Base Effect and Inhibition of Catalytic Activity in Palladium-Catalyzed *N*-Heteroarylation of Pyrazoles with 2,6-Dibromopyridine

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Using the catalytic system $Pd(OAc)_2/PPh_3$, coupling of 2,6-dibromopyridine (**1**) and pyrazoles (**2**) in a molar ratio of **1**:**2**:base = 1:2.4:2.5 afforded the monosubstituted compounds **3** as the major products when KO*t*Bu was used as the base. Without using the catalyst or using NaO*t*Bu as the base the disubstituted compounds **4** were formed as the major products in yields up to 93%. Reactions of **1** and **2** in a molar ratio of **1**:**2**:base = 1:1:1 selectively produced compounds **3** in yields up to 82% when KO*t*Bu was used as the base. The complex from the reaction of **3** and $Pd(OAc)_2$ did not undergo further reaction with **1** to form **4** in the presence of a base. The base effect and inhibition of catalytic activity for $Pd(OAc)_2$ are discussed.

Introduction

Development of new ligands bearing donor atoms other than phosphorus, particularly nitrogen-containing heterocyclic ligands, has been arousing more and more interest in the fields of coordination chemistry, transition metal-based homogeneous catalysis, and organic synthesis. Phosphine ancillary ligands are often susceptible to undergo degradation such as P−C bond cleavage, oxidation to phosphine oxides, and *ortho*-metalation, during the reaction or under storage conditions. Organometallic complexes containing nitrogen donor ligands usually exhibit high reactivities.[1] Recently, planar tridentate nitrogen donor (N_3) ligands such as 2,2′:6′,2″-terpyridines (terpy) **A**,[2] 2,6-bis(imino)-pyridines **B**,[3] and 2,6-bis(oxazolinyl)pyridines (Pybox) **C**[4] have been well documented (Scheme 1). However, one new family of pseudo N_3 ligands, i.e., 2,6-bis-(pyrazol-1-yl)pyridines (**4**), have not been paid considerable attention, and only a few relevant reports were published over the last two decades.[5] Ligands of type **4** were prepared by reactions of 2,6-dibromopyridine (**1**) with the potassium or sodium salts of pyrazoles under harsh conditions.[6] Buchwald−Hartwig amination of aryl bromides has exhibited promising synthetic routes to C−N bond formation.[7,8] Both palladium-[9] and copper[10]-catalyzed cross-coupling of N−H-containing heterocycles with aryl halides, affording *N*-arylated heterocyclic compounds, has been only moderately successful in some cases. Copper-diamine-catalyzed *N*-arylation of pyrazoles with aryl bromides or iodides was reported to afford *N*-aryl pyrazoles.[10b] Palladium-catalyzed amination of **1** with amines has been known.[11] Pyrazole (**2a**) and 3,5-dimethylpyrazole (**2c**) have usually been used to test the relevant synthetic methodology.[10b,11] During the course of our study on pyrazolyl-based ligands, we investigated synthesis of compounds **4** in the presence of a base with or without a catalyst. Herein, we report catalytic synthesis of ligands **4**, the base effect, and inhibition of catalytic activity in palladium-catalyzed *N*-heteroarylation of pyrazoles with 2,6-dibromopyridine in the presence of a base.

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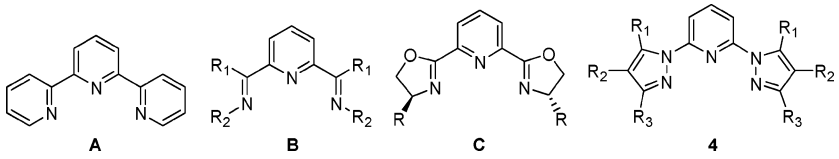
Scheme 1. N_3 and Pseudo N_3 Ligands



