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Palladium Catalyzed Direct 3-Arylation of Benzofurans using Low Catalyst Loadings

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The palladium-catalyzed direct 3-arylation of benzofurans provides a cost-effective and environmentally attractive route for the preparation of 3-arylbenzofuran derivatives. The reactions were carried out using a wide variety of electronically and sterically diverse aryl or heteroaryl bromides with low catalyst loadings. In the presence of only 0.1–0.5 mol% catalyst, products in moderate to good yields were obtained. The aryl bromide reactants were able to tolerate a wide range of functionalities, such as acetyl, propionyl, formyl, ester, nitrile, trifluoromethyl, or fluoro groups. Higher yields were obtained using electron-deficient aryl bromides as reactants compared to using electron-rich aryl bromides. Functionalized benzofuran derivatives, bearing formyl or hydroxymethyl on C2, were also successfully employed.

Introduction

The direct arylation of heteroaromatics, such as benzofurans is an important field for research in green chemistry due to the biological properties of some benzofuran derivatives (Figure 1).[1]

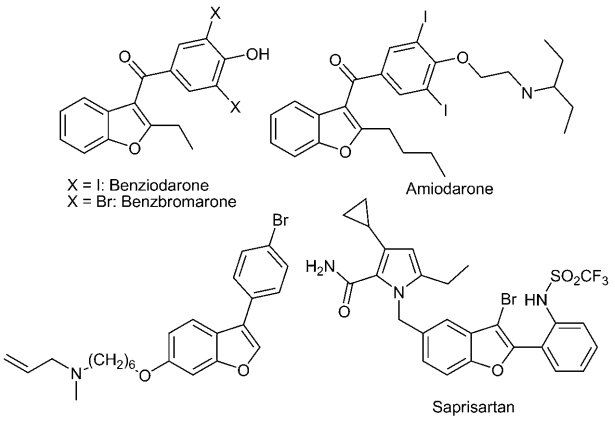

Figure 1. Examples of bioactive benzofurans.

In 1990, Ohta and co-workers reported that the direct 2- or 5-arylation of several heteroaromatics, including furans, with aryl halides proceed in moderate to good yields using $Pd(PPh_3)_4$ as the catalyst.[2a] Since these exciting results, the palladium-catalyzed direct arylation of heteroaryl derivatives with aryl halides or triflates has proved to be a very powerful method for the synthesis of a wide variety of arylated heterocycles.[2–9] The direct arylation of furans, thiophenes, or thiazoles has been largely described; however, benzofurans have rarely been employed.[10–12] Recently, Fagnou and co-workers reported the coupling of benzofuran with 2-bromotoluene using 2 mol% $Pd(OAc)_2$ and 4 mol% PCy_3 as the catalyst. 2-Arylated benzofuran was obtained in a low yield of 29%.[10b] An example of 2,3-diarylation of benzofuran in the presence of 5 mol% $Pd(OAc)_2$ and 10 mol% P*n*Bu(Ad)$_2$ as the catalyst has been described by Chiong and Daugulis.[11] The direct arylation on C3 of a 2-substituted benzofuran, via an intramolecular cyclization, has also been reported.[12]

The palladium-catalyzed direct 3-arylation of benzofurans should provide a cost-effective and environmentally attractive route for the preparation of 3-arylbenzofurans. The major by-product of the reaction is a base associated to HX, instead of metallic salts produced under classical cross-coupling procedures,[13–16] such as Suzuki,[14] Negishi,[15] or Stille[16] reactions. Moreover, the method avoids the preliminary preparation of a requisite organometallic, which reduces the number of steps to prepare these compounds.

Therefore, the discovery of more effective conditions, for the direct coupling of benzofuran derivatives with aryl bromides, especially using low catalyst loading conditions (less than 1 mol%), would be a considerable advantage for industrial applications and also for sustainable development. Herein, we report the use of 2-substituted benzofurans for the palladium-catalyzed synthesis of 3-arylated benzofuran derivatives, using a wide variety of electronically and sterically diverse aryl or heteroaryl bromides at low catalyst loadings.

Results and Discussion

In order to determine the reactivity of the 2-substituted benzofuran derivatives for palladium-catalyzed direct arylations, a set of direct arylation reactions of 2-ethylbenzofuran with 4-bro-

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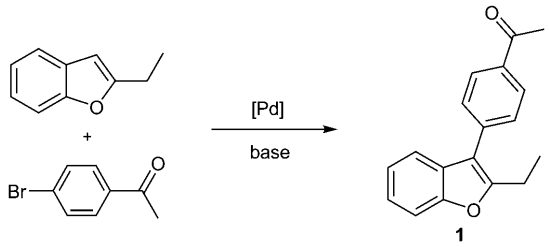
moacetophenone using several reaction conditions was carried out (Scheme 1, table 1). Firstly, the influence of several bases was explored using 0.1 mol% $Pd(OAc)_2$ as the catalyst and



Scheme 1. Coupling of 2-ethylbenzofuran with 4-bromoacetophenone.

DMAc as the solvent (Table 1, entries 1–9). Carbonates or K_3PO_4 were found to be ineffective bases for this reaction (Table 1, entries 2–5). The use of KF, NaOAc, or CsOAc led to 15–48% conversion of 4-bromoacetophenone; whereas, in the presence of KOAc as the base, a complete conversion of the aryl bromide was observed (Table 1, entries 1, 6–9). We then examined the influence of the solvent. Good conversions were obtained with DMAc or DMF; however, less side-products resulted in the presence of DMAc (Table 1, entries 7 and 11). A slower reaction was observed with NMP (Table 1, entry 12). Xylene was found to be ineffective to promote this coupling reaction (Table 1, entry 13). The influence of a few catalyst precursors was also studied (Table 1, entries 14–22). The direct arylation of 2-ethylbenzofuran proceeded nicely using only 0.1 mol% of $Pd(OAc)_2$/dppb, $Pd(OAc)_2$/dppe, $Pd(OAc)_2/PPh_3$, $[Pd(C_3H_5)Cl]_2$, $PdCl(C_3H_5)$-(dppb), or $PdCl_2$ as the catalyst precursors to provide **1** in high yields. However, the use of only 0.01 mol% of these catalysts gave very low yields of **1**. In the presence of the electron-deficient aryl bromide, 4-bromoacetophenone, the presence of a phosphine ligand in the reaction mixture appeared to be quite useless (Table 1, entry 8, 15, and 20). These results demonstrated that the 3-arylation rate of a 2-alkylbenzofuran is faster than the 3-arylation of 2,5-dialkylfuran derivatives,[5c] which might be due to the higher acidity at the C3 position of benzofuran.

Table 1. Influence of the reaction conditions on the palladium-catalyzed direct coupling of 2-ethylbenzofuran with 4-bromoacetophenone (Scheme 1).

