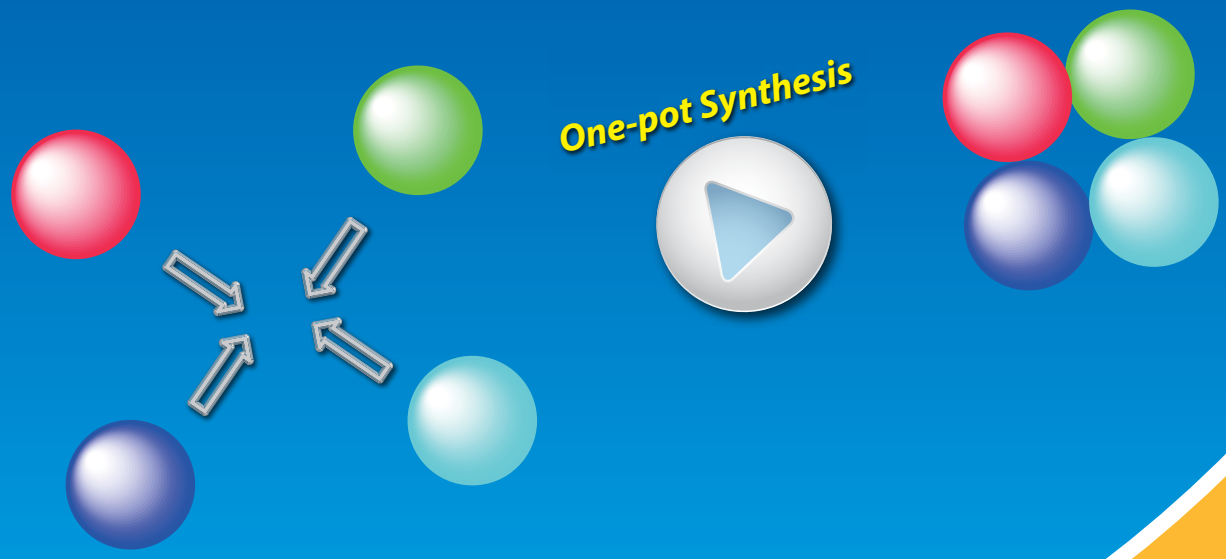
CHEMISTRY

多成分反応 (MCR)

Multicomponent Reaction (MCR)



- アルデヒド
- アミン
- カルボン酸
- β-ケトエステル
- イソニトリル
- 尿素
- チオ尿素
- ジアルキル亜リン酸エステル
- ベンザイン前駆体
- ルイス酸
- イオン液体

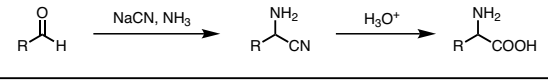
多成分反応 (MCR)

多成分反応(Multicomponent Reaction, MCR)とは、三種類以上の基質成分を一つの反応で結合させ、新しい化合物を得る反応形式です。MCRでは出発物質の大部分が生成物に取り込まれ、副生成物が極めて少ないことが特徴であり、アトムエコノミーの面から大変魅力的でグリーンケミストリー指向型の反応と言えます。極力少ない工程数でワンポットで目的物が得られることから、特に医薬品開発におけるリード化合物探索やコンビナトリアル化学の分野で非常に注目されている反応となっています。

MCRはこれまで多数報告例がありますが、代表的な反応例およびその特徴を以下に示しました。

1. Strecker反応 (三成分反応: 3CR)

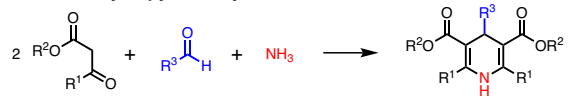
Strecker Reaction (Amino Acid Synthesis)



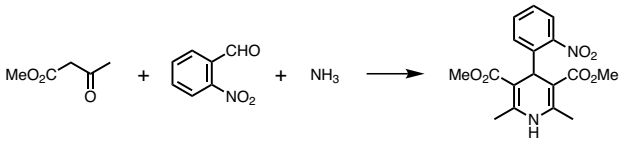
1850年にA.Streckerによって報告された反応で、α-アミノ酸の合成法として大変有名です。反応基質としてアルデヒド、シアン化水素およびアンモニアの三成分を用いた反応であり、MCRの報告としては世界初の反応として知られています[1]。

2. Hantzschジヒドロピリジン合成反応 (3CR)

Hantzsch Dihydropyridine Synthesis



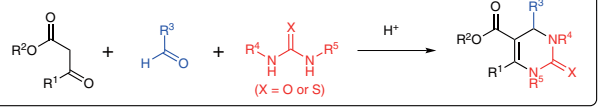
1881年にArthur Hantzschによって報告された反応であり、MCRの中で最もよく知られた三成分反応です[2]。β-ケトエステル、アルデヒドおよびアンモニアから1,4-ジヒドロピリジン誘導体を与えます。血管拡張薬として知られるニフェジピンもこの方法で得られています[3]



Nifedipine

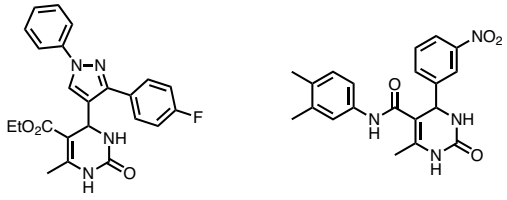
3. Biginelli反応 (3CR)

Biginelli reaction



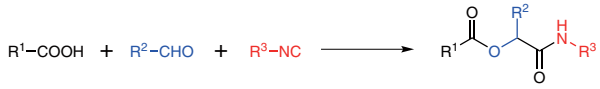
Biginelli反応は酸触媒(ブレンステッド酸あるいはルイス酸)存在下で、アセト酢酸エチル[A0649]などのβ-ケトエステル、ベンズアルデヒド[B2379]などの芳香族アルデヒド、そして尿素(あるいはチオ尿素)の三種類の基質が縮合してジヒドロピリミジノンを与える反応で、1891年にイタリアの化学者Pietro Biginelliによって報告されました[4]。ジヒドロピリミジン類は抗炎症作用、抗菌作用などの幅広い薬理活性を有し、医薬品研究において大変注目されています。この反応を用いた医薬品合成の例として、以下のような抗結核活性化合物の合成が報告されています[5]。

Examples of Anti-tubercular Agents using Biginelli Reaction

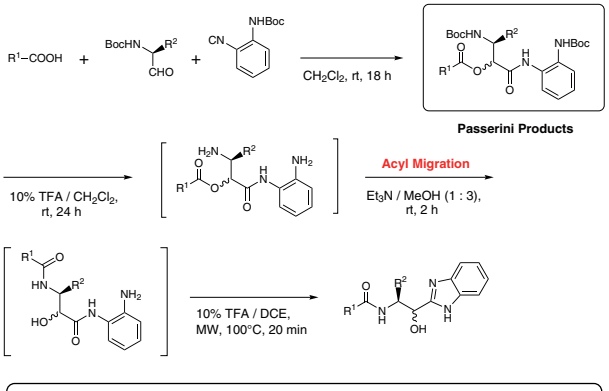


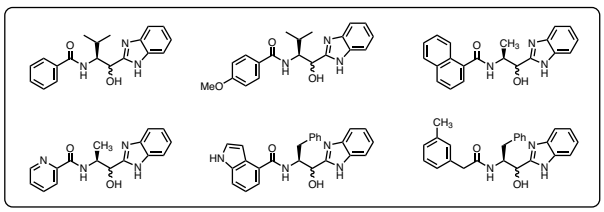
4. Passerini反応 (3CR)

