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Synthesis of *N*-Aryl Amides by Ligand-Free Copper-Catalyzed *ipso*-Amidation of Arylboronic Acids with Nitriles

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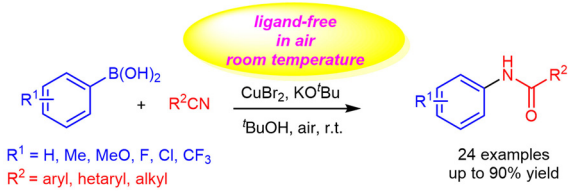

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Abstract A facile copper-catalyzed *ipso*-amidation of arylboronic acids with nitriles has been developed. The method provides a highly efficient and economical synthesis of *N*-aryl amides with a broad substrate scope.

Key words amides, nitriles, amination, copper catalysis, arylboronic acids, tandem reactions

N-Aryl amides are valuable compounds that are widely present in proteins, bioactive molecules, organic functional materials, and drugs.[1,2] Various approaches to *N*-aryl amides have been well documented in the literature. Access to *N*-aryl amides is mainly through coupling reactions of preformed amides with aryl halides. Amides can also be accessed through hydrolysis of nitriles; consequently, nitriles, as excellent precursors of amides with wide availability and low cost, have aroused great interest among organic chemists. Classical procedures for nitrile hydrolysis generally involve treatment with a strong inorganic acid or base in water. However, the formation of carboxylic acids through further hydrolysis of the amide is a serious problem that limits the application of such procedures. Recently, a copper-assisted hydrolysis of nitriles to give the corresponding amides was developed by Zhou et al.[3] This strategy, using 2.5 mol% of $Cu_4I_4(H_2O)_4$ complex in pure water, showed high efficiency and afforded the amides in high yields of up to 98%. Copper metal is also an active catalytic species in coupling reactions of amides with aryl halides.[4] Therefore, a combination of the copper-catalyzed hydrolysis of a nitrile to an amide and subsequent copper-catalyzed coupling of the resulting amide with an aryl halide in situ would be expected to provide an efficient approach to *N*-aryl amides from simple reactants. Accordingly, several excellent studies on copper-catalyzed sequential hydrolysis/coupling reactions of nitriles with aryl halides to give *N*-aryl amide motifs have been reported.[3,5–7] Furthermore, Jamieson and co-workers developed an efficient synthesis of *N*-aryl amides by a silanoate-mediated combination of hydrolysis of nitriles and palladium-catalyzed coupling with aryl bromides.[8] Nevertheless, most of these synthetic procedures require the assistance of expensive nongeneralized ligands, and the reactions must be performed under an inert atmosphere.

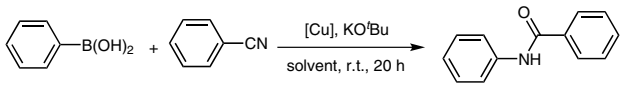
Chan–Lam coupling[9] is a popular C–N or C–O bond-forming reaction of organoboryl reagents with amines or alcohols, respectively. This reaction is catalyzed by copper(II) species and can be conducted in air using oxygen as an oxidant. Therefore, a combination of the hydrolysis of nitriles and a Chan–Lam reaction should significantly expand the substrate scope for *N*-aryl amide synthesis, avoid the use of ligands, and permit the synthetic operations to be conducted in air. In 2009, Prakash et al. reported a XeF_2-mediated synthesis of anilides from arylboronic acids and nitriles.[10] The reactions reach completion in a short time and generate anilides in moderate to high yields. However, it is disappointing that electron-deficient arylboronic acids give no or low yields of the desired products. Recently, Xiang et al. developed a copper-catalyzed amidation of arylboronic acids with nitriles.[11] The reactions showed a broad substrate scope and gave *N*-aryl amides in up to 87% yield. Nevertheless, these transformations required the use of $MesI(OAc)_2$ as an oxidant, $BF_3{\cdot}OEt_2$ and TMSOTf as additives, and proceeded under argon, making the method uneconomical. In 2015, Dash and co-workers reported the hydrolysis of nitriles to the corresponding amides by using potassium *tert*-butoxide in *tert*-butanol under nitrogen.[12] The hydrolysis proceeded smoothly for a broad range of nitriles under mild conditions, using the potassium *tert*-butoxide as an oxygen source, and it provided the amides in excellent yields without over-hydrolysis.