Entry	Solvent	Base	Catalyst	Substrate/catalyst ratio	Temp [°C]	Conversion [%][a]
1	DMAc	KF	$Pd(OAc)_2$	1000	150	40
2	DMAc	Cs_2CO_3	$Pd(OAc)_2$	1000	150	0
3	DMAc	Na_2CO_3	$Pd(OAc)_2$	1000	150	8
4	DMAc	K_2CO_3	$Pd(OAc)_2$	1000	150	0
5	DMAc	K_3PO_4	$Pd(OAc)_2$	1000	150	0
6	DMAc	NaOAc	$Pd(OAc)_2$	1000	150	48
7	DMAc	KOAc	$Pd(OAc)_2$	1000	150	100 (82)
8	DMAc	KOAc	$Pd(OAc)_2$	10000	150	13
9	DMAc	CsOAc	$Pd(OAc)_2$	1000	150	15
10	DMAc	KOAc	$Pd(OAc)_2$	1000	130	85
11	DMF	KOAc	$Pd(OAc)_2$	1000	150	91
12	NMP	KOAc	$Pd(OAc)_2$	1000	150	47
13	xylene	KOAc	$Pd(OAc)_2$	1000	150	0
14	DMAc	KOAc	$Pd(OAc)_2$/dppb	1000	150	100
15	DMAc	KOAc	$Pd(OAc)_2$/dppb	10000	150	13
16	DMAc	KOAc	$Pd(OAc)_2$/dppe	1000	150	100
17	DMAc	KOAc	$Pd(OAc)_2$/dppe	10000	150	11
18	DMAc	KOAc	$Pd(OAc)_2/PPh_3$	1000	150	100
19	DMAc	KOAc	$Pd(OAc)_2/PPh_3$	10000	150	18
20	DMAc	KOAc	$^1/_2$ $[Pd(C_3H_5)Cl]_2$	1000	150	85
21	DMAc	KOAc	$Pd(C_3H_5)Cl$(dppb)	1000	150	100
22	DMAc	KOAc	$Pd(C_3H_5)Cl$(dppb)	10000	150	28
23	DMAc	KOAc	$PdCl_2$	1000	150	100
24	DMAc	KOAc	$PdCl_2$	10000	150	7

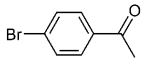
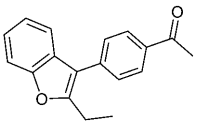
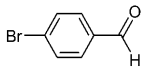
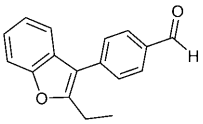
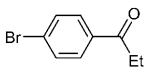
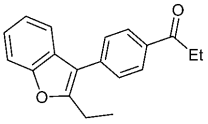
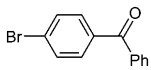
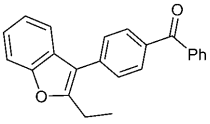
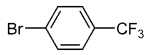
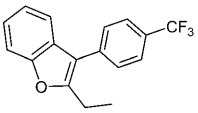
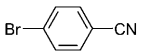
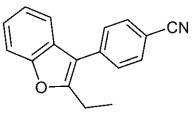
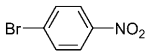
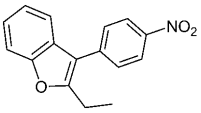
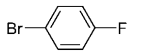
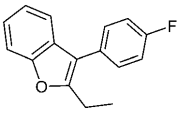
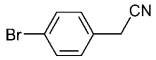
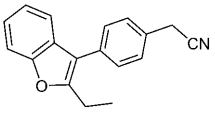
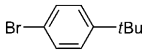
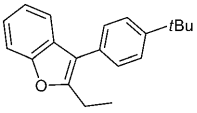
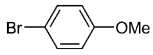
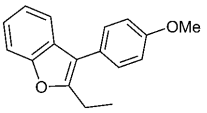
[a] Conditions: 2-ethylbenzofuran (2 equiv.), 4-bromoacetophenone (1 equiv.), base (2 equiv.), 16 h, conversion of 4-bromoacetophenone, value in parentheses is the isolated yield.

We studied the scope and limitations of this reaction, using a wide variety of aryl bromides (Scheme 2, Tables 2–4). In all cases, we initially employed the phosphine-free procedure ($Pd(OAc)_2$ 0.1 mol%, DMAc, KOAc, 150 °C). When low conversions of the aryl bromides were observed, then we employed 0.5 mol% of $Pd(C_3H_5)Cl$(dppb) as the catalyst. 4-Bromobenzaldehyde, 4-bromopropiophenone, 4-bromobenzophenone, 4-bromobenzonitrile, or 4-trifluoromethylbromobenzene reacted with 2-ethylbenzofuran in the presence of 0.1 mol% $Pd(OAc)_2$ as the catalyst to give the expected products **2**–**6** in 72–82% yields (Table 2, entries 2–6). However, in the presence of 4-bromonitrobenzene, a mixture of several unidentified products was obtained (Table 2, entry 7). 4-Bromofluorobenzene and the electron-rich aryl bromides, 4-*tert*-butylbromobenzene or 4-bromoanisole, were found to give low to moderate yield of **8**, **10**, and **11** due to partial conversions of these aryl bromides, when we employed 0.1 or 0.2 mol% $Pd(OAc)_2$ as the catalyst. This was probably due to a slow oxidative addition of these aryl bromides to palladium. With these substrates, the oxidative addition to palladium appeared to be the rate-limiting step of the catalytic cycle. With these three reactants, 0.5–1 mol% $Pd(C_3H_5)Cl$(dppb) had to be employed as the catalyst in order to obtain high yields of the coupling products (Table 2, entries 9, 12, and 13).

The reactivity of the four *meta*-substituted aryl bromides were examined (Table 3). As expected, similar results as in the presence of *para*-substituted aryl bromides were obtained. 3-Bromobenzaldehyde, 3-bromoacetophenone, 3-bromobenzonitrile, or 3,5-bis(trifluoromethyl)bromobenzene gave **12**–**15** in 74–78% yields (Table 3, entries 1–6). 2-Bromonaphthalene was also found to be a suitable coupling partner for this reaction, but 0.5 mol% $Pd(C_3H_5)Cl$(dppb) had to be employed as the catalyst in order to obtain a high yield of **16** (Table 3, entries 7 and 8).

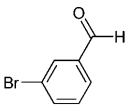
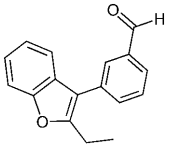
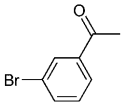
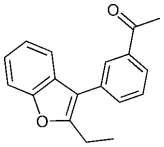
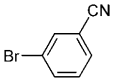
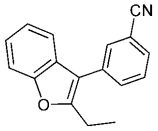
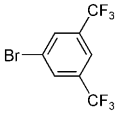
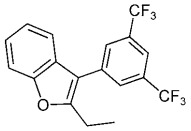
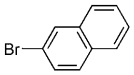
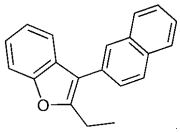
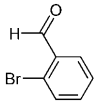
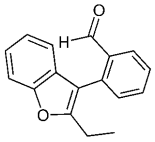
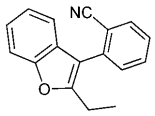
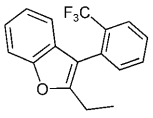
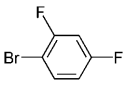
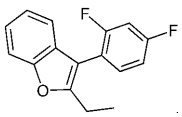
Ortho-substituents on the aryl bromides generally have a more important influence on the yields of palladium-catalyzed reactions, due to their steric and/or coordination properties.[18] *Ortho*-substituted 2-bromobenzaldehyde, 2-bromobenzonitrile, 2-fluorobromobenzene, or 1-bromonaphthalene reacted with 2-ethylbenzofuran using 0.1 mol% $Pd(OAc)_2$ to give **17**, **18**, **21**, and **22** in 62–78% yields (Table 3, entries 9, 10, 14, and 15). 2-Bromobenzotrifluoride of 2,4-difluorobromobenzene gave only

Table 2. Palladium-catalyzed coupling of 2-ethylbenzofuran with *para*-substituted aryl bromides (Scheme 2).

Entry	Aryl bromide	Product		Yield [%][a]
1			**1**	82
2			**2**	79
3			**3**	72
4			**4**	74
5			**5**	81
6			**6**	82
7			**7**	0
8,9			**8**	52,[b] 80[c]
10			**9**	61
11,12			**10**	11, 65[d]
13			**11**	78[c]

[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-ethylbenzofuran (2 equiv.), aryl bromide (1 equiv.), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields. [b] $Pd(OAc)_2$ (0.002 equiv.) was employed as the catalyst. [c] $Pd(C_3H_5)Cl$-(dppb) (0.005 equiv.) was employed as the catalyst. [d] $Pd(C_3H_5)Cl(dppb)$ (0.01 equiv.) was employed as the catalyst.

