Synthesis of (Poly)halo-substituted Diarylsulfones through Palladium Catalyzed C-H Bond Sulfonylation using (Poly)Halobenzenesulfonyl Chlorides

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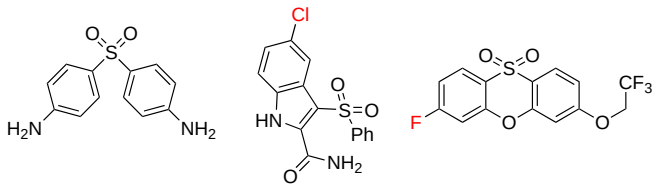
Synthesis of (Poly)halo-substituted Diarylsulfones through Palladium Catalyzed C–H Bond Sulfonylation using (Poly)Halobenzenesulfonyl Chlorides

Arpan Sasmal,[a] Jitendra K. Bera,[b] Henri Doucet*[a] and Jean-François Soulé*[a]

Abstract: The reactivity of (poly)halo-substituted benzenesulfonyl chlorides in palladium-catalyzed *ortho*-directed C–H bond sulfonylation of 2-arylpyridines was investigated. The use of Ag_2CO_3 in concert with $Cu(OAc)_2$ was found to be critical to promote the chemoselective sulfonylation reaction. Fluoro-, chloro-, bromo-, and even iodo-benzenesulfonyl chlorides react nicely to afford halo-substituted diarylsulfones in good to high yields without cleavage of the C–halo bonds, allowing further transformations.

Introduction

Unsymmetrical diarylsulfones are important motifs, which are embedded in many drugs and pharmacologically active compounds. For examples, Dapsone, which exhibits antibacterial properties, is administrated for the treatment of leprosy and for the treatment of pneumocystis pneumonia (Figure 1 left).[1] L-737, 126 is a non-nucleoside inhibitor of HIV-1 reverse transcriptase (Figure 1 middle).[2] Its structure contains a chlorine atom, which is very important for its activity. CX157 is a fluorinated fused diarylsulfone, which has been in phase II clinical trials for the treatment of depression (Figure 1 right). There is a high demand for the preparation of diarylsulfones using mild reaction conditions with high functional group tolerance, including C–halo bonds.



Dapsone **L-737, 126** **CX157**

Figure 1. Examples of Relevant Diarylsulfones

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Although there are different reported methods for the synthesis of diarylsulfones, most of them suffer from limitations. For example, the oxidation of sulfides could be only achieved with substrates which are compatible with oxidizing agents.[3] Friedel–Crafts-type sulfonylation of arenes are often carried out under harsh reaction conditions and are not regiospecific, leading to mixtures of compounds.[4] Nucleophilic substitution of sulfonate esters or coupling of sulfinates required the use of organometallic reagents.[5] Alternatively, transition-metal catalyzed C–H bond activation/functionalization allows the preparation of organic molecules in more efficient and shorter ways with higher atom economy compared to the traditional cross-coupling reactions.[6] Most of the reported protocols for *ortho*-regioselective aryl C–H bond sulfonylation reaction required a chelate directing group[7] or occurred at a remote C–H bond.[8] In 2009, V. Dong and co-workers reported Pd-catalyzed *ortho*-directed C–H bond sulfonylation of 2-arylpridines from benzenesulfonyl chlorides (Figure 2a).[9] However, no examples using halo-substituted benzenesulfonyl chlorides were described, although it could allow the synthesis of halo-substituted diarylsulfones, which are useful synthetic intermediates.[10] Sodium arylsulfinates have been also employed for sulfonylation, although scarce examples involving chemoselective C–H bond functionalization tolerant to C–halo bond were reported.[11] In 2012, formal C–H bond sulfonylations of 2-arylpyridines were achieved through sequential metal-free *ortho*-directed borylation followed by copper-catalyzed sulfonylation using sodium arylsulfinates. These conditions tolerated a chloro substituent on the phenyl unit of 2-phenylpyridine derivatives. However, there was no example tolerant to C–Br or C–I bonds (Figure 2b).[12] In 2016, Li and co-workers reported the rhodium-catalyzed sulfonylation of 2-arylpyridines (Figure 2c).[13] The reaction proceeded by initial Rh(III)-catalyzed C–H hyperiodination of arene at room temperature followed by uncatalyzed nucleophilic functionalization using sodium arylsulfinates. The procedure required the use of 1.6 equivalent of hypervalent iodine, making this protocol not very user- and eco-friendly for the preparation of (poly)halo-substituted diarylsulfones. The authors shown that the reaction was tolerant to C–Cl and C–Br bonds. However, no example with substrate bearing a C–I bond was reported.

In 2015, our group shown that (poly)halo-benzenesulfonyl chlorides, which are commercially available at an affordable cost and are easy to handle, undergo palladium-catalyzed chemo- and regio-selective C–H bond arylation of heteroarenes allowing the formation of (poly)halo-substituted bi(hetero)aryls, including iodo-substituted ones.[14] In our continuous efforts to employ (poly)halo-benzenesulfonyl chlorides in chemoselective C–H

bond functionalizations, we wish to report a practical and cost-effective method for the synthesis of unsymmetrical halo-diarylsulfones through a palladium catalyzed C–H bond sulfonylation using (poly)halo-benzenesulfonyl chlorides (Figure 2d).

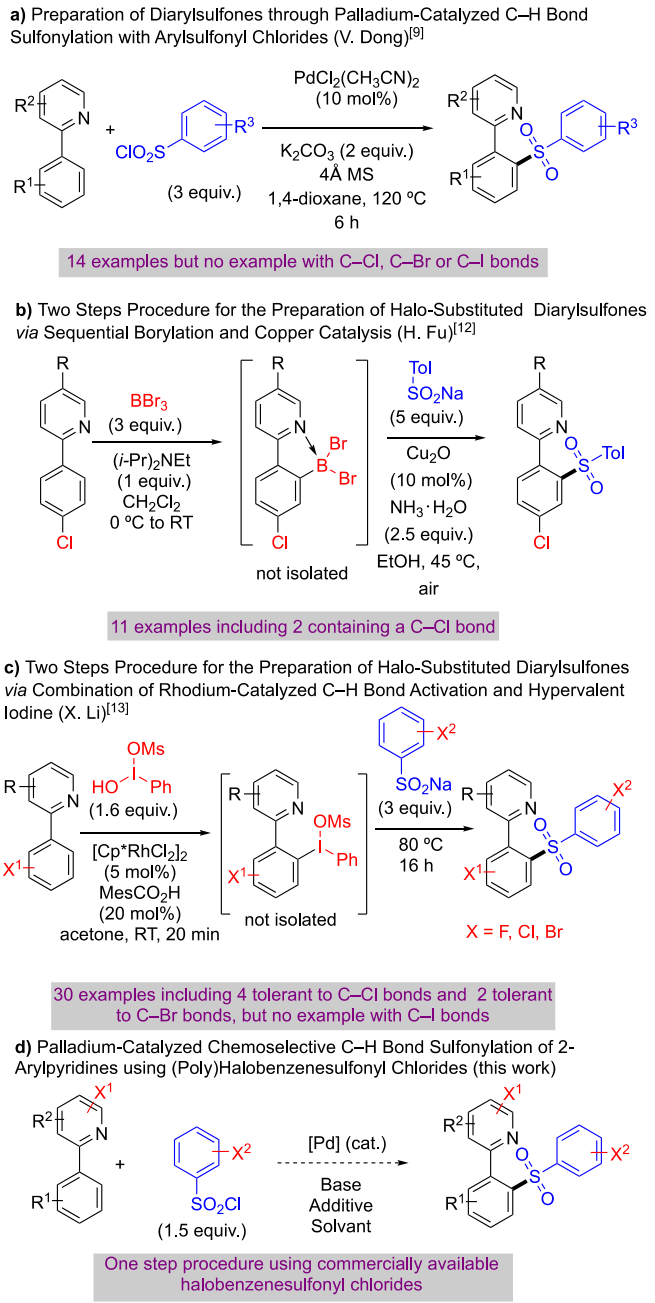
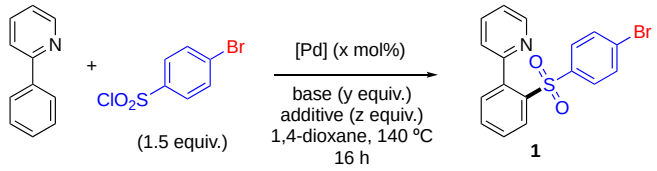


