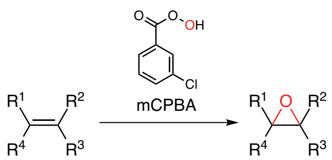
One-pot β-substitution of enones [24)]



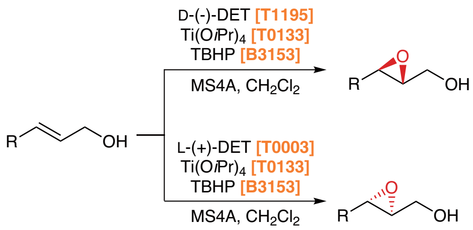
Epoxidation Reaction

Epoxidation is also an oxidation reaction and the Prilezhaev (Prileschajew) reaction[26)] with mCPBA is regarded as a representative epoxidation. Furthermore, asymmetric epoxidation reactions have been reported such as Sharpless-Katsuki asymmetric epoxidation[27)] for allyl alcohols and Jacobsen-Katsuki asymmetric epoxidation[28)] of *cis*-olefins. Sharpless-Katsuki asymmetric epoxidation is often used in the total syntheses of natural products.

Prilezhaev epoxidation

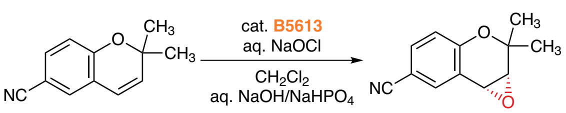


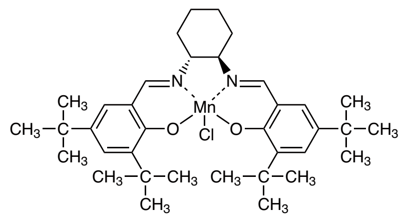
Sharpless-Katsuki asymmetric epoxidation



Jacobsen-Katsuki asymmetric epoxidation

28c)





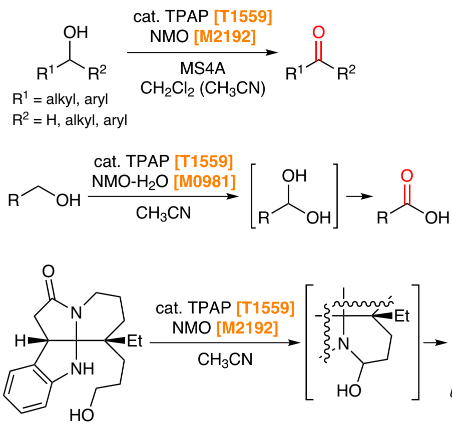
(*R*,*R*)-Jacobsen's Catalyst
[B5613]

Catalytic Oxidation Reactions

1. Oxidation with TPAP Catalyst

Tetrapropylammonium perruthenate (= TPAP) [T1559] catalyst can oxidize alcohols into aldehydes and ketones by the addition of 4-methylmorpholine *N*-oxide (= NMO) [M2192] as a cooxidant (Ley-Griffith oxidation).[29)] This reaction proceeds under very mild conditions to give the corresponding product in high yield even when applied to unstable substances. Moreover, this reaction can oxidize primary alcohols to carboxylic acids in the presence of water by hydration of the aldehyde to form a *gem*-diol and subsequent reoxidation.[30)] TPAP and NMO are often applied in the syntheses of natural products. Gaich's group, for instance, have reported the total synthesis of (-)-leuconoxine by ingeniously applying this reaction at the last step.[31)]

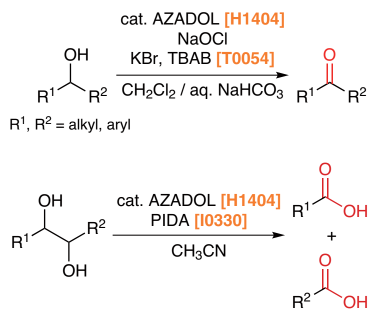
Ley-Griffith oxidation



2. Oxidation Using AZADOL®

AZADOL® [H1404], known as the precursor of an oxidation catalyst, is a hydroxyamine developed by Iwabuchi *et al.*[32)] The oxidizing ability of H1404 is superior to that of TEMPO [T1560], particularly for secondary alcohols. In addition, 1,2-diols are oxidatively cleaved by the treatment of a catalytic amount of PIDA [I0330] to afford two carboxylic acids. H1404 is anticipated as a green catalyst for oxidation since sodium hypochlorite, sodium chlorite and even oxygen in air can be utilized as cooxidants.

