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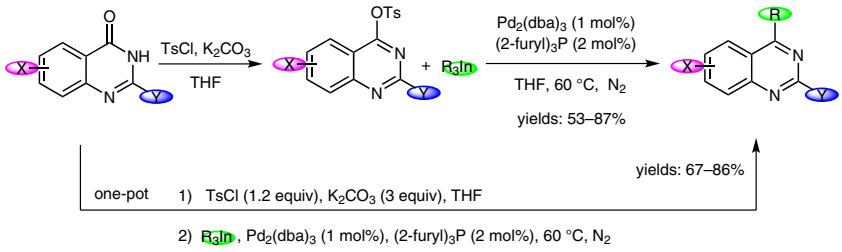
Palladium-Catalyzed Cross-Coupling of 4-Tosyloxyquinazolines with Organoindium Reagents: An Efficient Route to 4-Substituted Quinazolines

Xinglin Ye[a,b]
Jianjun Yuan[a]
Yirong Zhou[a]
Zhihong Deng[a]
Xuechun Mao[a]
Yiyuan Peng*[a]

[a] National Research Center for Carbohydrate Synthesis and Key Laboratory of Small Functional Organic Molecule, Ministry of Education, and Key Laboratory of Green Chemistry of Jiangxi Province, Nanchang, Jiangxi 330022, P. R. of China
yypeng@jxnu.edu.cn
yiyuanpeng@yahoo.com
[b] Department of Chemistry and Environmental Engineering, Jiujiang University, Jiujiang, Jiangxi, 330025, P. R. of China



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Abstract An efficient route to 4-substituted quinazolines by arylation or alkylation of quinazolinones under mild conditions is described. 4-Tosyloxyquinazolines were obtained through the reaction of quinazolinones and *p*-methylbenzenesulfonyl chloride in the presence of K_2CO_3. The cross-coupling reaction of 4-tosyloxyquinazolines with organoindium reagents, carried out in tetrahydrofuran, catalyzed by $Pd_2(dba)_3$/$(2\text{-furyl})_3P$ led to the formation of 4-functionalized quinazolines in good to excellent yields. Higher yields were obtained by the one-pot reaction of quinazolinone, *p*-methylbenzenesulfonyl chloride, $Pd_2(dba)_3$-/$(2\text{-furyl})_3P$, and organoindium reagent. These methods using organoindium compounds as coupling partners provided an efficient route to 4-(hetero)aryl/alkylquinazolines, especially 4-substituted quinazolines bearing a halogen scaffold.

Key words quinazoline, organoindium reagent, 4-tosyloxyquinazoline, 4-substituted quinazoline, cross-coupling

Quinazoline-incorporating heterocycles, which exhibit a broad range of potential biological activities and are found ubiquitously in organic and medicinal chemistry, have attracted continuous interest of synthetic chemists.[1] In particular, 4-functionalized quinazolines have been demonstrated to have anti-inflammatory, anticonvulsant, vasodilator, antihypertensive, antibiosis, and fibrinogen receptor anti-agonistic properties.[2] For example, erlotinib and gefitinib, which contain the quinazoline core with amino building blocks at the C4 position, are two anticancer drugs that have been approved by the FDA (Figure 1). Considering their potential utilization, tremendous efforts have been made to develop methodologies for the synthesis of 4-functionalized quinazoline derivatives during the past decade.[3–5]

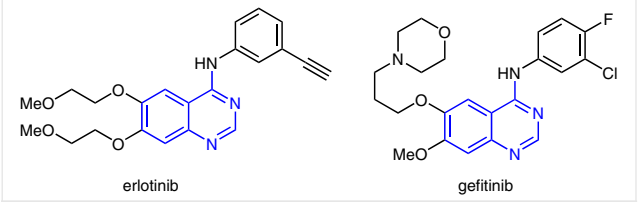
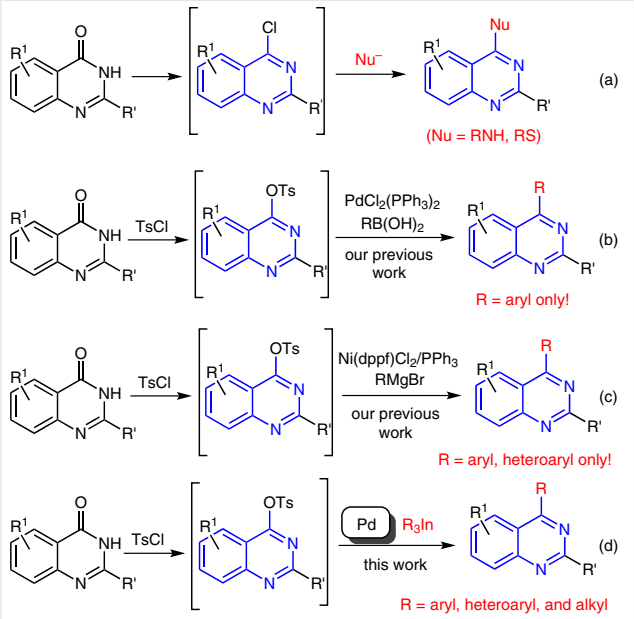


Figure 1 The structure of erlotinib and gefitinib

To date, two elegant protocols have been used to achieve C4-functionalization of quinazolines; in both cases, 4-haloquinazoline and analogues are generally used as precursors through: (a) substitution with nucleophiles (amines, thiols, etc.) to afford the corresponding 4-substituted quinazolines (Scheme 1, a);[4c–r] (b) coupling with organometallic reagents (B, Mg, etc.) to form 4-functionalized quinazoline (Scheme 1, b and c).[5]