Passerini Reaction



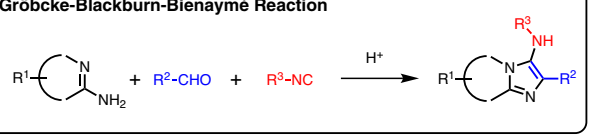
Passerini反応は、カルボン酸、アルデヒドそしてイソニトリルの三成分が縮合してα-アシルオキシアミドを与える反応で、1921年にイタリアの化学者Mario Passeriniによって報告されました[6]。Passerini反応も医薬品研究の分野で用いられており、例えばHulmeらはPasserini反応を用い、ベンゾイミダゾールを置換基に持つ新規ノルスタチン誘導体のライブラリー合成を報告しています[7]。



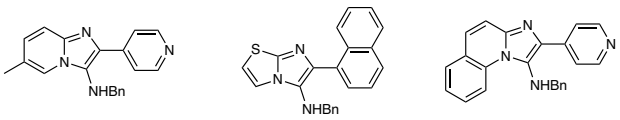


5. Gröbcke-Blackburn-Bienaymé反応[8] (3CR)

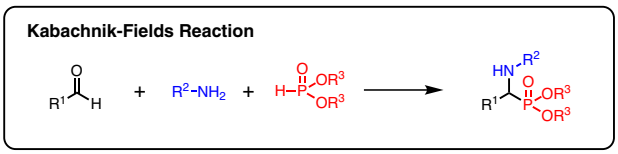
Gröbcke-Blackburn-Bienaymé Reaction



酸触媒の存在下、2-アミノイミダゾール、2-アミノピリジンなどα-アミノアジン化合物とアルデヒドおよびイソニトリルを用いた三成分反応で、以下のような含窒素縮環芳香族化合物の合成に持ちいられています。

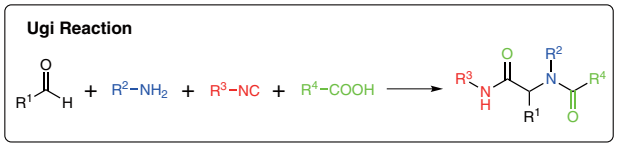


6. Kabachnik-Fields反応 (3CR)

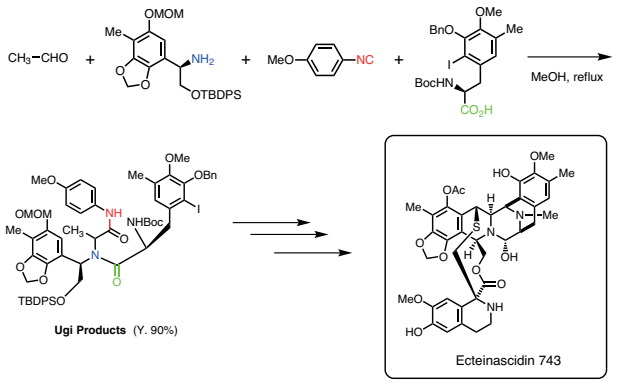


酸触媒(ブレンステッド酸あるいはルイス酸)存在下で、アルデヒド、アミンそしてジアルキルリン酸エステルの三成分からα-アミノホスホン酸エステルを与える反応で、1952年にM. I. Kabachinikによって報告されました[9]。近年、生成物のα-アミノホスホン酸エステルは、ペプチドの加水分解遷移状態のミミックとしてレニン阻害剤やHIVプロテアーゼ阻害剤などのプロテアーゼ阻害剤の研究に応用されています[10]。

7. Ugi反応 (4CR)



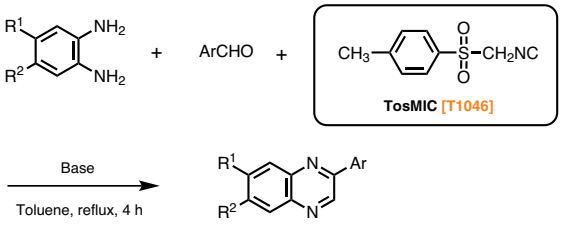
1962年にI. K. Ugiによって報告さた本反応は、アルデヒド、アミン、イソニトリルおよびカルボン酸の四成分を一度に縮合させることが可能です[11]。個々の基質の幅広い組み合わせが可能であり、最も汎用性が高いMCRと言えます。福山らは、Ugi反応を鍵反応に用い、高い抗腫瘍活性を有する海洋天然物エクティナサイジン743の全合成を達成しています[12]。



その他MCRの例

●p-トルエンスルホニルメチルイソシアニド (TosMIC)を用いたMCR (3CR)

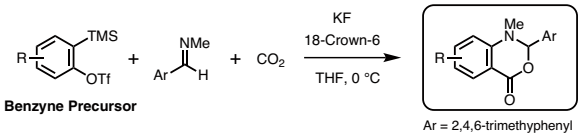
p-トルエンスルホニルメチルイソシアニド(TosMIC) **[T1046]** は、Leusenらによって開発された合成試薬で、分子内にイソニトリル基と、脱離基であるトシル基を持ちます[13]。他のイソニトリル化合物が悪臭を有するのに対し、TosMICは無臭の固体化合物で取り扱いやすい化合物で、オキサゾールなど含窒素複素環芳香族化合物の合成に幅広く用いられています[14]。TosMICはMCRでも大変有用な試薬であり、例えばTsoleridisらは、*o*-フェニレンジアミンと芳香族アルデヒド化合物、そしてTosMICのMCRによるキノキサリン誘導体の合成を報告しています[15]



Entry	R^1	R^2	Ar	Base	Quinoxaline (Y. %)
1	H	H	phenyl	DABCO	91
2	H	H	2,4-dimethylphenyl	DABCO	81
3	H	H	4-chlorophenyl	DABCO	84
4	Me	Me	phenyl	DBU	86
5	Me	Me	2-methylphenyl	DBU	85

●ベンザインを用いたMCR (3CR)

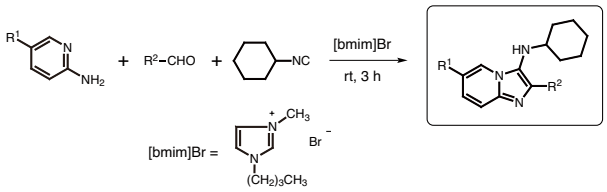
最近では、ベンザインを用いたMCRの反応も報告されています。例えば吉田らは、反応系中で発生させたベンザインと、イミンおよび二酸化炭素によるベンゾオキサジノンの合成反応について報告しています[16]。近年、環境調和の観点から炭素源として二酸化炭素を有機合成に利用する研究が盛んに行われており、本反応は極めて有用な反応と言えます。



Benzyne Precursor	Reaction time (h)	Product
[T2089]	15	(Y. 82%)
	63	(Y. 63%, 4 : 1)
[M1884]	46	(Y. 73%)
[T2466]	60	(Y. 44%)

このようにMCRは一度に複数の基質の縮合が可能な強力な合成手法ですが、反応の種類や用いる基質により反応の進行が遅く、ルイス酸の種類など反応条件を検討しても収率の改善が見られないこともあります。この解決策として最近ではイオン液体を溶媒に用い、反応を促進させる報告例もあります。例えばShaabaniらは、Gröbcke-Blackburn-Bienaymé反応におけるイ

オン液体の反応促進効果について報告しており[17]、イオン液体を使用した場合には反応が速やかに進行し、高収率で目的物が得られます。一方、イオン液体を用いない場合には反応時間を長くしても収率が改善されません(Entry 2')。またEntry 1に示すように、反応で使用したイオン液体は回収して再利用しても収率の大幅な低減はありません。



[B2193]

Entry	R^1	R^2	Yield (%)
1	Br	Ph	98 (95, 92, 90, 85) [a]
2	Me	Ph	98
2' [b]	Me	Ph	25
3	Me	4-$CH_3C_6H_4$	99
4	Me	4-$O_2NC_6H_4$	92
5	Me	4-Pyridyl	97

[a] The same ionic liquid is used for each of the five runs.
[b] Ionic liquid is not used. Reaction time is 12 h.