Scheme 2. Pyrazoles 2a−h

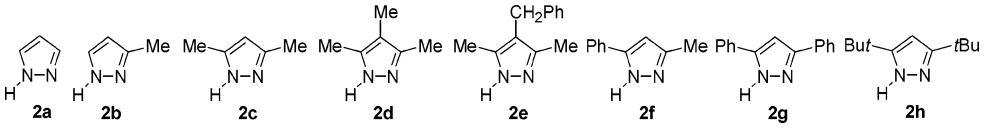
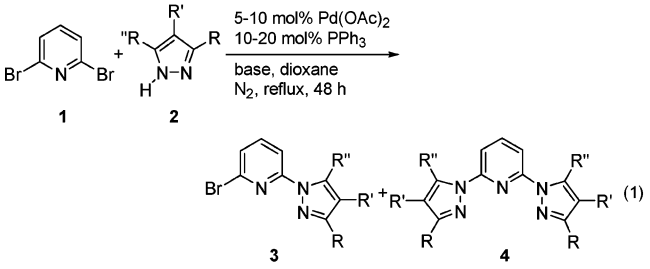


Table 1. Reactions of 1 and 2 in a 1:2.4 Molar Ratio[a]



		KO*t*Bu		NaO*t*Bu	
run	pyrazole	yield (%)[c]		yield (%)[c]	
1[b]	**2a**	**3a**, 29 (46)	**4a**, 69 (54)	**3a**, none	**4a**, 86 (93)
2	**2b**	**3b**, 64 (36)[d]	**4b**, 35 (62)	**3b**, <1	**4b**, 86 (85)
3[b]	**2c**	**3c**, 57 (37)	**4c**, 35 (54)	**3c**, 20 (16)	**4c**, 63 (72)
4[b]	**2d**	**3d**, 58 (40)	**4d**, 30 (59)	**3d**, 25 (22)	**4d**, 62 (64)
5	**2e**	**3e**, 66 (43)	**4e**, 25 (55)	**3e**, 13 (7)	**4e**, 76 (79)
6	**2f**	**3f**, 65 (58)	**4f**, 30 (42)	**3f**, 37 (28)	**4f**, 60 (56)
7	**2g**	**3g**, 29 (33)	**4g**, none	**3g**, 8 (11)	**4g**, none
8	**2h**	**3h**, none	**4h**, none	**3h**, none	**4h**, none

[a] Reaction conditions: **1**, 2.0 mmol; **2**, 4.8 mmol; base, 5.0 mmol; $Pd(OAc)_2$, 10 mol %; PPh_3, 20 mol %; dioxane, 10.0 mL; 102 °C, 48 h. [b] $Pd(OAc)_2$, 5 mol %; PPh_3, 10 mol %. [c] Isolated yields based on **1**, and data in parentheses are the product yields without using $Pd(OAc)_2/PPh_3$. [d] Determined as a 4:1 mixture of two regioisomers (2-bromo-6-(3-methylpyrazol-1-yl)pyridine/2-bromo-6-(5-methylpyrazol-1-yl)pyridine) by ^{1}HNMR.