On the other hand, the transition-metal-catalyzed cross-coupling reaction has been regarded as one of the most powerful methods for carbon–carbon and carbon–heteroatom bond formation, and this approach is employed extensively in synthetic chemistry.[6] Recently, among the organometallic reagents (Mg, B, Zn, Sn, Si, etc.) utilized in the cross-coupling reactions, organoindium compounds have attracted particular attention because of their versatile chemistry and stability in protic/aqueous conditions.[7] In our previous paper, we found that 4-tosyloxyquinazolines



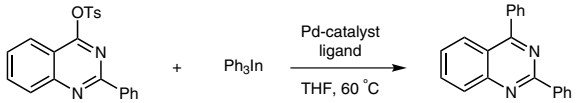
Scheme 1 Protocols for the synthesis of 4-functionalized quinazolines

could couple with boronic acids under palladium catalysis[5e] to produce 4-functionalized quinazolines. However, the scope of the reaction was limited, with only arylboronic acids being efficient reaction partners; heteroarylboronic acids and alkylboronic acids were not compatible (Scheme 1, b). More recently, we reported that 4-arylquinazolines could also be obtained by the Kumada cross-coupling reaction of 4-tosyloxyquinazolines and Grignard reagents (Scheme 1, c).[5g] However, alkyl Grignard reagents were not suitable for these reactions, in which a formal C–O bond cleavage coupling was involved.

Prompted by the advantages of organoindium compounds, and as a continuation of our interest in structural elaboration of quinazoline heterocycles and their application,[5e–g,7m,8] we investigated the coupling reactions of the 4-tosyloxyquinazolines and organoindium reagents, with the aim of providing an alternative, efficient route for the synthesis of 4-(hetero)aryl/alkylquinazolines (Scheme 1, d).

We started our studies by investigating the reaction between 2-phenyl-4-tosyloxyquinazoline (**2a)** with triphenylindium (**3a**; Table 1). When $Pd(OAc)_2$ (5 mol%) was used as palladium source and PPh_3 as the ligand, we were pleased to find that the reaction proceeded smoothly to afford the desired product **4a** in 53% yield in THF at 60 °C (entry 1). Encouraged by this result, other Pd sources and ligands were examined (entries 2–9). We found that the reaction worked efficiently with the formation of the product **4a** in 72% yield when the catalytic system comprised of $Pd_2(dba)_3/Ph_3P$ was used (entry 4). Further screenings of various ligands revealed that $(2\text{-furyl})_3P$ was the best choice (85%; entry 9). Reducing the amount of Pd catalyst to 1 mol% did not inhibit the efficiency of this transformation (84%; entry 10). Control experiments confirmed that palladium species were crucial for the reaction (entry 11). Usually, 4-tosyloxyquinazolines were derived from the reaction of quinazolinone and TsCl in the presence of K_2CO_3.[4p–r,5e–g] We envisioned that the desired product **4a** may be obtained from the one-pot reaction of quinazolinones, TsCl, K_2CO_3, and organoindium reagents under optimized conditions. Indeed, by using the one-pot strategy, the reaction produced **4a** in 83% yield (entry 12), which is higher than that of the two-step reaction.

Table 1 Influence of Reaction Conditions on the Cross-Coupling Reaction of **2a** with **3a**[a]



2a **3a** **4a**

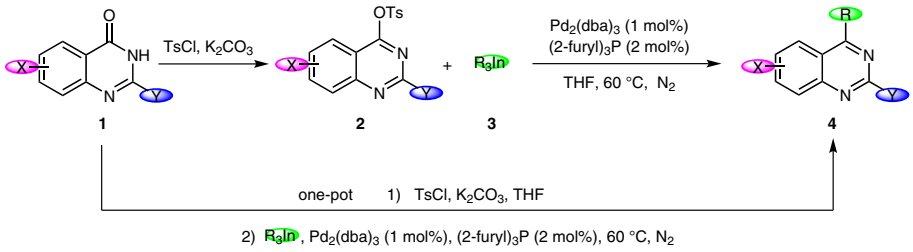
Entry	Catalyst	Time (h)	Ligand	Yield (%)[b]
1	$Pd(OAc)_2$	4.0	Ph_3P	53
2	$PdCl_2$	4.0	Ph_3P	56
3	$Pd(PhCN)_2Cl_2$	3.5	Ph_3P	60
4	$Pd_2(dba)_3$	4.0	Ph_3P	72
5	$Pd(dppf)Cl_2$	5.0	Ph_3P	67
6	$Pd_2(dba)_3$	8.0	Cy_3P	35
7	$Pd_2(dba)_3$	8.0	X-Phos	36
8	$Pd_2(dba)_3$	6.0	S-Phos	70
9	$Pd_2(dba)_3$	3.5	$(2\text{-furyl})_3P$	85
10[c]	$Pd_2(dba)_3$	4.0	$(2\text{-furyl})_3P$	84
11	–	10.0	$(2\text{-furyl})_3P$	trace
12[c]	$Pd_2(dba)_3$	5.0	$(2\text{-furyl})_3P$	83[d]

[a] Reaction conditions: **2a** (0.2 mmol), **3a** (0.22 mmol), Pd catalyst (5 mol%), ligand (10 mol%), THF (2 mL), 60 °C, under N_2.
[b] Isolated yield based on **2a**.
[c] With 1 mol% Pd catalyst and 2 mol% ligand.
[d] Isolated yield based on **1a** for one-pot reaction of quinazolinone **1a**, TsCl-K_2CO_3 (3 equiv) and triphenylindium.