AZADOL® is a registered trademark of Nissan Chemical Corporation.

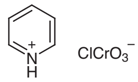


References

1) a) T. J. Donohoe, *Oxidation and Reduction in Organic Synthesis.* Oxford Univ Pr on Demand, **2000**.
   b) A. H. Haines, *Methods for the Oxidation of Organic Compounds: Alcohols, Alcohol Derivatives, Alky Halides, Nitroalkanes, Alkyl Azides, Carbonyl Compounds, Hydroxyarenes and Aminoarenes*, **1988**.
   c) G. Tojo, M. I. Fernandez, *Oxidation of Alcohols to Aldehydes and Ketones: A Guide to Current Common Practice.* Springer, **2005**.
   d) L. Kürti, B. Czakó, *Strategic Applications of Named Reactions in Organic Synthesis*, Elsevier, **2005**.
2) K. Bowden, I. M. Heilbron, E. R. H. Jones, B. C. L. Weedon, *J. Chem. Soc*. **1946**, 39.
3) a) G. I. Poos, G. E. Arth, R. E. Beyler, L. H. Sarett, *J. Am. Chem. Soc*. **1953**, *75*, 422.
   b) J. C. Collins, W. W. Hess, F. J. Frank, *Terahedron Lett*. **1968**, *9*, 3363.
4) E. J. Corey, J. W. Suggs, *Terahedron Lett*. **1975**, *16*, 2647.
5) E. J. Corey, G. Schmidt, *Terahedron Lett*. **1979**, *20*, 399.
6) T. Okada, T. Asawa, Y. Sugiyama, M. Kirihara, T. Iwai, Y. Kimura, *Synlett* **2014**, *25*, 596.
7) M. Kirihara, R. Osugi, K. Saito, K. Adachi, K. Yamazaki, R. Matsushima, Y. Kimura, *J. Org. Chem*. **2019**, *84*, 8330.
8) T. Okada, H. Matsumuro, S. Kitagawa, T. Iwai, K. Yamazaki, Y. Kinoshita, Y. Kimura, M. Kirihara, *Synlett* **2015**, *26*, 2547.
9) A. Watanabe, K. Miyamoto, T. Okada, T. Asawa, M. Uchiyama, *J. Org. Chem*. **2018**, *83*, 14262.
10) R. Criegee, *Ber*. **1933**, *64*, 260.
11) a) L. Malaprade, *Bull. Soc. Chim. Fr*. **1934**, *3*, 833.
   b) P. Karrer, R. Hirohata, *Helv. Chim. Acta* **1933**, *16*, 959.
12) a) D. B. Dess, J. C. Martin, *J. Org. Chem*. **1983**, *48*, 4155.
   b) V. Beghetto, A. Scrivanti, M. Bertoldini, M. Aversa, A. Zancanaro, U. Matteoli, *Synthesis* **2015**, *47*, 272.
13) M. Frigerio, M. Santagostino, *Terahedron Lett*. **1994**, *35*, 8019.
14) M. Iinuma, K. Moriyama, H. Togo, *Eur. J. Org. Chem*. **2014**, 772.
15) review: a) H. Tohma, Y. Kita, *Adv. Synth. Catal*. **2004**, *346*, 111.
   b) A. Yoshimura, V. V. Zhdankin, *Chem. Rev*. **2016**, *116*, 3328.
16) a) N. Kornblum, J. W. Powers, G. J. Anderson, W. J. Jones, H. O. Larson, O. Levand, W. M. Weaver, *J. Am. Chem. Soc*. **1957**, *79*, 6562.