Results and Discussion

To achieve our objectives, $Pd(OAc)_2$-catalyzed reactions of **1** and pyrazoles (**2a**−**h**) were systematically investigated in the presence of a base, i.e., KO*t*Bu or NaO*t*Bu. Pyrazole (**2a**) and substituted pyrazoles (**2b**−**h**) were used in the reactions (Scheme 2). We intended to synthesize 2,6-bis(pyrazol-1-yl)pyridines (**4**) from the reactions of **1** and an excess of **2** (>2.0 equiv), i.e., in a molar ratio of 1:2.4:2.5 for **1**, **2**, and KO*t*Bu in dioxane at 102 °C. Using 5−10 mol % $Pd(OAc)_2$ as the catalyst and 10−20 mol % PPh_3 as the ligand, the reaction mixture was stirred under a nitrogen atmosphere for 48 h and followed by purification with column chromatography on silica gel. In the case of **2a**, compound **4a** was obtained as the major product in 69% yield and the monosubstituted product, i.e., 2-bromo-6-(pyrazol-1-yl)-pyridine (**3a**), was collected as the minor product in 29% yield (Table 1, run 1). However, in the cases using the substituted pyrazoles, i.e., **2b**−**g**, compounds of type **3** were formed in yields up to 66% as the major products (Table 1, runs 2−7, and Figure 1a). Steric hindrance from the substituent(s) on the corresponding pyrazolyl rings is **2a** < **2b** < **2c** < **2d** < **2e** < **2f** < **2g** < **2h**. For the most sterically hindered pyrazoles **2g** and **2h**, the monosubstituted product **3h** and the disubstituted products **4g** and **4h** were not formed, and only the less sterically hindered 2-bromo-6-(3,5-diphenylpyrazol-1-yl)pyridine (**3g**) was obtained in a yield as low as 29% (Table 1, runs 7, 8). Under harsh conditions, i.e., using potassium salts of pyrazoles, 110−130 °C in diglyme for 4 days, reactions of **1** and the potassium salts of **2a** and **2c** afforded 2,6-bis(pyrazol-1-yl)pyridine (**4a**) and 2,6-bis(3,5-dimethylpyrazol-1-yl)pyridine (**4c**) in 85% and 77% yields, respectively.[5] Without using the catalyst, the same reactions using KO*t*Bu as the base gave compounds **4** as the major products (Table 1, runs 1−5, Figure 1b) except in the case of **2f** (Table 1, run 6), and for pyrazoles **2g** and **2h**, the results are similar to those using $Pd(OAc)_2$ as the catalyst (Table 1, runs 7, 8). It is noted that the catalyst inhibited formation of the disubstituted products, i.e., **4**, except in the case using pyrazole **2a** (Table 1, run 1).

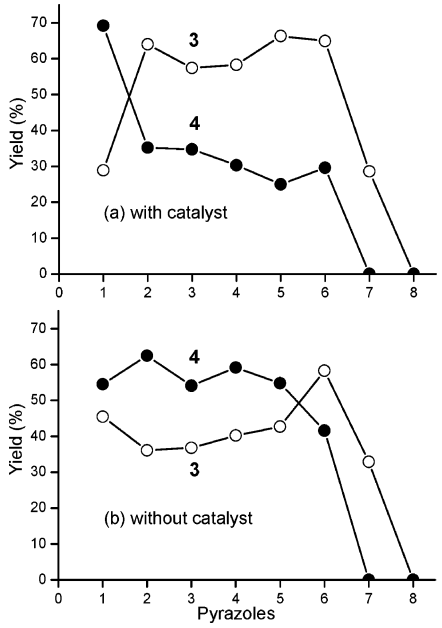


Figure 1. Yields of **3** and **4** from the reactions of **1** and **2** in a 1:2.4 molar ratio using KO*t*Bu as the base. Pyrazole: **1**−**2a**, **2**−**2b**, **3**−**2c**, **4**−**2d**, **5**−**2e**, **6**−**2f**, **7**−**2g**, **8**−**2h**.

When the base NaO*t*Bu was employed with a molar ratio of **1**:**2**:base = 1:2.4:2.5 under the same reaction conditions, compounds **4** were obtained as the major products in 56−93% yields with or without using the catalyst (Table 1). Compounds **4** were formed in yields much higher than those using KO*t*Bu as the base, revealing that a stronger base improves formation of

Table 2. Reactions of 1 and 2 in a 1:1 Molar Ratio[a]

		KO*t*Bu		NaO*t*Bu	
run	pyrazole	yield (%)[c]		yield (%)[c]	
1[b]	**2a**	**3a**, 73 (73)	**4a**, 2 (5)	**3a**, 54 (52)	**4a**, 30 (28)
2	**2b**	**3b**, 76 (66)	**4b**, <1	**3b**, 46 (42)	**4b**, 3 (6)
3[b]	**2c**	**3c**, 68 (69)	**4c**, <1	**3c**, 42 (45)	**4c**, 4 (5)
4[b]	**2d**	**3d**, 54 (57)	**4d**, <1	**3d**, 39 (46)	**4d**, 2 (6)
5	**2e**	**3e**, 43 (59)	**4e**, <1	**3e**, 31 (55)	**4e**, 3 (8)
6	**2f**	**3f**, 76 (82)	**4f**, <1	**3f**, 70 (74)	**4f**, 3 (9)
7	**2g**	**3g**, 11 (19)	**4g**, none	**3g**, 14 (16)	**4g**, none
8	**2h**	**3h**, none	**4h**, none	**3h**, none	**4h**, none

