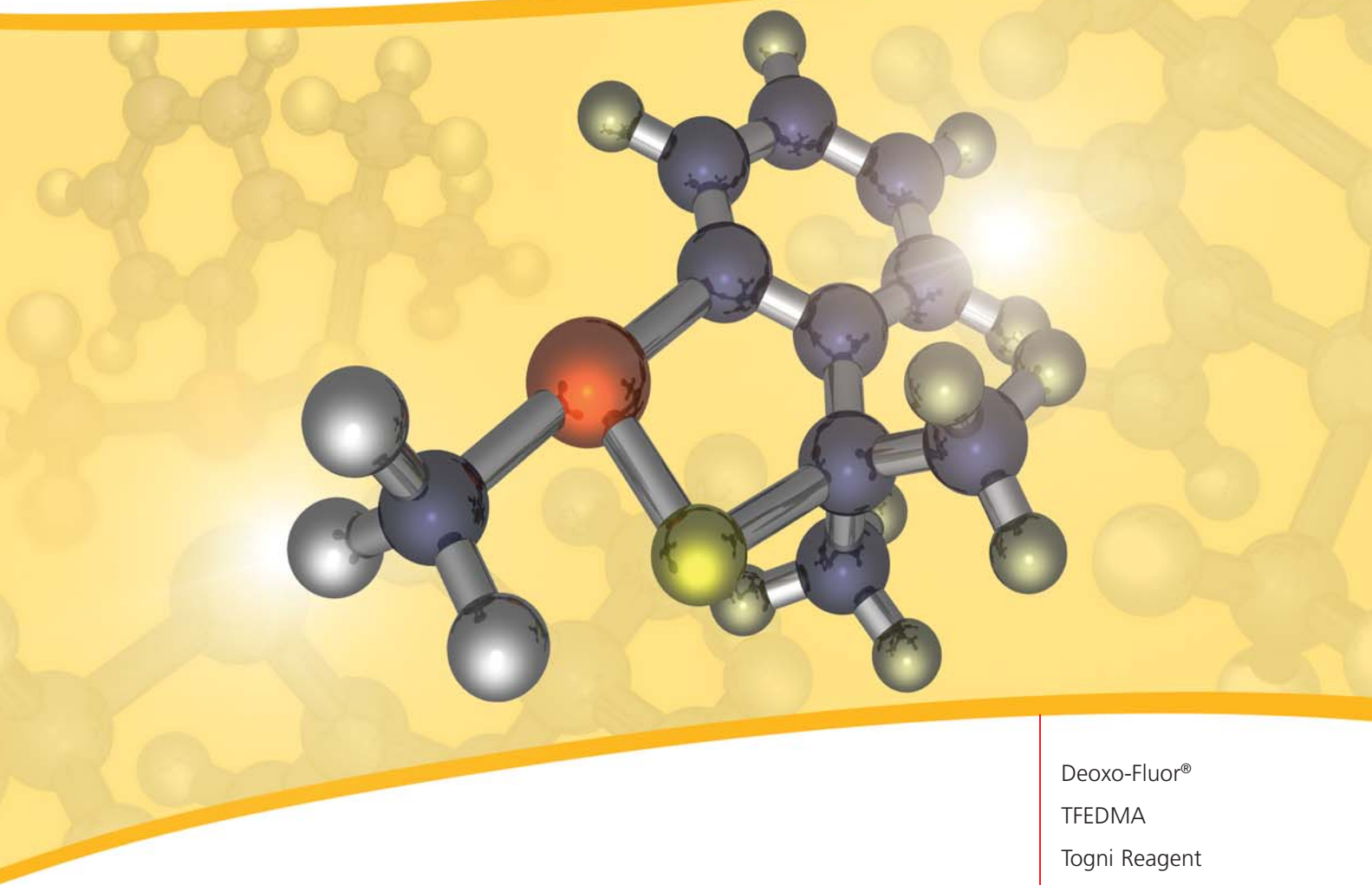
ChemFiles

Vol. 8, No. 3

ALDRICH Chemistry

Fluorination



3,3-Dimethyl-1-(trifluoromethyl)-1,2-benziodoxole (Togni Reagent): an effective reagent for electrophilic trifluoromethylation

Deoxo-Fluor®

TFEDMA

Togni Reagent

Ruppert–Prakash Reagent

TDAE

Introduction

Mark Redlich
Product Manager

The introduction of fluorine in medicinally and agrochemically relevant molecular structures is an important task due to fluorine's ability to profoundly alter the biological properties of a compound without significantly altering the steric properties compared to the hydrocarbon. However, the mild and selective fluorination of functionalized molecules is often a synthetic challenge and continues to be a highly researched area.

In this issue of *ChemFiles*, we are pleased to introduce some of the highlights of our fluorination product line. Deoxo-Fluor® and 1,1,2,2-tetrafluoroethyl-*N*,*N*-dimethylamine are fluorinating reagents which display excellent selectivity and exhibit increased stability versus similar products. The Ruppert–Prakash reagent and TDAE are reagents for nucleophilic trifluoromethylation, while the Togni reagent is a complementary electrophilic reagent. Also, we would like to feature some of the fluorinated building blocks we have recently added to our ever-expanding product catalog.

If you are unable to find the specific reagent or building block for your research, "Please Bother Us" with your suggestions at *mark.redlich@sial.com*, or contact your local Sigma-Aldrich® office (see back cover).

