Tetrahedron Letters 59 (2018) 3104–3107

Contents lists available at ScienceDirect

Tetrahedron Letters

journal homepage: www.elsevier.com/locate/tetlet

Transition-metal-free phenylselenylation of arenes with triflic anhydride activated methyl phenyl selenoxide

Yuyao Shi, Pingfan Li *

Department of Organic Chemistry, Faculty of Science, Beijing University of Chemical Technology, Beijing 100029, China

ARTICLE INFO

Article history:
Received 29 April 2018
Revised 27 June 2018
Accepted 2 July 2018
Available online 2 July 2018

Keywords:
Selenium
Transition-metal-free
Electrophilic aromatic substitution

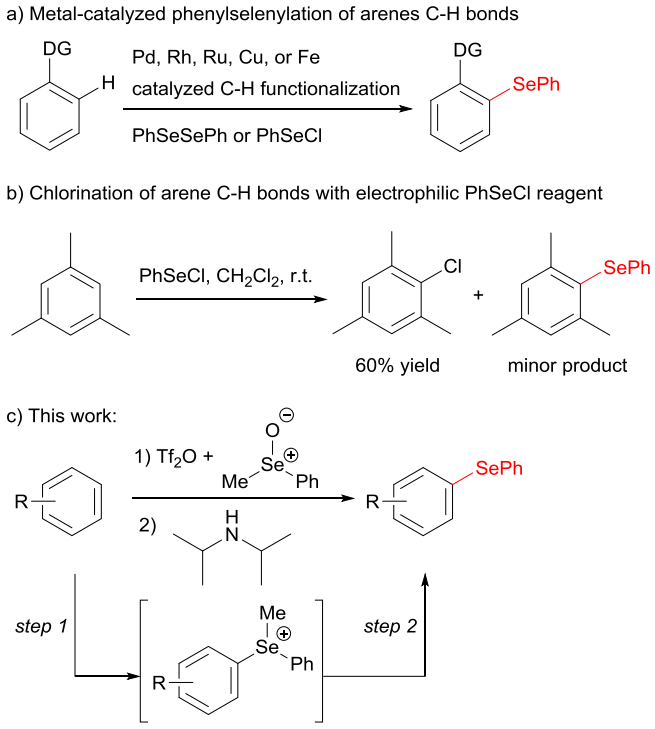
Organoselenides, in particular diarylselenides [1], are a class of molecules with important biological activity [2]. Traditional methods for the synthesis of diarylselenides usually involves the reaction between aryl Grignard or aryllithium reagents with electrophilic arylselenium reagents [3], or alternatively, aryldiazonium salts with nucleophilic arylselenium reagents [4]. Transition-metal catalyzed cross-coupling reactions between aryl halides or aryl boronic acids with phenylselenyl chloride, diphenyl diselenide or phenylselenyl tributyltin reagents were also extensively examined [5]. Recently, a number of transition-metals have been used to catalyzed the phenylselenylation of arene C–H bonds ortho to the directing groups, including palladium [6], rhodium [7], ruthenium [8], copper [9], and iron (Scheme 1a) [10]. For the synthesis of α,β-unsaturated carbonyl compounds through oxidation and elimination of corresponding α-selenylated carbonyl compounds, phenylselenylation of enol derivatives were widely used to prepare such precursors [11]. Phenylselenylation of alkenes were also accomplished with electrophilic arylselenium reagents, and there has been some great interest to render such reactions catalytic enantioselective [12]. However, if phenylselenylation of arenes were attempted with PhSeCl, except for electron-rich aniline type substrates, chlorination products were obtained in most cases instead of the desired selenylation products (Scheme 1b) [13].

In connection with our group's continuous interest in sulfur mediated C–H functionalization reactions [14], and Procter's report for the synthesis of diarylthioethers through triflic anhydride activated sulfoxides [15], we would like to extend such reactions to the corresponding selenium versions. It should be noted that despite the recent interest in studying various reactivity of triflic anhydride activated sulfoxides [16], research work on corresponding selenium version is still very rare. We report herein our results for the preparation diarylselenides under transition-metal-free conditions through a one-pot, two-step sequence: electrophilic substitution of arenes with triflic anhydride activated methyl phenyl selenoxide, and then demethylation of the initially formed diaryl methyl selenonium salt with diisopropylamine (Scheme 1c).

