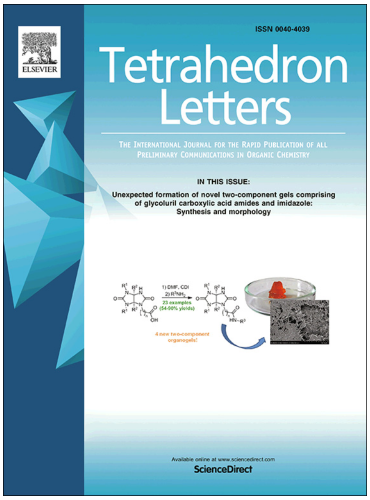


Copper(I)-Promoted Trifluoromethylthiolation of Arenediazonium salts with $AgSCF_3$

Changge Zheng, Yang Liu, Jianquan Hong, Shuai Huang, Wei Zhang, Yupeng Yang, Ge Fang

PII: S0040-4039(19)30341-7
DOI: https://doi.org/10.1016/j.tetlet.2019.04.018
Reference: TETL 50733

To appear in: *Tetrahedron Letters*

Received Date: 4 March 2019
Revised Date: 6 April 2019
Accepted Date: 9 April 2019

Please cite this article as: Zheng, C., Liu, Y., Hong, J., Huang, S., Zhang, W., Yang, Y., Fang, G., Copper(I)-Promoted Trifluoromethylthiolation of Arenediazonium salts with $AgSCF_3$, *Tetrahedron Letters* (2019), doi: https://doi.org/10.1016/j.tetlet.2019.04.018

Tetrahedron Letters
journal homepage: www.elsevier.com

Copper(I)-Promoted Trifluoromethylthiolation of Arenediazonium salts with $AgSCF_3$

Changge Zheng[a, *, b], Yang Liu[a], Jianquan Hong[a], Shuai Huang[a], Wei Zhang[b], Yupeng Yang[a], Ge Fang[b]

[a]*Key Laboratory of Synthetic and Biological Colloids, Ministry of Education, School of Chemical and Material Engineering, Jiangnan University, Wuxi, Jiangsu 214122, P. R. China*
[b]*School of Chemical Engineering, Xinjiang Agricultural University, Urumqi 830052, Xinjiang Uygur Autonomous Region, P. R. China*

ARTICLE INFO

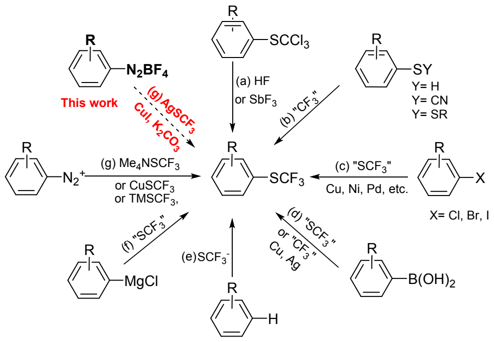
Article history:
Received
Received in revised form
Accepted
Available online

Keywords:
Trifluoromethylthiolation
$AgSCF_3$
Arenediazonium salts
Sandmeyer reaction

ABSTRACT

An efficient method for trifluoromethylthiolation of arenediazonium salts has been developed in mild conditions with a stable and convenient $AgSCF_3$. It provides a straightforward and convenient way for the synthesis of trifluoromethylthiolated compound from diazonium salts in moderate to good yields.

The compound with a aryl trifluoromethyl sulfides ($ArSCF_3$) structural motif have recently attracted great attention as pharmaceuticals and agrochemicals.[1] Due to the strong electron-withdrawing effect and high lipophilicity, the trifluoromethylthio group (SCF_3) could enhance the metabolic stability and bioavailability of the parent molecules. Since natural compounds containing SCF_3 are uncommon, it is urgently needed to develop synthetic methodologies of trifluoromethylthio compound.[2] As the traditional method for introduction of SCF_3 into aromatic backbones, the chlorine-fluorine exchange reactions of trihalogenomethyl thioethers usually suffer from harmful waste and multistep synthesis under harsh reaction conditions (Scheme 1).[3] Through the trifluoromethylations of sulfur-containing substrates precursors, such as thiols,[4] thiocyanates[5] and disulfides,[6] these synthetic methods are limited by substrate availability and/or functional group tolerance. By the transition metal-catalyzed/mediated conversion of halogen[7] or boric acid substituents,[8] the one-step trifluoromethylthiolation have been carried out using easily stored, inexpensive and handled reagents as SCF_3 or CF_3 sources. With nucleophilic and electrophilic trifluoromethylthio reagents recently, direct C-H aromatic trifluoromethylthiolation was also developed remarkably.[9] The electrophilic trifluoromethylthiolation with aryl-magnesium or lithium reagents have been exemplified employing CF_3SCl or N-SCF_3 reagents.[10] The straight-forward Sandmeyer-type reaction are potential and easy-to-handle alternatives for the trifluoromethylthiolations, through arenediazonium salts from cheap and broadly available aromatic amines.[11]