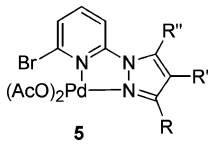
[a] Reaction conditions: **1**, 2.0 mmol; **2**, 2.0 mmol; base, 2.0 mmol; $Pd(OAc)_2$, 10 mol %; PPh_3, 20 mol %; dioxane, 10.0 mL; 102 °C, 48 h. [b] $Pd(OAc)_2$, 5 mol %; PPh_3, 10 mol %. [c] Isolated yields based on **1**, and data in parentheses are the product yields without using $Pd(OAc)_2/PPh_3$.

the disubstituted products. In the presence of the catalyst, a considerable amount (0−37%) of **3** was obtained as well (Table 1, runs 3−7). In most cases, without using the catalyst, compounds **4** were formed in yields higher than those reactions using the catalyst (Table 1). Compounds **3h**, **4g**, and **4h** were not formed in any case due to steric hindrance of the substituents. It is also noted that using much weaker bases such as Cs_2CO_3, K_3PO_4, or K_2CO_3 led only to the monosubstituted product, i.e., **3c**, in yields less than 40% in the reactions of **2c** and **1**.

For the reactions of **1** with pyrazoles in a 1:1:1 molar ratio for **1**, **2**, and KO*t*Bu using $Pd(OAc)_2$ as the catalyst, 2-bromo-6-(pyrazol-1-yl)pyridines (**3**) were selectively formed in yields up to 76% (Table 2, runs 1−7), and the disubstituted products, i.e., **4**, were hardly formed. The highly sterically hindered pyrazoles **2g** and **2h** showed only very low or no reactivity to form **3** (Table 2, runs 7, 8). With the catalyst, in the case using **2b** as the substrate, a product of type **3**, i.e., **3b**, was produced in 76% yield, but in other cases, using the catalyst, yields of **3** were lower than those without using the catalyst (up to 82% yield, Table 2). The inhibition effect of catalyst was also observed; that is, the presence of $Pd(OAc)_2$ inhibited the formation of both **3** and **4** except in the case using **2b** (Table 2). Using the stronger base NaO*t*Bu under the same conditions lower yields of **3** were obtained as compared to the reactions using KO*t*Bu as the base, and small amounts of the disubstituted products **4** were produced (Table 2). Only in the cases of **2a** and **2b** were yields of **3a** and **3b** in the presence of $Pd(OAc)_2$ a little bit higher (54% and 46%, respectively) than those without using the catalyst. In other cases, the presence of the catalyst also inhibited formation of both the products **3** and **4**. CuI as the catalyst in the 1:2.4 or 1:1 molar ratio reactions of **1** and **2** showed only very poor catalytic activity, and the reactions afforded **3c** in 10−30% yields in the presence of a typical base[8] for amination, e.g., K_3PO_4, and 1,2-diaminocyclohexane.[10b]

During the reaction both coordination of the N−H of pyrazoles and C−Br of **1** or **3** to the metal center led to catalytic coupling of **1** and **2**, and further **3** and **2**, forming **3** and/or **4**, and competitive deprotonation of the N−H of pyrazoles by the base generated pyrazolate anions, which attacked **1** and/or **3**, affording **3** and/or **4**, respectively. A base effect was observed in the palladium-catalyzed amination of aryl iodides.[12] In our case, NaO*t*Bu, which behaved stronger than NaO*t*Bu, improved the formation of the disubstituted products **4** in the reactions of **1** and **2** in a molar ratio 1:2.4 (Table 1), while a relatively weak base, i.e., KO*t*Bu, prompted production of the monosubstituted products **3** in the reactions of **1** and **2** in a molar ratio 1:1 (Table 2). Use of $Pd(OAc)_2$ as the catalyst inhibited further reaction of **3** with **2** to form **4** in the presence of KO*t*Bu (Table 1). Possible formation of complexes **5** (Scheme 3) decreases coordination of N−H of **2**, and C−Br of **3**, to the metal center and led to increase of the steric hindrance around the C−Br bond, reducing the reactivity of **3** to form **4** by nucleophilic attack of the pyrazolate anion on the C−Br bond or by catalytic coupling. For comparison, two experiments were carried out (see the Experimental Section) to demonstrate inhibition of the catalytic activity for $Pd(OAc)_2$. Using KO*t*Bu as the base, reaction of **3e** and **2e** in a 1:1 molar ratio gave the disubstituted product **4e** in 72% yield. However, under the same conditions, the complex from the reaction of **3e** and $Pd(OAc)_2$ hardly underwent coupling with **2e** to form **4e**. These results reveal that the catalyst inhibited further coupling of **3** with **2** to form the final product **4**.