   b) N. Kornblum, W. J. Jones. G. J. Anderson, *J. Am. Chem. Soc*. **1959**, *81*, 4113.
17) a) K. E. Pfitzner, J. G. Moffatt, *J. Am. Chem. Soc*. **1963**, *85*, 3027.
   b) K. E. Pfitzner, J. G. Moffatt, *J. Am. Chem. Soc*. **1965**, *87*, 5661.
   c) K. E. Pfitzner, J. G. Moffatt, *J. Am. Chem. Soc*. **1965**, *87*, 5670.
18) J. D. Albright, L. Goldman, *J. Am. Chem. Soc*. **1967**, *89*, 2416.
19) J. R. Parikh, W. v. E. Doering, *J. Am. Chem. Soc*. **1967**, *89*, 5505.
20) a) A. K. Sharma, D. Swern, *Terahedron Lett*. **1974**, *15*, 1503.
   b) K. Omura, A. K. Sharma, D. Swern, *J. Org. Chem*. **1976**, *41*, 957.
   c) L. Huang, D. Swern, *J. Org. Chem*. **1978**, *43*, 4537.
   d) K. Omura, D. Swern, *Terahedron* **1978**, *34*, 1651.
21) a) D. Tsuchiya, K. Moriyama, H. Togo, *Synlett* **2011**, 2701.
   b) D. Tsuchiya, M. Tabata, K. Moriyama, H. Togo, *Tetrahedron* **2012**, *68*, 6849.
22) T. Mukaiyama, J. Matsuo, D. Iida, H. Kitagawa, *Chem. Lett*. **2001**, *30*, 846.
23) T. Mukaiyama, J. Matsuo, M. Yanagisawa, *Chem. Lett*. **2000**, *29*, 1072.
24) a) J. Matsuo, Y. Aizawa, *Chem. Comm.* **2005**, 2399.
   b) W. J. Kerr, C. M. Pearsona, G. J. Thurston, *Org. Biomol. Chem*. **2006**, *4*, 47.
25) J. J. Crawford, K. W. Henderson, W. J. Kerr, *Org. Lett*. **2006**, *8*, 5073.
26) N. Prileschajew, *Ber*. **1909**, *42*, 4811.
27) a) T. Katsuki, K. B. Sharpless, *J. Am. Chem. Soc*. **1980**, *102*, 5974.
   b) review: A. Pfenninger, *Synthesis* **1986**, 89.
28) a) W. Zhang, J. L. Loebach, S. R. Wilson, E. N. Jacobsen, *J. Am. Chem. Soc*. **1980**, *102*, 5974.
   b) R. Irie, K. Noda, Y. Ito, T. Katsuki, *Terahedron Lett*. **1991**, *32*, 1055.
   c) N. H. Lee, A. R. Muci, E. N. Jacobsen, *Terahedron Lett*. **1991**, *32*, 5055.
29) W. P. Griffith, S. V. Ley, G. P. Whitcombe, A. D. White, *J. Chem. Soc., Chem. Commun*. **1987**, 1625.
30) A.-K. C. Schmidt, C. B. W. Stark, *Org. Lett*. **2011**, *13*, 4164.
31) M. Pfaffenbach, T. Gaich, *Chem. Eur. J.* **2015**, *21*, 6355.
32) a) M. Shibuya, Y. Sasano, M. Tomizawa, T. Hamada, M. Kozawa, N. Nagahama, Y. Iwabuchi, *Synthesis* **2011**, *21*, 3418.
   b) review: Y. Iwabuchi, *Chem. Pharm. Bull*. **2013**, *61*, 1197.
33) M. Shibuya, T. Shibuta, H. Fukuda, Y. Iwabuchi, *Org. Lett*. **2012**, *14*, 5010.