About Our Cover

The cover graphic shows a rendering of the structure of 3,3-dimethyl-1-(trifluoromethyl)-1,2-benziodoxole (Togni Reagent). The Togni reagent is an electrophilic reagent for trifluoromethylation that is easy to handle, tolerant of various functional groups, and does not exhibit significant solvent dependence.

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Bis(2-methoxyethyl)aminosulfur Trifluoride (Deoxo-Fluor®)

Originally reported by Lal and coworkers in 1999,[1] bis(2-methoxyethyl)aminosulfur trifluoride (Deoxo-Fluor®) has shown remarkable utility in organic synthesis as a thermally stable alternative to (diethylamino)sulfur trifluoride (DAST). Deoxo-Fluor can easily convert alcohols to alkyl fluorides, aldehydes and ketones to *gem*-difluorides, and carboxylic acids to acid fluorides or trifluoromethyl derivatives (**Scheme 1**).[2]

A recent report showed the use of Deoxo-Fluor in the synthesis of a 2-azabicyclo[2.1.1]hexane analogue of 4-fluoroproline (**Scheme 2**).[3] Although the reaction generally proceeds with inversion at the chiral carbon, the configuration is retained in this constrained substrate due to neighboring-group participation of the amide group.

Deoxo-Fluor can be used to effect a wide array of additional transformations. One recent example highlights its use in the syntheses of a series of chiral C_2 bis-oxazoline ligands (**Scheme 3**).[4] The chemoselectivity of Deoxo-Fluor was superior to other reagents, including DAST, and was tolerant of steric and electronic variations within the ligands. Furthermore, the Deoxo-Fluor protocol also allowed the majority of the ligands to be purified without requiring chromatography.

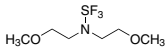
Gunda Georg at the University of Kansas has reported the use of Deoxo-Fluor in a one-flask protocol to convert acids to amides and peptides or Weinreb amides (**Scheme 4**).[5] The reaction proceeded under mild conditions and provided the desired products in high yields with facile purification.

The Kangani group has devoted several publications to one-pot transformations achievable with Deoxo-Fluor.[6] Generally, the reactions begin with the conversion of a carboxylic acid to an acid fluoride, which is then reacted with various nucleophiles to produce oxazolines, aldehydes, ketones, benzoxazoles, oxadiazoles, acyl azides or nitriles (**Scheme 5**).

References: (1)(a) Lal, G. S. et al. *J. Org. Chem.* **1999**, *64*, 7048. (b) Lal, G. S. et al. *Chem. Commun.* **1999**, 215. (2) Singh, R. P.; Shreeve, J. M. *Synthesis* **2002**, 2561. (3) Jenkins, C. L. et al. *J. Org. Chem.* **2004**, *69*, 8565. (4) Albano, V. G. et al. *J. Org. Chem.* **2006**, *71*, 6451. (5) White, J. M. et al. *J. Org. Chem.* **2004**, *69*, 2573. (6)(a) Kangani, C. O.; Kelley, D. E. *Tetrahedron Lett.* **2005**, *46*, 8917. (b) Kangani, C. O. et al. *Tetrahedron Lett.* **2006**, *47*, 6289. (c) Kangani, C. O. et al. *Tetrahedron Lett.* **2006**, *47*, 6497. (d) Kangani, C. O. et al. *Tetrahedron Lett.* **2007**, *48*, 5933.

Bis(2-methoxyethyl)aminosulfur trifluoride

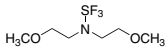
Deoxo-Fluor®
[202289-38-1]
$C_6H_{14}F_3NO_2S$
FW 221.24



494119-5G	5 g
494119-25G	25 g
494119-100G	100 g

Deoxo-Fluor® solution

Bis(2-methoxyethyl)aminosulfur trifluoride solution
[202289-38-1]
$C_6H_{14}F_3NO_2S$
FW 221.24

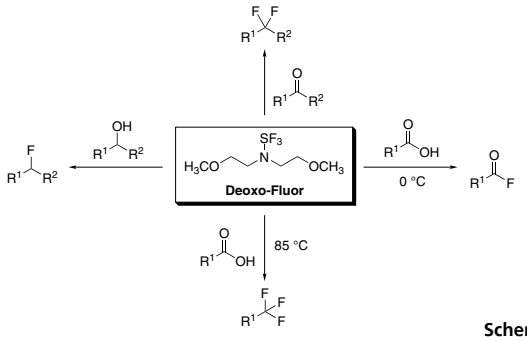


▸ ~50% in toluene (NMR)