We set out to develop an efficient, air-tolerant, and economical copper-catalyzed procedure for the preparation of *N*-aryl amides by a combination of potassium *tert*-butoxide mediated hydrolysis of nitriles and subsequent coupling with arylboronic acids. In this sequential hydrolysis/coupling method, a wide variety of arylboronic acids and nitriles were well tolerated and successfully afforded the corresponding *N*-aryl amides in good to excellent yields in air.

Initially, we chose phenylboronic acid (**1a**) and benzonitrile (**2a**) as model substrates to investigate the reaction parameters. As shown in Table 1, we first performed the reaction in the presence of $Cu(OAc)_2$ and *t*-BuOK in *tert*-butyl alcohol in air at room temperature. Gratifyingly, the desired *N*-phenylbenzamide (**3aa**) was successfully isolated in 61% yield (entry 1). Further screening of the solvents indicated that THF, DMSO, and DMF were completely ineffective for this transformation (entries 2–4). When the solvent was changed to *i*-PrOH, a decreased yield (42%) was obtained (entry 5). To our surprise, none of the desired product was formed in EtOH (entry 6). However, when bulky neopentyl alcohol was used as a solvent, a 49% yield of *N*-phenylbenzamide (**3aa**) was isolated (entry 7). This indicated that steric hindrance of the alkyl group in the alcohol has a marked effect on the formation of the desired product and that *t*-BuOH is the optimal solvent. Next, we examined the catalytic performance of various copper species, including CuI, CuBr, CuCl, Cu powder, CuO, $CuBr_2$, $CuCl_2$, and $Cu(OTf)_2$ (entries 8–15). $CuBr_2$ showed the best catalytic ability and finally improved the yield to 90%. When the reaction was performed under the optimal conditions in argon, only benzamide was formed and no *N*-phenylbenzamide was produced, confirming that oxygen in air as an oxidant was essential for the Chan–Lam process in the current strategy.

Having identified the optimal reaction conditions (Table 1, entry 13), we next investigated the substrate scope of the copper-catalyzed tandem hydrolysis/coupling reaction. First, the reactions of various arylboronic acids with benzonitrile were examined, and the results are summarized in Table 2. Arylboronic acids bearing either electron-withdrawing or electron-donating groups smoothly underwent the sequential transformation to give the corresponding *N*-aryl amides in moderate to excellent yields. Arylboronic acids with *ortho*-substituents showed a lower reactivity than the corresponding *para*-substituted compounds (Table 2; entry 2 versus entry 3; entry 5 versus entry 7). Furthermore, when the sterically hindered arylboronic acids 1-naphthylboronic acid, 9-phenanthrylboronic acid, and mesitylboronic acid were subjected to this transformation, all successfully gave the corresponding products (entries 11, 12 , and 4); however, the most hindered reactant, mesitylboronic acid, gave the corresponding product **3da** in only 25% yield, indicating that steric hindrance has a marked effect on this reaction. For the halo-substituted arylboronic acids (4-chlorophenyl)boronic acid and (4-fluorophenyl)boronic acid, the corresponding products **3ia** and **3ja** were obtained in excellent yields of 88% and 85%, respectively (entries 8 and 9). Note that the incorporation of halo substituents in *N*-aryl amides has great significance because the products can be easily derivatized by means of simple coupling strategies or the like.

Table 1 Optimization of the Reaction Conditions[a]



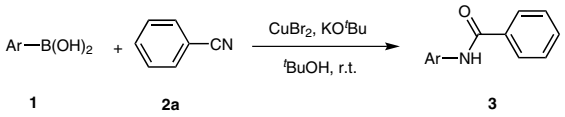
1a **2a** **3aa**

Entry	[Cu]	Solvent	Yield[b] (%)
1	$Cu(OAc)_2·H_2O$	*t*-BuOH	61
2	$Cu(OAc)_2·H_2O$	THF	n.r.[c]
3	$Cu(OAc)_2·H_2O$	DMSO	n.r.[c]
4	$Cu(OAc)_2·H_2O$	DMF	n.r.[c]
5	$Cu(OAc)_2·H_2O$	*i*-PrOH	42
6	$Cu(OAc)_2·H_2O$	EtOH	n.d.[d]
7	$Cu(OAc)_2·H_2O$	*t*-BuCH$_2$OH	49
8	CuI	*t*-BuOH	51
9	CuBr	*t*-BuOH	73
10	CuCl	*t*-BuOH	69
11	Cu powder	*t*-BuOH	50
12	CuO	*t*-BuOH	30
13	$CuBr_2$	*t*-BuOH	90
14	$CuCl_2$	*t*-BuOH	76
15	$Cu(OTf)_2$	*t*-BuOH	68
16[e]	$CuBr_2$	*t*-BuOH	n.d.[d]