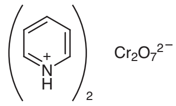
Chromates

P0930 25g 100g 500g



PCC
CAS RN: 26299-14-9

P0931 25g 100g 500g



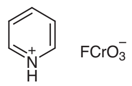
PDC
CAS RN: 20039-37-6

B1123 10g

$2[(C_4H_9)_4N]^+\ Cr_2O_7^{2-}$

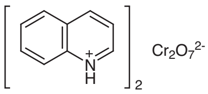
Bis(tetrabutylammonium) Dichromate
CAS RN: 56660-19-6

P1088 5g



Pyridinium Fluorochromate
CAS RN: 83042-08-4

Q0058 10g 25g



Quinolinium Dichromate
CAS RN: 56549-24-7

Hypochlorites

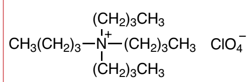
S0939 25g 500g

$NaClO \cdot 5H_2O$

Sodium Hypochlorite
Pentahydrate
CAS RN: 10022-70-5

Perchlorates

T0836 25g 100g 500g



Tetrabutylammonium Perchlorate
CAS RN: 1923-70-2

L0379 25g 100g 500g

$LiClO_4$

Lithium Perchlorate
CAS RN: 7791-03-9

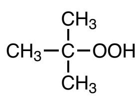
P2988 25g 500g

$KClO_4$

Potassium Perchlorate
CAS RN: 7778-74-7

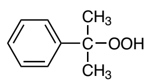
Peroxides

B3153 100g



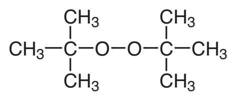
TBHP (70% in Water)
CAS RN: 75-91-2

C2223 100g



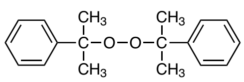
Cumene Hydroperoxide
(contains *ca.* 20% Aromatic Hydrocarbon)
CAS RN: 80-15-9

D3411 100mL



Di-*tert*-butyl Peroxide
CAS RN: 110-05-4

D4894 100g 500g



Dicumyl Peroxide
(contains *ca.* 60% $CaCO_3$)
CAS RN: 80-43-3

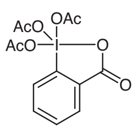
H1222 300mL

H_2O_2

Hydrogen Peroxide
(35% in Water)
CAS RN: 7722-84-1

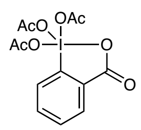
Hypervalent Iodine

D2045 1g 5g 25g



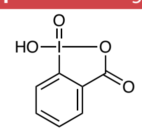
DMP
CAS RN: 87413-09-0

D4477 25mL 250mL



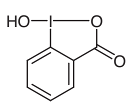
DMP (8-12% in Dichloromethane)
CAS RN: 87413-09-0

I0791 5g 25g



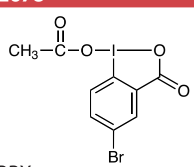
IBX (stabilized with Benzoic Acid + Isophthalic Acid)
CAS RN: 61717-82-6

I0073 1g 10g



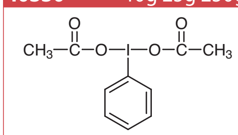
IBA
CAS RN: 304-91-6

A2678 1g



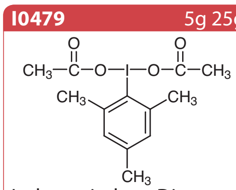
ABBX
CAS RN: 1580548-81-7

I0330 10g 25g 250g



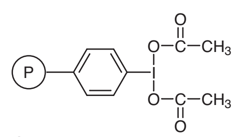
PIDA
CAS RN: 3240-34-4

I0479 5g 25g



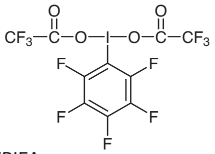
Iodomesitylene Diacetate
CAS RN: 33035-41-5

P1415 1g 5g



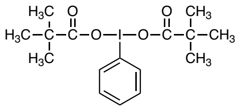
PSDIB
CAS RN: 36290-94-5

B1616 1g 5g



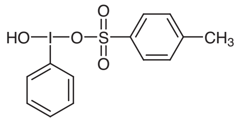
FPIFA
CAS RN: 14353-88-9

B5405 5g



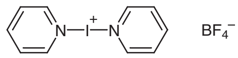
[Bis(*tert*-butylcarbonyloxy)-iodo]benzene
CAS RN: 57357-20-7

P1015 5g 25g



[Hydroxy(tosyloxy)iodo]-benzene
CAS RN: 27126-76-7

B2539 1g



Barluenga's Reagent
CAS RN: 15656-28-7

P0077 25g

Trisodium Paraperiodate
CAS RN: 13940-38-0

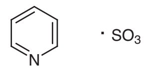
Sulfur Oxides

O0310 25g 500g

$2KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$

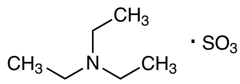
Oxone
CAS RN: 37222-66-5

P0998 25g 100g 500g



Pyridine - Sulfur Trioxide Complex
CAS RN: 26412-87-3

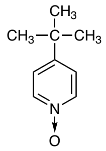
T2136 5g 25g



Sulfur Trioxide - Triethylamine Complex
CAS RN: 761-01-3

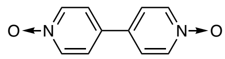
N-Oxides

B6158 250mg



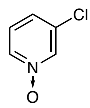
4-(*tert*-Butyl)pyridine 1-Oxide
CAS RN: 23569-17-7