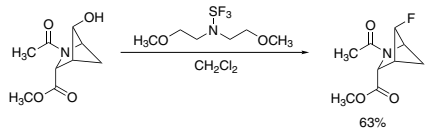
94324-10ML-F	10 mL
94324-50ML-F	50 mL

▸ 50% in tetrahydrofuran

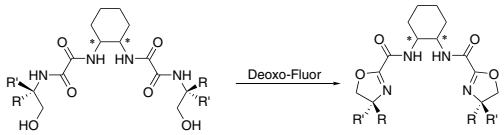
94327-10ML-F	10 mL
94327-50ML-F	50 mL



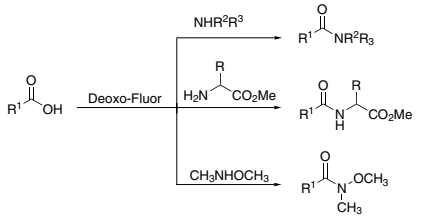
Scheme 1



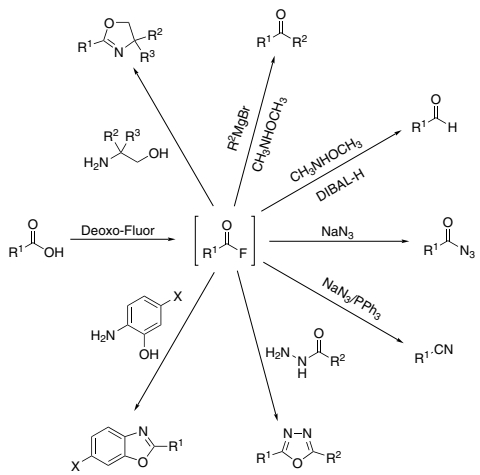
Scheme 2



Scheme 3



Scheme 4

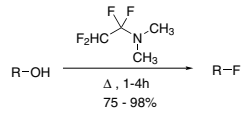


Scheme 5

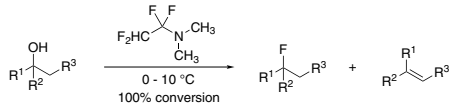
1,1,2,2-Tetrafluoroethyl-*N*,*N*-dimethylamine (TFEDMA)

1,1,2,2-Tetrafluoroethyl-*N*,*N*-dimethylamine (TFEDMA) is a new, mild, and selective nucleophilic fluorination reagent for fluorination of alcohols and activated carbonyl compounds.[1] In contrast to the similar Yarovenko–Raksha reagent (2-chloro-1,1,2-trifluoroethyl-*N*,*N*-diethylamine), the material is stable at ambient temperature with unlimited shelf life as long as it is contained in polyethylene, Teflon®, or metal containers.

Reactions of TFEDMA with primary alcohols provide the corresponding alkyl fluorides in good to excellent yields (**Scheme 1**). Secondary and tertiary alcohols are more reactive towards TFEDMA, though in some cases provide the elimination product in addition to the fluoride (**Scheme 2**). Aldehydes and ketones can also react with TFEDMA to yield the *gem*-difluorides, and carboxylic or sulfonic acids produce the corresponding acyl or sulfonyl fluorides. The amide byproduct of TFEDMA in fluorination reactions is water-soluble and can usually be washed from the reaction mixture, simplifying reaction workup.



Scheme 1

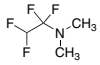


Scheme 2

Reference: (1) Petrov, V. A. et al. *J. Fluorine Chem.* **2001**, *109,* 25.

1,1,2,2-Tetrafluoro-*N*,*N*-dimethylethylamine, 97%

1,1,2,2-Tetrafluoro-*N*,*N*-dimethylethanamine;
TFEDMA; *N*,*N*-Dimethyl-1,1,2,2-tetrafluoroethylamine
[1550-50-1]
$C_4H_7F_4N$
FW 145.10



693332-5G	5 g
693332-25G	25 g

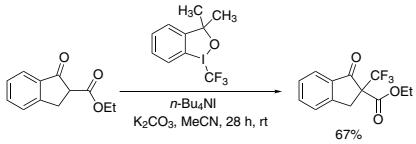
3,3-Dimethyl-1-(trifluoromethyl)-1,2-benziodoxole (Togni Reagent)

The direct transfer of a trifluoromethyl group usually requires harsh conditions that are often incompatible with more sensitive functionalities in a molecule. Nucleophilic trifluoromethylation is the most common method, due in large part to the broad applicability of the Ruppert–Prakash reagent (Me_3SiCF_3). Most reagents for electrophilic *C*- and *S*-trifluoromethylation are considerably less developed. Antonio Togni and coworkers have recently reported a new electrophilic reagent based on hypervalent iodine, 3,3-dimethyl-1-(trifluoromethyl)-1,2-benziodoxole,[1] which nicely complements the nucleophilic Ruppert–Prakash reagent.

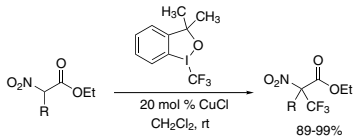
The Togni reagent is easy to handle, and can be exposed to moist air for short periods of time without any apparent alteration. β-Ketoesters were found to react with the Togni reagent under phase-transfer catalysis conditions to yield the α-trifluoromethylated derivatives (**Scheme 1**). More interesting are the trifluoromethylations of α-nitroesters, which yield precursors to α-trifluoromethyl-α-amino acids (**Scheme 2**).

Aromatic and aliphatic thiols undergo selective *S*-trifluoromethylation in the presence of the Togni reagent, without formation of the corresponding disulfide (**Scheme 3**). The reaction is remarkably tolerant of various functional groups and does not show significant solvent dependence, allowing for the use of the Togni reagent at the latter stages of syntheses of complex molecules.

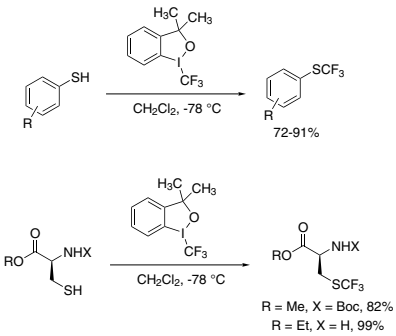
References: (1)(a) Eisenberger, P. et al. *Chem.-Eur. J.* **2006**, *12*, 2579. (b) Kieltsch, I. et al. *Angew. Chem. Int. Ed.* **2007**, *46*, 754.