Scheme 1. Methods for aryl trifluoromethylthiolation.

Firstly reported by J. H. Clark,[12] the classical Sandmeyer-type reaction system were not suitable for the substrates of electron-donating groups, using the expensive and unstable copper(I) trifluoromethanethiolate ($CuSCF_3$) (Scheme 1). Through reaction system of CuSCN and inexpensive Ruppert-Prakash reagent ($TMSCF_3$) by Goossen,[13, 14] aryl trifluoromethyl thioethers are exclusively formed using sodium thiocyanate (NaSCN) as a sulfur source. With the unstable Me_4NSCF_3 as the trifluoromethylthiolation reagent, the Sandmeyer-type reaction could also be carried out in the presence of CuSCN,[15] even under condition of metal-free.[16] Recently, the toxic and hard-to-get bis(trifluoromethyl) disulfide $(CF_3S)_2$ can also be employed in the straight-forward Sandmeyer-type trifluoromethylthiolation of readily available arenediazonium salts, in the presence of photocatalyst (eosin Y) by Wangelin.[17] Although some important achievements have been made in Sandmeyer trifluoromethylthiolation, some drawbacks are still found in these reaction systems. For example, the trifluoromethylthiolation reagents employed in these approaches are toxic or unstable to

---

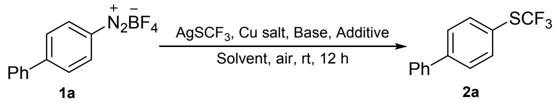
* Corresponding author. Tel.: +86-510-85917763; Fax: +86-510-85917763; E-mail: cgzheng@jiangnan.edu.cn (C.-G. Zheng)

† Permanent address.

storage for extended periods. Recently, Y. Yang and coworker have developed a low-cost method for the preparation of $CuSCF_3$ *via* triphenylphospine-mediated deoxygenative reduction of Langlois' reagent (CF_3SO_2Na) in the presence of CuCl.[7h] However, the preparation procedure is somewhat complicated which must be carried out in high temperature under nitrogen atmosphere. Moreover, excessive amount of triphenylphosphine is also employed in this procedure, generating a large amount of environmentally harmful $Ph_3P{=}O$ as by-product. As the relatively inexpensive, stable and easy-to-handle reagent, $AgSCF_3$ could form a reactive source of $^{-}SCF_3$ in the presence of n-Bu_4NI or KI.[18] Intrigued by the Sandmeyer trifluoromethylation of aromatic amines and trifluoromethylthiolation with $AgSCF_3$,[19, 20] we have been trying to develop effective approaches for metal-mediated trifluoromethylthiolation of arenediazonium salts with $AgSCF_3$.

Table 1

Optimization of the reaction conditions.[a]



Entry	Cu salt	[Cu] (mmol)	Base	Additive	Solvent	**2a** Yield (%)[b]
1	CuCl	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	13
2	CuBr	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	10
3	CuI	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	25
4	CuSCN	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	21
5	$CuBr_2$	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	14
6	$Cu(OAc)_2$	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	20
7	$Cu(OTf)_2$	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	19
8	$Cu(MeCN)_4BF_4$	0.01	K_2CO_3	n-Bu_4NI	CH_3CN	23
9	CuI	0.02	K_2CO_3	n-Bu_4NI	CH_3CN	32
10	CuI	0.05	K_2CO_3	n-Bu_4NI	CH_3CN	53
11	CuI	0.1	K_2CO_3	n-Bu_4NI	CH_3CN	80
12	CuI	0.1	K_2CO_3	-	CH_3CN	82
13	CuI	0.1	Na_2CO_3	-	CH_3CN	46
14	CuI	0.1	$NaHCO_3$	-	CH_3CN	49
15	CuI	0.1	Cs_2CO_3	-	CH_3CN	52
16	CuI	0.1	K_2CO_3	-	DMSO	59
17	CuI	0.1	K_2CO_3	-	DMF	63
18	CuI	0.1	K_2CO_3	-	NMP	50
19[c]	CuI	0.1	K_2CO_3	-	CH_3CN	78