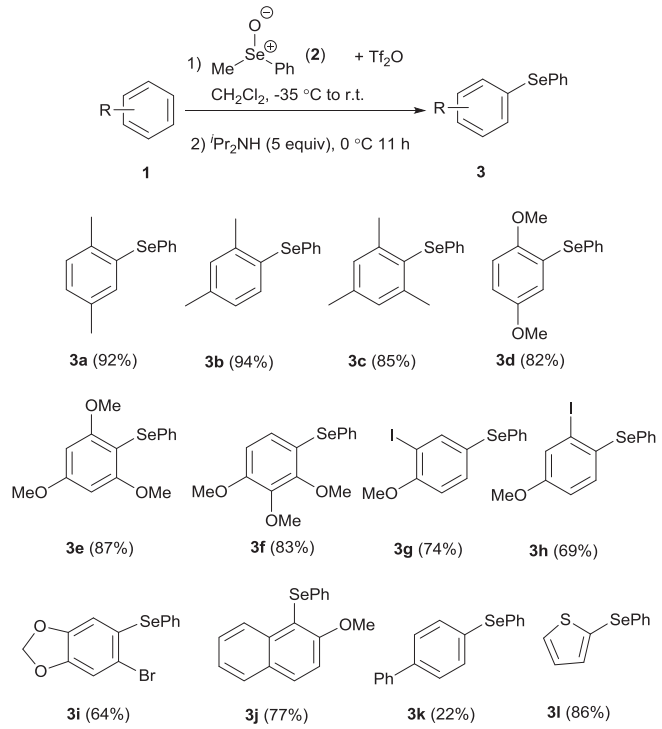
The reaction between *p*-xylene (**1a**) and triflic anhydride activated methyl phenyl selenoxide (**2**) was chosen as the model reaction to optimize the reaction conditions (Scheme 2). When 2.1 equivalent of DBU was used as the base for the demethylation step, the desired product **3a** was isolated in 13% yield (entry 1). The use of pyridine type bases did not improve the reaction yield (entries 2–5), while MeONa/MeOH gave 31% yield (entry 6). We then screened a number of amine bases (entries 7–12), and the best result was obtained with diisopropylamine (entry 12). By increasing the amount of diisopropylamine, up to 87% yield of **3a** was obtained (entries 13–15). Increasing the reaction time for the second step did not increase the isolated yield (compare entries 14 and16), while the yield dropped at higher temperature (entry 17). Finally, 92% yield of **3a** was obtained when we lowered the reaction temperature for the second step to 0 °C (entry 18). Thus, the optimized one-pot, two-step reaction procedure was: dissolve **2** with CH_2Cl_2, add Tf_2O at −35 °C, and then add **1a**. After 15 min, the reaction tube was warmed up to room temperature for 1.5 h. After cooling down to 0 °C, diisopropylamine was added and stirred for 11 h before quenching.

* Corresponding author.
E-mail address: lipf@mail.buct.edu.cn (P. Li).

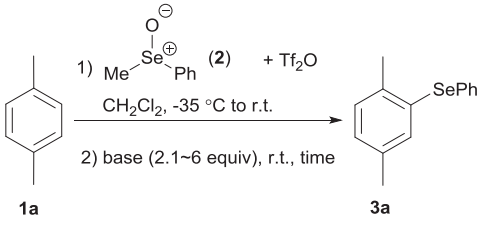
https://doi.org/10.1016/j.tetlet.2018.07.005



Scheme 1. Phenylselenylation of arene C–H bonds. DG = directing groups, Tf_2O = trifluoromethanesulfonic anhydride.



Scheme 3. Substrate scope.



entry	base	equiv	time (h)	yield (%)[a]
1	DBU	2.1	4	13
2	pyridine	2.1	4	10
3	2,6-lutidine	2.1	4	trace
4	2,6-dichloropyridine	2.1	4	10
5	2,6-difluoropyridine	2.1	4	trace
6	MeONa/MeOH	2.1	4	31
7	Et_2NH	2.1	4	5
8	Et_3N	2.1	4	15
9	morpholine	2.1	4	8
10	$^{n}Pr_2NH$	2.1	4	23
11	$^{t}BuNH_2$	2.1	4	15
12	$^{i}Pr_2NH$	2.1	4	31
13	$^{i}Pr_2NH$	4.2	4	54
14	$^{i}Pr_2NH$	5	4	87
15	$^{i}Pr_2NH$	6	4	79
16	$^{i}Pr_2NH$	5	11	87
17	$^{i}Pr_2NH$	5	11	48[b]
18	$^{i}Pr_2NH$	5	11	92[c]

[a] Isolated yields after flash column chromatography. [b] The second step was conducted at 40 °C. [d] The second step was conducted at 0 °C.

Scheme 2. Optimization of reaction conditions.