Scheme 1



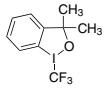
Scheme 2



Scheme 3

3,3-Dimethyl-1-(trifluoromethyl)-1,2-benziodoxole, 97%

Togni Reagent; 1,3-Dihydro-3,3-dimethyl-1-(trifluoromethyl)-1,2-benziodoxole
[887144-97-0]
$C_{10}H_{10}F_3IO$
FW 330.09



696641-250MG	250 mg
696641-1G	1 g

Trimethyl(trifluoromethyl)silane (Ruppert–Prakash Reagent)

One of the most widely used reagents for nucleophilic trifluoromethylation is trimethyl(trifluoromethyl)silane, $TMSCF_3$. The reagent has become widely referred to as the Ruppert–Prakash reagent, after Ruppert who introduced the material in 1984,[1] and Prakash who is largely responsible for popularizing its use.[2] The broad applicability of the $TMSCF_3$ makes it a popular reagent in syntheses of various medicinal targets.

In one example, a series of four tri- and tetraglutamic acid and glutamine peptides were created that incorporate a trifluoromethyl ketone group.[3] The β-amino alcohol synthon was synthesized in five steps where the key step utilized $TMSCF_3$ to create the resultant trifluoromethylated silyl ether as a single diastereomer (**Scheme 1**). Two of the peptides in the report were shown to exhibit inhibitory activity against severe acute respiratory syndrome coronavirus protease (SARS-CoV $3CL^{pro}$).

Another example employs $TMSCF_3$ in the synthesis of a non-steroidal selective androgen receptor modulator that displays excellent oral bioavailability and anabolic activity in muscle (**Scheme 2**).[4] The compound also improved bone strength in a rat model of postmenopausal osteoporosis. Similarly, Hudson and coworkers used $TMSCF_3$ to create a selective glucocorticoid receptor modulator that demonstrated antiproliferative activity equal to the myeloma therapeutic, dexamethasone (**Scheme 3**).[5]

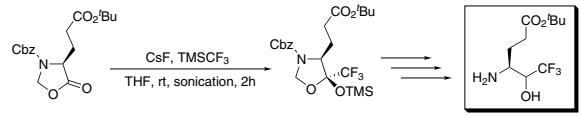
Commonly, an additional fluoride source (TBAF, CsF, etc.) is required to initiate the trifluoromethylation reaction. However, a recent report from Prakash detailed the trilfuoromethylation of carbonyl compounds using a new series of catalysts which do not require additional fluoride initiators or water-free conditions (**Scheme 4**).[6]

Another report from Prakash demonstrated the use of $TMSCF_3$ on *N*-unactivated imines to yield the corresponding trifluoromethylated amine. With a slight variation in the reaction conditions, difluoromethylated amines can also be prepared via HF elimination and reduction (**Scheme 5**).[7]

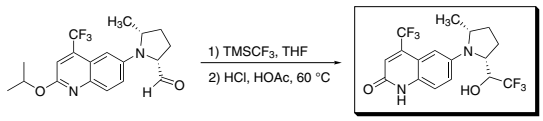
Despite its wide use, stereoselective trifluoromethylation using the Ruppert–Prakash reagent is still challenging. However, several groups have made significant progress in this arena. Dieter Enders has reported diastereoselective trifluoromethylation of α-alkylated dioxanones with very good yields and high diastereo- and enantiomeric excesses.[8] The acetonide group is easily removed to generate the 2-trifluoromethyl-1,2,3-triols (**Scheme 6**).

Shibata, Toru, and coworkers have recently reported an operationally simple method for enantioselective trifluoromethylation based on the combination of the ammonium bromide of a cinchona alkaloid, **1**, and tetramethylammonium fluoride (TMAF).[9] The reaction proceeds in modest to excellent yields with ee's up to 93% (**Scheme 7**).

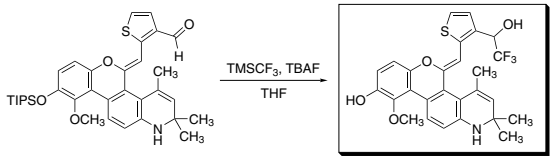
References: (1) Ruppert, I. et al. *Tetrahedron Lett.* **1984**, *24*, 2195. (2)(a) Prakash, G. K. S. et al. *J. Am. Chem. Soc.* **1989**, *111*, 393. (b) Prakash, G. K. S.; Mandal, M. *J. Am. Chem. Soc.* **2002**, *124*, 6538. (3) Syndes, M. O. et al. *Tetrahedron* **2006**, *62*, 8601. (4) Martinborough, E. et al. *J. Med. Chem.* **2007**, *50*, 5049. (5) Hudson, A. R. et al. *J. Med. Chem.* **2007**, *50*, 4699. (6) Prakash, G. K. S. et al. *J. Org. Chem.* **2006**, *71*, 6806. (7) Prakash, G. K. S. et al. *Org. Lett.* **2006**, *8*, 3589. (8) Enders, D.; Herriger, C. *Eur. J. Org. Chem.* **2007**, 1085. (9)(a) Mizuta, S. et al. *Org. Lett.* **2007**, *9*, 3707. (b) Mizuta, S. et al. *Tetrahedron* **2007**, *63*, 8521.