[a] Reaction conditions: **1a** (0.6 mmol), **2a** (0.5 mmol), [Cu] (5.0 mol%), *t*-BuOK (3.0 equiv), solvent (3 mL), 20 h, r.t., air.
[b] Isolated yield.
[c] No reaction.
[d] Not determined.
[e] The reaction was performed under argon.

Phenylboronic acid was next selected as a coupling partner to react with various nitriles to examine the reaction scope (Table 3). Substituted benzonitriles with either electron-withdrawing or electron-donating groups successfully underwent the transformation to give the corresponding *N*-aryl amides in moderate to excellent yields. Benzonitriles with *para*-substituents such as methyl, methoxy, fluoro, bromo, or iodo were well tolerated, and all smoothly furnished the desired products (Table 3, entries 1–5). Sterically hindered 2-bromobenzonitrile and 2,6-dimethylbenzonitrile afforded the corresponding amides **3ag** and **3ah** in yields of 83% and 30%, respectively (entries 6 and 7). The heteroaromatic nitriles 4-cyanopyridine and 2-cyanopyrazine also underwent the transformation, affording the corresponding *N*-substituted amides **3aj** and **3ak** in good yields (entries 9 and 10). When isophthalonitrile was used, the monohydrolysis/coupling product **3al** was obtained in

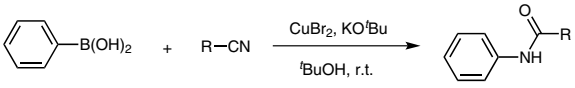
Table 2 Reactions of Arylboronic Acids with Benzonitrile



1 2a 3

Entry	Ar	Product	Time (h)	Yield (%)
1	Ph	**3aa**	20	90
2	4-MeC_6H_4	**3ba**	20	84
3	2-MeC_6H_4	**3ca**	20	59
4	Mes	**3da**	38	25
5	4-MeOC_6H_4	**3ea**	20	75
6	3-MeOC_6H_4	**3fa**	20	72
7	2-MeOC_6H_4	**3ga**	20	52
8	4-ClC_6H_4	**3ha**	20	88
9	4-FC_6H_4	**3ia**	20	85
10	4-$F_3C$$C_6H_4$	**3ja**	26	65
11	1-naphthyl	**3ka**	26	45
12	9-phenanthryl	**3la**	20	40

Table 3 Reactions of Nitriles with Phenylboronic Acid



1a 2 3

Entry	R	Product	Time (h)	Yield (%)
1	4-MeC_6H_4	**3ab**	24	81
2	4-MeOC_6H_4	**3ac**	24	82
3	4-FC_6H_4	**3ad**	28	64
4	4-BrC_6H_4	**3ae**	28	65
5	4-IC_6H_4	**3af**	28	61
6	2-BrC_6H_4	**3ag**	35	83
7	2,6-$Me_2C_6H_3$	**3ah**	30	30
8	3-$F_3C$$C_6H_4$	**3ai**	28	72
9	4-pyridyl	**3aj**	37	73
10	pyrazin-2-yl	**3ak**	37	56
11	3-NCC_6H_4	**3al**	24	69
12	Me	**3am**	35	79

69% yield, and no dihydrolysis/coupling product was formed (entry 11). The aliphatic nitrile acetonitrile reacted smoothly with phenylboronic acid to give *N*-phenylacetamide (**3am**) in 79% yield.

In summary, we have developed a facile copper-catalyzed *ipso*-amidation of arylboronic acids with nitriles to give *N*-aryl amides. The current strategy shows a high efficiency and a wide functional-group tolerance. All halo substituents are well tolerated. The transformations is also highly economical, as it can be carried out effectively in air at room temperature in the presence of only catalytic amounts of $CuBr_2$ and *t*-BuOK, without the use of expensive ligands, oxidants, or other additives.