一般にイオン液体は回収および再利用が可能で、通常の反応ではほとんど再利用されずに廃棄されていた有機溶媒の使用量・廃棄量を低減することができます。またイオン液体は揮発性をほとんど示さないことから安全性の面からも優れた溶媒として注目を集めており、本反応はより環境調和型の反応例と言えます。

本パンフレットではMCRで利用できるアルデヒド、アミン、カルボン酸、β-ケトエステル、尿素・チオ尿素、ジアルキルリン酸エステルのビルディングブロック製品を豊富に収載しました。アルデヒド、アミン、カルボン酸についてはこれまでのMCRの報告例から代表的なものを抽出して収載しています。またベンザイン前駆体、ルイス酸およびイオン液体についても製品を収載しました。ぜひご利用ください。

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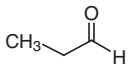
アルデヒド

P0498 25mL 500mL

Propionaldehyde
CAS RN: 123-38-6

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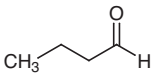
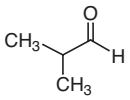
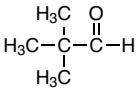

Butyraldehyde
CAS RN: 123-72-8

I0101 25mL 500mL

Isobutyraldehyde
CAS RN: 78-84-2

P0847 5mL 25mL

Pivalaldehyde
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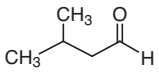
I0192 25mL 100mL 500mL

Isovaleraldehyde
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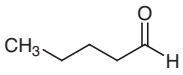
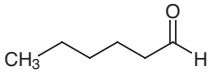
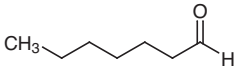
V0001 25mL 500mL

Valeraldehyde
CAS RN: 110-62-3

H0133 25mL 100mL 500mL

Hexanal
CAS RN: 66-25-1

H0025 25mL 500mL

Heptanal
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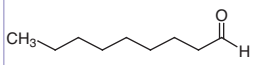
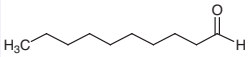
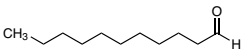
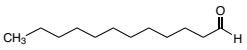
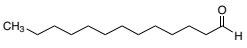
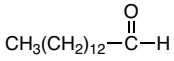
N0296 25mL 100mL 500mL

Nonanal
CAS RN: 124-19-6

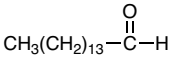
D0032 25mL 500mL

Decanal
CAS RN: 112-31-2

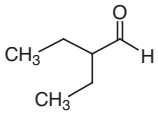
U0009 25mL 250mL

Undecanal
CAS RN: 112-44-7

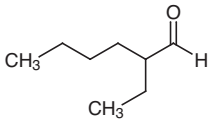
D0979 25mL 500mL

Dodecanal (stabilized with DL-α-Tocopherol)
CAS RN: 112-54-9

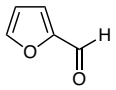
T0410 5mL

Tridecanal
CAS RN: 10486-19-8

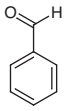
T2696 1g

Tetradecanal
CAS RN: 124-25-4

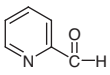
P1869 1g

Pentadecanal
CAS RN: 2765-11-9

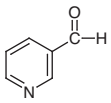
E0069 25mL 100mL 500mL

2-Ethylbutyraldehyde
CAS RN: 97-96-1

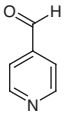
E0125 25mL 500mL

2-Ethylhexanal
CAS RN: 123-05-7

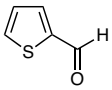
F0073 25g 500g

Furfural
CAS RN: 98-01-1

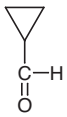
B2379 500g

Benzaldehyde
CAS RN: 100-52-7

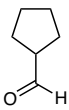
P0425 25g 100g 500g

2-Pyridinecarboxaldehyde
CAS RN: 1121-60-4

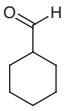
N0090 25mL 100mL

3-Pyridinecarboxaldehyde
CAS RN: 500-22-1

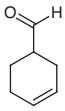
I0143 25mL

4-Pyridinecarboxaldehyde
CAS RN: 872-85-5

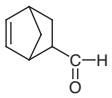
T0725 25mL 100mL 500mL

2-Thiophenecarboxaldehyde (stabilized with HQ)
CAS RN: 98-03-3

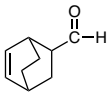
C1707 1g 5g

Cyclopropanecarboxaldehyde
CAS RN: 1489-69-6

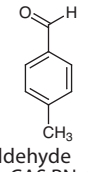
C3019 1mL 5mL

Cyclopentanecarboxaldehyde (stabilized with HQ)
CAS RN: 872-53-7

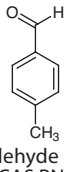
C0880 25mL 100mL

Cyclohexanecarboxaldehyde
CAS RN: 2043-61-0

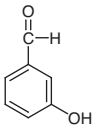
C0881 25mL

3-Cyclohexene-1-carboxaldehyde
CAS RN: 100-50-5

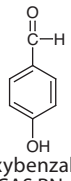
N0504 5mL 25mL

5-Norbornene-2-carboxaldehyde
CAS RN: 5453-80-5

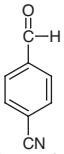
B5279 200mg 1g

Bicyclo[2.2.2]oct-5-ene-2-carboxaldehyde
CAS RN: 38259-00-6

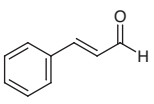
T1073 25mL 500mL

p-Tolualdehyde
CAS RN: 104-87-0

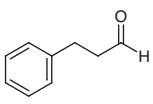
T0259 25mL 100mL 500mL

p-Tolualdehyde
CAS RN: 104-87-0

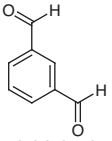
H0197 25g 100g 500g

3-Hydroxybenzaldehyde
CAS RN: 100-83-4

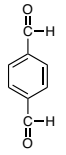
H0198 25g 100g 500g

4-Hydroxybenzaldehyde
CAS RN: 123-08-0

C0443 5g 25g

4-Cyanobenzaldehyde
CAS RN: 105-07-7

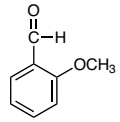
C0352 25mL 500mL

trans-Cinnamaldehyde
CAS RN: 14371-10-9

P0217 25g 100g

3-Phenylpropionaldehyde
CAS RN: 104-53-0

I0153 25g 250g

Isophthalaldehyde
CAS RN: 626-19-7

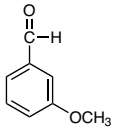
T0010 25g 100g 500g

Terephthalaldehyde
CAS RN: 623-27-8

A0479 25g 100g 500g



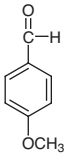
o-Anisaldehyde
CAS RN: 135-02-4

A0478 25mL 100mL



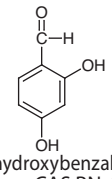
m-Anisaldehyde
CAS RN: 591-31-1

A0480 25mL 500mL



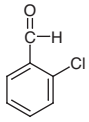
p-Anisaldehyde
CAS RN: 123-11-5

D0564 25g 100g 500g



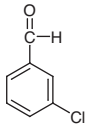
2,4-Dihydroxybenzaldehyde
CAS RN: 95-01-2