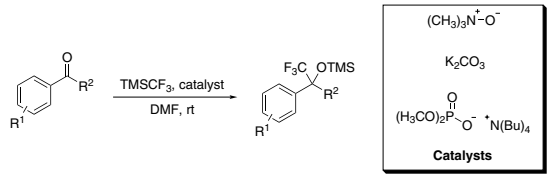
Scheme 1



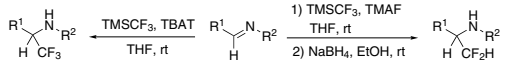
Scheme 2



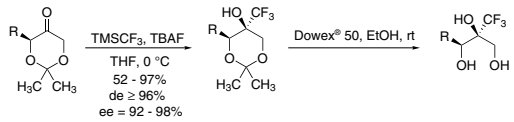
Scheme 3



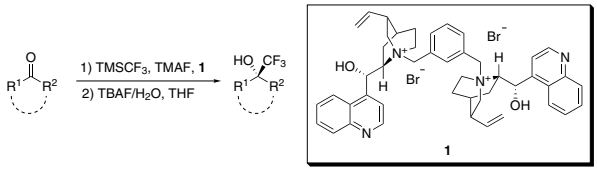
Scheme 4



Scheme 5



Scheme 6



Scheme 7

Trimethyl(trifluoromethyl)silane, 99%

Ruppert's Reagent; TFMTMS; (Trifluoromethyl)trimethylsilane
[81290-20-2]
$C_4H_9F_3Si$
FW 142.19

488712-5ML	5 mL
488712-25ML	25 mL

Trimethyl(trifluoromethyl)silane, ≥98.0% (GC)

Ruppert's Reagent; TFMTMS; (Trifluoromethyl)trimethylsilane
[81290-20-2]
$C_4H_9F_3Si$
FW 142.19

91873-1ML	1 mL
91873-5ML	5 mL
91873-25ML	25 mL

Trimethyl(trifluoromethyl)silane solution

(Trifluoromethyl)trimethylsilane
[81290-20-2]
$C_4H_9F_3Si$
FW 142.19

▸ **~2.0 M in tetrahydrofuran**

91862-10ML	10 mL
91862-50ML	50 mL

Triethyl(trifluoromethyl)silane

(Trifluoromethyl)triethylsilane; Triethylsilyl trifluoromethane
[120120-26-5]
$C_7H_{15}F_3Si$
FW 184.27

▸ **≥98.0% (GC)**

90570-5ML	5 mL

▸ **98%**

419982-1G	1 g

Cesium fluoride

[13400-13-0]
CsF
FW 151.90

▸ **99.9% trace metals basis**

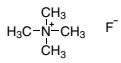
289345-5G	5 g
289345-25G	25 g
289345-100G	100 g

▸ **99%**

198323-25G	25 g
198323-100G	100 g

Tetramethylammonium fluoride, 97%

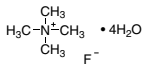
[373-68-2]
$C_4H_{12}FN$
FW 93.14



459135-1G	1 g
459135-5G	5 g

Tetramethylammonium fluoride tetrahydrate, 98%

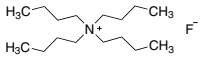
[17787-40-5]
$C_4H_{12}FN \cdot 4H_2O$
FW 165.20



107212-5G	5 g
107212-25G	25 g

Tetrabutylammonium fluoride solution

TBAF solution
[429-41-4]
$C_{16}H_{36}FN$
FW 261.46



▸ **1.0 M in tetrahydrofuran**

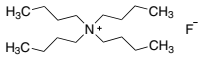
216143-5ML	5 mL
216143-100ML	100 mL
216143-500ML	500 mL
216143-2L	2 L

▸ **75 wt. % in H_2O**

361399-25G	25 g
361399-100G	100 g
361399-500G	500 g

Tetrabutylammonium fluoride on silica gel

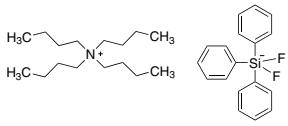
[429-41-4]
$C_{16}H_{36}FN$
FW 261.46



358673-5G	5 g
358673-25G	25 g

Tetrabutylammonium difluorotriphenylsilicate, 97%

TBAT
[163931-61-1]
$C_{34}H_{51}F_2NSi$
FW 539.86



441457-5G	5 g
441457-25G	25 g

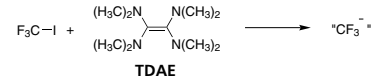
Tetrakis(dimethylamino)ethylene (TDAE)

In 2001, Professor William Dolbier, Jr., at the University of Florida reported[1] an approach to nucleophilic trifluoromethylation based on the generation of a trifluoromethyl anion using CF_3I in the presence of a powerful two-electron reductant, tetrakis(dimethylamino)ethylene (TDAE) (**Scheme 1**).

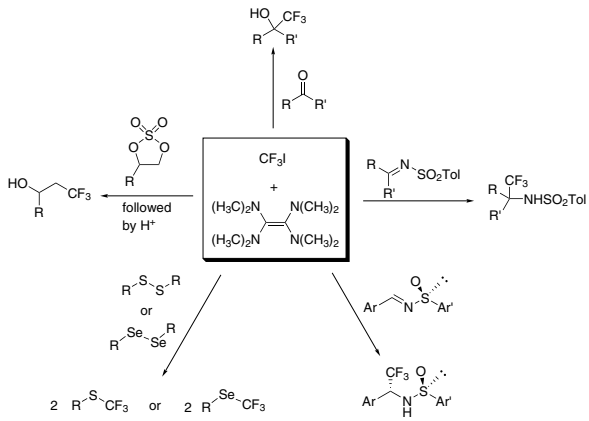
Over the ensuing years, Dolbier's group has developed numerous reactions featuring this reagent system, including the trifluoromethylation of aldehydes and ketones,[1a] cyclic sulfates,[2] disulfides and diselenides,[3] and imines[1b] (**Scheme 2**). In many cases, the TDAE/CF_3I method provided results that complement other nucleophilic trifluoromethylation reagents. Recently, Dolbier has expanded the use of his system to perfluoroalkylation,[4] and was able to achieve similar results as with CF_3I; however, when the perfluorobutyl system was used, yields tended to decrease noticeably.