Under the optimized conditions [$Pd_2(dba)_3$ (1 mol%), $(2\text{-furyl})_3P$ (2 mol%), THF, 60 °C], the scope of this Pd-catalyzed cross-coupling of 4-tosyloxyquinazolines **2** with organoindium reagents **3** was investigated (Table 2); the one-pot reactions [quinazolinone **1**, TsCl (1.2 equiv), K_2CO_3 (3.0 equiv), organoindium reagent (1.1 equiv), $Pd_2(dba)_3$ (1 mol%), $(2\text{-furyl})_3P$ (2 mol%), THF, and 60 °C] were also studied. The results are presented in Table 2. Notably, all reactions proceeded smoothly under standard conditions with good to excellent yields, and the strategy of one-pot reaction gave higher yields than those of the two-step reactions. When Y was an aryl group, quinazolinones **1** (or 4-tosyloxyquinazolines **2**) with electron-donating groups or electron-with-

drawing groups attached on Y were all good partners in this transformation (entries 1–11). For example, substrates with electron-donating substituents such as 2-(4-methyl)phenyl, 2-(3-methyl)phenyl, 2-(2-methyl)phenyl, 2-(4-methoxy)phenyl, and 2-(4-dimethylamino)phenyl substituted **1** or **2** reacted with **3a** to provide the corresponding products **4b–f** in good yields (entries 2–6). Excellent yields (83–87%) could be obtained for quinazolines bearing electron-withdrawing groups (entries 7–11).

Table 2 Palladium-Catalyzed Reactions of 4-Tosyloxyquinazolines **2** with Organoindium Reagents **3**[a]



Entry	X	Y	R	4	Yield (%)[b]
1	H	Ph	Ph (**3a**)	**4a**	84 (83)
2	H	2-MeC_6H_4	Ph (**3a**)	**4b**	81 (82)
3	H	3-MeC_6H_4	Ph (**3a**)	**4c**	78 (76)
4	H	4-MeC_6H_4	Ph (**3a**)	**4d**	83 (80)
5	H	4-$MeOC_6H_4$	Ph (**3a**)	**4e**	80 (81)
6	H	4-$Me_2NC_6H_4$	Ph (**3a**)	**4f**	83 (80)
7	H	4-ClC_6H_4	Ph (**3a**)	**4g**	83 (83)
8	H	3-ClC_6H_4	Ph (**3a**)	**4h**	84 (82)
9	H	2,5-$Cl_2C_6H_3$	Ph (**3a**)	**4i**	86 (85)
10	H	4-FC_6H_4	Ph (**3a**)	**4j**	85 (86)
11	H	4-$F_3CC_6H_4$	Ph (**3a**)	**4k**	87 (86)
12	H	2-thienyl	Ph (**3a**)	**4l**	79 (80)
13	H	propyl	Ph (**3a**)	**4m**	61 (68)
14	H	H	Ph (**3a**)	–	0
15	7-Me	4-MeC_6H_4	Ph (**3a**)	**4n**	78 (75)
16	5-F	Ph	Ph (**3a**)	**4o**	80 (78)
17	H	Ph	2-MeC_6H_4 (**3b**)	**4p**	69 (70)
18	H	4-MeC_6H_4	3-MeC_6H_4 (**3c**)	**4q**	78 (76)
19	H	Ph	4-MeC_6H_4 (**3d**)	**4r**	81 (82)
20	H	Ph	4-$MeOC_6H_4$(**3e**)	**4s**	78 (79)
21	H	Ph	4-ClC_6H_4 (**3f**)	**4t**	67 (61)
22	H	Ph	4-FC_6H_4 (**3g**)	**4u**	71 (70)
23	H	Ph	2-thienyl (**3h**)	**4v**	67 (68)
24	H	4-MeC_6H_4	2-thienyl (**3h**)	**4w**	69 (78)
25	H	2-thienyl	4-$MeOC_6H_4$ (**3e**)	**4x**	77 (73)
26	H	4-pyridyl	4-MeC_6H_4 (**3d**)	**4y**	82 (80)
27	H	Ph	*n*-pentyl (**3i**)	**4z**	71 (70)
28	H	4-MeC_6H_4	*n*-pentyl (**3i**)	**4za**	75 (73)
29	H	4-MeC_6H_4	Me (**3j**)	**4zb**	68
30	H	Ph	Et (**3k**)	**4zc**	73

Table 2 (continued)

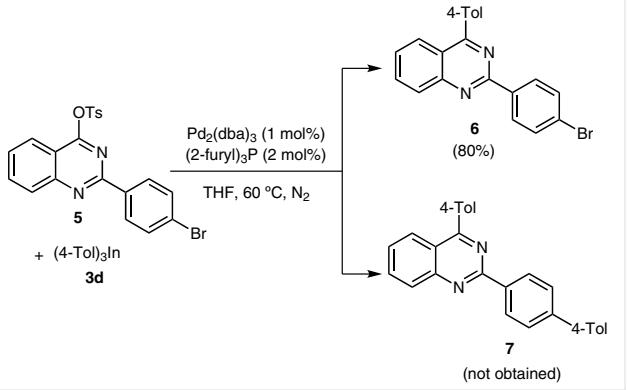
Entry	X	Y	R	4	Yield (%)[b]
31	H	Ph	isopropyl (**3m**)	**4zd**	58
32	H	Ph	cyclopropyl (**3n**)	**4ze**	63
33	H	Ph	cyclopentyl (**3o**)	**4zf**	74
34	H	Ph	(*N*-methyl)indol-2-yl (**3p**)	**4zg**	53
35	H	Ph	5-methylfuran-2-yl (**3q**)	**4zh**	73