Figure 2. C–H Bond Functionalization using Benzenesulfonyl chloride or Sodium Sulfinates

Results and Discussion

2-Phenylpyridine and 4-bromobenzenesulfonyl chloride were selected as model substrates to study the Pd-catalyzed chemoselective C–H bond sulfonylation. Using our previous conditions –namely 5 mol% $PdCl_2(CH_3CN)_2$ in the presence of Li_2CO_3 as base in 1,4-dioxane– which are tolerant to C–halo bonds in Pd-catalyzed desulfitative arylation of heteroarenes,[14] no coupling product was obtained (Table 1, entry 1). The conditions reported by Dong *et al.* for the sulfonylation of 2-phenylpyridine with benzenesulfonyl chloride (i.e. 10 mol% $PdCl_2(CH_3CN)_2$ associated to K_2CO_3 as base in 1,4-dioxane in the presence of 4Å molecular sieves),[9a] also failed, and only degradation products from 4-bromobenzenesulfonyl chloride were observed (Table 1, entry 2). When the reaction was carried out without molecular sieves, again no formation of **1** was observed (Table 1, entry 3). However, the use of Ag_2CO_3 as base allowed the formation of 2-(2-((4-bromophenyl)sulfonyl)phenyl)pyridine **1** in 27% yield (Table 1, entry 4). Noteworthy, the reaction is highly chemoselective toward S–Cl bond activation and no coupling product derived from the activation of the C–Br bond was detected by ^{1}H NMR or GC/MS analysis of the crude mixture. This chemoselectivity might be explained by the fast oxidation addition of the sulfonyl chloride function to a Pd^{II} species as reported by Dong.[9] In the presence of benzenesulfonyl chlorides using Ag_2CO_3 as base, the formation of Pd^0 species is suppressed and no oxidative addition of the C–Br bond to palladium is observed. $Pd(OAc)_2$ displayed a higher catalytic activity for this sulfonylation reaction than $PdCl_2(CH_3CN)_2$ and allowed the formation of the brominated sulfone **1** in 50% yield (Table 1, entry 5). Previously, we had shown that copper salts can affect the outcome of coupling reactions with benzenesulfonyl chlorides, especially for substrates containing a nitrogen atom.[15] Therefore, we investigated the effect of set of copper salts as oxidant on the reactivity (Table 1, entries 6–9). The reaction was completely inhibited in the presence of 1 equivalent of CuI; whereas, better yields of 65% and 75% in **1** were obtained in the presence of 1 equivalent of CuOTf or CuBr as additives. Finally, $Cu(OAc)_2{\cdot}nH_2O$ was found the be the most efficient additive for this reaction. In the presence of $Cu(OAc)_2{\cdot}nH_2O$, the amount of Ag_2CO_3 can be decreased to 1 equivalent without loss of activity, and the bromo-substituted diarylsulfone **1** was isolated in 78% yield (Table 1, entry 10). However, the use of only 0.5 equivalent of $Cu(OAc)_2{\cdot}nH_2O$ resulted in a lower yield of **1** (Table 1, entry 11). Other solvent such as CPME, DMF, or 1,2-dichloroethane ($ClCH_2CH_2Cl$) did not allow any improvement (Table 1, entries 12-14). Notably, in all cases, we did not observe the formation of arylated products resulting from a desulfitative coupling,[16] probably due to the conformation of the cyclometalated palladium(IV) sulfinate, which allows quite easily the formation of the carbon–sulfur bond.[9b]

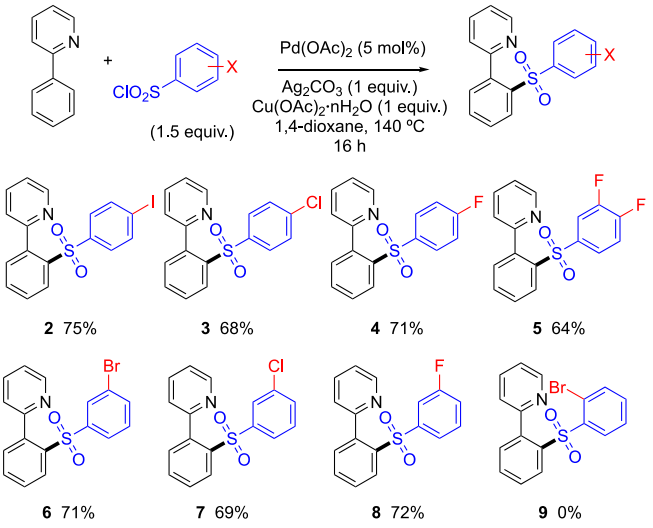
Table 1. Optimization of the Reaction Conditions