C0561 25g 500g



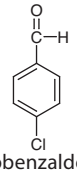
2-Chlorobenzaldehyde
CAS RN: 89-98-5

C0124 25g 100g 500g



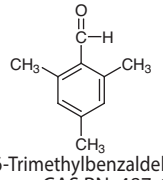
3-Chlorobenzaldehyde
CAS RN: 587-04-2

C0125 25g 100g 500g



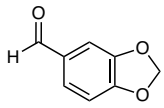
4-Chlorobenzaldehyde
CAS RN: 104-88-1

T1368 25mL



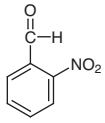
2,4,6-Trimethylbenzaldehyde
CAS RN: 487-68-3

P0456 25g 500g



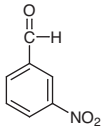
Piperonal
CAS RN: 120-57-0

N0130 25g 100g 500g



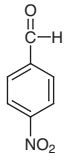
2-Nitrobenzaldehyde
CAS RN: 552-89-6

N0129 25g 500g



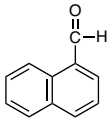
3-Nitrobenzaldehyde
CAS RN: 99-61-6

N0559 25g 100g 500g



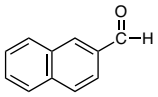
4-Nitrobenzaldehyde
CAS RN: 555-16-8

N0002 25mL 100mL 500mL



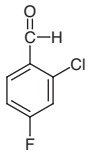
1-Naphthaldehyde
CAS RN: 66-77-3

N0003 5g 25g



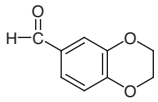
2-Naphthaldehyde
CAS RN: 66-99-9

C1465 1g 5g



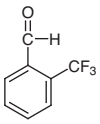
2-Chloro-4-fluorobenzaldehyde
CAS RN: 84194-36-5

B2019 1g 5g



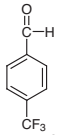
3,4-Ethylenedioxy-
benzaldehyde
CAS RN: 29668-44-8

T1281 25g



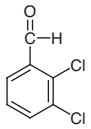
2-(Trifluoromethyl)-
benzaldehyde
CAS RN: 447-61-0

T1091 5g 25g 250g



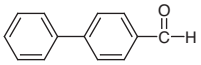
4-(Trifluoromethyl)-
benzaldehyde
CAS RN: 455-19-6

D1666 25g



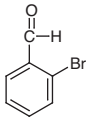
2,3-Dichlorobenzaldehyde
CAS RN: 6334-18-5

B0242 5g 25g 250g



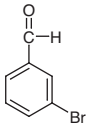
4-Phenylbenzaldehyde
CAS RN: 3218-36-8

B0836 25g 100g 500g



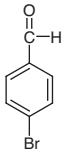
2-Bromobenzaldehyde
CAS RN: 6630-33-7

B0548 25g 100g 500g



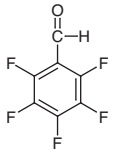
3-Bromobenzaldehyde
CAS RN: 3132-99-8

B0549 25g 250g



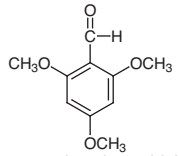
4-Bromobenzaldehyde
CAS RN: 1122-91-4

P0746 5g 25g



Pentafluorobenzaldehyde
CAS RN: 653-37-2

T2651 5g 25g



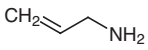
2,4,6-Trimethoxybenzaldehyde
CAS RN: 830-79-5

アミン

P0911 5mL 25mL

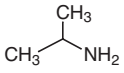
Propargylamine
CAS RN: 2450-71-7

A0219 25mL 500mL



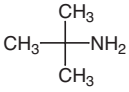
Allylamine
CAS RN: 107-11-9

I0165 25mL 500mL



Isopropylamine
CAS RN: 75-31-0

B0709 25mL 100mL 500mL

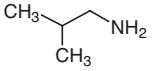


tert-Butylamine
CAS RN: 75-64-9

B0707 25mL 500mL

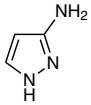
Butylamine
CAS RN: 109-73-9

I0095 25mL 500mL



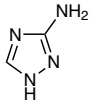
Isobutylamine
CAS RN: 78-81-9

A1859 5g 25g



3-Aminopyrazole
CAS RN: 1820-80-0

A0432 25g 500g

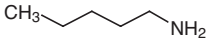


3-Amino-1,2,4-triazole
CAS RN: 61-82-5

C0887 25mL 500mL

Cyclopentylamine
CAS RN: 1003-03-8

A0445 25mL 100mL 500mL

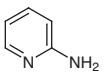


Amylamine
CAS RN: 110-58-7

A0463 500g

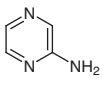
Aniline
CAS RN: 62-53-3

A0411 25g 100g 500g



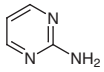
2-Aminopyridine
CAS RN: 504-29-0

A0989 5g 25g



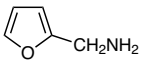
2-Aminopyrazine
CAS RN: 5049-61-6

A0412 25g



2-Aminopyrimidine
CAS RN: 109-12-6

F0091 25mL 100mL 500mL

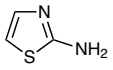


Furfurylamine
CAS RN: 617-89-0

C0494 25mL 500mL

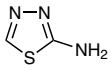
Cyclohexylamine
CAS RN: 108-91-8

A0633 25g 100g 500g



2-Aminothiazole
CAS RN: 96-50-4

A1060 5g 25g

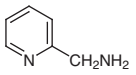


2-Amino-1,3,4-thiadiazole
CAS RN: 4005-51-0

B0406 25mL 500mL

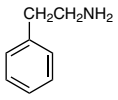
Benzylamine
CAS RN: 100-46-9

A1161 25g 250g



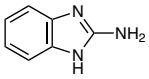
2-Picolylamine
CAS RN: 3731-51-9

P0085 25mL 100mL 500mL



2-Phenylethylamine
CAS RN: 64-04-0

A0850 5g 25g



2-Aminobenzimidazole
CAS RN: 934-32-7

B0541 25g 250g

2-Bromoaniline
CAS RN: 615-36-1

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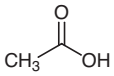
F0513 300mL

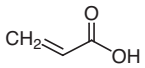
Formic Acid
CAS RN: 64-18-6

A2035 300mL



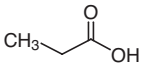
Acetic Acid
CAS RN: 64-19-7

A0141 25g 500g



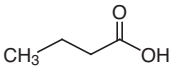
Acrylic Acid
(stabilized with MEHQ)
CAS RN: 79-10-7

P0500 25mL 500mL



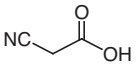
Propionic Acid
CAS RN: 79-09-4

B0754 25mL 500mL



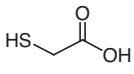
Butyric Acid
CAS RN: 107-92-6

C0439 25g 500g



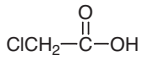
Cyanoacetic Acid
CAS RN: 372-09-8

M0052 25g 500g



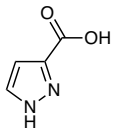
Thioglycolic Acid
CAS RN: 68-11-1

C2123 25g 500g



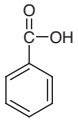
Chloroacetic Acid
CAS RN: 79-11-8

P1862 1g 5g



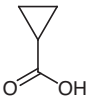
Pyrazole-3-carboxylic Acid
CAS RN: 1621-91-6

B2635 25g 500g



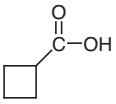
Benzoic Acid
CAS RN: 65-85-0

C0387 25mL 100mL 500mL



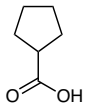
Cyclopropanecarboxylic Acid
CAS RN: 1759-53-1

C0888 10g 25g



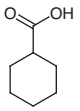
Cyclobutanecarboxylic Acid
CAS RN: 3721-95-7

C0512 5g 25g



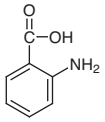
Cyclopentanecarboxylic Acid
CAS RN: 3400-45-1