B6159 250mg 1g



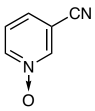
4,4'-Bipyridine 1,1'-Dioxide
CAS RN: 24573-15-7

C2329 1g 5g



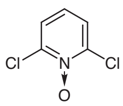
3-Chloropyridine *N*-Oxide
CAS RN: 1851-22-5

C3416 1g



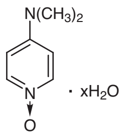
3-Cyanopyridine *N*-Oxide
CAS RN: 14906-64-0

D3219 5g



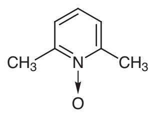
2,6-Dichloropyridine *N*-Oxide
CAS RN: 2587-00-0

D3220 1g 5g



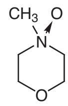
DMAPO Hydrate
CAS RN: 1005-31-8

L0069 5g 25g



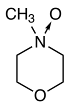
2,6-Lutidine *N*-Oxide
CAS RN: 1073-23-0

M0981 25mL 500mL



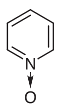
NMO
(50% in Water, *ca.* 4.8mol/L)
CAS RN: 7529-22-8

M2192 5g 25g



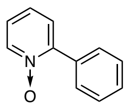
NMO
CAS RN: 7529-22-8

P0557 25g 100g 500g



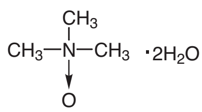
Pyridine *N*-Oxide
CAS RN: 694-59-7

P2775 250mg 1g



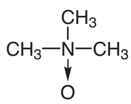
2-Phenylpyridine 1-Oxide
CAS RN: 1131-33-5

T0466 25g 100g 500g



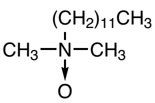
TMANO Dihydrate
CAS RN: 62637-93-8

T1362 1g 5g



TMANO Anhydrous
CAS RN: 1184-78-7

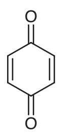
L0361 50mL 250mL



Lauryldimethylamine *N*-Oxide (ca. 30% in Water)
CAS RN: 1643-20-5

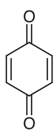
Other Oxidizing Agents

B0089 25g 100g 500g



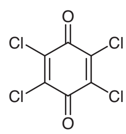
1,4-Benzoquinone (>98.0%)
CAS RN: 106-51-4

B0887 25g 500g



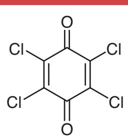
1,4-Benzoquinone (>97.0%)
CAS RN: 106-51-4

T0061 25g 500g



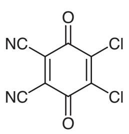
Chloranil
CAS RN: 118-75-2

C1770 10mL



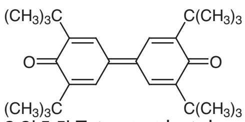
Chloranil (*ca.* 2% in *N*,*N*-Dimethylformamide)
CAS RN: 118-75-2

D1070 25g 250g



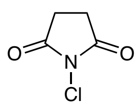
DDQ
CAS RN: 84-58-2

T1503 1g



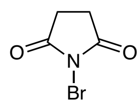
3,3',5,5'-Tetra-*tert*-butyl-4,4'-diphenoquinone
CAS RN: 2455-14-3

C0291 25g 100g 500g



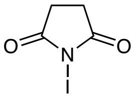
N-Chlorosuccinimide
CAS RN: 128-09-6

B0656 25g 100g 500g



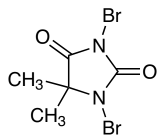
N-Bromosuccinimide
CAS RN: 128-08-5

I0074 5g 25g 100g



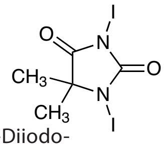
N-Iodosuccinimide
CAS RN: 516-12-1

D1265 25g 500g



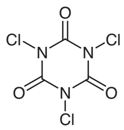
DBDMH
CAS RN: 77-48-5

D3657 5g 25g



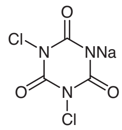
1,3-Diiodo-5,5-dimethylhydantoin
CAS RN: 2232-12-4