Entry[a]	[Pd] (x)	Base (y)	Additive (z)[b]	Yield in **1**[a]
1	$PdCl_2(CH_3CN)_2$ (5)	Li_2CO_3 (3)	–	0%
2	$PdCl_2(CH_3CN)_2$ (10)	K_2CO_3 (2)	MS 4Å	0%
3	$PdCl_2(CH_3CN)_2$ (5)	K_2CO_3 (2)	–	0%
4	$PdCl_2(CH_3CN)_2$ (5)	Ag_2CO_3 (2)	–	27%
5	$Pd(OAc)_2$ (5)	Ag_2CO_3 (2)	–	50%
6	$Pd(OAc)_2$ (5)	Ag_2CO_3 (2)	CuI (1)	0%
7	$Pd(OAc)_2$ (5)	Ag_2CO_3 (2)	CuOTf (1)	65%
8	$Pd(OAc)_2$ (5)	Ag_2CO_3 (2)	CuBr (1)	75%
9	$Pd(OAc)_2$ (5)	Ag_2CO_3 (2)	$Cu(OAc)_2{\cdot}nH_2O$ (1)	81%
10	$Pd(OAc)_2$ (5)	Ag_2CO_3 (1)	$Cu(OAc)_2{\cdot}nH_2O$ (1)	83% (78%)
11	$Pd(OAc)_2$ (5)	Ag_2CO_3 (1)	$Cu(OAc)_2{\cdot}nH_2O$ (0.5)	27%
12[b]	$Pd(OAc)_2$ (5)	Ag_2CO_3 (1)	$Cu(OAc)_2{\cdot}nH_2O$ (1)	0%
13[c]	$Pd(OAc)_2$ (5)	Ag_2CO_3 (1)	$Cu(OAc)_2{\cdot}nH_2O$ (1)	41%
14[d]	$Pd(OAc)_2$ (5)	Ag_2CO_3 (1)	$Cu(OAc)_2{\cdot}nH_2O$ (1)	0%

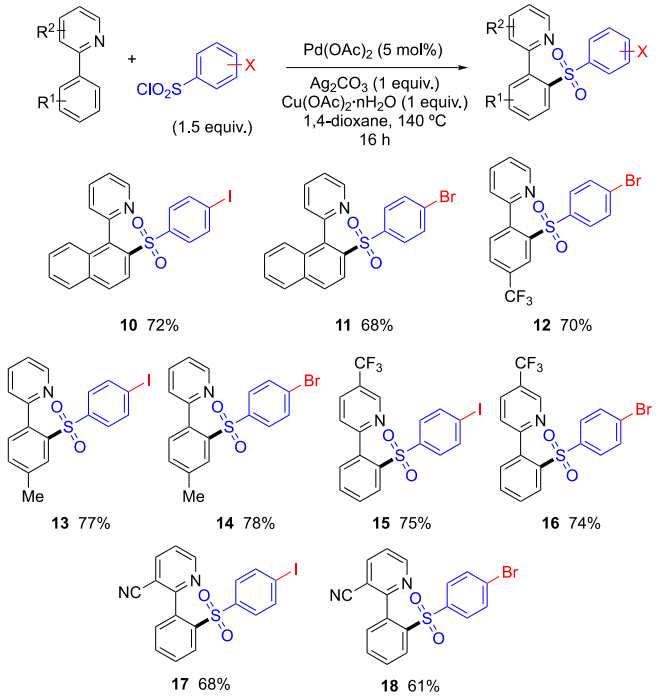
[a] Determined by ^1H NMR spectroscopy using 1,3,5-trimethoxybenzene as internal standard. The number in parentheses shows the isolated yield. [b] Reaction performed in CPME instead of 1,4-dioxane. [c] Reaction performed in DMF instead of 1,4-dioxane. [d] Reaction performed in $ClCH_2CH_2Cl$ instead of 1,4-dioxane.

Having the optimized reaction conditions in hands, we investigated the reactivity of other benzenesulfonyl chlorides bearing C–halo bonds (Scheme 1). The reaction was also tolerant toward the very reactive C–I bonds, as 4-iodobenzenesulfonyl chloride chemoselectively reacted with 2-phenylpyridine to afford the diarylsulfone **2** in 75% yield, without C–I bond cleavage. The synthesis of diarylsulfones bearing C–Cl or C–F bonds, such as compounds **3**-**5**, can also be achieved in good yields using this protocol. From 3-bromo-, 3-chloro- or 3-fluorobenzenesulfonyl chlorides, the halo-substituted diarylsulfones **6**-**8** were obtained in 71%, 69% and 72% yields, respectively; whereas, no reaction occurred using 2-bromobenzenesulfonyl chloride.



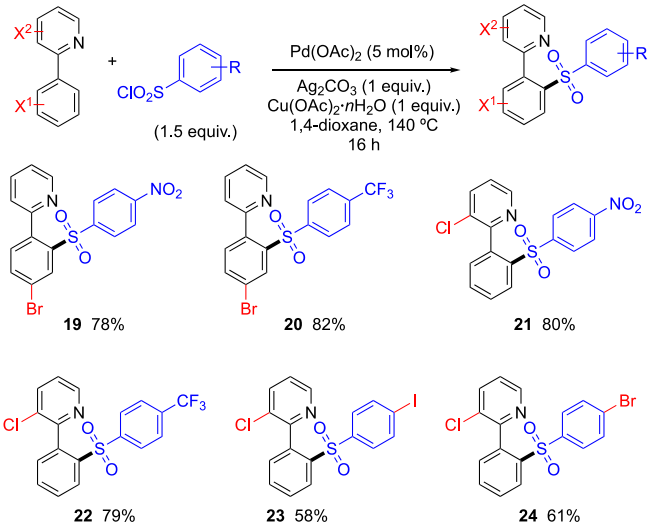
Scheme 1. Reactivity of Halo-Substituted Benzenesulfonyl Chlorides in Pd-Catalyzed C–H Bond Sulfonylation of 2-Phenylpyridine

We next evaluated the reaction scope with respect to the 2-arylpyridine derivatives in reactions with halo-substituted benzenesulfonyl chlorides (Scheme 2). 2-(Naphthalen-1-yl)pyridine also underwent palladium-catalyzed C–H bond sulfonylation with 4-bromo- or 4-iodo-benzenesulfonyl chlorides to afford the diarylsulfones **10** and **11** in 72% and 68% yields, respectively. An electron-withdrawing group such as trifluoromethyl on the phenyl ring of the 2-phenylpyridine slightly decreased the efficiency of the C–H bond sulfonylation reaction, as the desired sulfonated product **12** was obtained in 70% yield. In contrast, when the phenyl ring bears an electron-donating group such as a methyl, the reaction with 4-iodo- or 4-bromo-benzenesulfonyl chlorides delivered the halo-substituted diarylsulfones **13** and **14** in 77% and 78% yields, respectively. The substituent on the pyridine ring seems to have a minor influence on the reactivity of 2-phenylpyridine derivatives in Pd-catalyzed C–H bond sulfonylation with halo-benzenesulfonyl chlorides. Indeed, from 2-phenyl-5-(trifluoromethyl)pyridine and 4-bromo- or 4-iodo-benzenesulfonyl chlorides, the optimized reaction condition allowed the exclusive formation of the halo-substituted diarylsulfones **15** and **16** in good yields. 2-Phenylnicotinonitrile also reacted nicely with 4-bromo-, or 4-iodo-, benzenesulfonyl chlorides to deliver the halo-substituted diarylsulfones **17** and **18** in 68 and 61% yields, respectively.