TDAE has a reducing power comparable to zinc metal and as such has also been used as a reducing agent in organic synthesis. Recently, Vanelle and coworkers have exploited this reductive property to obtain epoxides from aldehydes and 2-(dibromomethyl)quinoxaline (**Scheme 3**),[5] as well as α-chloroketones from aldehydes and 2-(trichloromethyl)-substituted azaheterocycles (**Scheme 4**).[6] The Nishiyama group at Kansai University in Osaka has also used TDAE to obtain 1,2,3,4-tetrahydronaphthalenes from 1,2-bis(bromomethyl)arenes and olefins,[7] and 1,4-diketones or diesters through reductive coupling of α-bromoketones or esters (**Scheme 5**).[8]

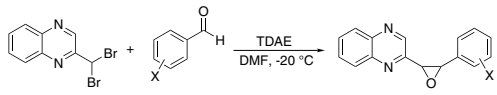
References: (1)(a) Aït-Mohand, S. et al. *Org. Lett.* **2001**, *3*, 4271. (b) Xu, W.; Dolbier, W. R., Jr. *J. Org. Chem.* **2005**, *70*, 4741. (2) Takechi, N. et al. *Org. Lett.* **2002**, *4*, 4671. (3) Pooput, C. et al. *Org. Lett.* **2004**, *6*, 301. (4) Pooput, C. et al. *J. Org. Chem.* **2006**, *71*, 3564. (5) Montana, M. et al. *Tetrahedron Lett.* **2005**, *46*, 8373. (6) Montana, M. et al. *Tetrahedron Lett.* **2006**, *47*, 6573. (7) Nishiyama, Y. et al. *Tetrahedron Lett.* **2005**, *46*, 867. (8) Nishiyama, Y.; Kobayashi, A. *Tetrahedron Lett.* **2006**, *47*, 5565.



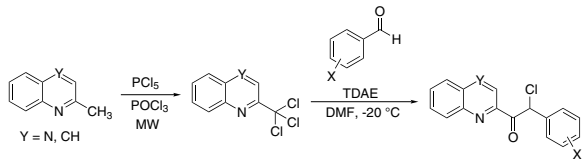
Scheme 1



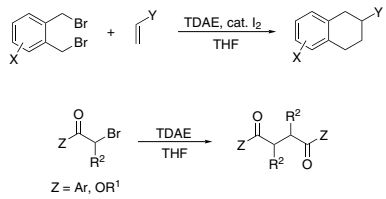
Scheme 2



Scheme 3



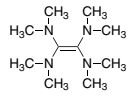
Scheme 4



Scheme 5

Tetrakis(dimethylamino)ethylene

Octamethylethylenetetramine; TDAE
[996-70-3]
$C_{10}H_{24}N_4$
FW 200.32



674613-1G	1 g
674613-10G	10 g
674613-50G	50 g

Trifluoroiodomethane, 99%

Iodotrifluoromethane; Perfluoromethyl iodide; Trifluoromethyl iodide
[2314-97-8]
CF_3I
FW 195.91

171441-25G	25 g
171441-100G	100 g

Other Reagents for Fluorination and Trifluoromethylation

Potassium fluoride

[7789-23-3]
FK
FW 58.10

KF

▸ **≥99.0%**

402931-5G	5 g
402931-100G	100 g
402931-500G	500 g
402931-12KG	12 kg

▸ **99%**

307599-50G	50 g
307599-250G	250 g
307599-1KG	1 kg

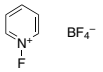
Hydrogen fluoride pyridine

HF-Pyridine; Pyridine hydrofluoride
[62778-11-4]
$C_5H_5N \cdot (HF)_x$

184225-25G	25 g
184225-100G	100 g

1-Fluoropyridinium tetrafluoroborate, 97%

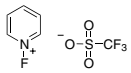
[107264-09-5]
$C_5H_5BF_5N$
FW 184.90



377260-1G	1 g
377260-5G	5 g

1-Fluoropyridinium triflate, 99%

1-Fluoropyridinium trifluoromethanesulfonate
[107263-95-6]
$C_6H_5F_4NO_3S$
FW 247.17



323659-1G	1 g
323659-5G	5 g

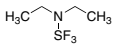
(Dimethylamino)sulfur trifluoride

Methyl DAST
[3880-03-3]
$C_2H_6F_3NS$
FW 133.14

248215-5G	5 g
248215-25G	25 g

(Diethylamino)sulfur trifluoride

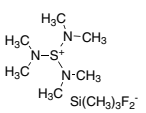
DAST
[38078-09-0]
$C_4H_{10}F_3NS$
FW 161.19



235253-1G	1 g
235253-5G	5 g
235253-25G	25 g
235253-125G	125 g
235253-250G	250 g

Tris(dimethylamino)sulfonium difluorotrimethylsilicate

TASF; Tris(dimethylamino)sulfur trimethylsilyl difluoride; TAS-F
[59218-87-0]
$C_9H_{27}F_2N_3SSi$
FW 275.48