Commercially available reagents were used directly without further purification. *t*-BuOH was freshly distilled before use. Melting points were recorded on a Beijing Tech X-5 instrument and are uncorrected. Column chromatography was performed on silica gel (particle size 10–40 μm; Ocean Chemical Factory, Qingdao). ^{1}H NMR spectra were recorded on Bruker 300M and 400M instruments at r.t. with $CDCl_3$ or DMSO-d_6 as the solvent.

Amides 3aa–la and 3ab–am; General Procedure

A 10 mL round-bottomed flask was charged with the appropriate nitrile **2** (0.50 mmol), arylboronic acid **1** (0.60 mmol), $CuBr_2$ (6 mg, 5 mol%), *t*-BuOK (168 mg, 1.50 mmol), and *t*-BuOH (3.0 mL), and the mixture was stirred at r.t. until the reaction was complete (TLC). H_2O (4.0 mL) was added, and the mixture was extracted with EtOAc (3 × 10 mL). The combined organic layers were washed twice with H_2O, dried (Na_2SO_4), and concentrated to give a residue that was purified by column chromatography (silica gel, PE–EtOAc).

N-Phenylbenzamide (3aa)[11]

White solid; yield: 89 mg (90%); mp 159.2–160.9 °C (Lit.[24] 159–161 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.88–7.85 (m, 3 H), 7.64 (d, *J* = 7.6 Hz, 2 H), 7.58–7.50 (m, 1 H), 7.49–7.46 (m, 2 H), 7.38 (t, *J* = 7.6 Hz, 2 H), 7.15 (t, *J* = 7.4 Hz, 1 H).

N-(4-Tolyl)benzamide (3ba)[13]

White solid; yield: 89 mg (84%); mp 155.0–156.2 °C (Lit.[25] 155–156 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.85 (d, *J* = 7.6 Hz, 3 H), 7.52 (d, *J* = 7.9 Hz, 3 H), 7.49–7.46 (m, 2 H), 7.16 (d, *J* = 8.1 Hz, 2 H), 2.30 (s, 3 H).

N-(2-Tolyl)benzamide (3ca)[14]

White solid; yield: 62 mg (59%); mp 142.1–143.5 °C (Lit.[26] 142–144 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.97 (s, 1 H), 7.85 (d, *J* = 7.3 Hz, 2 H), 7.54–7.50 (m, 3 H), 7.44 (t, *J* = 7.5 Hz, 2 H), 7.15 (d, *J* = 8.3 Hz, 2 H), 2.34 (s, 3 H).

N-Mesitylbenzamide (3da)[15]

White solid; yield: 30 mg (25%); mp 198.8–200.2 °C (Lit.[27] 202–204 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.94–7.90 (m, 2 H), 7.57–7.54 (m, 1 H), 7.52–7.49 (m, 2 H), 7.31 (s, 1 H), 6.94 (s, 2 H), 2.30 (s, 3 H), 2.25 (s, 6 H).

N-(4-Methoxyphenyl)benzamide (3ea)[11]

White solid; yield: 85 mg (75%); mp 151.5–152.3 °C (Lit.[28] 153–154 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.87–7.82 (m, 3 H), 7.55–7.52 (m, 3 H), 7.49–7.46 (m, 2 H), 6.90 (d, *J* = 8.6 Hz, 2 H), 3.81 (s, 3 H).

N-(3-Methoxyphenyl)benzamide (3fa)[16]

White solid; yield: 82 mg (72%); mp 105.3–106.1 °C (Lit.[29] 103–104 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.98 (s, 1 H), 7.84 (dd, *J* = 1.48, 3.2 Hz, 2 H), 7.53–7.48 (m, 1 H), 7.48–7.43 (m, 3 H), 7.24–7.21 (m, 1 H), 6.72–6.71 (m, 1 H), 6.47–6.42 (m, 1 H), 3.80 (s, 3 H).

N-(2-Methoxyphenyl)benzamide (3ga)[16]

White solid; yield: 59 mg (52%); mp 59.5–60.1 °C (Lit.[29] 60–61 °C).