C0470 25g 500g



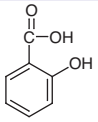
Cyclohexanecarboxylic Acid
CAS RN: 98-89-5

A0497 25g 100g 500g



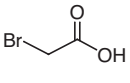
Anthranilic Acid
CAS RN: 118-92-3

H0206 25g 500g



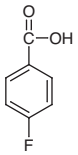
2-Hydroxybenzoic Acid
CAS RN: 69-72-7

B0531 25g 500g



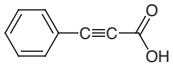
Bromoacetic Acid
CAS RN: 79-08-3

F0112 25g



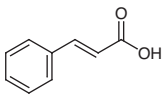
4-Fluorobenzoic Acid
CAS RN: 456-22-4

P0610 5g 25g



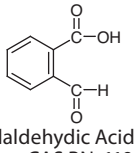
Phenylpropiolic Acid
CAS RN: 637-44-5

C0353 25g 100g 500g



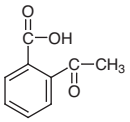
trans-Cinnamic Acid
CAS RN: 140-10-3

P0281 25g 100g 500g



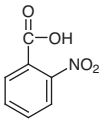
Phthalaldehydic Acid
CAS RN: 119-67-5

A1075 5g



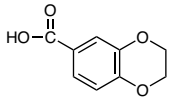
2-Acetylbenzoic Acid
CAS RN: 577-56-0

N0155 25g 500g



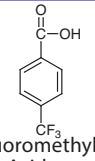
2-Nitrobenzoic Acid
CAS RN: 552-16-9

B3764 5g 25g



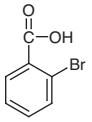
1,4-Benzodioxane-
6-carboxylic Acid
CAS RN: 4442-54-0

T1145 5g 25g



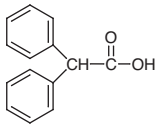
4-(Trifluoromethyl)-
benzoic Acid
CAS RN: 455-24-3

B0552 25g 100g 500g



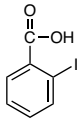
2-Bromobenzoic Acid
CAS RN: 88-65-3

D0869 25g 100g 500g



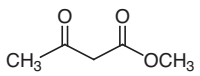
Diphenylacetic Acid
CAS RN: 117-34-0

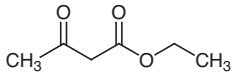
I0053 25g 100g 500g

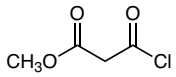


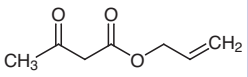
2-Iodobenzoic Acid
CAS RN: 88-67-5

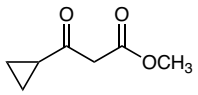
β- ケトエステル

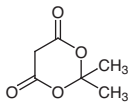
A0650 25g 500g

Methyl Acetoacetate
CAS RN: 105-45-3

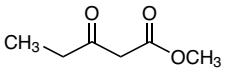
A0649 25g 500g

Ethyl Acetoacetate
CAS RN: 141-97-9

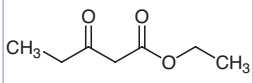
M2315 5g 25g

Methyl Malonyl Chloride
CAS RN: 37517-81-0

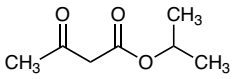
A1981 25g 500g

Allyl Acetoacetate
CAS RN: 1118-84-9

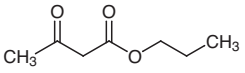
M2277 5g 25g

Methyl 3-Cyclopropyl-3-oxopropionate
CAS RN: 32249-35-7

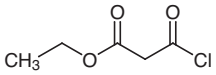
M0799 25g 100g 500g

Meldrum's Acid (=2,2-Dimethyl-1,3-dioxane-4,6-dione)
CAS RN: 2033-24-1

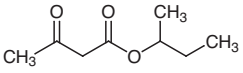
K0035 25g 100g 500g

Methyl 3-Oxovalerate
CAS RN: 30414-53-0

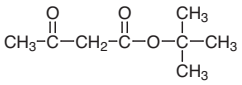
K0031 5g 25g

Ethyl 3-Oxovalerate
CAS RN: 4949-44-4

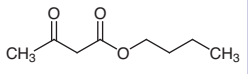
I0826 25g 500g

Isopropyl Acetoacetate
CAS RN: 542-08-5

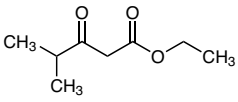
A0817 25mL

Propyl Acetoacetate
CAS RN: 1779-60-8

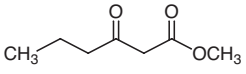
E0484 5g 25g

Ethyl Malonyl Chloride
CAS RN: 36239-09-5

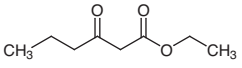
A0815 25mL

sec-Butyl Acetoacetate
CAS RN: 13562-76-0

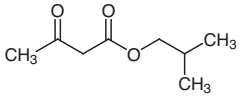
A0816 25mL 100mL 500mL

tert-Butyl Acetoacetate
CAS RN: 1694-31-1

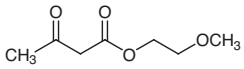
A0795 25mL

Butyl Acetoacetate
CAS RN: 591-60-6

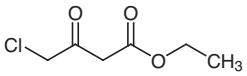
E0882 5g 25g

Ethyl Isobutyrylacetate
CAS RN: 7152-15-0

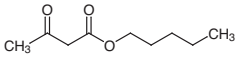
K0037 25mL 500mL

Methyl 3-Oxohexanoate
CAS RN: 30414-54-1

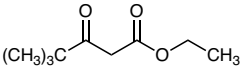
K0030 25mL 500mL

Ethyl 3-Oxohexanoate
CAS RN: 3249-68-1

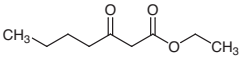
A0814 25mL

Isobutyl Acetoacetate
CAS RN: 7779-75-1

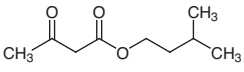
A1583 25g 500g

2-Methoxyethyl Acetoacetate
CAS RN: 22502-03-0

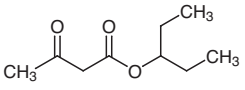
C0911 25g 500g

Ethyl 4-Chloroacetoacetate
CAS RN: 638-07-3

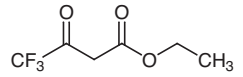
A0811 25mL 500mL

Amyl Acetoacetate
CAS RN: 6624-84-6

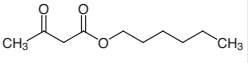
D1891 5mL 25mL

Ethyl 4,4-Dimethyl-3-oxovalerate
CAS RN: 17094-34-7

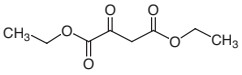
O0216 10g 25g

Ethyl 3-Oxoheptanoate
CAS RN: 7737-62-4

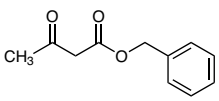
A0812 25mL 500mL

Isoamyl Acetoacetate
CAS RN: 2308-18-1

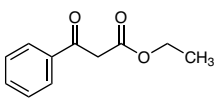
A0813 25mL

3-Pentyl Acetoacetate
CAS RN: 13562-81-7

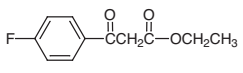
T0810 25g 100g 500g

Ethyl 4,4,4-Trifluoroacetoacetate
CAS RN: 372-31-6

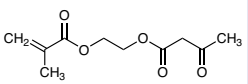
A0913 25mL

Hexyl Acetoacetate
CAS RN: 13562-84-0

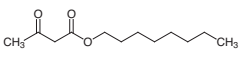
O0073 5g 25g

Diethyl Oxalacetate
CAS RN: 108-56-5

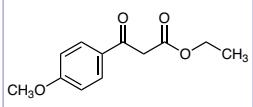
A1080 25mL 100mL 500mL

Benzyl Acetoacetate
CAS RN: 5396-89-4

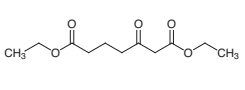
B0097 25g 100g 500g

Ethyl Benzoylacetate
CAS RN: 94-02-0

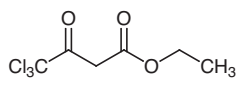
F0435 1g 5g 25g

Ethyl (4-Fluorobenzoyl)acetate
CAS RN: 1999-00-4

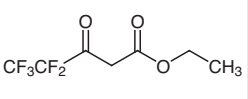
E0489 25g 500g

Ethylene Glycol Monoacetoacetate Monomethacrylate
(stabilized with BHT)
CAS RN: 21282-97-3