[a] Reaction conditions: 4-tosyloxyquinazoline **2** (0.2 mmol), organoindium reagent **3** (0.22 mmol), $Pd_2(dba)_3$ (1 mol%), $(2\text{-furyl})_3P$ (2 mol%), THF (2 mL), 60 °C, 4 h, under N_2; One-pot reaction conditions: 3*H*-quinazolinone **1** (0.2 mmol), TsCl (1.2 equiv), K_2CO_3 (3.0 equiv), organoindium reagents **2** (0.22 mmol), $Pd_2(dba)_3$ (1 mol%), $(2\text{-furyl})_3P$ (2 mol%), THF (2 mL), 60 °C, 4 h, under N_2.
[b] Isolated yield based on **2**; isolated yield based on **1** in one-pot reaction is given in parentheses.

Interestingly, both a halogen atom (Table 2, entries 7–10) on the 2-aryl ring and 2-heteroaryl substituted **1** or **2** (entry 12) were tolerated in this reaction, and good yields of the expected product were obtained. The reaction gave moderate yield when Y was an alkyl group (such as propyl) (entry 13). However, no desired product was obtained when the parent quinazolinone ring (Y = H) was used (entry 14), because the reactant (4-tosyloxyquinazoline) decomposed to the corresponding quinazolinone under the reaction conditions. Finally, the electronic effect of substituents on the parent quinazoline ring was investigated; the results indicated that substrates with either electron-withdrawing or electron-donating substituents on the quinazoline core gave good yields (entries 15 and 16).

The use of a range of organoindium reagents **3b**–**q** was then explored (Table 2, entries 17–35). Arylindium reagents with electron-donating groups on the ring **3c**–**e** could be employed in the coupling reaction and gave the corresponding products in good yields (entries 18–20, 25 and 26). Slightly lower yield was obtained when 2-methylphenylindium reagent **3b** was used (entry 17). Arylindium reagents bearing a halogen atom (Cl or F) afforded the corresponding products in 67 and 71% yields, respectively (entries 21 and 22). Heteroaryl-substituted indium reagents such as **3h**, **3p**, and **3q** also worked well to generate the corresponding products in moderate yields (entries 23, 24, 34 and 35). Notably, the corresponding Suzuki coupling reaction of 4-tosyloxyquinazolines with heteroarylboronic acids do not proceed at all.[5e] Alkyl and cycloalkyl indiums **3i**–**o** were also suitable substrates in the reaction, which afforded the corresponding products **4z**–**zf** in good yields (entries 27–33). In contrast, 4-alkylquinazolines were not observed when alkyl metal reagents (such as B, Mg, Zn and Sn) were utilized in similar cross-coupling reactions.[5e,g] This is attributed to the β-hydrogen elimination of alkyl metal reagents. Therefore, the present method using organoindium compounds as coupling partners provides an especially efficient route to 4-heteroaryl and 4-alkylquinazolines.

Furthermore, the presence of a bromo functional group was also tolerated in this reaction. Thus, when substrate **5**, which contained both OTs and an aryl bromide moiety, was utilized under the standard conditions with organoindium reagent **3d**, the coupling product **6** was obtained in 80% yield. The bromo group survived this reaction, and the double-coupled product **7** was not detected (Scheme 2). This result contrasts with Kumada and Suzuki cross-coupling reactions, in which both aryl-OTs and aryl-X (Br and Cl) were coupled.[5e,g]



Scheme 2 The coupling reaction of 2-(4-bromophenyl)quinazoline with organoindium reagent

In summary, we have described an efficient synthesis of 4-substituted quinazolines through palladium-catalyzed cross-coupling reactions of 4-tosyloxyquinazolines with organoindium compounds or one-pot reaction of quinazolinones, TsCl, and organoindium compounds. This catalytic system has several advantages including mild and practical reaction conditions, low Pd-catalyst loading, good to excellent yields, and great functional group tolerance. In particular, this catalytic system can be used to produce 4-heteroaryl/4-alklylquinazolines and 4-substituted quinazolines with a halogen atom on the molecule. The efficiency

of this method, combined with the functional group tolerance, should make it attractive for the preparation of quinazoline libraries.

Unless otherwise stated, all commercial reagents were used as received. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (60 Å pore size, 32–63 μm, standard grade). Analytical thin-layer chromatography was performed using glass plates pre-coated with 0.25 mm 230–400 mesh silica gel impregnated with a fluorescent indicator (254 nm). Thin-layer chromatography plates were visualized by exposure to ultraviolet light. Organic solutions were concentrated with rotary evaporators at ca. 20 Torr at 25–35 °C. NMR spectra are recorded in parts per million from internal tetramethylsilane on the δ scale. ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ with a Bruker DRX-400 spectrometer operating at 400 and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants are quoted in Hz. High-resolution mass spectrometry (HRMS) spectra were obtained with a micrOTOF II Instrument.

Two-Step Synthesis of 4; General Procedure

4-Tosyloxyquinazoline derivatives **2** were obtained by using our reported method.[5e] A solution of quinazolin-4-ones **1** (0.2 mmol) in THF (2 mL) was treated with TsCl (1.2 equiv) and K_2CO_3 (3.0 equiv) at 60 °C. Upon completion of the reaction as indicated by TLC, the solvent was evaporated and the residue was purified on silica gel to give product **2**.