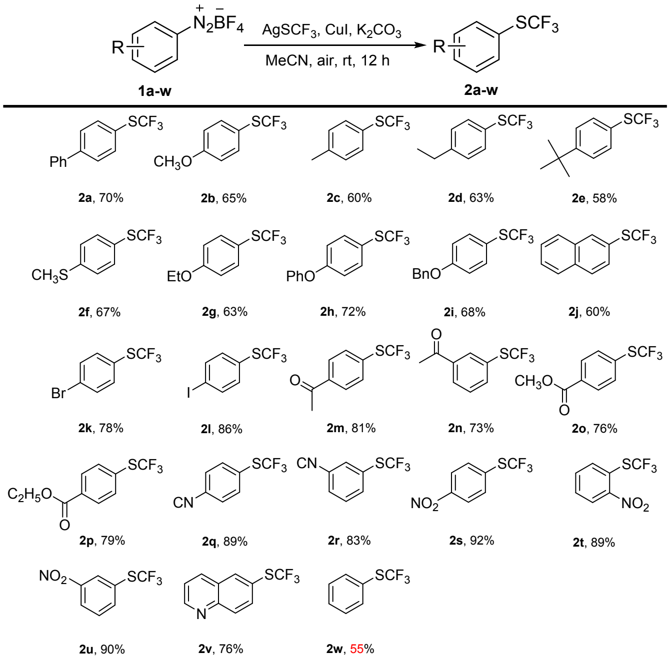
[a] Reaction conditions: **1a** (0.1 mmol), $AgSCF_3$ (0.15 mmol, 1.5 equiv.), copper salt, base (0.2 mmol, 2.0 equiv.), additive (0.2 mmol, 2.0 equiv). solvent (1 mL), [b] Yields were determined by ^{19}F NMR spectroscopy based on **1a** using 4,4′-difluorobiphenyl as an internal standard. [c] under N_2.

Initially, the model substrate **1a** of trifluoromethylthiolation reaction was screened to investigate the effects of different copper salts, bases, solvents, and additives (Table 1). There is only 13% yield of trifluoromethylthiolated product to be obtained, using 0.01 mmol CuCl as the catalyst. Investigating copper catalyst such as CuCl, CuBr, CuI, CuSCN, $CuBr_2$, $Cu(OAc)_2$, $Cu(OTf)_2$ and $Cu(MeCN)_4BF_4$ (entries 1–8), CuI was suggested to be best choice for the reaction with the highest yield. With increasement of the amount of CuCl, the improved significantly yield of **2a** show that catalytic amounts of copper salt were insufficient to achieve high yields. Surprisingly, a slightly higher yield of 82% was achieved in the absence of n-Bu_4NI (entry 12). Several bases such as Na_2CO_3, $NaHCO_3$, Cs_2CO_3 and K_2CO_3 were also examined to further optimize the reaction conditions. Obviously, K_2CO_3 is most suitable for achievement of corresponding product **2a** in the highest yield (entries 12–15). The influence of solvents was also investigated in such solvents as DMSO, DMF and NMP (entries 16–18) besides CH_3CN. Furthermore, the reaction was carried out under nitrogen to gain the expected product. A slightly higher yield in air shows that the reaction proceeds can be carried through in an easy-to-handle approach. (entry 19).

Based on the optimized reaction conditions (Table 1, Entry 12), the substrate scope of oxidative trifluoromethylthiolation for arenediazonium salts was investigated as summarized in Table 2. With the electron-donating substituent in aromatic ring as aryl, alkyl, alkoxy and methylthio, the arenediazonium salt derivatives reacted smoothly to give the corresponding trifluoromethylthiolated products (**2a**–**2i**) in reasonable yields of 58-72%. The 2-naphthyl diazonium salt was also suitable for the reaction system to give product **2j** in 60% yield. Examined the substrate with electron-withdrawing substituent in aromatic ring, such as halogen (1k and 1l), acetyl (1m and 1n), carbomethoxy (**1o** and **1p**) and cyano (**1q** and **1r**), the arenediazonium salt derivatives can tolerate this reaction system more efficiently with slightly higher yields (**2k**-**2u**, 73-92%, Table 2) than the electron-donating substituent. Comparing with aromatic substrates with in nitro substituent in ortho (**2t**, 89%) and meta- (**2u**, 90%) position, the pretty higher yield of the electron-withdrawing nitro in para (**2s**, 92%) position indicated that electronic effect rather than steric effects remains to be the most important influence to the reaction system. Contrary to other SCF_3 or CF_3 sources, the trifluoromethylthiolated yield of electron-deficient substrates is overall higher than the electron-rich substrates using $AgSCF_3$. In addition, some arenediazonium salt derivatives, bearing pyridine moiety (**1v**) and electron-withdrawing substituent, can be converted to the corresponding trifluoromethylthiolated products in higher yields to the reported.[11-16]