^{1}H NMR (400 MHz, DMSO-d_6): δ = 9.43 (s, 1 H), 7.97 (d, *J* = 7.4 Hz, 2 H), 7.79 (d, *J* = 7.7 Hz, 1 H), 7.60–7.57 (m, 1 H), 7.55–7.50 (m, 2 H), 7.19 (t, *J* = 7.5 Hz, 1 H), 7.10 (d, *J* = 8.0 Hz, 1 H), 6.97 (t, *J* = 7.5 Hz, 1 H), 3.84 (s, 3 H).

N-(4-Chlorophenyl)benzamide (3ha)[17]

White solid; yield: 102 mg (88%); mp 192.8–193.4 °C (Lit.[30] 192–193 °C).

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.38 (s, 1 H), 7.94 (d, *J* = 7.4 Hz, 2 H), 7.82 (d, *J* = 8.7 Hz, 2 H), 7.61–7.58 (m, 1 H), 7.56–7.51 (m, 2 H), 7.41 (d, *J* = 8.7 Hz, 2 H).

N-(4-Fluorophenyl)benzamide (3ia)[11]

White solid; yield: 91 mg (85%); mp 184.6–185.6 °C (Lit.[31] 184–185 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.90–7.86 (m, 2 H), 7.80 (s, 1 H), 7.64–7.58 (m, 2 H), 7.56 (d, *J* = 7.3 Hz, 1 H), 7.52–7.49 (m, 2 H), 7.09 (t, *J* = 8.6 Hz, 2 H).

N-[(4-Trifluoromethyl)phenyl]benzamide (3ja)[16]

White solid; yield: 86 mg (65%); mp 204.5–205.5 °C (Lit.[32] 205–206 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.18 (s, 1 H), 8.13 (d, *J* = 7.9 Hz, 1 H), 8.04 (s, 1 H), 7.82 (d, *J* = 7.6 Hz, 1 H), 7.65–7.60 (m, 3 H), 7.38 (t, *J* = 7.4 Hz, 2 H), 7.19 (t, *J* = 7.4 Hz, 1 H).

N-1-Naphthylbenzamide (3ka)[13]

White solid; yield: 56 mg (45%); mp 157.2–158.7 °C Lit.[4b] 159–160 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.46 (s, 1 H), 8.10 (d, *J* = 7.2 Hz, 2 H), 8.01–7.97 (m, 2 H), 7.88 (d, *J* = 7.9 Hz, 1 H), 7.64–7.54 (m, 7 H).

N-9-Phenanthrylbenzamide (3la)[18]

White solid; yield: 59 mg (40%); mp 197.5–198.6 °C (Lit.[33] 199–201 °C).

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.52 (s, 1 H), 8.92 (d, *J* = 8.1 Hz, 1 H), 8.86 (d, *J* = 7.9 Hz, 1 H), 8.15–8.08 (m, 3 H), 8.02 (d, *J* = 7.6 Hz, 1 H), 7.97 (s, 1 H), 7.78–7.57 (m, 7 H).

4-Methyl-N-phenylbenzamide (3ab)[13]

White solid; yield: 85 mg (81%); mp 143.5–144.5 °C (Lit.[19] 143–144 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.88 (s, 1 H), 7.77 (d, *J* = 8.2 Hz, 2 H), 7.64 (d, *J* = 7.9 Hz, 2 H), 7.36 (t, *J* = 7.9 Hz, 2 H), 7.28–7.25 (m, 2 H), 7.14 (t, *J* = 7.4 Hz, 1 H), 2.42 (s, 3 H).

4-Methoxy-N-phenylbenzamide (3ac)[11]

White solid; yield: 93 mg (82%); mp 165.8–166.4 °C (Lit.[34] 168–170 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.84 (d, *J* = 8.7 Hz, 2 H), 7.77 (s, 1 H), 7.63 (d, *J* = 7.8 Hz, 2 H), 7.36 (t, *J* = 7.8 Hz, 2 H), 7.14 (t, *J* = 7.4 Hz, 1 H), 6.97 (d, *J* = 8.5 Hz, 2 H), 3.87 (s, 3 H).

4-Fluoro-N-phenylbenzamide (3ad)[11]

White solid; yield: 69 mg (64%); mp 179.2–180.1 °C (Lit.[19] 180–181 °C).