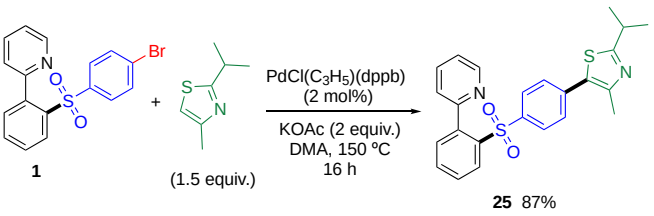
Scheme 2. Scope of 2-Arylpyridine Derivatives in Pd-Catalyzed C–H Bond Sulfonylation with Halo-Benzenesulfonyl Chlorides

So far, all the reported protocols for the *ortho*-sulfonylation of halo-substituted 2-arylpyridine derivatives required two steps procedures (Figure 2b and 2c).[12-13] Therefore, we investigated the reactivity of halo-substituted 2-arylpyridine derivatives in such Pd-catalyzed direct sulfonylation reaction (Scheme 3). Under optimized reaction conditions, *ortho*-C–H bond sulfonylation of 2-(4-bromophenyl)pyridine was selectively achieved with 4-nitro or 4-(trifluroromethyl)benzenesulfonyl chlorides to give the diarylsulfones **19** and **20** in 78% and 82% yields, respectively without cleavage of the C–Br bonds. A similar reactivity's trend was observed with 3-chloro-2-phenylpyridine, which allowed the formation of **21** and **22** in high yields from with 4-nitro- and 4-(trifluroromethyl)benzenesulfonyl chlorides, respectively. From 3-chloro-2-phenylpyridine and halo-benzenesulfonyl chlorides, the polyhalogenated diarylsulfones **23** and **24** were synthetized in good yields. Noteworthy, no cleavage of both C–halo bond –i.e., on 2-phenylpyridine derivatives and on halo-benzenesulfonyl chlorides– was observed.



Scheme 3. Reactivity of Halo-substituted 2-Arylpyridine Derivatives in Pd-Catalyzed C–H Bond Sulfonylation with (Halo)-Benzenesulfonyl Chlorides

We further demonstrated the potential of chemoselective C–H bond sulfonylation of 2-arylpyridines with 4-halobenzene sulfonyl chlorides by performing successive C–H bond functionalizations (Scheme 4). The direct arylation of 2-isopropyl-4-methylthiazole at C5 position using 2-(2-((4-bromophenyl)sulfonyl)phenyl)pyridine (**1**) as aryl source was performed using the our previously optimized catalytic system [i.e., $PdCl(C_3H_5)(dppb)$ (1 mol%) in the presence of KOAc (2 equiv.) as base in DMA at 150 °C],[17] to afford the product **25** in 85% yield.



Scheme 4. Reactivity of Halo-substituted 2-Arylpyridine Derivatives in Pd-Catalyzed C–H Bond Arylation using a Thiazole Derivative

Conclusions

We have developed a one step synthetic scheme for access to (poly)halosubstituted diarylsulfones from commercially available substrates. The reaction proceeds *via* Pd-catalyzed C–H sulfonylation of from 2-arylpyridine derivatives using poly(halo)-substituted benzenesulfonyl chlorides. The use of Ag_2CO_3 in concert with $Cu(OAc)_2$ in the presence of a catalytic amount of phosphine-free $Pd(OAc)_2$ was found to be critical to promote these chemoselective sulfonylation reactions. These reaction conditions were found to be tolerant to C–Br and even C–I bonds, allowing further functionalizations. These reaction conditions also tolerated C–Br and C-Cl bonds on the 2-arylpyridines.

Experimental Section

General: All reactions were carried out under argon atmosphere with standard Schlenk-tube techniques. HPLC grade 1,4-dioxane was stored under argon and used without further purification. ^{1}H NMR spectra were recorded on Bruker GPX (400 MHz or 300 MHz) spectrometers. Chemical shifts (d) were reported in parts per million relative to residual chloroform (7.26 ppm for ^{1}H ; 77.0 ppm for ^{13}C), constants were reported in Hertz. ^{1}H NMR assignment abbreviations were the following: singlet (s), doublet (d), triplet (t), quartet (q), doublet of doublets (dd), doublet of triplets (dt), and multiplet (m). ^{13}C NMR spectra were recorded at 100 MHz on the same spectrometer and reported in ppm. All reagents were weighed and handled in air.

General procedure for synthesis of (poly)halo-substituted diarylsulfones: To a 25 mL oven dried Schlenk tube, arylsulfonyl chloride (1.5 mmol), 2-phenylpyridine derivative (1 mmol), Ag_2CO_3 (0.275 g, 1 mmol), $Cu(OAc)_2{\cdot}nH_2O$ (181 mg, 1mmol), 1,4-dioxane (2 mL) and $Pd(OAc)_2$ (11.1 mg, 0.05 mmol) were successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 140 ºC (oil bath temperature) for 16 h (see tables and schemes). After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography to afford the (poly)halo-substituted diarylsulfones.

2-(2-((4-Bromophenyl)sulfonyl)phenyl)pyridine (1): 2-phenylpyridine (0.155 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **1** in 78% (0.292 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.43 (s, 1H), 8.35 (d, *J* = 7.7 Hz, 1H), 7.80 (t, *J* = 7.7 Hz, 1H), 7.73 – 7.63 (m, 2H), 7.57 (d, *J* = 7.7 Hz, 1H), 7.48 (d, *J* = 8.6 Hz, 2H), 7.41 (d, *J* = 7.2 Hz, 1H), 7.38 – 7.33 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.6, 148.5, 140.9, 140.5, 138.9, 135.7, 133.5, 132.1, 131.9, 129.2, 129.2, 128.8, 128.0, 125.8, 122.7. This is a known compound and the spectral data are identical to those reported in literature.[13]

2-(2-((4-Iodophenyl)sulfonyl)phenyl)pyridine (2): 2-phenylpyridine (0.155 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **2** in 75% (0.316 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.39 (ddd, *J* = 1.0, 1.8, 4.9 Hz, 1H), 8.34 (dd, *J* = 1.2, 7.6 Hz, 1H), 7.74 (td, *J* = 1.8, 7.7 Hz, 1H), 7.70 – 7.59 (m, 4H), 7.52 (dt, *J* = 1.1, 7.9 Hz, 1H), 7.40 – 7.35 (m, 1H), 7.29 (ddd, *J* = 1.2, 4.9, 7.6 Hz, 1H), 7.16 (d, *J* = 8.6 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 159.0, 149.5, 140.9, 139.4, 139.4, 137.2, 135.5, 131.6, 130.6, 130.3, 128.7, 128.0, 125.3, 121.5, 92.6. Elemental analysis: calcd (%) for $C_{17}H_{12}INO_2S$ (421.25): C 48.47, H 2.97; found: C 48.51, H 3.09.