Table 2.

Trifluoromethylthiolation of Arenediazonium salts under the optimized reaction conditions.[a,b]



[a] Reaction conditions: **1a-1w** (0.5 mmol), $AgSCF_3$ (0.75 mmol, 1.5 equiv.), CuI (0.5 mmol, 1.0 equiv.), K_2CO_3 (1.0 mmol, 2.0 equiv.), CH_3CN (5 mL), air, rt, 12 h. [b] Isolated yields.

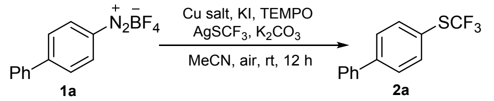
Secondarily, this reaction system is feasible particularly for large-scale applications due to its irreplaceable advantages as easily available raw material, air insensitivity and mild reaction conditions. To illustrate the practical application of this transformation, the reaction was scaled up using 5 mmol of the substrate **1s**. The corresponding trifluoromethylthiolated product

2s was also obtained in isolated yield of 85% through this reaction proceeds under the optimal conditions.

To elucidate a plausible reaction mechanism, some control experiments were carried as shown in Table 3. Without copper salt in the reaction system, only 10% desired product **2a** was detected. Obviously, the reactivity of metallic silver is low without copper salt. Using 1.0 equivalents of $Cu(MeCN)_4BF_4$ as catalyst instead of CuI, the yield of **2a** was apparently declined to 40%. Added 1.0 equivalents of KI to the above reaction system, the improved yield 78% of **2a** indicated that iodine anion (I^-) play a significant role in this reaction system. As the previous reported,[21] the active species $[Ag(SCF_3)I]^-$ can generate through this reaction system with the stronger nucleophilicity than $AgSCF_3$. The result of the above investigation show further that $CuSCF_3$ species will generate on site in the presence of $AgSCF_3$ or $[Ag(SCF_3)I]^-$ with copper salt.[22] Added 4.0 equivalents of the radical-trapping reagent TEMPO (2,2,6,6-tetramethyl-1-oxylpiperidine), the reaction was obviously suppressed to give only 8% products under the optimal conditions. It indicates that the reaction may proceed *via* a radical pathway. The investigations of reaction temperature suggest that the yield of product **2a** decreases significantly by increase of the reaction temperature, along with the augment of the iodobenzene as main by-product (See the Supporting Information).

Table 3

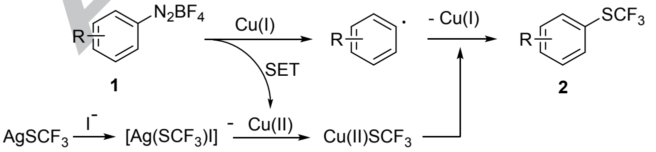
Control experiments.



Entry	Cu salt	KI	TEMPO	**2a** Yield (%)[c]
1[a]	-	-	-	10%
2[a]	$Cu(MeCN)_4BF_4$ (1.0)	-	-	40%
3[a]	$Cu(MeCN)_4BF_4$ (1.0)	1.0	-	78%
4[b]	CuI (1.0)	-	2.0	21%
5[b]	CuI (1.0)	-	4.0	8%

Reaction conditions: **1a** ([a] 0.1 mmol, 1 equiv; [b] 0.5 mmol, 1 equiv.), $AgSCF_3$ (1.5 equiv.), K_2CO_3 (2.0 equiv.), CH_3CN (5 mL), air, rt, 12 h, Cu salt, KI, and TEMPO (equiv.). [c] Yield was determined by ^{19}F NMRspectroscopy using 4,4′-difluorobiphenyl as an internal standard.