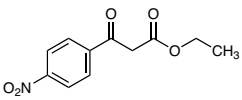
A0915 25mL

n-Octyl Acetoacetate
CAS RN: 16436-00-3

M1380 5g 25g

Ethyl 4-Methoxybenzoylacetate
CAS RN: 2881-83-6

O0229 1g 5g

Diethyl 3-Oxopimelate
CAS RN: 40420-22-2

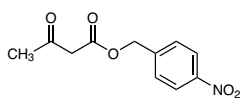
T1285 10g 25g

Ethyl 4,4,4-Trichloroacetoacetate
CAS RN: 3702-98-5

P1062 5g

Ethyl 4,4,5,5,5-Pentafluoro-3-oxovalerate
CAS RN: 663-35-4

N0513 5g 25g

Ethyl 4-Nitrobenzoylacetate
CAS RN: 838-57-3

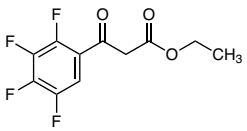
価格についてはウェブサイトでご覧いただけます。ウェブサイトでは構造式から試薬を検索することができます。
www.TCIchemicals.com/JP/ja/structure-search

N0875 5g 25g



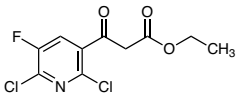
4-Nitrobenzyl Acetoacetate
CAS RN: 61312-84-3

E0759 25g



Ethyl (2,3,4,5-Tetrafluoro-benzoyl)acetate
CAS RN: 94695-50-8

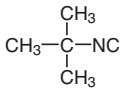
E0811 5g 25g



Ethyl 3-(2,6-Dichloro-5-fluoro-3-pyridyl)-3-oxopropionate
CAS RN: 96568-04-6

イソニトリル

B1274 5mL 25mL

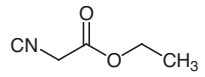


tert-Butyl Isocyanide
CAS RN: 7188-38-7

C1438 1g 5g

Cyclohexyl Isocyanide
CAS RN: 931-53-3

I0562 5g 25g

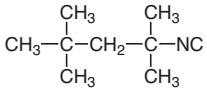


Ethyl Isocyanoacetate
CAS RN: 2999-46-4

B2185 1g 5g

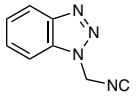
Benzyl Isocyanide
CAS RN: 10340-91-7

T1054 1mL 5mL



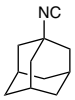
1,1,3,3-Tetramethylbutyl Isocyanide
CAS RN: 14542-93-9

I0455 1g 5g



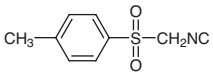
1-(Isocyanomethyl)-1*H*-benzotriazole
CAS RN: 87022-42-2

I0824 1g 5g



1-Isocyanoadamantane
CAS RN: 22110-53-8

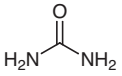
T1046 5g 25g



p-Toluenesulfonylmethyl Isocyanide (= TosMIC)
CAS RN: 36635-61-7

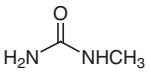
尿素

U0073 300g



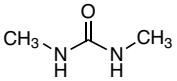
Urea
CAS RN: 57-13-6

M0455 25g 500g



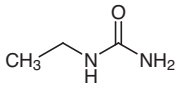
1-Methylurea
CAS RN: 598-50-5

D0289 25g 500g



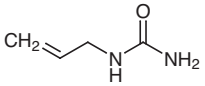
1,3-Dimethylurea
CAS RN: 96-31-1

E0192 25g 500g



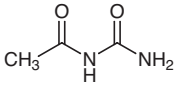
Ethylurea
CAS RN: 625-52-5

A0237 25g



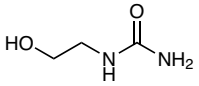
Allylurea
CAS RN: 557-11-9

A0124 25g



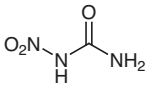
Acetylurea
CAS RN: 591-07-1

H0700 25g



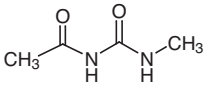
2-Hydroxyethylurea
CAS RN: 2078-71-9

N0328 5g



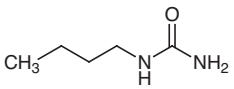
Nitrourea
CAS RN: 556-89-8

A0101 25g



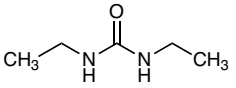
1-Acetyl-3-methylurea
CAS RN: 623-59-6

B1831 25g



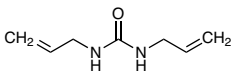
Butylurea
CAS RN: 592-31-4

D0534 25g 500g



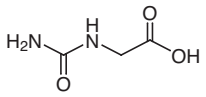
1,3-Diethylurea
CAS RN: 623-76-7

D5170 1g 5g



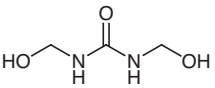
1,3-Diallylurea
CAS RN: 1801-72-5

H0655 25g



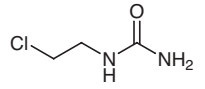
Hydantoic Acid
CAS RN: 462-60-2

D0767 25g 500g



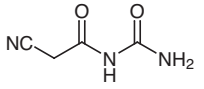
1,3-Bis(hydroxymethyl) urea
CAS RN: 140-95-4

C0173 25g



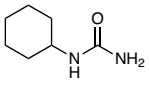
2-Chloroethylurea
CAS RN: 6296-42-0

C1101 25g 250g



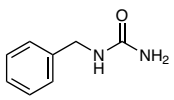
Cyanoacetylurea
CAS RN: 1448-98-2

C2034 25g



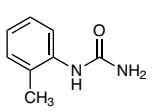
Cyclohexylurea
CAS RN: 698-90-8

B0449 25g



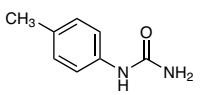
Benzylurea
CAS RN: 538-32-9

T0802 25g



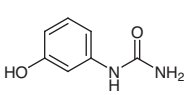
o-Tolylurea
CAS RN: 614-77-7

T0328 25g



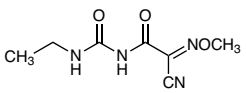
p-Tolylurea
CAS RN: 622-51-5

H0438 25g



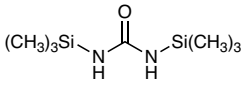
3-Hydroxyphenylurea
CAS RN: 701-82-6

C2657 5g 25g



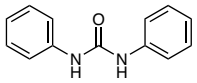
Cymoxanil
CAS RN: 57966-95-7

B1103 25g



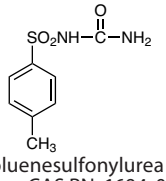
N,*N*'-Bis(trimethylsilyl)urea
CAS RN: 18297-63-7