2-(2-((4-Chlorophenyl)sulfonyl)phenyl)pyridine (3): 2-phenylpyridine (0.155 g, 1 mmol) and 4-chlorobenzenesulfonyl chloride (0.317 g, 1.5 mmol) affords **3** in 68% (0.224 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.39 (d, *J* = 4.8 Hz, 1H), 8.34 (dd, *J* = 1.6, 7.7 Hz, 1H), 7.75 (td, *J* = 1.8, 7.7 Hz, 1H), 7.70 – 7.60 (m, 2H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.43 – 7.36 (m, 3H), 7.29 – 7.27 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.5, 148.4, 140.8, 139.8, 139.3, 138.8, 135.6, 133.4, 132.0, 129.1, 129.0, 128.8, 128.7, 125.7, 122.6. This is a known compound and the spectral data are identical to those reported in literature.[13]

2-(2-((4-Fluorophenyl)sulfonyl)phenyl)pyridine (4): 2-phenylpyridine (0.155 g, 1 mmol) and 4-fluorobenzenesulfonyl chloride (0.291 g, 1.5 mmol) affords **4** in 71% (0.222 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.42 (d, *J* = 5.0 Hz, 1H), 8.36 (dd, *J* = 1.1, 7.8 Hz, 1H), 7.77 (td, *J* = 1.8, 7.7 Hz, 1H), 7.70 – 7.61 (m, 2H), 7.56 (dt, *J* = 1.1, 7.9 Hz, 1H), 7.52 – 7.45 (m, 2H), 7.39 (dd, *J* = 1.6, 7.3 Hz, 1H), 7.30 (dd, *J* = 2.1, 7.3 Hz, 1H), 7.00 (dd, *J* = 8.0, 9.2 Hz, 2H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -104.9. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 165.1 (d, *J* = 255.5 Hz), 156.7, 148.5, 140.8, 139.2, 137.4, 135.7, 133.3, 132.1, 130.5 (d, *J* = 9.6 Hz), 129.1, 128.8, 125.9, 122.7. 115.9 (d, *J* = 22.7 Hz). Elemental analysis: calcd (%) for $C_{17}H_{12}FNO_2S$ (313.34): C 65.16, H 3.86; found: C 65.28, H 3.79.

2-(2-((3,4-Difluorophenyl)sulfonyl)phenyl)pyridine (5): 2-phenylpyridine (0.155 g, 1 mmol) and 3,4-difluorobenzenesulfonyl chloride (0.319 g, 1.5 mmol) affords **5** in 64% (0.212 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.43 (ddd, J = 1.0, 1.8, 4.9 Hz, 1H), 8.33 (dd, *J* = 1.6, 7.8 Hz, 1H), 7.78 (td, *J* = 1.8, 7.7 Hz, 1H), 7.73 – 7.60 (m, 2H), 7.54 (dt, *J* = 1.1, 7.8 Hz, 1H), 7.39 (dd, *J* = 1.6, 7.4 Hz, 1H), 7.31 (dddd, *J* = 1.4, 4.8, 7.9, 9.1 Hz, 3H), 7.17 – 7.08 (m, 1H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -129.1 (d, *J* = 20.8 Hz), -134.2 (d, *J* = 20.8 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.2, 153.2 (dd, *J* = 12.9, 253.7 Hz), 149.8 (dd, *J* = 12.9, 253.7 Hz), 148.5, 140.9, 138.8, 138.3 (t, *J* = 4.9 Hz), 135.8, 133.6, 132.2, 129.4, 128.9, 125.8, 125.0 (dd, *J* = 4.0, 7.7 Hz), 122.9, 117.9 (dd, *J* = 1.9, 20.1 Hz), 117.8 (d, *J* = 18.6 Hz). Elemental analysis: calcd (%) for $C_{17}H_{11}F_2NO_2S$ (331.33): C 61.63, H 3.35; found: C 61.79, H 3.59.

2-(2-((3-Bromophenyl)sulfonyl)phenyl)pyridine (6): 2-phenylpyridine (0.155 g, 1 mmol) and 3-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **6** in 71% (0.266 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.43 (d, *J* = 4.9 Hz, 1H), 8.37 (dd, *J* = 2.0, 7.4 Hz, 1H), 7.80 (dt, *J* = 1.6, 7.7 Hz, 1H), 7.68 (dt, *J* = 1.7, 6.5 Hz, 2H), 7.63 – 7.58 (m, 1H), 7.58 – 7.52 (m, 2H), 7.50 – 7.44 (m, 1H), 7.43 – 7.39 (m, 1H), 7.38 – 7.32 (m, 1H), 7.26 – 7.21 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.3, 148.6, 143.2, 140.9, 138.8, 135.8, 135.7, 133.6, 132.1, 130.8, 130.3, 129.3, 128.9, 126.4, 125.7, 123.0, 122.4. Elemental analysis: calcd (%) for $C_{17}H_{12}BrNO_2S$ (374.25): C 54.56, H 3.23; found: C 54.59, H 3.41.

2-(2-((3-Chlorophenyl)sulfonyl)phenyl)pyridine (7): 2-phenylpyridine (0.155 g, 1 mmol) and 3-chlorobenzenesulfonyl chloride (0.317 g, 1.5 mmol) affords **7** in 69% (0.228 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.41 – 8.38 (m, 1H), 8.38 – 8.33 (m, 1H), 7.76 (td, *J* = 1.8, 7.7 Hz, 1H), 7.71 – 7.60 (m, 2H), 7.52 (d, *J* = 7.8 Hz, 1H), 7.44 – 7.39 (m, 2H), 7.39 – 7.37 (m, 2H), 7.33 – 7.25 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.5, 148.6, 143.2, 141.1, 139.0, 135.9, 134.8, 133.7, 133.1, 132.2, 130.2, 129.4, 129.0, 128.1, 126.0, 125.9, 123.0. Elemental analysis: calcd (%) for $C_{17}H_{12}ClNO_2S$ (329.80): C 61.91, H 3.67; found: C 62.07, H 3.55.

2-(2-((3-Fluorophenyl)sulfonyl)phenyl)pyridine (8): 2-phenylpyridine (0.155 g, 1 mmol) and 3-fluorobenzenesulfonyl chloride (0.291 g, 1.5 mmol) affords **8** in 72% (0.226 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.42 (d, *J* = 4.9 Hz, 1H), 8.39 – 8.35 (m, 1H), 7.82 – 7.75 (m, 1H), 7.74 – 7.62 (m, 2H), 7.55 (d, *J* = 7.8 Hz, 1H), 7.41 (d, *J* = 7.1 Hz, 1H), 7.39 – 7.28 (m, 3H), 7.22 – 7.12 (m, 2H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -110.3. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 162.0 (d, *J* = 251.3 Hz), 156.6, 148.5, 143.6 (d, *J* = 6.7 Hz), 141.0, 138.9, 135.7, 133.5, 132.1, 130.5 (d, *J* = 7.7 Hz), 129.4, 128.8, 125.7, 123.5 (d, *J* = 3.3 Hz), 122.8, 120.0 (d, *J* = 21.4 Hz), 115.2 (d, *J* = 24.8 Hz). Elemental analysis: calcd (%) for $C_{17}H_{12}FNO_2S$ (313.36): C 65.16, H 3.86; found: C 65.18, H 3.91.