T0620 25g 500g



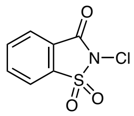
Trichloroisocyanuric Acid
CAS RN: 87-90-1

D1003 25g 500g



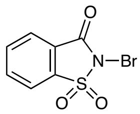
Sodium Dichloroisocyanurate
CAS RN: 2893-78-9

C1674 5g 25g



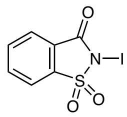
N-Chlorosaccharin
CAS RN: 14070-51-0

B2152 5g 25g



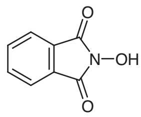
N-Bromosaccharin
CAS RN: 35812-01-2

I0784 5g



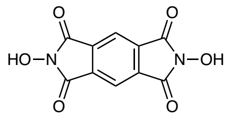
N-Iodosaccharin
CAS RN: 86340-94-5

H0395 25g 100g 500g



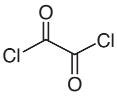
NHPI
CAS RN: 524-38-9

D4413 1g 5g



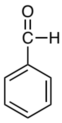
NDHPI
CAS RN: 57583-53-6

O0082 25g 100g 500g



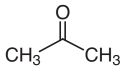
Oxalyl Chloride
CAS RN: 79-37-8

B2379 500g



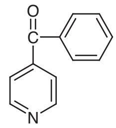
Benzaldehyde
CAS RN: 100-52-7

A0054 500mL



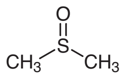
Acetone
CAS RN: 67-64-1

B0306 25g



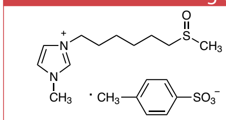
4-Benzoylpyridine
CAS RN: 14548-46-0

D0798 25g 500g



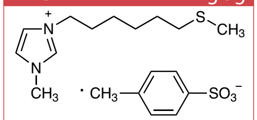
Dimethyl Sulfoxide
CAS RN: 67-68-5

M2274 1g 5g



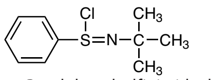
1-Methyl-3-[6-(methylsulfinyl)-hexyl]imidazolium *p*-Toluenesulfonate
CAS RN: 1352947-66-0

M2321 1g 5g



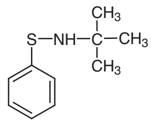
1-Methyl-3-[6-(methylthio)-hexyl]imidazolium *p*-Toluenesulfonate
CAS RN: 1352947-63-7

B2188 1g 5g



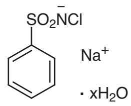
N-*tert*-Butylphenylsulfinimidoyl Chloride
CAS RN: 49591-20-0

B2240 1g 5g 25g



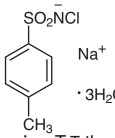
N-*tert*-Butylbenzenesulfenamide
CAS RN: 19117-31-8

C0075 25g 100g 500g



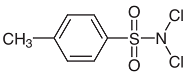
Chloramine B Hydrate
CAS RN: 304655-80-9

C0076 25g 500g



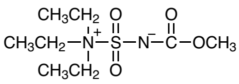
Chloramine T Trihydrate
CAS RN: 7080-50-4

D0318 25g 100g 500g



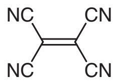
Dichloramine T
CAS RN: 473-34-7

M1279 1g 5g 25g



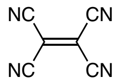
Burgess Reagent
CAS RN: 29684-56-8

T0077 5g 25g



TCNE
CAS RN: 670-54-2

T3264 1g 5g



TCNE (purified by sublimation)
CAS RN: 670-54-2

C1806 50g 500g

$(NH_4)_2Ce(NO_3)_6$

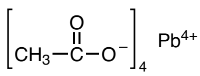
CAN
CAS RN: 16774-21-3

E1459 25g 100g

SeO_2

Selenium Dioxide
CAS RN: 7446-08-4

L0021 25g 500g



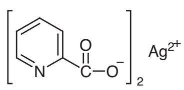
LTA (contains Acetic Acid)
CAS RN: 546-67-8