To a mixture of 4-tosyloxyquinazoline **2** (0.20 mmol) and organoindium reagent[9] **3** (1.0 equiv) in anhydrous THF (2.0 mL), $Pd_2(dba)_3$ (1 mol %) and $(2\text{-furyl})_3P$ (2 mol%) were added. The mixture was stirred and heated at 60 °C under N_2. Upon completion of the reaction as indicated by TLC, the solvent was evaporated. The residue was then diluted with EtOAc (10 mL), washed with H_2O (10 mL), and dried with anhydrous $MgSO_4$. Evaporation of the solvent followed by purification on silica gel (PE–EtOAc, 50:1 to 20:1) provided the corresponding product **4**.

One-Pot Synthesis of 4; General Procedure

A solution of quinazolin-4-one **1** (0.2 mmol) in anhydrous THF (2 mL) was treated with TsCl (1.2 equiv) and K_2CO_3 (3.0 equiv) at 60 °C. After 60 min, organoindium reagent **3** (1.1 equiv), $Pd_2(dba)_3$ (1 mol%), and $(2\text{-furyl})_3P$ (2 mol%) were added under N_2 atmosphere. Upon completion of the reaction as indicated by TLC, the solvent was evaporated. The residue was then diluted with EtOAc (10 mL), washed with H_2O (10 mL), and dried with anhydrous $MgSO_4$. Evaporation of the solvent followed by purification on silica gel (PE–EtOAc, 50:1 to 20:1) provided the corresponding product **4**.

Yields reported below are for the two-step procedure and are based on the amount of compound **2** used in the second step.

2,4-Diphenylquinazoline (4a)[4b]

Yield: 47.4 mg (84%); white solid; mp 122–123 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.52–7.61 (m, 7 H), 7.87–7.91 (m, 3 H), 8.15 (t, *J* = 8.4 Hz, 2 H), 8.69 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 121.7, 126.9, 127.1, 128.4, 128.6, 128.7, 129.2, 129.9, 130.2, 130.5, 133.6, 137.7, 138.2, 152.0, 160.3, 168.3.

2-*o*-Tolyl-4-phenylquinazoline (4b)[4b]

Yield: 47.9 mg (81%); white solid; mp 72–74 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.67 (s, 3 H, CH_3), 7.34–7.57 (m, 3 H), 7.58–7.62 (m, 4 H), 7.86–7.99 (m, 4 H), 8.16 (d, *J* = 8.8 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.3, 121.0, 126.1, 127.0, 127.3, 128.6, 129.2, 129.9, 130.0, 130.2, 130.8, 131.3, 133.6, 137.4, 137.5, 138.8, 151.7, 163.4, 168.1.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{21}H_{16}N_2Na$: 319.1211; found: 319.1207.

2-*m*-Tolyl-4-phenylquinazoline (4c)[4b]

Yield: 46.2 mg (78%); white solid; mp 115–117 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.49 (s, 3 H, CH_3), 7.31–7.33 (m, 1 H), 7.41–7.44 (m, 1 H), 7.53–7.60 (m, 4 H), 7.87–7.89 (m, 3 H), 8.11–8.17 (m, 2 H), 8.48 (d, *J* = 7.6 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.7, 121.8, 126.0, 127.1, 127.2, 128.6, 128.7, 129.2, 129.3, 130.0, 130.3, 131.5, 133.7, 137.8, 138.3, 152.1, 160.5, 168.4.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{21}H_{16}N_2Na$: 319.1211; found: 319.1232.

2-*p*-Tolyl-4-phenylquinazoline (4d)[5e]

Yield: 49.2 mg (83%); white solid; mp 189–190 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.44 (s, 3 H, CH_3), 7.33 (d, *J* = 8.0 Hz, 2 H, ArH), 7.51–7.60 (m, 4 H, ArH), 7.84–7.89 (m, 3 H, ArH), 8.12 (t, *J* = 8.8 Hz, 2 H, ArH), 8.58 (d, *J* = 8.0 Hz, 2 H, ArH).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.6, 121.6, 126.7, 127.0, 128.5, 128.7, 129.1, 129.3, 129.9, 130.2, 133.5, 135.5, 137.8, 140.7, 152.0, 160.4, 168.2.

2-(4-Methoxylphenyl)-4-phenylquinazoline (4e)[5e]

Yield: 50.0 mg (80%); white solid; mp 158–160 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.90 (s, 3 H, OCH_3), 7.03 (d, *J* = 8.8 Hz, 2 H), 7.49 (t, *J* = 8.0 Hz, 1 H), 7.57–7.60 (m, 3 H), 7.85–7.89 (m, 3 H), 8.11 (t, *J* = 7.6 Hz, 2 H), 8.65 (d, *J* = 8.8 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 55.4, 113.8, 121.4, 126.5, 127.0, 128.5, 128.9, 129.9, 130.2, 130.4, 130.9, 133.4, 137.8, 152.1, 160.1, 161.8, 168.2.

2-(4-*N*,*N*-Dimethylaminophenyl)-4-phenylquinazoline (4f)

Yield: 54.0 mg (83%); brown solid; mp 177–179 °C.