2-(2-((4-Iodophenyl)sulfonyl)naphthalen-1-yl)pyridine (10): 2-(naphthalen-1-yl)pyridine (0.205 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **10** in 72% (0.339 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.54 (dt, *J* = 1.2, 5.0 Hz, 1H), 8.33 (d, *J* = 8.8 Hz, 1H), 8.10 (d, *J* = 8.9 Hz, 1H), 7.95 (d, *J* = 8.2 Hz, 1H), 7.88 (td, *J* = 1.9, 7.7 Hz, 1H), 7.75 – 7.69 (m, 2H), 7.62 (ddd, *J* = 1.2, 6.8, 8.2 Hz, 1H), 7.59 – 7.55 (m, 1H), 7.46 – 7.39 (m, 2H), 7.26 (d, *J* = 7.9 Hz, 2H), 7.18 (d, *J* = 8.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 154.9, 148.8, 141.4, 139.5, 138.0, 136.1, 135.7, 135.5, 132.8, 129.5, 129.0, 128.9, 128.1, 127.7, 127.6, 127.3, 123.6, 122.9, 100.6. Elemental analysis: calcd (%) for $C_{21}H_{14}INO_2S$ (471.31): C 53.52, H 2.99; found: C 53.51, H 2.76.

2-(2-((4-Bromophenyl)sulfonyl)naphthalen-1-yl)pyridine (11): 2-(naphthalen-1-yl)pyridine (0.205 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **11** in 68% (0.288 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.56 (d, *J* = 5.0 Hz, 1H), 8.31 (d, *J* = 8.9 Hz, 1H), 8.10 (d, *J* = 8.8 Hz, 1H), 7.96 (d, *J* = 8.2 Hz, 1H), 7.91 (t, *J* = 7.8 Hz, 1H), 7.64 (d, *J* = 7.4 Hz, 1H), 7.62 – 7.57 (m, 1H), 7.51 (d, *J* = 8.6 Hz, 2H), 7.45 (t, *J* = 7.3 Hz, 4H), 7.18 (d, *J* = 8.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 154.9, 148.8, 140.7, 139.4, 136.1, 135.7, 135.5, 132.8, 132.0, 129.5, 129.2, 128.9, 128.1, 128.0, 127.7, 127.6, 127.3, 123.6, 123.0. Elemental analysis: calcd (%) for $C_{21}H_{14}BrNO_2S$ (422.31): C 59.44, H 3.33 found: C 59.67, H 3.49.

2-(2-((4-Bromophenyl)sulfonyl)-4-(trifluoromethyl)phenyl)pyridine (12): 2-(4-(trifluoromethyl)phenyl)pyridine (0.223 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.283 g, 1.5 mmol) affords **12** in 70% (0.309 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.63 (s, 1H), 8.40 (d, *J* = 4.8 Hz, 1H), 7.92 (d, *J* = 8.0 Hz, 1H), 7.78 (dt, *J* = 4.8, 7.8 Hz, 1H), 7.53 (dd, *J* = 7.9, 10.8 Hz, 2H), 7.47 (d, *J* = 8.3 Hz, 2H), 7.38 – 7.23 (m, 3H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -62.7. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.3, 148.7, 144.2, 140.3, 139.5, 136.0, 133.0, 132.1, 131.4 (q, *J* = 33.6 Hz), 130.0 (m), 129.3, 128.6, 126.4 (q, *J* = 4.1 Hz), 125.8, 123.3 123.0 (q, *J* = 272.1 Hz). Elemental analysis: calcd (%) for $C_{18}H_{11}F_3BrNO_2S$ (442.25): C 48.89, H 2.51; found: C 48.96, H 2.69.

2-(2-((4-Iodophenyl)sulfonyl)-4-methylphenyl)pyridine (13): 2-(*p*-tolyl)pyridine (0.169 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **13** in 77% (0.335 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.42 – 8.38 (m, 1H), 8.16 (s, 1H), 7.75 (td, *J* = 2.9, 5.7 Hz, 1H), 7.69 (d, *J* = 8.6 Hz, 1H), 7.55 – 7.46 (m, 2H), 7.42 (d, *J* = 9.2 Hz, 1H), 7.33 – 7.25 (m, 3H), 7.19 (d, *J* = 7.9 Hz, 1H), 2.54 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 148.4, 141.3, 139.2, 138.5, 137.8, 135.6, 134.1, 132.0, 129.5, 129.1, 129.0, 128.9, 126.0, 122.6, 100.5, 21.2. Elemental analysis: calcd (%) for $C_{18}H_{14}INO_2S$ (435.28): C 49.67, H 3.24; found: C 49.41, H 3.55.

2-(2-((4-Bromophenyl)sulfonyl)-4-methylphenyl)pyridine (14): 2-(*p*-tolyl)pyridine (0.169 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **14** in 78% (0.303 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (d, *J* = 4.3 Hz, 1H), 8.16 (s, 1H), 7.76 (t, *J* = 7.7 Hz, 1H), 7.56 – 7.53 (m, 1H), 7.51 – 7.49 (m, 1H), 7.50 – 7.46 (m, 2H), 7.36 (d, *J* = 8.7 Hz, 2H), 7.32 – 7.29 (m, 2H), 2.54 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 156.6, 148.4, 140.6, 139.2, 138.5, 138.0, 135.7, 134.1, 132.0, 131.8, 129.5, 129.1, 127.9, 126.0, 122.6, 21.3. Elemental analysis: calcd (%) for $C_{18}H_{14}BrNO_2S$ (388.28): C 55.68, H 3.63; found: C 55.81, H 3.70.

2-(2-((4-Iodophenyl)sulfonyl)phenyl)-5-(trifluoromethyl)pyridine (15): 2-phenyl-5-(trifluoromethyl)pyridine (0.223 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **15** in 75% (0.367 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.68 (s, 1H), 8.34 (dd, *J* = 1.6, 7.7 Hz, 1H), 8.01 (dd, *J* = 2.0, 8.2 Hz, 1H), 7.74 (d, *J* = 8.5 Hz, 2H), 7.71 – 7.66 (m, 3H), 7.39 (dd, *J* = 2.3, 7.4 Hz, 1H), 7.26 – 7.21 (m, 2H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -62.3. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 160.3, 145.3 (q, *J* = 4.0 Hz), 141.0, 139.5, 139.1, 138.1, 133.6, 132.9 (q, *J* = 3.5 Hz), 131.8, 129.5, 128.9, 125.7 (q, *J* = 33.5 Hz), 125.5, 123.4 (q, *J* = 272.1 Hz), 100.9. Elemental analysis: calcd (%) for $C_{18}H_{11}F_3INO_2S$ (489.25): C 44.19, H 2.27; found: C 44.28, H 2.56.