Table 3. Palladium-catalyzed coupling of 2-ethylbenzofuran with *meta*- or *ortho*-substituted aryl bromides (Scheme 2).

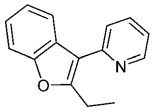
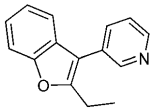
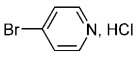
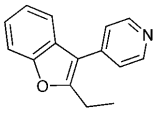
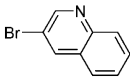
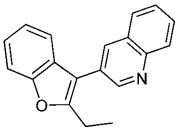
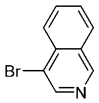
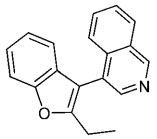
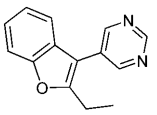
Entry	Aryl bromide	Product		Yield [%][a]
1			**12**	75
2			**13**	78
3,4,5			**14**	51, 50[b], 74[c]
6			**15**	78
7,8			**16**	31, 73[c]
9			**17**	71
10			**18**	78
11,12			**19**	58,[b] 80[c]
13			**20**	69[c]
14			**21**	62
15			**22**	78

[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-ethylbenzofuran (2 equiv.), aryl bromide (1 equiv), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields. [b] $Pd(OAc)_2$ (0.002 equiv.) was employed as the catalyst. [c] $Pd(C_3H_5)Cl$-(dppb) (0.005 equiv.) was employed as the catalyst.

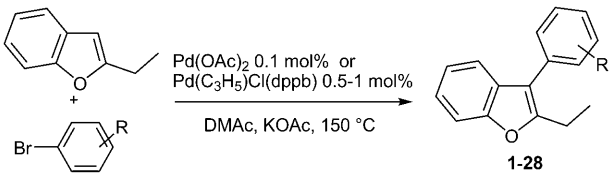
moderate yields of **19** and **20** in the presence of $Pd(OAc)_2$. For these two substrates, $Pd(C_3H_5)Cl(dppb)$ should be employed as the catalyst (Table 3, entries 11–13).

Next, we explored the reactivity of 2-ethylbenzofuran with heteroaryl bromides. The results depicted in Table 4 reveals the good performance of the ligandless procedure in direct coupling with some bromopyridines or bromoquinolines. Selective reactions were observed using 3-bromopyridine, 3-bromoqui-

Table 4. Palladium-catalyzed coupling of 2-ethylbenzofuran with heteroaryl bromides (Scheme 2).

Entry	Heteroaryl bromide	Product		Yield [%][a]
1, 2			**23**	0, 0[b]
3			**24**	84
4, 5			**25**	43, 66[b]
6			**26**	67
7			**27**	61[c]
8			**28**	70

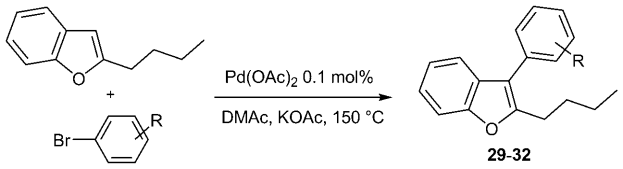
[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-ethylbenzofuran (2 equiv.), aryl bromide (1 equiv.), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields. [b] $Pd(C_3H_5)Cl(dppb)$ (0.005 equiv.) was employed as the catalyst. [c] $Pd(OAc)_2$ (0.002 equiv.) was employed as the catalyst.



Scheme 2. Coupling of 2-ethylbenzofuran with aryl bromides.

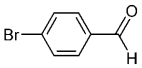
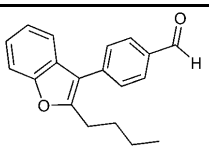
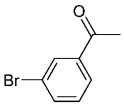
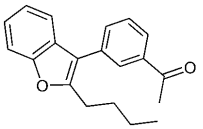
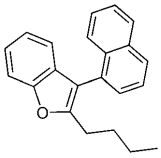
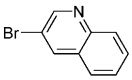
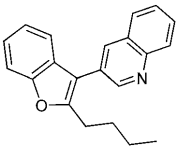
noline, or 5-bromopyrimidine. With these substrates, the target products **24**, **26**, and **28** were obtained in 67–84% yields (Table 4, entries 3, 6, and 8). The reaction in the presence of 4-bromoisoquinoline, which is more congested than 3-bromoquinoline, was found to be quite slow. However, a high yield of 61% was obtained in the presence of 0.2 mol% $Pd(OAc)_2$ as the catalyst (Table 4, entry 7). On the other hand, 2-bromopyridine was found to be unreactive in this reaction (Table 4, entries 1 and 2). We had previously found that 2-bromopyridine is less reactive than 3- or 4-bromopyridine for the Heck reaction.[19]

As expected, the reactivity of 2-*n*butylbenzofuran was found to be very similar to 2-ethylbenzofuran (Scheme 3; Table 5). The coupling of this reactant with 4-bromobenzaldehyde, 3-



Scheme 3. Coupling of 2-*n*-butylbenzofuran with aryl bromides.

Table 5. Palladium-catalyzed coupling of 2-*n*-butylbenzofuran with (hetero)aryl bromides (Scheme 3).

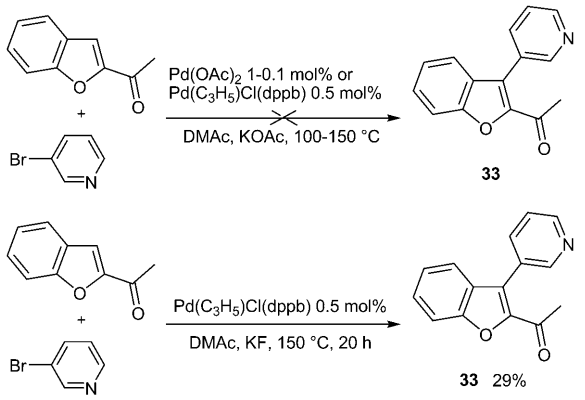
Entry	Aryl bromide	Product		Yield [%][a]
1			**29**	78
2			**30**	72
3			**31**	74
4			**32**	70

[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-*n*-butylbenzofuran (2 equiv.), aryl bromide (1 equiv.), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields.

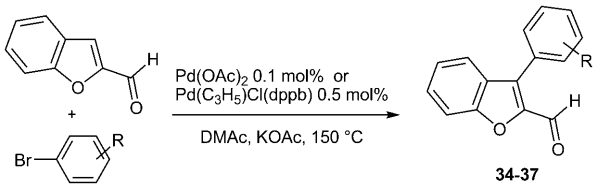
bromoacetophenone, 1-bromonaphthalene, or 3-bromoquinoline gave the expected compounds **29**–**32** in 70–78% yield using as little as 0.1 mol% $Pd(OAc)_2$ as the catalyst.

Next, we examined the reactivity of 2-acetylbenzofuran (Scheme 4). In the presence of this reactant, when we employed $Pd(OAc)_2$ as the catalyst, DMAc as the solvent and KOAc as the base at 150 °C, an inseparable mixture of several products, which did not contain **33**, was obtained. When we employed lower reaction temperatures (100 or 130 °C), low conversions of 3-bromopyridine were observed, and the desired product **33** was not detected. The use of $PdCl(C_3H_5)$-(dppb) as the catalyst gave a similar mixture of unidentified products. These results might be explained by a partial deprotonation of the acetyl function of this benzofuran derivative by KOAc to form an enolate. In order to avoid such deprotonation, the reaction was performed using KF as the base (Scheme 4, bottom). Under these reaction conditions, the coupling product **33** was obtained in 29% yield.

We also studied the reactivity of 2-formylbenzofuran (Scheme 5; Table 6). With this reactant, a selective 3-arylation



Scheme 4. Reaction of 2-acetylbenzofuran with 3-bromopyridine.