IR (KBr): 3052, 2954, 1602, 1529, 1482, 1370, 1173, 946, 777, 702 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.05 (s, 6 H, $N(CH_3)_2$), 6.81 (d, *J* = 8.8 Hz, 2 H), 7.43 (t, *J* = 7.6 Hz, 1 H), 7.54–7.57 (m, 3 H), 7.79–7.82 (m, 1 H), 7.86–7.88 (m, 2 H), 8.03–8.09 (m, 2 H), 8.59 (d, *J* = 8.8 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 40.3, 111.7, 121.2, 125.8, 125.9, 127.0, 128.4, 128.5, 128.7, 129.7, 130.0, 130.2, 133.3, 138.0, 152.2, 160.7, 168.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{20}N_3$: 326.1657; found: 326.1663.

2-(4-Chlorophenyl)-4-phenylquinazoline (4g)[4b]

Yield: 52.6 mg (83%); light-yellow solid; mp 190–192 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.48–7.61 (m, 6 H), 7.87–7.92 (m, 3 H), 8.12–8.16 (m, 2 H), 8.64 (d, *J* = 7.6 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 121.7, 127.1, 127.2, 127.3, 128.5, 128.7, 128.8, 129.1, 129.9, 130.2, 133.7, 136.7, 137.5, 151.9, 159.2, 168.5.

2-(3-Chlorophenyl)-4-phenylquinazoline (4h)

Yield: 53.2 mg (84%); yellow solid; mp 168–170 °C.

IR (KBr): 3064, 1563, 1487, 1390, 1341, 778 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.45–7.47 (m, 2 H), 7.55–7.61 (m, 4 H), 7.87–7.92 (m, 3 H), 8.13–8.18 (m, 2 H), 8.58–8.61 (m, 1 H), 8.70 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 120.9, 125.8, 126.1, 126.4, 127.6, 127.7, 128.2, 128.7, 129.1, 129.2, 129.5, 132.7, 133.7, 136.5, 139.1, 150.9, 157.9, 167.5.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{14}ClN_2$: 317.0846; found: 317.0848.

2-(2,5-Dichlorophenyl)-4-phenylquinazoline (4i)

Yield: 60.4 mg (86%); yellow solid; mp 177–179 °C.

IR (KBr): 3063, 1724, 1557, 1387, 1334, 732 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.32 (d, *J* = 6.4 Hz, 1 H), 7.42 (d, *J* = 8.4 Hz, 1 H), 7.54–7.55 (m, 3 H), 7.61 (t, *J* = 8.0, 7.2 Hz, 1 H), 7.83–7.93 (m, 4 H), 8.15 (d, *J* = 8.8 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 121.5, 127.1, 127.6, 128.1, 128.6, 129.2, 130.1, 130.2, 131.6, 131.7, 131.8, 132.8, 133.9, 137.1, 139.7, 151.6, 160.1, 168.5.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{13}Cl_2N_2$: 351.0456; found: 351.0458.

2-(4-Fluorophenyl)-4-phenylquinazoline (4j)[4b]

Yield: 51.1 mg (85%); white solid; mp 153–157 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.17–7.21 (m, 2 H), 7.52–7.62 (m, 4 H), 7.86–7.90 (m, 3 H), 8.12 (d, *J* = 4.0 Hz, 2 H), 8.70 (dd, *J* = 5.6, 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 115.4 (d, $^2J_{C-F}$ = 20.0 Hz), 121.6, 126.9 (d, $^3J_{C-F}$ = 12.0 Hz), 128.6, 129.1, 130.0, 130.2, 130.7, 130.9, 133.6, 134.4, 137.6, 152.0, 159.3, 163.4 (d, $^1J_{C-F}$ = 248.0 Hz), 168.4.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{20}H_{13}FN_2Na$: 323.0960; found: 323.0983.

2-(4-Trifluoromethylphenyl)-4-phenylquinazoline (4k)[4b]

Yield: 60.9 mg (87%); white solid; mp 123–126 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.60–7.62 (m, 4 H), 7.76–7.78 (m, 2 H), 7.88–7.94 (m, 3 H), 8.17 (t, *J* = 7.6 Hz, 2 H), 8.81 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 120.9, 121.9, 124.4, 126.1, 126.6, 127.6, 127.9, 128.2, 129.1, 131.5 (q, J_{C-F} = 32.0 Hz), 132.8, 136.3, 140.5, 150.8, 157.7, 167.5.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{21}H_{13}F_3N_2Na$: 373.0929; found: 373.0957.

2-(Thiophen-2-yl)-4-phenylquinazoline (4l)

Yield: 45.6 mg (79%); white solid; mp 156–158 °C.

IR (KBr): 3046, 1611, 1540, 1454, 1387, 772 cm^{-1}.

^{1}HNMR (400 MHz, $CDCl_3$): δ = 7.10 (s, 1 H), 7.45–7.49 (m, 2 H), 7.53–7.60 (m, 3 H), 7.80–7.84 (m, 3 H), 8.04 (d, *J* = 8.4 Hz, 2 H), 8.19 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 121.6, 126.7, 127.2, 128.3, 128.5, 128.7, 129.4, 129.9, 130.0, 130.2, 133.8, 137.3, 144.2, 151.8, 157.2, 168.5.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{18}H_{12}N_2SNa$: 311.0619; found: 311.0626.

2-Propyl-4-phenylquinazoline (4m)[5e]

Yield: 30.3 mg (61%); white solid; mp 108–109 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.07 (t, *J* = 7.4 Hz, 3 H), 1.97–2.03 (m, 2 H), 3.16 (t, *J* = 7.8 Hz, 2 H), 7.49–7.56 (m, 4 H), 7.75–7.77 (m, 2 H), 7.85 (t, *J* = 7.8 Hz, 1 H), 8.03 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.1, 22.4, 42.0, 121.2, 126.7, 127.0, 128.4, 128.6, 129.8, 129.9, 133.5, 137.5, 151.4, 167.1, 168.5.