2-(2-((4-Bromophenyl)sulfonyl)phenyl)-5-(trifluoromethyl)pyridine (16): 2-phenyl-5-(trifluoromethyl)pyridine (0.223 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **16** in 74% (0.327 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.67 (s, 1H), 8.32 (dd, *J* = 1.3, 7.7 Hz, 1H), 8.00 (dd, *J* = 2.2, 9.0 Hz, 1H), 7.74 – 7.64 (m, 3H), 7.50 (d, *J* = 8.6 Hz, 2H), 7.40-7.35 (m, 3H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -62.3. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 160.3, 145.3 (q, *J* = 4.0 Hz), 140.3, 139.5, 139.1, 133.6, 132.9 (q, *J* = 3.5 Hz), 132.1, 131.8, 129.6, 129.1, 128.4, 127.0, 125.8 (q, *J* = 33.1 Hz), 125.5, 123.1 (q, *J* = 272.5 Hz). Elemental analysis: calcd (%) for $C_{18}H_{11}BrF_3NO_2S$ (442.25): C 48.89, H 2.51; found: C 49.05, H 2.80.

2-(2-((4-Iodophenyl)sulfonyl)phenyl)nicotinonitrile (17): 2-phenylnicotinonitrile (0.180 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **17** in 68% (0.303 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.71 (dd, *J* = 1.7, 4.9 Hz, 1H), 8.29 – 8.19 (m, 1H), 8.06 (dd, *J* = 1.7, 7.9 Hz, 1H), 7.80 (d, *J* = 8.6 Hz, 2H), 7.76 – 7.67 (m, 2H), 7.48 (dd, *J* = 4.9, 7.9 Hz, 1H), 7.44 – 7.36 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 160.3, 151.2, 141.4, 140.1, 139.2, 138.2, 137.2, 133.6, 131.3, 130.5, 130.4, 129.1, 122.7, 115.9, 110.9, 101.1. Elemental analysis: calcd (%) for $C_{18}H_{11}IN_2O_2S$ (446.26): C 48.45, H 2.48; found: C 48.51, H 2.36.

2-(2-((4-Bromophenyl)sulfonyl)phenyl)nicotinonitrile (18): 2-phenylnicotinonitrile (0.180 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **18** in 61% (0.244 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.75 (d, *J* = 3.8 Hz, 1H), 8.26 (dd, *J* = 2.0, 7.2 Hz, 1H), 8.09 (dd, *J* = 1.7, 7.8 Hz, 1H), 7.79 – 7.71 (m, 2H), 7.63 – 7.57 (m, 4H), 7.51 (dd, *J* = 4.8, 8.1 Hz, 1H), 7.45 (dd, *J* = 2.1, 6.7 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 160.3, 151.2, 140.7, 140.2, 139.2, 137.2, 133.7, 132.3, 131.9, 131.3, 130.5, 130.4, 129.3, 129.3, 128.5, 122.8. Elemental analysis: calcd (%) for $C_{18}H_{11}BrN_2O_2S$ (399.26): C 54.15, H 2.78; found: C 53.87, H 3.04.

2-(4-Bromo-2-((4-nitrophenyl)sulfonyl)phenyl)pyridine (19): 2-(4-bromophenyl)pyridine (0.234 g, 1 mmol) and 4-nitrobenzenesulfonyl chloride (0.332 g, 1.5 mmol) affords **19** in 78% (0.327 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.56 (d, *J* = 2.0 Hz, 1H), 8.34 (d, *J* = 4.5 Hz, 1H), 8.22 (d, *J* = 8.9 Hz, 2H), 7.87 (dd, *J* = 2.1, 8.1 Hz, 1H), 7.81 (td, *J* = 1.8, 7.8 Hz, 1H), 7.73 (d, *J* = 8.9 Hz, 2H), 7.55 (d, *J* = 7.8 Hz, 1H), 7.37 – 7.34 (m, 1H), 7.32 (d, *J* = 8.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.4, 150.1, 148.4, 146.9, 139.8, 139.6, 137.0, 136.3, 133.7, 132.5, 129.0, 125.6, 123.8, 123.3, 123.1. Elemental analysis: calcd (%) for $C_{17}H_{11}BrN_2O_4S$ (419.24): C 48.70, H 2.64; found: C 48.79, H 2.91.

2-(4-Bromo-2-((4-(trifluoromethyl)phenyl)sulfonyl)phenyl)pyridine (20): 2-(4-bromophenyl)pyridine (0.234 g, 1 mmol) and 4-(trifluoromethyl)benzenesulfonyl chloride (0.367 g, 1.5 mmol) affords **20** in 82% (0.362 g) yield. ^{1}H NMR (400 MHz, d_6-DMSO) 8.50 (d, *J* = 2.0 Hz, 1H), 8.33 (ddd, *J* = 0.9, 1.8, 4.8 Hz, 1H), 8.07 (dd, *J* = 2.0, 8.2 Hz, 1H), 7.95 – 7.84 (m, 5H), 7.51 – 7.46 (m, 2H), 7.41 (ddd, *J* = 1.1, 4.8, 7.6 Hz, 1H). ^{19}F{^{1}H} NMR (376.5 MHz, d_6-DMSO) δ (ppm) -61.6. ^{13}C NMR (100 MHz, d_6-DMSO) δ (ppm) 171.9, 155.7, 148.6, 140.4, 140.2, 137.6, 137.0, 134.6, 133.3 (q, *J* = 33.1 Hz), 132.7, 129.0, 126.6 (q, *J* = 5.1 Hz), 124.8, 123.8 (q, *J* = 273.5 Hz), 123.7, 122.6. Elemental analysis: calcd (%) for $C_{18}H_{11}BrF_3NO_2S$ (442.25): C 48.89, H 2.51; found: C 49.04, H 2.11.

3-Chloro-2-(2-((4-nitrophenyl)sulfonyl)phenyl)pyridine (21): 3-chloro-2-phenylpyridine (0.189 g, 1 mmol) and 4-nitrobenzenesulfonyl chloride (0.332 g, 1.5 mmol) affords **21** in 80% (0.299 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.41 (dd, *J* = 1.4, 4.7 Hz, 1H), 8.32 (dd, *J* = 1.5, 8.4 Hz, 1H), 8.28 (d, *J* = 8.8 Hz, 2H), 7.88 (d, *J* = 8.8 Hz, 2H), 7.85 (dd, *J* = 1.4, 8.1 Hz, 1H), 7.77 (td, *J* = 1.5, 7.5 Hz, 1H), 7.71 (td, *J* = 1.5, 7.6 Hz, 1H), 7.42 – 7.39 (m, 1H), 7.39 – 7.35 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.1, 150.2, 147.5, 146.2, 138.5, 137.8, 137.3, 134.1, 132.1, 131.7, 130.4, 129.8, 129.1, 124.5, 124.0. Elemental analysis: calcd (%) for $C_{17}H_{11}ClN_2O_4S$ (374.80): C 54.48, H 2.96; found: C 54.30, H 2.87.