Scheme 3. Complex 5



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Conclusions

In conclusion, the stronger base NaO*t*Bu prompted formation of the disubstituted products, i.e., 2,6-bis(pyrazol-1-yl)pyridines, from the reactions of 2,6-dibromopyridine and pyrazoles (>2.0 equiv), while the base KO*t*Bu prompted formation of the monosubstituted products, i.e., 2-bromo-6-(pyrazol-1-yl)pyridines. The catalyst $Pd(OAc)_2$ inhibited further coupling of 2-bromo-6-(pyrazol-1-yl)pyridines with pyrazoles in the presence of a base. The present work has offered a general route to 2,6-bis(pyrazol-1-yl)pyridine and 2-bromo-6-(pyrazol-1-yl)pyridine derivatives.

Experimental Section

General Considerations. All the reactions were carried out under a nitrogen atmosphere with a drybox and standard Schlenk techniques. ^1H and $^{13}C\{^1H\}$ NMR spectra were recorded on a Bruker DRX-400 spectrometer. Elemental analysis was achieved by the Analysis Center, Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences. Pyrazole and substituted pyrazoles were commercially available or prepared as reported.[13] 3,4,5-Trimethylpyrazole[14] and 3,5-dimethyl-4-benzylpyrazole[15] were synthesized by known procedures.

Representative Procedure for the Preparation of 3 and 4. A 50 mL Schlenk flask was charged with 2,6-dibromopyridine, **1** (0.474 g, 2.0 mmol), 3,5-dimethylpyrazole, **2c** (0.461 g, 4.8 mmol), KO*t*Bu (0.561 g, 5.0 mmol), $Pd(OAc)_2$ (22.5

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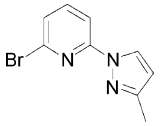
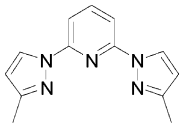
mg, 0.1 mmol), and PPh_3 (52.4 mg, 0.2 mmol). With stirring 10 mL of dioxane was introduced. The flask was placed in an oil bath preheated at 102 °C, and the mixture was stirred at the refluxing temperature for 2 days. After cooling to ambient temperature, the reaction mixture was diluted with ethyl acetate (10 mL) and filtered through Celite, and all the volatiles were removed under reduced pressure. Purification by column chromatography (silica gel, ethyl acetate/petroleum ether (v/v, 20:1−10:1)) afforded 2-bromo-6-(3,5-dimethylpyrazol-1-yl)pyridine, **3c** (0.287 g, 57%), and 2,6-bis(3,5-dimethylpyrazol-1-yl)pyridine**, 4c (**0.187 g, 35%).

Synthesis of 2,6-Bis(3,5-dimethyl-4-benzylpyrazol-1-yl)pyridine (4e) from the Reaction of 2-Bromo-6-(3,5-dimethyl-4-benzylpyrazol-1-yl)pyridine (3e) and 3,5-Dimethyl-4-benzylpyrazole (2e). A mixture of **3e** (0.343 g, 1.0 mmol), **2e** (0.187 g, 1.0 mmol), KO*t*Bu (0.113 g, 1.0 mmol), and dioxane (8 mL) was stirred at 102 °C for 2 days. A workup procedure the same as the above-mentioned gave a liquid residue. Purification by column chromatography (silica gel, ethyl acetate/petroleum ether (v/v, 20:1−10:1)) afforded **4e** as a pale yellow liquid (0.323 g, 72%).