250600-250MG	250 mg
250600-1G	1 g
250600-5G	5 g

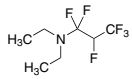
Morpholinosulfur trifluoride

Morpho-DAST; Morph-DAST
[51010-74-3]
$C_4H_8F_3NOS$
FW 175.17

338915-1G	1 g
338915-5G	5 g

Ishikawa's Reagent

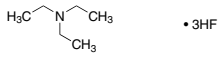
N,*N*-Diethyl-1,1,2,3,3,3-hexafluoropropylamine
[309-88-6]
$C_7H_{11}F_6N$
FW 223.16



564990-25G	25 g

Triethylamine trihydrofluoride, 98%

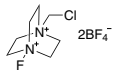
Hydrogen fluoride triethylamine
[73602-61-6]
$C_6H_{15}N \cdot 3HF$
FW 161.21



344648-5G	5 g
344648-25G	25 g
344648-100G	100 g

Selectfluor® fluorinating reagent

1-Chloromethyl-4-fluoro-1,4-diazoniabicyclo[2.2.2]octane bis(tetrafluoroborate); *N*-Chloromethyl-*N*'-fluorotriethylenediammonium bis(tetrafluoroborate); F-TEDA
[140681-55-6]
$C_7H_{14}B_2ClF_9N_2$
FW 354.26

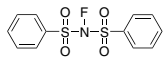


▸ **>95% in F+ active**

439479-5G	5 g
439479-25G	25 g
439479-100G	100 g

N-Fluorobenzenesulfonimide, 97%

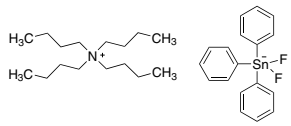
NFSI; *N*-Fluorodibenzenesulfonimide; *N*-Fluorodi(benzenesulfonyl)amine
[133745-75-2]
$C_{12}H_{10}FNO_4S_2$
FW 315.34



392715-1G	1 g
392715-5G	5 g

Tetrabutylammonium difluorotriphenylstannate, 97%

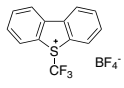
[139353-88-1]
$C_{34}H_{51}F_2NSn$
FW 630.48



418625-250MG	250 mg
418625-1G	1 g

5-(Trifluoromethyl)dibenzothiophenium tetrafluoroborate, 97%

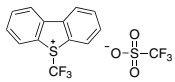
[131880-16-5]
$C_{13}H_8BF_7S$
FW 340.07



483869-1G	1 g

5-(Trifluoromethyl)dibenzothiophenium trifluoromethanesulfonate, 97%

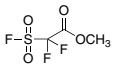
[129946-88-9]
$C_{14}H_8F_6O_3S_2$
FW 402.33



483877-1G	1 g

Methyl 2,2-difluoro-2-(fluorosulfonyl)acetate, 97%

[680-15-9]
$C_3H_3F_3O_4S$
FW 192.11



390755-1G	1 g
390755-5G	5 g

Fluorinated Building Blocks

1,1,2,2-Tetrafluoroethanesulfonic acid, 97%

TFESA
[464-14-2]
$C_2H_2F_4O_3S$
FW 182.09

693294-5G	5 g
693294-25G	25 g

2-Fluoropropionic acid, 97%

[6087-13-4]
$C_3H_5FO_2$
FW 92.07

694371-250MG	250 mg

4,5,6-Trifluoropyrimidine, 96%

[17573-78-3]
$C_4HF_3N_2$
FW 134.06

684643-250MG	250 mg

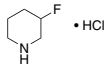
3-Fluoro-4-iodopyridine, 97%

4-Iodo-3-fluoropyridine
[22282-75-3]
C_5H_3FIN
FW 222.99

685216-1G	1 g
685216-5G	5 g

3-Fluoropiperidine hydrochloride, 97% NEW

[116574-75-5]
$C_5H_{10}FN \cdot HCl$
FW 139.60



680168-250MG	250 mg
680168-1G	1 g

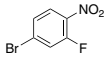
1-Bromo-4-fluoro-2-iodobenzene, 97%

2-Iodo-4-fluorobromobenzene
[202865-72-3]
C_6H_3BrFI
FW 300.89

686786-1G	1 g
686786-10G	10 g

4-Bromo-2-fluoro-1-nitrobenzene, 95%

[321-23-3]
$C_6H_3BrFNO_2$
FW 220.00



680931-500MG	500 mg
680931-5G	5 g

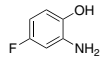
2,4-Difluororesorcinol, 95%

2,4-Difluorobenzene-1,3-diol;
2,4-Difluoro-1,3-dihydroxy benzene
[195136-71-1]
$C_6H_4F_2O_2$
FW 146.09

687421-500MG	500 mg

2-Amino-4-fluorophenol, 96%

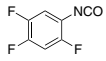
5-Fluoro-2-hydroxyaniline
[399-97-3]
C_6H_6FNO
FW 127.12



683302-1G	1 g

2,4,5-Trifluorophenyl isocyanate, 97%

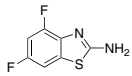
$C_7H_2F_3NO$
FW 173.09



682551-1G	1 g

2-Amino-4,6-difluorobenzothiazole, 97% NEW

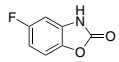
[119256-40-5]
$C_7H_4F_2N_2S$
FW 186.18



683337-1G	1 g
683337-5G	5 g

5-Fluoro-2(3*H*)-benzoxazolone, 96% NEW

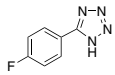
5-Fluorobenzo[*d*]oxazol-2(3*H*)-one
[13451-79-1]
$C_7H_4FNO_2$
FW 153.11