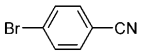
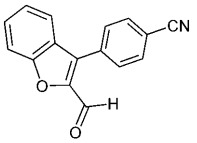
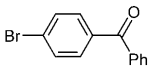
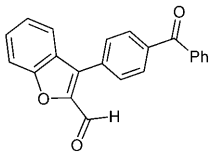
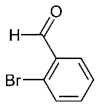
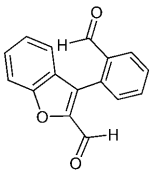
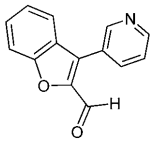
Scheme 5. Coupling of 2-formylbenzofuran with aryl bromides.

reaction took place in the presence of 4-bromobenzonitrile (Table 6, entry 1). In the course of this reaction, some side-products formed; however, **34** was easily obtained in pure form in 51% yield by chromatography on silica gel. The reaction of 2-formylbenzofuran with 4-bromobenzophenone, 2-bromobenzaldehyde, or 3-bromopyridine also gave the desired 3-arylated benzofurans **35**–**37** in moderate yields (Table 6, entries 2–4).

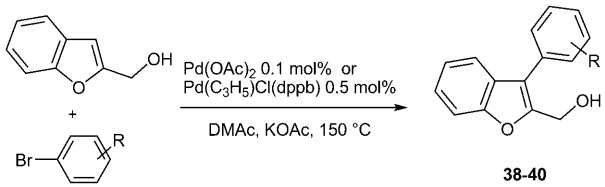
The use of benzofurans bearing an unprotected hydroxymethyl function could be very useful in organic synthesis, because the hydroxyl protection/deprotection sequence could be avoided, thus providing a more environmentally and economically attractive route to such arylated benzofurans. The direct arylation of 2-hydroxymethylbenzofuran with aryl bromides gave the desired 3-arylation products **38**–**40** (Scheme 6; Table 7). However, only moderate yields were obtained due to the formation of some side-products.

In conclusion, these results demonstrate that 2-substituted benzofurans can be employed for palladium-catalyzed direct arylation. In the presence of electron-deficient aryl bromides, a low loading of a phosphine-free catalyst generally gave the 3-arylated benzofurans in moderate to high yields. When low yields were obtained with this phosphine-free catalyst, the use of 0.5 mol% $Pd(C_3H_5)Cl(dppb)$ as the catalyst improved the yields. It should be noted that a wide range of functional groups such as acetyl, propionyl, formyl, ester, nitrile, trifluoromethyl, or fluoro on the aryl bromide is tolerated. Higher yields were obtained in the presence of electron-deficient aryl bromides than with electron-rich aryl bromides. Valuable functionalized benzofuran derivatives bearing formyl or hydroxymethyl groups on C2, have also been successfully employed.

Table 6. Palladium-catalyzed coupling of 2-formylbenzofuran with (hetero)aryl bromides (Scheme 5).

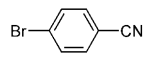
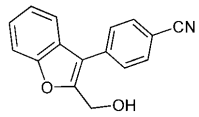
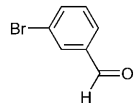
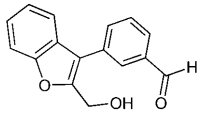
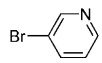
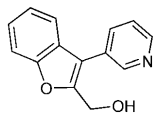
Entry	Aryl bromide	Product		Yield [%][a]
1			**34**	51
2			**35**	60
3			**36**	53
4			**37**	32[b]

[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-formylbenzofuran (1.5 equiv.), aryl bromide (1 equiv.), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields. [b] $Pd(C_3H_5)Cl(dppb)$ (0.005 equiv.) was employed as the catalyst.



Scheme 6. Coupling of 2-hydroxymethylbenzofuran with aryl bromides.

Table 7. Palladium-catalyzed coupling of 2-hydroxymethylbenzofuran with (hetero)aryl bromides (Scheme 6).

Entry	Aryl bromide	Product		Yield [%][a]
1			**38**	68
2			**39**	54[b]
3			**40**	55[b]

[a] Conditions: $Pd(OAc)_2$ (0.001 equiv.), 2-hydroxymethylbenzofuran (1.5 equiv.), aryl bromide (1 equiv.), KOAc (2 equiv.), DMAc, 150 °C, 16 h, isolated yields. [b] $Pd(C_3H_5)Cl(dppb)$ (0.005 equiv.) was employed as the catalyst.

The major byproducts of these coupling reactions were AcOH associated to KBr instead of metallic salts which result from more classical coupling procedures. Therefore, this reaction should give an economically viable and environmentally attractive route to 3-arylated benzofurans. Moreover, most of the products prepared by this method are new, indicating a fastidious access using more traditional coupling reactions, such as Suzuki, Negishi, or Stille couplings.

Experimental Section

2-Ethylbenzofuran and 2-acetylbenzofuran were provided by PCAS. 2-Formylbenzofuran, ethyl 7-methoxybenzofuran-2-carboxylate, 2-hydroxymethylbenzofuran, and DMAc (99%) were purchased from Acros. 2-Butylbenzofuran, $Pd(OAc)_2$, and KOAc (99%) were purchased from Alfa Aesar. These compounds were not purified before use.

Preparation of the $PdCl(C_3H_5)(dppb)$ catalyst:[17] An oven-dried 40 mL Schlenk tube equipped with a magnetic stirring bar under an argon atmosphere, was charged with $[Pd(C_3H_5)Cl]_2$ (182 mg, 0.5 mmol) and dppb (426 mg, 1 mmol). Anhydrous dichloromethane (10 mL) was added, then the solution was stirred at room temperature for 20 min. The solvent was removed in vacuum. The yellow powder was used without purification. ^{31}P NMR (81 MHz, $CDCl_3$): $\delta = 19.3$ (s).

As a typical experiment, the reaction of 4-bromoacetophenone (0.199 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) at 150 °C during 16 h in DMAc (5 mL) in the presence of $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) under argon affords the corresponding product 4-(2-ethylbenzofuran-3-yl)-acetophenone **1** after evaporation and filtration on silica gel (pentane/ether) in 82% (0.217 g) yield. ^1H NMR (200 MHz, $CDCl_3$): $\delta = 8.10$ (d, $J = 8.3$ Hz, 2H), 7.62 (d, $J = 8.3$ Hz, 2H), 7.64–7.48 (m, 2H), 7.40–7.25 (m, 2H), 2.93 (q, $J = 7.5$ Hz, 2H), 2.69 (s, 3H), 1.42 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 197.6$, 157.0, 154.0, 138.1, 135.5, 129.0, 128.8, 128.2, 123.9, 122.8, 119.2, 115.4, 111.0, 26.6, 20.4, 12.8 ppm. Elemental analysis: calcd (%) for $C_{18}H_{16}O_2$ (264.32): C 81.79, H 6.10; found: C 81.61, H 6.02.

4-(2-Ethylbenzofuran-3-yl)-benzaldehyde **2**: The reaction of 4-bromobenzaldehyde (0.185 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **2** (0.198 g, 79%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 10.10$ (s, 1H), 8.02 (d, $J = 8.3$ Hz, 2H), 7.69 (d, $J = 8.3$ Hz, 2H), 7.64–7.48 (m, 2H), 7.40–7.25 (m, 2H), 2.94 (q, $J = 7.5$ Hz, 2H), 1.42 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 191.7$, 157.2, 154.0, 139.5, 134.9, 130.2, 129.3, 128.0, 124.0, 122.9, 119.2, 115.4, 111.0, 20.4, 12.8 ppm. Elemental analysis: calcd (%) for $C_{17}H_{14}O_2$ (250.29): C 81.58, H 5.64; found: C 81.67, H 5.92.