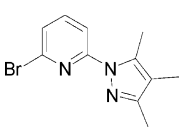
Reaction of the Complex of 2-Bromo-6-(3,5-dimethyl-4-benzylpyrazol-1-yl)pyridine (3e) and $Pd(OAc)_2$ with 3,5-Dimethyl-4-benzylpyrazole (2e) in the Presence of KO*t*Bu. A mixture of $Pd(OAc)_2$ (0.224 g, 1.0 mmol), **3e** (0.341 g, 1.0 mmol), and 10 mL of dioxane was refluxed at 102 °C for 5.5 h until **3e** was completely consumed by TLC determination. Thus **5e** was presumably formed. To the mixture were successively added **2e** (0.186 g, 1.0 mmol) and KO*t*Bu (0.113 g, 1.0 mmol), and the mixture was further stirred at 102 °C for 2 days. Formation of palladiun black was observed during the reaction. A trace amount of **4e** was detected in the reaction mixture by TLC on silica gel. Workup by the procedure described above did not afford a measurable amount of **4e**.



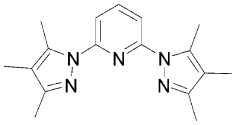
2-Bromo-6-(3-methylpyrazol-1-yl)pyridine (3b): white solid, mp 52 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 (br, 1H), 7.86 (d, 1H), 7.61 (t, 1H), 7.29 (d, 1H), 6.26 (br, 1H), 2.38 (s, 3H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 152.53, 151.46, 140.65, 139.95, 128.31, 124.64, 110.54, 108.60, 13.99. Anal. Calcd for $C_9H_8BrN_3$: C, 45.49; H, 3.36; N, 18.48. Found: C, 45.40; H, 3.39; N, 17.65.



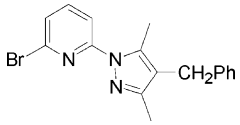
2,6-Bis(3-methylpyrazol-1-yl)pyridine (4b): white solid, mp 74 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.44 (d, 2H), 7.85 (m, 1H), 7.73 (m, 2H), 6.27 (d, 2H), 2.39 (s, 6H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 152.11, 150.06, 141.25, 127.78, 108.55, 108.22, 14.03. Anal. Calcd for $C_{13}H_{13}N_5$: C, 65.18; H, 5.43; N, 29.54. Found: C, 65.25; H, 5.48; N, 29.27.



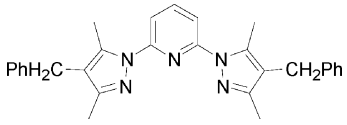
2-Bromo-6-(3,4,5-trimethylpyrazol-1-yl)pyridine (3d): white solid, mp 89 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 (d, 1H), 7.58 (t, 1H), 7.26 (d, 1H), 2.57 (s, 3H), 2.24 (s, 3H), 1.96 (s, 3H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 153.44, 150.36, 140.27, 138.92, 138.34, 123.96, 115.85, 113.57, 12.93, 12.27, 8.09. Anal. Calcd for $C_{11}H_{12}BrN_3$: C, 49.34; H, 4.50; N, 18.33. Found: C, 49.64; H, 4.54; 18.79.



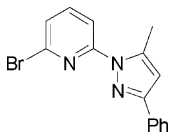
2,6-Bis(3,4,5-trimethylpyrazol-1-yl)pyridine (4d): white solid, mp 114 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.85 (t, 1H), 7.63 (d, 2H), 2.51 (s, 6H), 2.26 (s, 6H), 1.97 (s, 6H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 151.70, 149.65, 140.44, 137.47, 115.10, 113.32, 12.54, 12.21, 8.16. Anal. Calcd for $C_{17}H_{21}N_5$: C, 68.87; H, 7.02; N, 23.24. Found: C, 69.12; H, 7.17; N, 23.71.