P1910 25g 100g 500g

$12MoO_3 \cdot H_3PO_4 \cdot xH_2O$

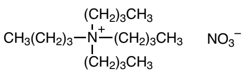
Molybdo(VI)phosphoric Acid Hydrate
CAS RN: 51429-74-4

S0815 1g 5g



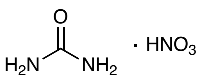
Picolinic Acid Silver(II) Salt
CAS RN: 14783-00-7

T3651 5g 25g



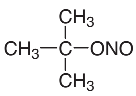
Tetrabutylammonium Nitrate
CAS RN: 1941-27-1

U0015 25g



Urea Nitrate
(wetted with *ca.* 25% Water)
(unit weight on dry weight basis)
CAS RN: 124-47-0

N0357 25mL 250mL



tert-Butyl Nitrite
CAS RN: 540-80-7

B2414 90g 500g

Br_2

Bromine
CAS RN: 7726-95-6

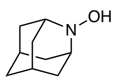
I0604 25g 500g

I_2

Iodine
CAS RN: 7553-56-2

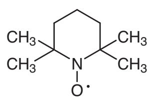
Catalysts for Oxidation

H1404 200mg 1g 5g



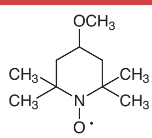
AZADOL®
CAS RN: 1155843-79-0

T1560 5g 25g



TEMPO Free Radical
CAS RN: 2564-83-2

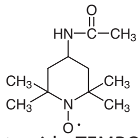
M1197 1g 5g



4-Methoxy-TEMPO Free Radical
CAS RN: 95407-69-5

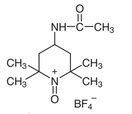
Please inquire for pricing and availability of listed products to our local sales representatives.

A1348 5g 25g



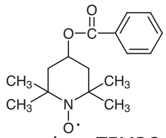
4-Acetamido-TEMPO Free Radical
CAS RN: 14691-89-5

A2065 5g



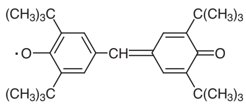
4-Acetamido-2,2,6,6-tetramethyl-1-oxopiperidinium Tetrafluoroborate
CAS RN: 219543-09-6

H0878 1g 5g



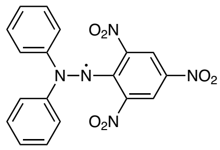
4-Benzoyloxy-TEMPO Free Radical
CAS RN: 3225-26-1

G0020 1g 5g



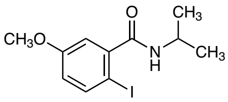
Galvinoxyl Free Radical
CAS RN: 2370-18-5

D4313 1g 5g



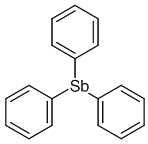
DPPH Free Radical
CAS RN: 1898-66-4

I1117 100mg



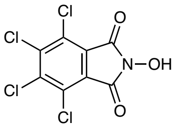
2-Iodo-*N*-isopropyl-5-methoxybenzamide
CAS RN: 1820802-04-7

T0476 25g



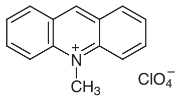
Triphenylantimony
CAS RN: 603-36-1

H1765 1g 5g



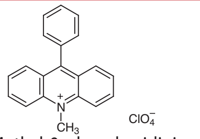
TCNHPI
CAS RN: 85342-65-0

M1787 250mg 1g



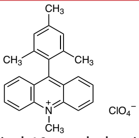
10-Methylacridinium Perchlorate
CAS RN: 26456-05-3

M1775 1g 5g



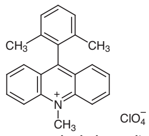
10-Methyl-9-phenylacridinium Perchlorate
CAS RN: 36519-61-6

M1774 1g 5g



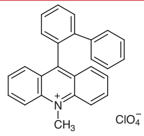
9-Mesityl-10-methylacridinium Perchlorate
CAS RN: 674783-97-2

D3429 1g



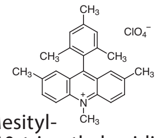
9-(2,6-Dimethylphenyl)-10-methylacridinium Perchlorate
CAS RN: 1276539-32-2