Based on the above experimental results, a plausible mechanism was proposed about the copper(I)-promoted trifluoromethylthiolation process *via* $[Ag(SCF_3)I]^-$ as shown in Scheme 2. Firstly transferred a single electron (SET) to arenediazonium salts 1, Cu(I) afford aryl radicals and Cu(II) species. Then, $Cu(II)SCF_3$ species will generate on-site quickly through combination of Cu(II) and active species $[Ag(SCF_3)I]^-$ from the reaction of $AgSCF_3$ and iodine anion. The desired product **2a** can achieve by aryl radicals with $Cu(II)SCF_3$.



Scheme 2. Plausible mechanism.

In summary, we have developed an efficient preparation method through copper(I)-promoted trifluoromethylthiolation for the various arenediazonium salts, using a stable and inexpensive $AgSCF_3$ in moderate to good yields and mild reaction conditions. A preliminary mechanistic investigation suggests that this reaction process *via* a radical pathway. With the extensive reaction tolerance, mild reaction condition and the easy-to-get raw material, this method achieve a useful and practical strategy in the synthesis of aryl trifluoromethyl sulfides, for great potential application of synthetic, medicinal, and agrochemical research.

Acknowledgments

We acknowledge the financial support for this work from the National Natural Science Foundation of China (Nos. 21562041 and 21502070) and the Fundamental Research Funds for the Central Universities.

References

1. (a) X.-H. Xu, K. Matsuzaki, N. Shibata, Chem. Rev. 2015, 115, 731-764.
   (b) L. Chu, F.-L. Qing, Acc. Chem. Res. 2014, 47, 1513−1522;
   (c) D. C. Remy, S. F. Britcher, S. W. King, P. S. Anderson, C. A. Hunt, W. C. Randall, P. Bélanger, J. G. Atkinson, Y. Girard, C. S. Rooney, J. J. Fuentes, J. A. Totaro, J. L. Robinson, E. A. Risley, M. Williams, J. Med. Chem. 1983, 26, 974-980;
   (d) B. Manteau, S. Pazenok, J.-P. Vors, F. R. Leroux, J. Fluorine Chem. 2010, 131, 140-158;
   (e) V. N. Boiko, Beilstein J. Org. Chem. 2010, 6, 880-921;
   (f) T. Nguyen, W.-L. Chiu, X.-Y. Wang, M. O. Sattler, J. A. Love, Org. Lett. 2016, 18, 5492-5495;
   (g) P. Nikolaienko, T. Yildiz, M. Rueping, Eur. J. Org. Chem. 2016, 1091-1094.
2. (a) C. Shen, P. Zhang, Q. Sun, S. Bai, T. S. A. Hor, X. Liu, Chem. Soc. Rev., 2015, 44, 291-314;
   (b) F. Leroux, P. Jeschke, M. Schlosser, Chem. Rev. 2005, 105, 827-856;
   (c) T. Liang, C. N. Neumann, T. Ritter, Angew. Chem., Int. Ed. 2013, 52, 8214-8264;
   (d) A. Tlili, T. Billard, Angew. Chem., Int. Ed. 2013, 52, 6818-6819;
   (e) F. Toulgoat, S. Alazet, T. Billard, Eur. J. Org. Chem. 2014, 2415-2428.
3. (a) E. A. Nodiff, S. Lipschutz, P. N. Craig, M. Gordon, J. Org. Chem. 1960, 25, 60-65;
   (c) J. M. Kremsner, M. Rack, C. Pilger, C. O. Kappe, Tetrahedron Lett. 2009, 50, 3665-3668.
4. (a) C. Wakselman, M. Tordeux, J. Org. Chem. 1985, 50, 4047-4051;
   (b) I. Kieltsch, P. Eisenberger, A. Togni, Angew. Chem. Int. Ed. 2007, 46, 754-757;
   (c) A. Harsanyi, E. Dorko, A. Csapo, T. Bako, C. Peltz, J. Rabai, J. Fluorine Chem. 2011, 132, 1241;
   (d) J.-J. Ma, W.-B. Yi, G.-P. Lu, C. Cai, Catal. Sci. Technol. 2016, 6, 417-421;
   (e) J. J. Ma, Q. R. Liu, G. P. Lu, W. B. Yi, J. Fluorine Chem. 2017, 193, 113-117.
5. (a) T. Billard, S. Large, B.R. Langlois, Tetrahedron Lett. 1997, 38, 65-68;
   (b) S. Potash, S. Rozen, J. Fluor. Chem. 2014, 168, 173-176;
   (c) K. Jouvin, C. Matheis, L. J. Goossen, Chem. Eur. J. 2015, 41, 14324-14327;
   (d) B. Exner, B. Bayarmagnai, F. Jia, L. J. Goossen, Chem. Eur. J. 2015, 48, 17220-17223;
   (e) B. Bayarmagnai, C. Matheis, K. Jouvin, L. J. Goossen, Angew. Chem. Int. Ed. 2015, 54, 5753-5756.
6. (a) C. Wakselman, M. Tordeux, J.-L. Clavel, B. Langlois, J. Chem. Soc., Chem. Commun. 1991, 993-994;
   (b) B. Quiclet-Sire, R. N. Saicic, S. Z. Zard, Tetrahedron Lett. 1996, 37, 9057-9058;
   (c) N. Roques, J. Fluorine Chem. 2001, 107, 311-314;
   (d) G. Blond, T. Billard, B. R. Langlois, Tetrahedron Lett. 2001, 42, 2473-2475;
   (e) C. Pooput, M. M´edebielle, W. R. Dolbier, Org. Lett. 2004, 6, 301-303;
   (f) C. Pooput, W. R. Dolbier, M. M´edebielle, J. Org. Chem. 2006, 71, 3564-3568.
7. (a) C. Zhang, D. A. Vicic, J. Am. Chem. Soc. 2012, 134, 183-185;
   (b) C. Zhang, W. W. Brennessel, D. A. Vicic, J. Fluor. Chem. 2012, 140, 112-115;
   (c) Z. Weng, W. He, C. Chen, R. Lee, D. Tan, Z. Lai, D. Kong, Y. Yuan, K.-W. Huang, Angew. Chem. Int. Ed. 2013, 52, 1548-1552;
   (d) W. Zhong, X. Liu, Tetrahedron Lett. 2014, 55, 4909-4911;
   (e) G. Yin, I. Kalvet, F. Schönebeck, Angew. Chem. Int. Ed. 2015, 54, 6809-6813;
   (f) G. Yin, I. Kalvet, U. Englert, F. Schönebeck, J. Am. Chem. Soc. 2015, 137, 4164-4172;