C0031 25g 100g 500g



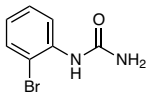
1,3-Diphenylurea
CAS RN: 102-07-8

T2890 5g



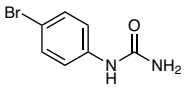
p-Toluenesulfonylurea
CAS RN: 1694-06-0

B2833 5g



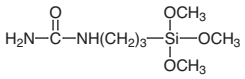
(2-Bromophenyl)urea
CAS RN: 13114-90-4

B2834 5g



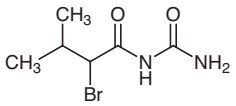
(4-Bromophenyl)urea
CAS RN: 1967-25-5

T1915 25g 250g



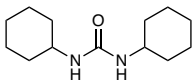
1-[3-(Trimethoxysilyl)-propyl]urea
CAS RN: 23843-64-3

B2842 25g



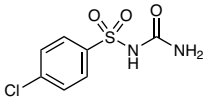
1-(2-Bromoisovaleryl)urea
CAS RN: 496-67-3

D0441 25g 500g



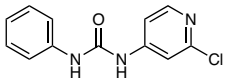
1,3-Dicyclohexylurea
CAS RN: 2387-23-7

C2266 5g



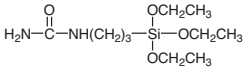
(4-Chlorophenylsulfonyl) urea
CAS RN: 22663-37-2

C0926 5g



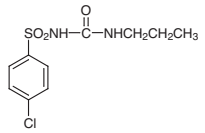
1-(2-Chloro-4-pyridyl)-3-phenylurea
CAS RN: 68157-60-8

U0048 25mL



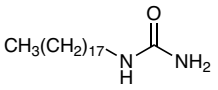
1-[3-(Triethoxysilyl)propyl]-urea (40-52% in Methanol)
CAS RN: 23779-32-0

C1220 25g



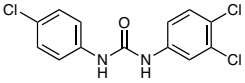
1-(4-Chlorophenylsulfonyl)-3-propylurea
CAS RN: 94-20-2

O0209 10g



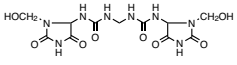
N-Octadecylurea
CAS RN: 2158-08-9

T1015 25g 500g



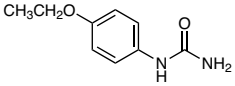
3,4,4'-Trichlorocarbanilide
CAS RN: 101-20-2

I0665 25g 250g



Imidazolidinyl Urea
CAS RN: 39236-46-9

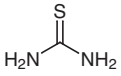
E1171 200mg 1g



(4-Ethoxyphenyl)urea
CAS RN: 150-69-6

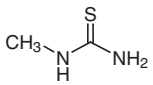
チオ尿素

T2475 300g



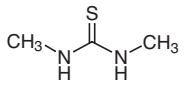
Thiourea
CAS RN: 62-56-6

M0619 25g 100g



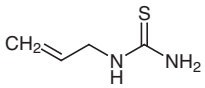
N-Methylthiourea
CAS RN: 598-52-7

D0804 25g 100g 500g



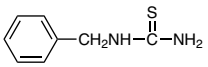
1,3-Dimethylthiourea
CAS RN: 534-13-4

A0220 25g 100g 500g



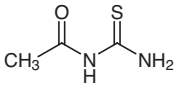
1-Allyl-2-thiourea
CAS RN: 109-57-9

B4612 1g 5g



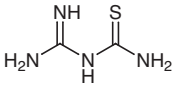
Benzylthiourea
CAS RN: 621-83-0

A0117 25g 500g



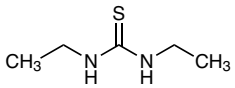
1-Acetyl-2-thiourea
CAS RN: 591-08-2

G0234 25g 100g 500g



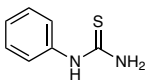
Guanylthiourea
CAS RN: 2114-02-5

D0530 25g 500g



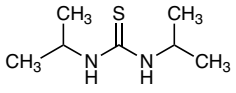
1,3-Diethyl-2-thiourea
CAS RN: 105-55-5

P0237 25g 500g



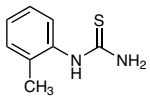
1-Phenyl-2-thiourea
CAS RN: 103-85-5

D0253 25g



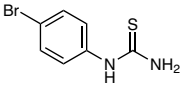
1,3-Diisopropylthiourea
CAS RN: 2986-17-6

T0657 25g



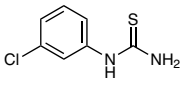
o-Tolylthiourea
CAS RN: 614-78-8

B4484 1g 5g



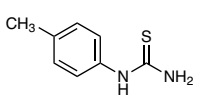
(4-Bromophenyl)thiourea
CAS RN: 2646-30-2

C3168 1g 5g



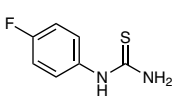
(3-Chlorophenyl)thiourea
CAS RN: 4947-89-1

T0656 5g



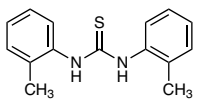
p-Tolylthiourea
CAS RN: 622-52-6

F0836 5g 25g



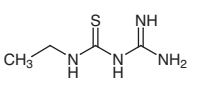
(4-Fluorophenyl)thiourea
CAS RN: 459-05-2

D0802 25g



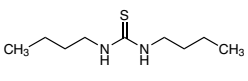
1,3-Di(*o*-tolyl)thiourea
CAS RN: 137-97-3

E0419 5g



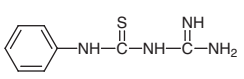
1-Ethyl-3-guanidinothiourea Hydrochloride
CAS RN: 381670-29-7

D0301 25g 500g



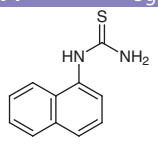
1,3-Dibutylthiourea
CAS RN: 109-46-6

P1167 5g



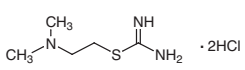
1-Phenyl-3-guanylthiourea
CAS RN: 15989-47-6

N0071 5g 25g



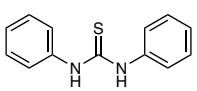
1-(1-Naphthyl)-2-thiourea
CAS RN: 86-88-4

D0652 10g



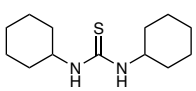
S-[2-(Dimethylamino)ethyl]-isothiourea Dihydrochloride
CAS RN: 16111-27-6

T0197 25g 500g



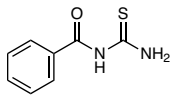
1,3-Diphenyl-2-thiourea
CAS RN: 102-08-9

D0440 5g 25g



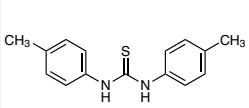
1,3-Dicyclohexylthiourea
CAS RN: 1212-29-9

B0802 25g



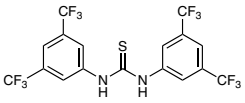
N-Benzoylthiourea
CAS RN: 614-23-3

D0803 5g 25g



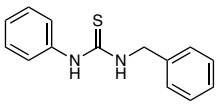
1,3-Di(*p*-tolyl)thiourea
CAS RN: 621-01-2

B3452 200mg 1g



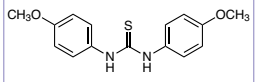
1,3-Bis[3,5-bis(trifluoromethyl)-phenyl]thiourea
CAS RN: 1060-92-0