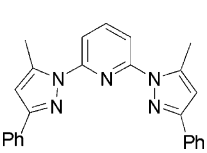
2-Bromo-6-(3,5-dimethyl-4-benzylpyrazol-1-yl)pyridine (3e): white solid, mp 60 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.86 (d), 7.60 (t), and 7.17 (d) (1:1:1 H, pyridyl CH), 7.29 and 7.15 (m each, 3:2 H, phenyl CH), 3.81 (s, 2H), 2.63 (s, 3H), 2.19 (s, 3H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 153.39, 150.47, 140.32, 139.19, 138.95, 128.58, 128.20, 126.16, 124.18, 119.07, 113.75, 29.22, 13.10, 12.48. Anal. Calcd for $C_{17}H_{16}BrN_3$: C, 59.29; H, 4.66; N, 12.36. Found: C, 59.66; H, 4.71; N, 12.28.



2,6-Bis(3,5-dimethyl-4-benzylpyrazol-1-yl)pyridine (4e): yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 (t, 1H) and 7.71 (d, 2H) (pyridyl CH), 7.29 and 7.17 (m each, 4:6 H, phenyl CH), 3.81 (s, 4H), 2.55 (s, 6H), 2.21 (s, 6H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 151.73, 149.95, 140.60, 140.41, 138.33, 128.62, 128.25, 126.18, 118.39, 113.78, 29.37, 12.75, 12.48. Anal. Calcd for $C_{29}H_{29}N_5$: C, 76.31; H, 6.64; N, 14.86. Found: C, 77.82; H, 6.53; N, 15.65.

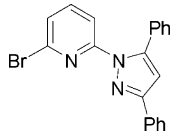


2-Bromo-6-(5-methyl-3-phenylpyrazol-1-yl)pyridine (3f): white solid, mp 95 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.04 (d), 7.65 (t), and 7.33 (d) (1:1:1 H, pyridyl CH), 7.88, 7.44 and 7.36 (m each, 2:2:1 H, phenyl CH), 6.53 (s, 1H), 2.76 (s, 3H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 153.26, 152.36, 143.03, 140.45, 138.94, 132.74, 128.77, 128.49, 126.04, 124.73, 114.03, 107.07, 15.09. Anal. Calcd for $C_{15}H_{12}BrN_3$: C, 57.37; H, 3.89; N, 13.40. Found: C, 57.34; H, 3.85; N, 13.37.



2,6-Bis(5-methyl-3-phenylpyrazol-1-yl)pyridine (4f): white solid, mp 146 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.98 and 7.36 (m each, 1:2 H, pyridyl CH), 7.91 and 7.45 (m each, 6:4 H, phenyl CH), 6.57 (s, 2H), 2.72 (s, 6H). $^{13}C\{^1H\}$ NMR (400 MHz, $CDCl_3$): δ 152.30, 151.65, 141.95, 140.81, 132.99, 128.81,

128.38, 126.00, 114.59, 106.47, 14.53. Anal. Calcd for $C_{25}H_{21}N_5$: C, 76.01; H, 5.69; N, 17.39. Found: C, 76.70; H, 5.41; N, 17.89.



2-Bromo-6-(3,5-diphenylpyrazol-1-yl)pyridine (3g): white solid, mp 120 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95, 7.46, and 7.38 (m each, 2:2:6 H, phenyl CH), 7.70 (d), 7.61 (t), and 7.37 (d) (1:1:1 H, pyridyl CH), 6.83 (s, 1 H). ^{13}C{^{1}H} NMR (400 MHz, $CDCl_3$): δ 153.02, 152.19, 145.80, 140.22, 139.50, 132.59, 131.10, 129.14, 128.80, 128.58, 128.50, 128.16, 126.15, 116.35, 107.32. Anal. Calcd for $C_{20}H_{14}BrN_3$: C, 63.12; H, 3.75; N, 11.02. Found: C, 63.84; H, 3.79; N, 11.17.

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Supporting Information Available: NMR spectra for compounds **3b**, **3d**−**g**, **4b**, and **4d**−**f**. This material is available free of charge via the Internet at http://pubs.acs.org.

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