(g) P. Saravanana, P. Anbarasana, Adv. Synth. Catal. 2015, 357, 3521-3528;
(h) Y. Yang, L. Xu, S. Yu, X. Liu, Y. Zhang, D. A. Vicic, Chem. Eur. J. 2016, 22, 858-863;
(i) I. Kalvet, Q. Guo, G. J. Tizzard, F. Schönebeck, ACS Catal. 2017, 7, 2126-2132.

8. (a) C. Chen, Y. Xie, L. Chu, R.-W. Wang, X. Zhang, F.-L. Qing, Angew. Chem. Int. Ed. 2012, 51, 2492-2495;
(b) C. Chen, L. Chu, F. Qing, J. Am. Chem. Soc. 2012, 134, 12454-12457;
(c) C. P. Zhang, D. A. Vicic, Chem. Eur. J. 2012, 7, 1756-1758;
(d) X. Shao, X. Wang, T. Yang, L. Lu, Q. Shen, Angew. Chem. Int. Ed. 2013, 52, 3457-3460;
(e) L. Zhai, Y. Li, J. Yin, K. Jin, R. Zhang, X. Fu, C. Duan, Tetrahedron 2013, 69, 10262-10266;
(f) R. Pluta, P. Nikolaienko, M. Rueping, Angew. Chem. Int Ed. 2014, 53, 1650-1653;
(g) K. Kang, C. Xu, Q. Shen, Org. Chem. Front. 2014, 1, 294-297;
(h) Q. Glenadel, S. Alazet, A. Tlili, T. Billard, Chem. Eur. J. 2015, 21, 14694-14698;
(i) M. Zhao, X. Zhao, P. Zheng, Y. Tian, J. Fluorine Chem. 2017, 194, 73-79;

9. (a) L. D. Tran, I. Popov, O. Daugulis, J. Am. Chem. Soc. 2012, 134, 18237-18240;
(b) A. Ferry, T. Billard, E. Bacqué, B. R. Langlois, J. Fluorine Chem. 2012, 134, 160-163.

10. (a) F. Baert, J. Colomb, T. Billard, Angew. Chem. Int. Ed. 2012, 51, 10382-10385;
(b) Q. Glenadel, S. Alazet, T. Billard, J. Fluorine Chem. 2015, 179, 89-95.