B4997 1g 5g



1-Benzyl-3-phenylthiourea
CAS RN: 726-25-0

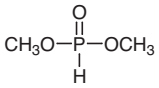
B4482 1g



1,3-Bis(4-methoxyphenyl)-thiourea
CAS RN: 1227-45-8

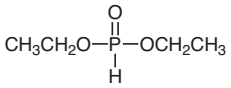
ジアルキル亜リン酸エステル

D0786 25mL



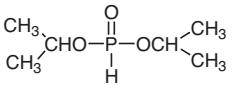
Dimethyl Phosphite
CAS RN: 868-85-9

D0521 25g 100g 500g



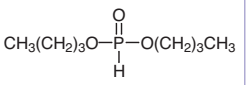
Diethyl Phosphite
CAS RN: 762-04-9

P0629 25g 500g



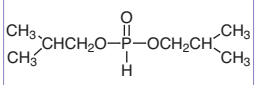
Diisopropyl Phosphite
CAS RN: 1809-20-7

D0300 25g



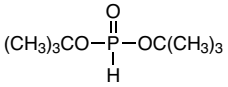
Dibutyl Phosphite
CAS RN: 1809-19-4

D3417 25g 500g



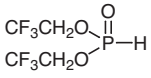
Diisobutyl Phosphite
CAS RN: 1189-24-8

D5814 1g 5g



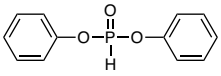
Di-*tert*-butyl Phosphonate
CAS RN: 13086-84-5

B2627 5g 25g



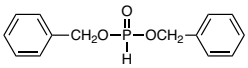
Bis(2,2,2-trifluoroethyl)-Phosphite
CAS RN: 92466-70-1

D0907 25g 100g 500g



Diphenyl Phosphite
CAS RN: 4712-55-4

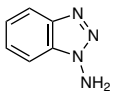
P1016 25g 250g



Dibenzyl Phosphite
CAS RN: 17176-77-1

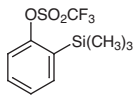
ベンザイン前駆体

A1464 1g 5g



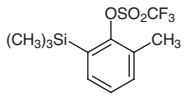
1-Aminobenzotriazole
CAS RN: 1614-12-6

T2089 1g 5g 25g



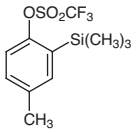
2-(Trimethylsilyl)phenyl Trifluoromethanesulfonate
CAS RN: 88284-48-4

M1883 1g 5g



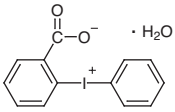
2-Methyl-6-(trimethylsilyl)phenyl Trifluoromethanesulfonate
CAS RN: 556812-44-3

M1882 1g 5g



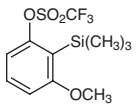
4-Methyl-2-(trimethylsilyl)phenyl Trifluoromethanesulfonate
CAS RN: 262373-15-9

D2503 5g 25g



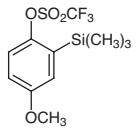
Diphenyliodonium-2-carboxylate Monohydrate
CAS RN: 96195-89-0

M1884 1g 5g



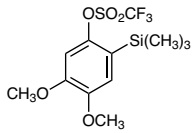
3-Methoxy-2-(trimethylsilyl)phenyl Trifluoromethanesulfonate
CAS RN: 217813-03-1

M1885 1g 5g



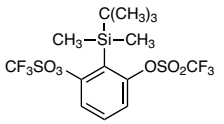
4-Methoxy-2-(trimethylsilyl)phenyl Trifluoromethanesulfonate
CAS RN: 556812-41-0

D3883 1g 5g



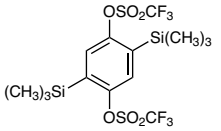
4,5-Dimethoxy-2-(trimethylsilyl)-phenyl Triflate
CAS RN: 866252-52-0

B5557 200mg 1g



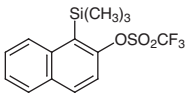
2-(*tert*-Butyldimethylsilyl)-1,3-phenylene Triflate
CAS RN: 1637638-66-4

B5559 1g



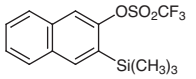
2,5-Bis(trimethylsilyl)-1,4-phenylene Triflate
CAS RN: 613676-07-6

T2465 1g 5g



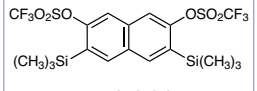
1-(Trimethylsilyl)-2-naphthyl Trifluoromethanesulfonate
CAS RN: 252054-88-9

T2466 1g 5g



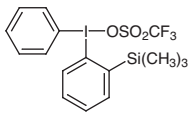
3-(Trimethylsilyl)-2-naphthyl Trifluoromethanesulfonate
CAS RN: 780820-43-1

B5080 1g



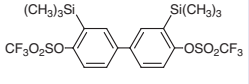
3,6-Bis(trimethylsilyl)-naphthalene-2,7-diyl Ditriflate
CAS RN: 947488-89-3

P1620 1g 5g



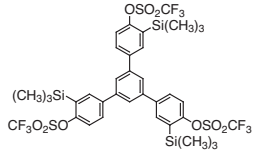
Phenyl[2-(trimethylsilyl)phenyl]-iodonium Trifluoromethanesulfonate
CAS RN: 164594-13-2

B3047 1g



3,3'-Bis(trimethylsilyl)biphenyl-4,4'-diyl Bis(trifluoromethanesulfonate)
CAS RN: 828282-80-0

T2467 1g



1,3,5-Tris[4-(trifluoromethanesulfonyloxy)-3-(trimethylsilyl)phenyl]benzene
CAS RN: 847925-63-7

ルイス酸

L0204 25g 300g

Lithium Chloride Anhydrous
CAS RN: 7447-41-8

L0210 25g 100g 500g

Lithium Bromide
CAS RN: 7550-35-8

N0850 25g 500g

Nickel(II) Chloride Anhydrous
CAS RN: 7718-54-9

Z0014 25g 300g

Zinc Chloride
CAS RN: 7646-85-7

B0527 25mL 100mL 500mL

Boron Trifluoride - Ethyl Ether Complex
CAS RN: 109-63-7

T0267 25g 500g

p-Toluenesulfonic Acid Monohydrate
CAS RN: 6192-52-5

T3238 100mL 500mL

Titanium(IV) Chloride (*ca.* 19% in Toluene, *ca.* 1.0mol/L)
CAS RN: 7550-45-0

T2052 20mL 100mL 500mL

Titanium(IV) Chloride (14% in Dichloromethane, ca. 1.0mol/L)
CAS RN: 7550-45-0

R0074 1g 5g

Ruthenium(III) Chloride Hydrate
CAS RN: 14898-67-0

I0778 5g 25g

Indium(III) Chloride Anhydrous
CAS RN: 10025-82-8

B3546 25g 250g

Bismuth(III) Chloride Anhydrous
CAS RN: 7787-60-2

T1663 1g 5g

Scandium(III) Trifluoromethanesulfonate
CAS RN: 144026-79-9

T1293 5g 25g

Lanthanum(III) Trifluoromethanesulfonate
CAS RN: 52093-26-2

T1610 5g 25g

Ytterbium(III) Trifluoromethanesulfonate Hydrate
CAS RN: 54761-04-5

イオン液体

B2194 5g 25g 100g

1-Butyl-3-methylimidazolium Chloride
CAS RN: 79917-90-1

B2193 5g

1-Butyl-3-methylimidazolium Bromide
CAS RN: 85100-77-2

B2195 5g 25g 100g

1-Butyl-3-methylimidazolium Tetrafluoroborate
CAS RN: 174501-65-6

T0055 5g 25g 100g

Tetrabutylammonium Chloride
CAS RN: 1112-67-0

B2320 5g 25g

1-Butyl-3-methylimidazolium Hexafluorophosphate
CAS RN: 174501-64-5

B2337 5g 25g

1-Butyl-3-methylimidazolium Trifluoromethanesulfonate
CAS RN: 174899-66-2

T0054 25g 100g 500g

Tetrabutylammonium Bromide
CAS RN: 1643-19-2

T1124 25g 100g 500g

Tetrabutylphosphonium Bromide
CAS RN: 3115-68-2

東京化成工業株式会社

試薬製品について

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