4-(2-Ethylbenzofuran-3-yl)-propiophenone **3**: The reaction of 4-bromopropiophenone (0.213 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol) and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **3** (0.200 g, 72%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 8.13$ (d, $J = 8.3$ Hz, 2H), 7.63 (d, $J = 8.3$ Hz, 2H), 7.64–7.48 (m, 2H), 7.40–7.25 (m, 2H), 3.09 (q, $J = 7.5$ Hz, 2H), 2.93 (q, $J = 7.5$ Hz, 2H), 1.42 (t, $J = 7.5$ Hz, 3H), 1.30 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 200.2$, 156.9, 154.0, 137.7, 135.3, 128.9, 128.4, 128.2, 123.8, 122.8, 119.2, 115.4, 110.9, 31.7, 20.4, 12.8, 8.3 ppm. Elemental analysis: calcd (%) for $C_{19}H_{18}O_2$ (278.35): C 81.99, H 6.52; found: C 81.80, H 6.37.

4-(2-Ethylbenzofuran-3-yl)-benzophenone **4**: The reaction of 4-bromobenzophenone (0.261 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **4** (0.241 g, 74%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.96$ (d, $J = 8.3$ Hz, 2H), 7.91 (d, $J = 8.3$ Hz, 2H), 7.70–7.48 (m, 7H), 7.40–7.25 (m, 2H), 2.95 (q, $J = 7.5$ Hz, 2H), 1.42 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 196.2$, 157.0, 154.0, 137.6, 137.4, 135.9, 132.4, 130.6, 130.0, 128.7, 128.3, 128.2, 123.8, 122.8, 119.2, 115.4, 110.9, 20.4, 12.9 ppm. Elemental analysis: calcd (%) for $C_{23}H_{18}O_2$ (326.39): C 84.64, H 5.56; found: C 84.81, H 5.64.

4-(2-Ethylbenzofuran-3-yl)-benzotrifluoride **5**: The reaction of 4-trifluoromethylbromobenzene (0.225 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **5** (0.235 g, 81%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.77$ (d, $J = 8.3$ Hz, 2H), 7.62 (d, $J = 8.3$ Hz, 2H), 7.64–7.45 (m, 2H), 7.40–7.25 (m, 2H), 2.91 (q, $J = 7.5$ Hz, 2H), 1.42 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 156.9$, 154.0, 136.7, 129.2, 129.1 (q, $J = 32.5$ Hz), 128.2, 125.6 (m), 123.9, 122.3, 119.1, 115.2, 111.0, 20.3, 12.8 ppm. Elemental analysis: calcd (%) for $C_{17}H_{13}F_3O$ (290.28): C 70.34, H 4.51; found: C 70.50, H 4.52.

4-(2-Ethylbenzofuran-3-yl)-benzonitrile **6**: The reaction of 4-bromobenzonitrile (0.182 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **6** (0.203 g, 82%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.80$ (d, $J = 8.3$ Hz, 2H), 7.62 (d, $J = 8.3$ Hz, 2H), 7.60–7.50 (m, 2H), 7.40–7.25 (m, 2H), 2.91 (q, $J = 7.5$ Hz, 2H), 1.44 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 157.2$, 154.0, 138.0, 132.5, 129.4, 127.8, 124.1, 123.0, 122.0, 119.0, 118.9, 111.1, 110.5, 20.4, 12.8 ppm. Elemental analysis: calcd (%) for $C_{17}H_{13}NO$ (247.29): C 82.57, H 5.30; found: C 82.59, H 5.41.

2-Ethyl-3-(4-fluorophenyl)-benzofuran **8**: The reaction of 4-fluorobromobenzene (0.175 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)(dppb)$ (3 mg, 0.005 mmol) affords **8** (0.192 g, 80%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.55$–7.45 (m, 2H), 7.44 (dd, $J = 8.0$ and 6.0 Hz, 2H), 7.30–7.20 (m, 2H), 7.19 (t, $J = 8.0$ Hz, 2H), 2.88 (q, $J = 7.5$ Hz, 2H), 1.37 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 161.9$ (d, $J = 246.1$ Hz), 156.2, 153.9, 130.6 (d, $J = 8.0$ Hz), 128.7, 128.6, 123.6, 122.6, 119.2, 115.6 ppm(d, $J = 21.4$ Hz), 115.2, 110.8, 20.2, 12.9. Elemental analysis: calcd (%) for $C_{16}H_{13}FO$ (240.27): C 79.98, H 5.45; found: C 79.82, H 5.57.

[4-(2-Ethylbenzofuran-3-yl)-phenyl]-acetonitrile **9**: The reaction of (4-bromophenyl)-acetonitrile (0.195 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **9** (0.160 g, 61%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.60$–7.35 (m, 6H), 7.35–7.10 (m, 2H), 3.84 (s, 2H), 2.88 (q, $J = 7.5$ Hz, 2H), 1.37 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 156.4$, 153.9, 132.8, 132.2, 129.6, 128.5, 128.3, 123.7, 122.6, 119.2, 117.8, 115.3, 110.9, 23.4, 20.2, 12.9 ppm. Elemental analysis: calcd (%) for $C_{18}H_{15}NO$ (261.32): C 82.73, H 5.79; found: C 82.70, H 5.97.

3-(4-*tert*-Butylphenyl)-2-ethylbenzofuran **10**: The reaction of 4-*tert*-butylbromobenzene (0.213 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)(dppb)$ (6 mg, 0.01 mmol) affords **10** (0.180 g, 65%). ^1H NMR (200 MHz, $CDCl_3$): $\delta = 7.65$–7.30 (m, 6H), 7.30–7.10 (m, 2H), 2.88 (q, $J = 7.5$ Hz, 2H), 1.40 (s, 9H), 1.37 ppm (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 156.1$, 154.0, 149.8, 129.8, 128.9, 128.6, 125.6, 123.4, 122.4, 119.6, 115.9, 110.7, 34.6, 31.4, 20.3, 13.0 ppm. Elemental analysis:

calcd (%) for $C_{20}H_{22}O$ (278.39): C 86.29, H 7.97; found: C 86.40, H 8.07.

2-Ethyl-3-(4-methoxyphenyl)-benzofuran **11**: The reaction of 4-bromoanisole (0.187 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **11** (0.197 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.60–7.50 (m, 2H), 7.44 (d, J = 8.3 Hz, 2H), 7.40–7.25 (m, 2H), 7.05 (d, J = 8.3 Hz, 2H), 2.91 (q, J = 7.5 Hz, 2H), 1.40 ppm(t, J=7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 158.6, 155.8, 153.9, 130.1, 129.0, 125.0, 123.4, 122.4, 119.4, 115.7, 114.2, 110.7, 20.2, 13.0 ppm. Elemental analysis: calcd (%) for $C_{17}H_{16}O_2$ (252.31): C 80.93, H 6.39; found: C 80.90, H 6.27.

3-(2-Ethylbenzofuran-3-yl)-benzaldehyde **12**: The reaction of 3-bromobenzaldehyde (0.185 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **12** (0.188 g, 75%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 10.12 (s, 1H), 8.02 (s, 1H), 7.91 (d, J = 8.3 Hz, 1H), 7.77 (d, J = 8.3 Hz, 1H), 7.72 (t, J = 7.8 Hz, 1H), 7.64–7.45 (m, 2H), 7.40–7.25 (m, 2H), 2.92 (q, J = 7.5 Hz, 2H), 1.42 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 192.2, 156.8, 154.0, 136.9, 134.9, 134.0, 130.0, 129.5, 128.4, 128.3, 123.9, 122.8, 119.1, 115.1, 111.0, 20.3, 12.8 ppm. Elemental analysis: calcd (%) for $C_{17}H_{14}O_2$ (250.29): C 81.58, H 5.64; found: C 81.60, H 5.82.