11. (a) J. Wu, Y. Gu, X. Leng, Q. Shen, Angew. Chem. Int. Ed. 2015, 54, 7648–7652;
(b) C. Matheis, B. Bayarmagnai, K. Jouvin, L. J. Goossen, : Org. Chem. Front., 2016, 3, 3, 949-952.
(c) Y. Liu, X. Xu, F. Qing, Tetrahedron 2018, 74, 5827-5832;

12. D. J. Adams, A. Goddard, J. H. Clark, D. J. Macquarrie, Chem. Commun. 2000, 987-988.

13. G. Danoun, B. Bayarmagnai, M. F. Gruenberg, L. J. Goossen, Chem. Sci. 2014, 5, 1312-1316.

14. B. Bayarmagnai, C. Matheis, E. Risto, L. J.Goossen, Adv. Synth. Catal. 2014, 356, 2343-2348.

15. C. Matheis, V. Wagner, L. J. Goossen, Chem. Eur. J. 2016, 22, 79-82.

16. G. Bertoli, B. Exner, M. V. Evers, K. Tschulik, L. Goossen, J. Fluorine Chem. 2018, 210, 132-136.

17. D. Koziakov, M. Majek, A. Jacobi von Wangelin, Eur. J. Org. Chem. 2017, 6722-6725;

18. D. J. Adams, J. H. Clark, J. Org. Chem. 2000, 65, 1456-1460.

19. (a) G. Teverovskiy, D. S. Surry, S. L. Buchwald, Angew. Chem. Int. Ed. 2011, 50, 7312-7314;
(b) J. Xu, X. Mu, P. Chen, J. Ye, G. Liu, Org. Lett. 2014, 16, 3942-3945;
(c) W. Wu, B. Wang, X. Ji, S. Cao, Org. Chem. Front. 2017, 4, 1299-1303.

20. (a) Danoun, G.; Bayarmagnai, B.; Grünberg, M. F.; Goossen, L. J. Angew. Chem., Int. Ed. 2013, 52, 7972;
(b) K. Zhang, X. Xu, F. Qing, J. Org. Chem. 2015, 80, 7658.
(c) J. Hong, G. Wang, L. Huo, Zheng, Chin. J. Chem. 2017, 35, 1761-1767.

21. (a) C. Chen, X. H. Xu, B. Yang, F. Qing, Org. Lett. 2014, 16, 3372-3375;
(b) M. Jiang, F. Zhu, H. Xiang, X. Xu, L. Deng, C. Yang, Org. Biomol. Chem. 2015, 13, 6935-6939;
(c) J. Liu, X. Xu, Z. Chen, F. Qing, Angew. Chem. Int. Ed. 2015, 54, 897-900.

22. (a) M. Hu, J. Rong, W. Miao, C. Ni, Y. Han, J. Hu, Org. Lett. 2014, 16, 2030-2033;
(b) X. Wang, Y. Zhou, G. Ji, G. Wu, M. Li, Y. Zhang, J. Wang, Eur. J. Org. Chem. 2014, 3093-3096.

Supplementary Material

Supplementary material for this article is available online at http://dx.doi.org/10.1016/j.tetlet.

Click here to remove instruction text...

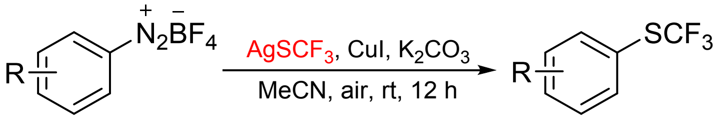
Graphical Abstract

An efficient method with a stable and convenient $AgSCF_3$ provides an additional way for the synthesis of trifluoromethylthiolated compound with arenediazonium salts, in very mild conditions and good yield.

Copper(I)-Promoted Trifluoromethylthiolation of Arenediazonium salts with $AgSCF_3$

Changge Zheng, Yang Liu, Jianquan Hong, Shuai Huang, Wei Zhang, Yupeng Yang and Ge Fang

Leave this area blank for abstract info.



1a

2a

Highlights

- The first example of the stable $AgSCF_3$ for trifluoromethylthiolation of arenediazonium salts.

An efficient method for trifluoromethylthiolation of arenediazonium salts was developed.

The mild reaction condition.

The trifluoromethylthiolated products with electron-withdrawing substituent were obtained in higher yields.