683264-1G	1 g

5-(4-Fluorophenyl)-1*H*-tetrazole, 95% NEW

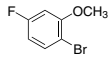
[50907-21-6]
$C_7H_5FN_4$
FW 164.14



681091-1G	1 g
681091-5G	5 g

2-Bromo-5-fluoroanisole, 99%

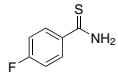
1-Bromo-4-fluoro-2-methoxybenzene
[450-88-4]
C_7H_6BrFO
FW 205.02



682543-5G	5 g

4-Fluorothiobenzamide, 97%

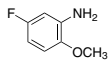
[22179-72-2]
C_7H_6FNS
FW 155.19



684775-1G	1 g

5-Fluoro-2-methoxyaniline, 97%

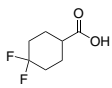
2-Amino-4-fluoroanisole; 5-Fluoro-*o*-anisidine;
5-Fluoro-2-methoxybenzenamine
[1978-39-8]
C_7H_8FNO
FW 141.14



683310-1G	1 g

4,4-Difluorocyclohexanecarboxylic acid, 97%

[122665-97-8]
$C_7H_{10}F_2O_2$
FW 164.15



684651-250MG	250 mg

2,2-Difluorocyclopropanecarboxylic acid, 97%

[107873-03-0]
$C_4H_4F_2O_2$
FW 122.07

684678-250MG	250 mg

1-Trifluoroacetyl piperidine, 97%

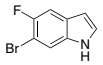
NEW

[340-07-8]
$C_7H_{10}F_3NO$
FW 181.16

683035-5G	5 g
683035-25G	25 g

6-Bromo-5-fluoroindole, 97%

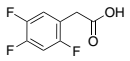
[259860-08-7]
C_8H_5BrFN
FW 214.03



691526-250MG	250 mg
691526-1G	1 g

2,4,5-Trifluorophenylacetic acid, 97%

[209995-38-0]
$C_8H_5F_3O_2$
FW 190.12



684155-1G	1 g
684155-5G	5 g

2-Fluoro-6-methylbenzonitrile, 97%

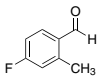
[198633-76-0]
C_8H_6FN
FW 135.14

686689-1G	1 g

4-Fluoro-2-methylbenzaldehyde, 97%

NEW

[63082-45-1]
C_8H_7FO
FW 138.14

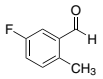


684953-5G	5 g

5-Fluoro-2-methylbenzaldehyde, 96%

NEW

[22062-53-9]
C_8H_7FO
FW 138.14

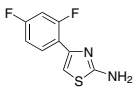


685003-1G	1 g

2-Amino-4-(2,4-difluorophenyl)thiazole, 97%

NEW

$C_9H_6F_2N_2S$
FW 212.22



683280-1G	1 g

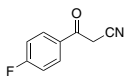
5,7-Difluoro-1-indanone, 97%

5,7-Difluoro-2,3-dihydroinden-1-one
[84315-25-3]
$C_9H_6F_2O$
FW 168.14

692093-1G	1 g

4-Fluorobenzoylacetonitrile, 97%

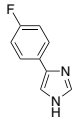
4-Fluorophenacyl cyanide;
4-Fluoro-μ-oxobenzenepropanenitrile;
3-Oxo-3-(4-fluorophenyl)propionitrile
[4640-67-9]
C_9H_6FNO
FW 163.15



681822-1G	1 g
681822-5G	5 g

4-(4-Fluorophenyl)-1*H*-imidazole, 97%

5-(4-Fluorophenyl)-3*H*-imidazole
[65020-70-4]
$C_9H_7FN_2$
FW 162.16



687065-5G	5 g

4-Fluoro-1-indanone, 97%

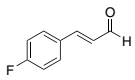
4-Fluoro-2,3-dihydro-1-indenone
[699-99-0]
C_9H_7FO
FW 150.15

681636-1G	1 g
681636-5G	5 g

trans-4-Fluorocinnamaldehyde, 97%

NEW

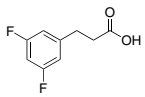
(*E*)-3-(4-Fluorophenyl)-2-propenal
[51791-26-5]
C_9H_7FO
FW 150.15



683027-500MG	500 mg

3-(3,5-Difluorophenyl)propionic acid, 97%

3-(3,5-Difluorophenyl)propanoic acid;
3,5-Difluorohydrocinnamic acid
[84315-24-2]
$C_9H_8F_2O_2$
FW 186.16

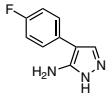


692115-5G	5 g

5-Amino-4-(4-fluorophenyl)-1*H*-pyrazole, 97%

NEW

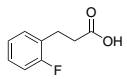
4-(4-Fluorophenyl)-1*H*-pyrazol-5-amine
[5848-05-5]
$C_9H_8FN_3$
FW 177.18



681083-1G	1 g

3-(2-Fluorophenyl)propionic acid, 97%

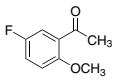
[1643-26-1]
$C_9H_9FO_2$
FW 168.16



681156-1G	1 g
681156-5G	5 g

5′-Fluoro-2′-methoxyacetophenone, 97%

1-(5-Fluoro-2-methoxyphenyl)ethanone
[445-82-9]
$C_9H_9FO_2$
FW 168.16

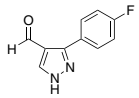


683299-1G	1 g

3-(4-Fluorophenyl)-1*H*-pyrazole-4-carboxaldehyde, 97%

NEW

[306936-57-2]
$C_{10}H_7FN_2O$
FW 190.17



683272-1G	1 g

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