1-[3-(2-Ethylbenzofuran-3-yl)-phenyl]-ethanone **13**: The reaction of 3-bromoacetophenone (0.199 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **13** (0.206 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.16 (s, 1H), 7.95 (d, J = 8.3 Hz, 1H), 7.73–7.40 (m, 4H), 7.38–7.25 (m, 2H), 2.95 (q, J = 7.5 Hz, 2H), 2.70 (s, 3H), 1.40 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 197.9, 156.6, 153.9, 137.6, 133.5, 133.4, 129.0, 128.7, 128.4, 126.9, 123.8, 122.7, 119.1, 115.4, 110.9, 26.7, 20.3, 12.9 ppm. Elemental analysis: calcd (%) for $C_{18}H_{16}O_2$ (264.32): C 81.79, H 6.10; found: C 81.80, H 6.19.

3-(2-Ethylbenzofuran-3-yl)-benzonitrile **14**: The reaction of 3-bromobenzonitrile (0.182 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **14** (0.183 g, 74%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.85–7.45 (m, 6H), 7.40–7.25 (m, 2H), 2.91 (q, J = 7.5 Hz, 2H), 1.44 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.9, 154.0, 136.1, 134.4, 133.3, 132.3, 130.5, 129.6, 127.9, 124.1, 123.0, 118.8, 118.7, 113.0, 111.1, 20.2, 12.8 ppm. Elemental analysis: calcd (%) for $C_{17}H_{13}NO$ (247.29): C 82.57, H 5.30; found: C 82.41, H 5.24.

3-[3,5-bis(trifluoromethyl)phenyl]-2-ethylbenzofuran **15**: The reaction of 3,5-bis(trifluoromethyl)bromobenzene (0.293 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **15** (0.279 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.95 (s, 2H), 7.91 (s, 1H), 7.60–7.45 (m, 2H), 7.40–7.25 (m, 2H), 2.91 (q, J = 7.5 Hz, 2H), 1.44 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.4, 154.0, 135.3, 132.4 (q, J = 33.3 hz), 128.9 (m), 127.6, 124.3, 123.2, 123.1 (q, J = 272.3 Hz), 120.6 ppm(m), 118.6, 114.0, 111.2, 20.3, 12.7. Elemental analysis: calcd (%) for $C_{18}H_{12}F_6O$ (358.28): C 60.34, H 3.38; found: C 60.43, H 3.20.

2-Ethyl-3-naphthalen-2-ylbenzofuran **16**: The reaction of 2-bromonaphthalene (0.207 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **16** (0.199 g, 73%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.05–7.85 (m, 4H), 7.70–7.45 (m, 5H), 7.40–7.25 (m, 2H), 2.98 (q, J = 7.5 Hz, 2H), 1.42 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.5, 154.0, 133.6, 132.4, 132.1, 130.3, 128.3, 127.8, 127.7, 127.6, 127.2, 126.3, 125.9, 123.6, 123.2, 122.6, 119.4, 110.9, 20.3, 13.0 ppm. Elemental analysis: calcd (%) for $C_{20}H_{16}O$ (272.34): C 88.20, H 5.92; found: C 88.40, H 5.91.

2-(2-Ethylbenzofuran-3-yl)-benzaldehyde **17**: The reaction of 2-bromobenzaldehyde (0.185 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **17** (0.178 g, 71%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.98 (s, 1H), 8.11 (d, J = 8.3 Hz, 1H), 7.70 (t, J = 8.0 Hz, 1H), 7.64–7.45 (m, 3H), 7.40–7.25 (m, 3H), 2.75 (q, J = 7.5 Hz, 2H), 1.32 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 192.2, 157.8, 153.8, 136.1, 134.9, 134.2, 131.9, 129.9, 128.2, 127.7, 124.2, 123.2, 119.1, 112.4, 111.0, 20.2, 12.5 ppm. Elemental analysis: calcd (%) for $C_{17}H_{14}O_2$ (250.29): C 81.58, H 5.64; found: C 81.51, H 5.54.

2-(2-Ethylbenzofuran-3-yl)-benzonitrile **18**: The reaction of 2-bromobenzonitrile (0.182 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **18** (0.193 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.85 (d, J = 8.3 Hz, 1H), 7.70 (t, J = 8.0 Hz, 1H), 7.62–7.45 (m, 3H), 7.42–7.25 (m, 3H), 2.85 (q, J = 7.5 Hz, 2H), 1.38 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.6, 153.9, 136.6, 133.5, 132.7, 131.2, 128.4, 127.8, 123.9, 122.8, 119.0, 118.2, 113.2, 113.1, 111.0, 20.8, 11.9 ppm. Elemental analysis: calcd (%) for $C_{17}H_{13}NO$ (247.29): C 82.57, H 5.30; found: C 82.54, H 5.50.

2-(2-Ethylbenzofuran-3-yl)-benzotrifluoride **19**: The reaction of 2-trifluoromethylbromobenzene (0.225 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$-(dppb) (3 mg, 0.005 mmol) affords **19** (0.232 g, 80%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.82 (d, J = 8.3 Hz, 1H), 7.70–7.10 (m, 7H), 2.63 (q, J = 7.5 Hz, 2H), 1.25 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.8, 153.5, 133.3, 131.6, 130.7 (q, J = 32.6 Hz), 130.4, 128.0, 126.2, 123.4, 123.3 (q, J = 273.6 Hz), 122.5, 119.5, 113.7, 110.6, 20.3, 12.2 ppm. Elemental analysis: calcd (%) for $C_{17}H_{13}F_3O$ (290.28): C 70.34, H 4.51; found: C 70.31, H 4.43.

3-(2,4-Difluorophenyl)-2-ethyl-benzofuran **20**: The reaction of 2,4-difluorobromobenzene (0.193 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$-(dppb) (3 mg, 0.005 mmol) affords **20** (0.178 g, 69%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.55–7.20 (m, 5H), 7.10–6.90 (m, 2H), 2.81 (q, J = 7.5 Hz, 2H), 1.35 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 162.9 (dd, J = 167.4, 11.7 Hz), 159.5 (dd, J = 168.8, 11.9 Hz), 157.4, 154.0, 132.3 (m), 128.7, 123.6, 122.6, 119.3, 111.5 (d, J = 3.7 Hz), 110.9, 109.3, 104.4 (m), 20.3, 12.9 ppm. Elemental analysis: calcd (%) for $C_{16}H_{12}F_2O$ (258.26): C 74.41, H 4.68; found: C 74.60, H 4.55.

2-Ethyl-3-(2-fluorophenyl)-benzofuran **21**: The reaction of 2-fluorobromobenzene (0.175 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **21** (0.149 g, 62%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.55–7.20 (m, 8H), 2.82 (q, J = 7.5 Hz, 2H), 1.35 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 160.0 (d, J = 247.3 Hz), 157.4, 154.1, 131.6 (d, J = 3.5 Hz), 129.1 (d, J = 8.0 Hz), 128.8, 124.2, 123.5, 122.6, 120.2 (d, J = 14.1 Hz), 119.6, 116.1 ppm(d, J=22.3 Hz), 110.8, 110.1, 20.6, 12.4. Elemental analysis: calcd (%) for $C_{16}H_{13}FO$ (240.27): C 79.98, H 5.45; found: C 79.87, H 5.37.

2-Ethyl-3-(1-naphtyl)-benzofuran **22**: The reaction of 1-bromonaphthalene (0.207 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol)

affords **22** (0.212 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.97 (d, J = 8.2 Hz, 1H), 7.95 (d, J = 8.2 Hz, 1H), 7.79 (d, J = 8.2 Hz, 1H), 7.62–7.05 (m, 8H), 2.74 (q, J = 7.5 Hz, 2H), 1.30 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.9, 154.3, 135.3, 134.2, 132.9, 130.6, 128.7, 128.6, 128.5, 126.5, 126.4, 126.3, 126.0, 123.9, 122.9, 120.5, 115.0, 111.2, 20.9, 13.2 ppm. Elemental analysis: calcd (%) for $C_{20}H_{16}O$ (272.34): C 88.20, H 5.92; found: C 88.14, H 5.99.