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.26 (s, 1 H), 8.05–8.01 (m, 2 H), 7.76 (d, *J* = 7.9 Hz, 2 H), 7.39–7.32 (m, 4 H), 7.10 (t, *J* = 7.4 Hz, 1 H).

4-Bromo-N-phenylbenzamide (3ae)[17]

White solid; yield: 89 mg (65%); mp 202.5–203.5 °C (Lit.[19] 202–204 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.80 (s, 1 H), 7.74 (d, *J* = 8.5 Hz, 2 H), 7.62 (d, *J* = 8.4 Hz, 4 H), 7.38 (t, *J* = 8.3 Hz, 2 H), 7.19–7.15 (m, 1 H).

4-Iodo-N-phenylbenzamide (3af)[11]

White solid; yield: 99 mg (61%); mp 205.5–207.0 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.29 (s, 1 H), 7.94–7.90 (m, 2 H), 7.77–7.73 (m, 4 H), 7.35 (t, *J* = 7.9 Hz, 2 H), 7.10 (t, *J* = 7.4 Hz, 1 H).

2-Bromo-N-phenylbenzamide (3ag)[19]

White solid; yield: 114 mg (83%); mp 120.4–121.0 °C (Lit.[19] 122–123 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.47 (s, 1 H), 7.72 (d, *J* = 8.2 Hz, 3 H), 7.57–7.54 (m, 1 H), 7.52–7.47 (m, 1 H), 7.44– 7.40 (m, 1 H), 7.37–7.32 (m, 2 H), 7.10 (t, *J* = 7.4 Hz, 1 H).

2,6-Dimethyl-N-phenylbenzamide (3ah)[20]

White solid; yield: 34 mg (30%); mp 127.4–128.2 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.63 (d, *J* = 7.6 Hz, 2 H), 7.39 (t, *J* = 7.9 Hz, 2 H), 7.32 (s, 1 H), 7.24–7.15 (m, 2 H), 7.08 (d, *J* = 7.6 Hz, 2 H), 2.40 (s, 6 H).

N-Phenyl-3-(trifluoromethyl)benzamide (3ai)[21]

White solid; yield: 95 mg (72%); mp 149.7–150.5 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.48 (s, 1 H), 8.29–8.25 (m, 2 H), 7.96 (d, *J* = 7.8 Hz, 1 H), 7.79–7.76 (m, 3 H), 7.37 (t, *J* = 7.9 Hz, 2 H), 7.13 (t, *J* = 7.4 Hz, 1 H).

N-Phenylisonicotinamide (3aj)[22]

White solid; yield: 72 mg (73%); mp 169.5–170.5 °C (Lit.[35] 169–171 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.76 (s, 2 H), 8.18–8.07 (m, 1 H), 7.70 (s, 2 H), 7.63 (d, *J* = 8.0 Hz, 2 H), 7.41–7.35 (m, 2 H), 7.19 (t, *J* = 7.5 Hz, 1 H).

N-Phenylpyrazine-2-carboxamide (3ak)[23]

White solid; yield: 56 mg (56%); mp 127.5–128.0 °C (Lit.[36] 128–130 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.67 (s, 1 H), 9.52 (d, *J* = 1.4 Hz, 1 H), 8.81 (d, *J* = 2.5 Hz, 1 H), 8.60–8.58 (m, 1 H), 7.76 (d, *J* = 7.9 Hz, 2 H), 7.40 (t, *J* = 7.9 Hz, 2 H), 7.19 (t, *J* = 7.5 Hz, 1 H).

3-Cyano-N-phenylbenzamide (3al)[21]

White solid; yield: 77 mg (69%); mp 172.5–173.4 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ = 10.42 (s, 1 H), 8.40 (s, 1 H), 8.25 (d, *J* = 7.9 Hz, 1 H), 8.07 (d, *J* = 7.7 Hz, 1 H), 7.78–7.73 (m, 3 H), 7.38 (t, *J* = 7.9 Hz, 2 H), 7.13 (t, *J* = 7.4 Hz, 1 H).

N-Phenylacetamide (3am)[11]

White solid; yield: 53 mg (79%); mp 113.8–114.6 °C (Lit.[37] 113–114 °C).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.49 (d, *J* = 7.9 Hz, 2 H), 7.34–7.28 (m, 3 H), 7.09 (t, *J* = 7.3 Hz, 1 H), 2.17 (s, 3 H).

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Supporting Information

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