7-Methyl-4-phenyl-2-(*p*-tolyl)quinazoline (4n)

Yield: 48.4 mg (78%); white solid; mp 202–204 °C.

IR (KBr): 3062, 2959, 1622, 1535, 1488, 1342, 1171, 795, 774, 694 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.44 (s, 3 H, CH_3), 2.60 (s, 3 H, CH_3), 7.31–7.36 (m, 3 H), 7.58–7.59 (m, 3 H), 7.87–7.89 (m, 2 H), 7.92 (s, 1 H), 8.00 (d, *J* = 7.6 Hz, 1 H), 8.57 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.5, 21.1, 118.7, 125.7, 126.9, 127.4, 127.5, 128.0, 128.2, 128.8, 129.1, 134.5, 136.8, 139.6, 143.4, 151.2, 159.4, 166.7.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{19}N_2$: 311.1548; found: 311.1549.

5-Fluoro-2,4-diphenylquinazoline (4o)[5e]

Yield: 48.0 mg (80%); white solid; mp 149–150 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.17–7.20 (m, 1 H), 7.52–7.55 (m, 6 H), 7.76–7.78 (m, 2 H), 7.81–7.86 (m, 1 H), 7.98 (d, *J* = 8.4 Hz, 1 H), 8.67–8.69 (m, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 112.2 (d, $^2J_{C-F}$ = 22.0 Hz), 112.6 (d, $^3J_{C-F}$ = 12.0 Hz), 125.4 (d,$^5J_{C-F}$ = 2.0 Hz), 127.9, 128.6, 128.8 (d, $^3J_{C-F}$ = 11.0 Hz), 129.3, 129.4 (d, $^2J_{C-F}$ = 27.0 Hz), 130.9, 133.6 (d, $^3J_{C-F}$ = 9.0 Hz), 137.5, 140.2 (d, $^4J_{C-F}$ = 3.0 Hz), 153.4, 156.7 (d, $^1J_{C-F}$ = 259.0 Hz), 160.3, 166.0 (d, $^4J_{C-F}$ = 4.0 Hz).

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{20}H_{13}FN_2Na$: 323.0960; found: 323.0983.

2-Phenyl-4-(*o*-tolyl)quinazoline (4p)

Yield: 40.9 mg (69%); white solid; mp 143–145 °C.

IR (KBr): 3061, 2957, 1605, 1567, 1540, 1385, 1337, 1258, 1025, 776 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.24 (s, 3 H, CH_3), 7.39–7.53 (m, 8 H), 7.69 (d, *J* = 8.4 Hz, 1 H), 7.88 (t, *J* = 7.6 Hz, 1 H), 8.16 (d, *J* = 8.4 Hz, 1 H), 8.66 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 19.0, 121.6, 124.6, 126.0, 126.1, 127.5, 127.7, 128.0, 128.2, 128.6, 129.5, 129.7, 132.7, 135.4, 135.9, 137.2, 150.4, 159.3, 168.8.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{21}H_{16}N_2Na$: 319.1211; found: 319.1224.

4-(*m*-Tolyl)-2-(*p*-tolyl)quinazoline (4q)

Yield: 48.4 mg (78%); white solid; mp 156–158 °C.

IR (KBr): 1565, 1375, 1174, 730 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.32 (s, 3 H), 2.37 (s, 3 H), 7.20–7.27 (m, 3 H), 7.32–7.38 (m, 2 H), 7.52–7.57 (m, 2 H), 7.71 (t, *J* = 7.6 Hz, 1 H), 7.95–8.01 (m, 2 H), 8.48 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.52, 20.53, 120.7, 125.7, 126.1, 126.3, 127.3, 127.7, 128.0, 128.3, 129.6, 129.7, 132.4, 134.6, 136.7, 137.3, 139.6, 150.9, 159.3, 167.4.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{22}H_{18}N_2Na$: 333.1368; found: 333.1379.

2-Phenyl-4-(*p*-tolyl)quinazoline (4r)[4b]

Yield: 48.0 mg (81%); white solid; mp 123–124 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.49 (s, 3 H, CH_3), 7.40 (d, *J* = 7.6 Hz, 2 H), 7.49–7.55 (m, 4 H), 7.80 (d, *J* = 8.0 Hz, 2 H), 7.84–7.88 (m, 1 H), 8.14 (d, *J* = 8.8 Hz, 2 H), 8.69 (d, *J* = 7.6 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.4, 120.6, 125.8, 126.0, 127.5, 127.7, 128.1, 128.2, 129.2, 129.4, 132.4, 133.8, 137.2, 139.1, 150.9, 159.2, 167.2.

4-(4-Methoxyphenyl)-2-phenylquinazoline (4s)[5e]

Yield: 48.7 mg (78%); white solid; mp 141–142 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.86 (s, 3 H, OCH_3), 7.05 (d, *J* = 8.0 Hz, 2 H), 7.42–7.50 (m, 4 H), 7.78–7.84 (m, 3 H), 8.06–8.12 (m, 2 H), 8.62 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 55.5, 114.0, 121.7, 126.8, 127.1, 128.5, 128.7, 129.2, 130.2, 130.4, 131.9, 133.4, 138.3, 152.1, 160.2, 161.3, 167.7.