B2897 1g 5g



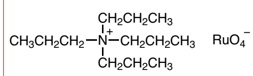
9-(2-Biphenylyl)-10-methylacridinium Perchlorate
CAS RN: 2743539-91-3

M2072 1g



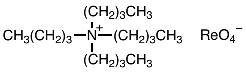
9-Mesityl-2,7,10-trimethylacridinium Perchlorate
CAS RN: 1216909-33-9

T1559 1g 5g



TPAP
CAS RN: 114615-82-6

T1803 1g 5g



Tetrabutylammonium Perrhenate
CAS RN: 16385-59-4

P1939 1g 5g

$KReO_4$

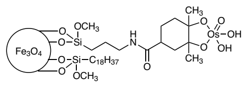
Potassium Perrhenate
CAS RN: 10466-65-6

O0308 10mL

OsO_4

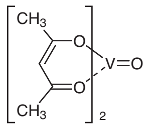
Osmium Tetroxide
(4% in Water)
CAS RN: 20816-12-0

O0414 1g



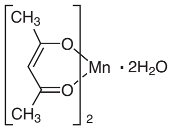
Osmium Catalyst supported on Magnetite
(0.07-0.09mmol/g)

V0016 25g



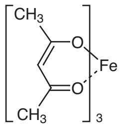
Vanadyl Acetylacetonate
CAS RN: 3153-26-2

M0042 25g



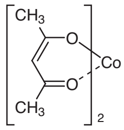
Manganese(II) Acetylacetonate Dihydrate
CAS RN: 22033-51-8

I0079 25g 100g 500g



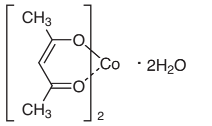
Acetylacetone Iron(III) Salt
CAS RN: 14024-18-1

B2681 25g



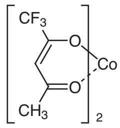
Cobalt(II) Acetylacetonate
CAS RN: 14024-48-7

C0373 25g 500g



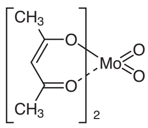
Cobalt(II) Acetylacetonate Dihydrate
CAS RN: 123334-29-2

T0746 5g



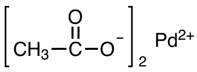
Cobalt(II) Trifluoroacetylacetonate
CAS RN: 16092-38-9

M0464 5g 25g



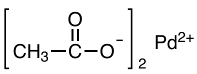
Molybdenum(VI)dioxy Acetylacetonate
CAS RN: 17524-05-9

A1424 1g 5g



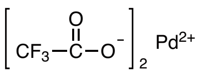
Palladium(II) Acetate
CAS RN: 3375-31-3

P2161 1g



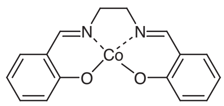
Palladium(II) Acetate (Purified)
CAS RN: 3375-31-3

P1870 1g 5g



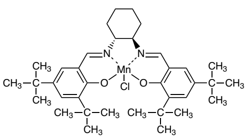
Palladium(II) Trifluoroacetate
CAS RN: 42196-31-6

S0318 25g 100g 500g



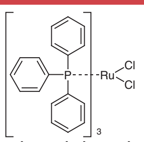
Salcomine
CAS RN: 14167-18-1

B5613 1g 5g



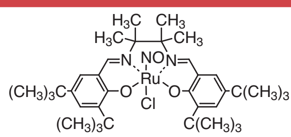
(*R,R*)-Jacobsen's Catalyst
CAS RN: 138124-32-0

D1997 1g 5g



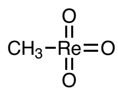
Tris(triphenylphosphine)ruthenium(II) Dichloride
CAS RN: 15529-49-4

C1944 100mg



Chloronitrosyl[*N,N'*-bis(3,5-di-*tert*-butylsalicylidene)-1,1,2,2-tetramethylethylenediaminato]ruthenium(IV)
CAS RN: 386761-71-3

M1296 100mg



Methyltrioxorhenium(VII)
CAS RN: 70197-13-6

По вопросам продаж и поддержки обращайтесь:

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-4159
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

Россия +7(495)268-04-70 Казахстан +7(7172)727-132 Киргизия +996(312)96-26-47

Адрес: https://tci.nt-rt.ru/ || эл.почта: tic@nt-rt.ru