3-(2-Ethylbenzofuran-3-yl)-pyridine **24**: The reaction of 3-bromopyridine (0.158 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **24** (0.187 g, 84%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.78 (s, 1H), 8.65 (d, J = 4.0 Hz, 1H), 7.83 (d, J = 6.5 Hz, 1H), 7.62–7.40 (m, 3H), 7.36–7.25 (m, 2H), 2.90 (q, J = 7.5 Hz, 2H), 1.41 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.0, 154.1, 149.8, 148.2, 136.2, 128.3, 123.9, 123.6, 122.8, 118.9, 112.9, 111.0, 20.2, 12.9 ppm. Elemental analysis: calcd (%) for $C_{15}H_{13}NO$ (223.27): C 80.69, H 5.87; found: C 80.68, H 5.69.

4-(2-Ethylbenzofuran-3-yl)-pyridine **25**: The reaction of 4-bromopyridine hydrochloride (0.195 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **25** (0.147 g, 66%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.72 (m, 2H), 7.66–7.40 (m, 4H), 7.36–7.25 (m, 2H), 2.93 (q, J = 7.5 Hz, 2H), 1.41 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.7, 154.1, 149.9, 141.4, 127.5, 124.2, 123.6, 123.1, 119.1, 113.9, 111.2, 20.4, 12.8 ppm. Elemental analysis: calcd (%) for $C_{15}H_{13}NO$ (223.27): C 80.69, H 5.87; found: C 80.54, H 5.98.

3-(2-Ethylbenzofuran-3-yl)-quinoline **26**: The reaction of 3-bromoquinoline (0.208 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **26** (0.183 g, 67%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.10 (d, J = 1.8 Hz, 1H), 8.27 (d, J = 1.8 Hz, 1H), 8.20 (d, J = 8.0 Hz, 1H), 7.91 (d, J = 8.0 Hz, 1H), 7.79 (t, J = 7.7 Hz, 1H), 7.70–7.50 (m, 3H), 7.40–7.25 (m, 2H), 2.97 (q, J = 7.5 Hz, 2H), 1.44 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.4, 154.1, 150.9, 146.8, 135.3, 129.6, 129.1, 128.4, 128.1, 127.7, 127.1, 126.2, 124.1, 122.9, 119.0, 113.5, 111.1, 20.4, 13.0 ppm. Elemental analysis: calcd (%) for $C_{19}H_{15}NO$ (273.33): C 83.49, H 5.53; found: C 83.38, H 5.41.

4-(2-Ethylbenzofuran-3-yl)-isoquinoline **27**: The reaction of 4-bromoisoquinoline (0.208 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.45 mg, 0.002 mmol) affords **27** (0.167 g, 61%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.35 (s, 1H), 8.56 (s, 1H), 8.12 (m, 1H), 7.70–7.42 (m, 3H), 7.57 (d, J = 8.0 Hz, 1H), 7.40–7.25 (m, 2H), 7.17 (d, J = 8.0 Hz, 1H), 2.77 (q, J = 7.5 Hz, 2H), 1.32 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 158.1, 154.1, 152.3, 143.9, 135.2, 130.6, 129.8, 128.0, 127.4, 125.1, 123.8, 122.7, 119.7, 111.2, 111.0, 20.4, 12.9 ppm. Elemental analysis: calcd (%) for $C_{19}H_{15}NO$ (273.33): C 83.49, H 5.53; found: C 83.56, H 5.60.

5-(2-Ethylbenzofuran-3-yl)-pyrimidine **28**: The reaction of 5-bromopyrimidine (0.159 g, 1 mmol), 2-ethylbenzofuran (0.292 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **28** (0.157 g, 70%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.26 (s, 1H), 8.92 (s, 2H), 7.60–7.50 (m, 2H), 7.40–7.25 (m, 2H), 2.93 (q, J = 7.5 Hz, 2H), 1.41 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 157.8, 157.2, 156.4, 154.2, 127.5, 124.4, 123.2, 118.6, 115.7, 111.3, 109.6, 20.3, 12.9 ppm. Elemental analysis: calcd (%) for $C_{14}H_{12}N_2O$ (224.26): C 74.98, H 5.39; found: C 74.92, H 5.47.

4-(2-Butylbenzofuran-3-yl)-benzaldehyde **29**: The reaction of 4-bromobenzaldehyde (0.185 g, 1 mmol), 2-*n*-butylbenzofuran (0.348, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **29** (0.217 g, 78%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 10.10 (s, 1H), 8.03 (d, J = 8.3 Hz, 2H), 7.69 (d, J = 8.3 Hz, 2H), 7.64–7.48 (m, 2H), 7.40–7.25 (m, 2H), 2.91 (t, J = 7.5 Hz, 2H), 1.80 (quint., J = 7.5 Hz, 2H), 1.44 (sext., J = 7.5 Hz, 2H), 0.94 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 191.7, 156.3, 154.0, 139.5, 134.8, 130.1, 129.3, 128.0, 123.9, 122.8, 119.1, 115.9, 111.0, 30.3, 26.6, 22.4, 13.7 ppm. Elemental analysis: calcd (%) for $C_{19}H_{18}O_2$ (278.35): C 81.99, H 6.52; found: C 81.87, H 6.70.

1-[3-(2-Butyl-benzofuran-3-yl)-phenyl]-ethanone **30**: The reaction of 3-bromoacetophenone (0.199 g, 1 mmol), 2-*n*-butylbenzofuran (0.348 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **30** (0.210 g, 72%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.16 (s, 1H), 7.95 (d, J = 8.3 Hz, 1H), 7.73–7.40 (m, 4H), 7.38–7.25 (m, 2H), 2.86 (t, J = 7.5 Hz, 2H), 2.69 (s, 3H), 1.80 (quint., J = 7.5 Hz, 2H), 1.45 (sext., J = 7.5 Hz, 2H), 0.92 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 197.8, 155.7, 153.9, 137.6, 133.6, 133.5, 129.0, 128.8, 128.4, 126.9, 123.7, 122.7, 119.1, 116.0, 110.9, 30.4, 26.7, 26.5, 22.4, 13.7 ppm. Elemental analysis: calcd (%) for $C_{20}H_{20}O_2$ (292.37): C 82.16, H 6.89; found: C 82.24, H 6.74.

2-Butyl-3-(1-naphtyl)-benzofuran **31**: The reaction of 1-bromonaphthalene (0.207 g, 1 mmol), 2-*n*-butylbenzofuran (0.348 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **31** (0.222 g, 74%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 7.97 (d, J = 8.2 Hz, 1H), 7.95 (d, J = 8.2 Hz, 1H), 7.79 (d, J = 8.2 Hz, 1H), 7.62–7.05 (m, 8H), 2.76 (t, J = 7.5 Hz, 2H), 1.75 (quint., J = 7.5 Hz, 2H), 1.45 (sext., J = 7.5 Hz, 2H), 0.92 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.4, 153.9, 144.2, 133.8, 132.5, 130.2, 128.3, 128.2, 128.1, 126.1, 125.9, 125.8, 125.5, 123.4, 122.4, 120.0, 115.2, 110.7, 30.2, 26.6, 22.3, 13.7 ppm. Elemental analysis: calcd (%) for $C_{22}H_{20}O$ (300.39): C 87.96, H 6.71; found: C 87.10, H 6.81.