3-Chloro-2-(2-((4-(trifluoromethyl)phenyl)sulfonyl)phenyl)pyridine (22): 3-chloro-2-phenylpyridine (0.189 g, 1 mmol) and 4-(trifluoromethyl)benzenesulfonyl chloride (0.367 g, 1.5 mmol) affords **22** in

79% (0.314 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.41 (d, *J* = 4.6 Hz, 1H), 8.31 (dd, *J* = 2.0, 7.8 Hz, 1H), 7.86 – 7.79 (m, 3H), 7.77 – 7.67 (m, 4H), 7.41 – 7.32 (m, 2H). ^{19}F{^{1}H} NMR (376.5 MHz, $CDCl_3$) δ (ppm) -63.2. ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.2, 146.3, 145.3, 138.4, 138.3, 137.1, 134.6 (q, *J* = 34.1 Hz), 133.8, 132.1, 131.5, 130.2, 129.7, 128.4, 126.0 (q, *J* = 3.5 Hz), 124.3, 123.2 (q, *J* = 272.5 Hz). Elemental analysis: calcd (%) for $C_{18}H_{11}ClF_3NO_2S$ (397.80): C 54.35, H 2.79; found: C 54.58, H 2.51.

3-Chloro-2-(2-((4-iodophenyl)sulfonyl)phenyl)pyridine (23): 3-chloro-2-phenylpyridine (0.189 g, 1 mmol) and 4-iodobenzenesulfonyl chloride (0.454 g, 1.5 mmol) affords **23** in 58% (0.264 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.43 (dd, *J* = 1.5, 4.7 Hz, 1H), 8.26 (dd, *J* = 1.6, 7.7 Hz, 1H), 7.83 – 7.78 (m, 2H), 7.74 – 7.63 (m, 3H), 7.40 – 7.32 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.3, 146.3, 141.4, 138.8, 138.1, 138.1, 137.1, 133.5, 132.1, 131.4, 130.0, 129.6, 129.2, 124.2, 100.9. Elemental analysis: calcd (%) for $C_{17}H_{11}ClINO_2S$ (455.69): C 44.81, H 2.43; found: C 45.03, H 2.89.

2-(2-((4-Bromophenyl)sulfonyl)phenyl)-3-chloropyridine (24): 3-chloro-2-phenylpyridine (0.189 g, 1 mmol) and 4-bromobenzenesulfonyl chloride (0.383 g, 1.5 mmol) affords **24** in 61% (0.249 g) yield. ^{1}H NMR (400 MHz, $CDCl_3$) 8.44 (dd, *J* = 1.5, 4.7 Hz, 1H), 8.27 (dd, *J* = 1.3, 7.4 Hz, 1H), 7.81 (dd, *J* = 1.5, 8.2 Hz, 1H), 7.71 (td, *J* = 1.6, 7.5 Hz, 1H), 7.66 (td, *J* = 1.7, 7.6 Hz, 1H), 7.60 – 7.49 (m, 4H), 7.39 – 7.31 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 155.4, 146.3, 140.8, 138.8, 138.2, 137.1, 133.5, 132.1, 132.1, 131.4, 130.0, 129.6, 129.4, 128.3, 124.2. Elemental analysis: calcd (%) for $C_{17}H_{11}BrClNO_2S$ (408.69): C 49.96, H 2.71; found: C 50.21, H 2.52.

Preparation of the $PdCl(C_3H_5)$(dppb) catalyst:[18] An oven-dried 40 mL Schlenk tube equipped with a magnetic stirring bar under argon atmosphere, was charged with $[Pd(C_3H_5)Cl]_2$ (182 mg, 0.5 mmol) and dppb (426 mg, 1 mmol). 10 mL of anhydrous dichloromethane were added, then, the solution was stirred at room temperature for twenty minutes. The solvent was removed in vacuum. The powder was used without purification. (^{31}P NMR 381 MHz, $CDCl_3$) δ = 19.3 (s).

2-Isopropyl-4-methyl-5-(4-((2-(pyridin-2-yl)phenyl)sulfonyl)phenyl)thiazole (25): To a 25 mL oven dried Schlenk tube, 2-(2-((4-bromophenyl)sulfonyl)phenyl)pyridine (**1**) (0.186 g, 0.5 mmol) and 2-isopropyl-4-methylthiazole (0. 106 g, 0.75 mmol) KOAc (0.196 g, 2 mmol), DMA (4 mL) and $PdCl(C_3H_5)$(dppb) (12.2 mg, 0.02 mmol) were successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 150 ºC (oil bath temperature) for 16 h. After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography to afford **25** in 87% (0.189 g). ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.38 (ddd, *J* = 2.0, 3.2, 4.2 Hz, 2H), 7.75 (td, *J* = 1.8, 7.7 Hz, 1H), 7.70 – 7.61 (m, 2H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.48 (d, *J* = 8.6 Hz, 2H), 7.41 – 7.38 (m, 1H), 7.36 – 7.32 (m, 2H), 7.30 – 7.26 (m, 1H), 3.41 – 3.19 (m, 1H), 2.45 (s, 3H), 1.41 (d, *J* = 6.9 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm) 176.7, 156.7, 148.5, 148.4, 140.9, 140.0, 139.3, 137.4, 135.7, 133.4, 132.1, 129.2, 129.0, 128.9, 128.8, 128.1, 125.9, 122.7, 33.5, 23.2, 16.4. Elemental analysis: calcd (%) for $C_{24}H_{22}N_2O_2S_2$ (434.57): C 66.33, H 5.10; found: C 66.38, H 5.21.

Acknowledgements

A.S. acknowledges the Indo-French Centre for the Promotion of Advanced Research (IFCPAR, Nº 5705-1) for a PhD grant and research support.

Keywords: C–H bond • Sulfonylation • Palladium • Halo Bonds • Sulfones

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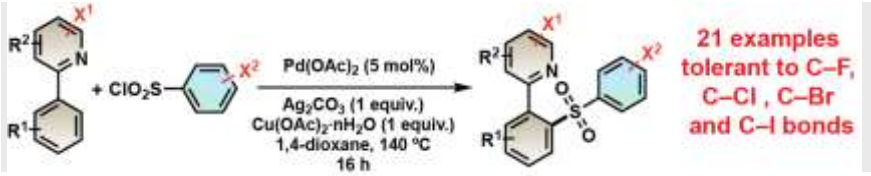

A one step procedure for the synthesis of (poly)halo-substituted diarylsulfones was developed. The reaction involves *ortho* C–H bond sulfonylation of 2-arylpyridines with (poly)halo-substituted benzenesulfonyl chlorides. These reaction conditions tolerated C–F, C–Cl, C–Br and even C–I bonds.

C–H bond Functionalization*

A. Sasmal, J. K. Bera, H. Doucet and J.-F. Soulé**

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Synthesis of (Poly)halo-substituted Diarylsulfones through Palladium Catalyzed C–H Bond Sulfonylation using (Poly)Halobenzenesulfonyl Chlorides