3-(2-Butylbenzofuran-3-yl)-quinoline **32**: The reaction of 3-bromoquinoline (0.208 g, 1 mmol), 2-*n*-butylbenzofuran (0.348 g, 2 mmol), and KOAc (0.196 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **32** (0.211 g, 70%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.10 (d, J = 1.8 Hz, 1H), 8.27 (d, J = 1.8 Hz, 1H), 8.21 (d, J = 8.0 Hz, 1H), 7.91 (d, J = 8.0 Hz, 1H), 7.79 (t, J = 7.7 Hz, 1H), 7.70–7.50 (m, 3H), 7.40–7.25 (m, 2H), 2.94 (t, J = 7.5 Hz, 2H), 1.84 (quint., J = 7.5 Hz, 2H), 1.45 (sext., J = 7.5 Hz, 2H), 0.94 ppm (t, J = 7.5 Hz, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 156.4, 154.1, 151.1, 147.0, 135.1, 129.4, 129.3, 128.4, 128.0, 127.7, 127.0, 126.2, 123.9, 122.9, 118.9, 113.5, 111.1, 30.4, 26.6, 22.4, 13.7 ppm. Elemental analysis: calcd (%) for $C_{21}H_{19}NO$ (301.28): C 83.69, H 6.35; found: C 83.50, H 6.40.

1-(3-Pyridin-3-ylbenzofuran-2-yl)-ethanone **33**: The reaction of 3-bromopyridine (0.158 g, 1 mmol), 2-acetylbenzofuran (0.320 g, 2 mmol), and KF (0.116 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **33** (0.069 g, 29%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 8.65–8.48 (m, 2H), 7.75–7.20 (m, 6H), 4.27 ppm (s, 3H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 187.3, 155.6, 151.8, 150.5, 148.4, 137.0, 129.3, 128.5, 126.8, 124.0, 123.4, 123.3, 113.6, 112.3, 42.5 ppm. Elemental analysis: calcd (%) for $C_{15}H_{11}NO_2$ (237.25): C 75.94, H 4.67; found: C 75.90, H 4.49.

4-(2-Formylbenzofuran-3-yl)-benzonitrile **34**: The reaction of 4-bromobenzonitrile (0.182 g, 1 mmol), 2-formylbenzofuran (0.219 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **34** (0.126 g, 51%). ^{1}H NMR (200 MHz, $CDCl_3$): δ = 9.93 (s, 1H), 7.91 (d, J = 8.3 Hz, 2H), 7.81 (d, J = 8.3 Hz, 2H), 7.75–7.60 (m, 3H), 7.47 ppm (t, J = 7.8 Hz, 1H). ^{13}C NMR (50 MHz, $CDCl_3$): δ = 179.4, 155.4, 147.6, 134.1, 132.8, 130.9, 130.6, 130.0, 126.4, 124.8, 122.1, 118.2, 113.2, 113.1 ppm. Elemental analysis:

calcd (%) for $C_{16}H_9NO_2$ (247.25): C 77.72, H 3.67; found: C 77.31, H 3.60.

3-(4-Benzoyl-phenyl)-benzofuran-2-carbaldehyde **35**: The reaction of 4-bromobenzophenone (0.261 g, 1 mmol), 2-formylbenzofuran (0.219 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **35** (0.196 g, 60%). ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 9.97$ (s, 1H), 8.04 (d, $J = 8.3$ Hz, 2H), 7.91 (d, $J = 8.3$ Hz, 2H), 7.85–7.35 ppm (m, 9H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 195.8$, 179.5, 155.4, 147.7, 138.2, 137.1, 133.2, 132.8, 130.7, 130.1, 130.0; 129.9, 129.8, 128.4, 126.7, 124.5, 122.4, 112.9 ppm. Elemental analysis: calcd (%) for $C_{22}H_{14}O_3$ (326.34): C 80.97, H 4.32; found: C 80.84, H 4.20.

3-(2-Formylphenyl)-benzofuran-2-carbaldehyde **36**: The reaction of 2-bromobenzaldehyde (0.185 g, 1 mmol), 2-formylbenzofuran (0.219 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **36** (0.132 g, 53%). ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 10.00$ (s, 1H), 9.79 (s, 1H), 8.19 (d, $J = 8.3$ Hz, 1H), 7.85–7.25 ppm (m, 7H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 190.4$, 179.3, 154.9, 148.4, 134.9, 134.1, 131.5, 132.1, 129.9, 129.8, 129.2, 129.1, 128.4, 124.8, 122.1, 112.9 ppm. Elemental analysis: calcd (%) for $C_{16}H_{10}O_3$ (250.25): C 76.79, H 4.03; found: C 76.89, H 3.90.

3-Pyridin-3-ylbenzofuran-2-carbaldehyde **37**: The reaction of 3-bromopyridine (0.158 g, 1 mmol), 2-formylbenzofuran (0.219 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **37** (0.072 g, 32%). ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 9.92$ (s, 1H), 8.93 (s, 1H), 8.81 (d, $J = 6.0$ Hz, 1H), 8.01 (d, $J = 7.2$ Hz, 1H), 7.82–7.35 ppm (m, 5H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 179.3$, 155.4, 147.7, 150.4, 150.1, 137.7, 130.0, 126.7, 125.6, 124.7, 123.8, 122.1, 113.0 ppm. Elemental analysis: calcd (%) for $C_{14}H_9NO_2$ (223.23): C 75.33, H 4.06; found: C 75.47, H 4.00.

4-(2-Hydroxymethylbenzofuran-3-yl)-benzonitrile **38**: The reaction of 4-bromobenzonitrile (0.182 g, 1 mmol), 2-hydroxymethylbenzofuran (0.222 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $Pd(OAc)_2$ (0.23 mg, 0.001 mmol) affords **38** (0.170 g, 68%). ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.84$ (d, $J = 8.3$ Hz, 2H), 7.73 (d, $J = 8.3$ Hz, 2H), 7.73–7.60 (m, 2H), 7.48–7.25 (m, 2H), 4.83 (s, 2H), 3.40 ppm (s, 1H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 154.3$, 152.6, 136.7, 132.6, 130.1, 129.6, 125.5, 123.5, 122.0, 119.9, 118.2, 111.7, 111.0, 56.3 ppm. Elemental analysis: calcd (%) for $C_{16}H_{11}NO_2$ (249.26): C 77.10, H 4.45; found: C 77.20, H 4.52.

3-(2-Hydroxymethylbenzofuran-3-yl)-benzaldehyde **39**: The reaction of 3-bromobenzaldehyde (0.185 g, 1 mmol), 2-hydroxymethylbenzofuran (0.222 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $PdCl(C_3H_5)$(dppb) (3 mg, 0.005 mmol) affords **39** (0.136 g, 54%). ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 10.12$ (s, 1H), 8.10 (s, 1H), 7.95 (d, $J = 8.3$ Hz, 1H), 7.87 (d, $J = 8.3$ Hz, 1H), 7.75–7.53 (m, 3H), 7.48–7.23 (m, 2H), 4.84 (s, 2H), 3.40 ppm (s, 1H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 192.1$, 154.3, 152.2, 136.9, 135.0, 133.2, 132.9, 130.1, 129.6, 128.9, 127.5, 125.3, 123.3, 120.1, 111.6, 56.3 ppm. Elemental analysis: calcd (%) for $C_{16}H_{12}O_3$ (252.26): C 76.18, H 4.79; found: C 76.28, H 4.97.

(3-Pyridin-3-ylbenzofuran-2-yl)-methanol **40**: The reaction of 3-bromopyridine (0.158 g, 1 mmol), 2-hydroxymethylbenzofuran (0.222 g, 1.5 mmol), and KOAc (0.192 g, 2 mmol) with $PdCl(C_3H_5)$-(dppb) (3 mg, 0.005 mmol) affords **40** (0.124 g, 55%) yield. ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 8.78$ (s, 1H), 8.58 (d, $J = 4.0$ Hz, 1H), 7.90 (d, $J = 6.5$ Hz, 1H), 7.60–7.25 (m, 5H), 4.83 (s, 2H), 3.96 ppm (s, 1H). ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 154.3$, 153.2, 149.3, 148.2, 136.7, 128.3, 127.4, 125.1, 123.8, 123.2, 119.7, 115.8, 111.5, 55.7 ppm. Elemental analysis: calcd (%) for $C_{14}H_{11}NO_2$ (225.24): C 74.65, H 4.92; found: C 74.70, H 4.87.

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