4-(4-Chlorophenyl)-2-phenylquinazoline (4t)[5e]

Yield: 42.5 mg (67%); white solid; mp 139–140 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.50–7.59 (m, 6 H), 7.83–7.91 (m,3 H), 8.06 (d, *J* = 8.0 Hz, 1 H), 8.15 (d, *J* = 8.0 Hz, 1 H), 8.66 (d, *J* = 7.2 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 121.6, 126.7, 127.4, 128.7, 128.8, 129.0, 129.5, 130.8, 131.7, 133.9, 136.2, 136.4, 138.2, 152.2, 160.4, 167.2.

4-(4-Fluorophenyl)-2-phenylquinazoline (4u)[4b]

Yield: 42.6 mg (71%); white solid; mp 144–146 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.28–7.32 (m, 2 H), 7.52–7.57 (m, 4 H), 7.89–7.93 (m, 3 H), 8.10 (d, *J* = 8.4 Hz, 1 H), 8.17 (d, *J* = 8.4 Hz, 1 H), 8.68 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 115.5 (d, $^2J_{C-F}$ = 22.0 Hz), 121.6, 126.7, 127.1, 128.6, 128.8, 129.3, 130.6, 132.2 (d, $^3J_{C-F}$ = 9.0 Hz), 133.6, 133.8 (d, $^4J_{C-F}$ = 3.0 Hz), 138.1, 152.1, 160.2, 162.7 (d, ^1J = 249.0 Hz), 167.2.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{20}H_{13}FN_2Na$: 323.0960; found: 323.0957.

2-Phenyl-4-(thiophen-2-yl)quinazoline (4v)

Yield: 38.6 mg (67%); white solid; mp 112–114 °C.

IR (KBr): 3069, 2956, 1560, 1488, 1337, 1260, 1028, 953, 731, 700 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.27–7.29 (m, 1 H), 7.51–7.67 (m, 5 H), 7.87–7.93 (m, 2 H), 8.13 (d, *J* = 8.4 Hz, 1 H), 8.50 (d, *J* = 8.4 Hz, 1 H), 8.69 (d, *J* = 7.6 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 120.6, 126.0, 127.4, 128.2, 128.6, 129.4, 130.4, 130.5, 130.6, 131.1, 133.6, 137.9, 142.0, 152.5, 160.0, 160.4.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{18}H_{13}N_2S$: 289.0799; found: 289.0812.

4-(Thiophen-2-yl)-2-(*p*-tolyl)quinazoline (4w)

Yield: 41.3 mg (69%); white solid; mp 162–164 °C.

IR (KBr): 3066, 2955, 1534, 1428, 1337, 733, 672 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.45 (s, 3 H, CH_3), 7.28 (t, *J* = 8.8 Hz, 1 H), 7.34 (d, *J* = 7.2 Hz, 2 H), 7.57–7.67 (m, 2 H), 7.86–7.91 (m, 2 H), 8.11 (d, *J* = 8.4 Hz, 1 H), 8.48 (d, *J* = 8.4 Hz, 1 H), 8.57 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.6, 120.5, 126.0, 127.2, 128.1, 128.2, 128.5, 129.4, 130.4, 131.0, 133.5, 135.2, 140.8, 142.1, 152.5, 160.1, 160.3.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{19}H_{15}N_2S$: 303.0956; found: 303.0966.

4-(4-Methoxyphenyl)-2-(thiophen-2-yl)quinazoline (4x)

Yield: 49.0 mg (77%); yellow solid; mp 189–190 °C.

IR (KBr): 2929, 1727, 1610, 1386, 1339, 1265, 1032, 723 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.90 (s, 3 H), 7.08 (d, *J* = 8.8 Hz, 2 H), 7.16–7.18 (m, 1 H), 7.46–7.50 (m, 2 H), 7.80–7.86 (m, 3 H), 8.04 (d, *J* = 8.4 Hz, 1 H), 8.10 (d, *J* = 8.4 Hz, 1 H), 8.20 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 55.5, 114.0, 121.5, 126.6, 127.2, 128.2, 128.7, 128.9, 129.2, 129.7, 131.9, 133.6, 144.3, 151.9, 157.1, 161.4, 167.8.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{19}H_{14}N_2OSNa$: 341.0725; found: 341.0738.

2-(Pyridin-4-yl)-4-(*p*-tolyl)quinazoline (4y)

Yield: 48.8 mg (82%); white solid; mp 177–178 °C.

IR (KBr): 2853, 1530, 1388, 1349, 797, 733 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.50 (s, 3 H), 7.40 (d, *J* = 8.0 Hz, 2 H), 7.60 (t, *J* = 7.6 Hz, 1 H), 7.78 (d, *J* = 8.0 Hz, 2 H), 7.91 (t, *J* = 7.0 Hz, 1 H), 8.17 (t, *J* = 8.0 Hz, 2 H), 8.52 (d, *J* = 6.0 Hz, 2 H), 8.79 (s, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.5, 122.3, 122.6, 127.2, 127.9, 129.4, 130.2, 130.3, 133.8, 134.5, 140.6, 145.8, 150.3, 151.8, 158.0, 168.7.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{20}H_{15}N_3Na$: 320.1164; found: 320.1160.

4-Pentyl-2-phenylquinazoline (4z)

Yield: 39.2 mg (71%); yellow liquid.

IR (KBr): 2925, 1548, 1383, 1343, 1081, 708 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94 (t, *J* = 7.0 Hz, 3 H), 1.41–1.52 (m, 4 H), 1.95–2.02 (m, 2 H), 3.32 (t, *J* = 7.8 Hz, 2 H), 7.48–7.58 (m, 4 H), 7.84 (t, *J* = 8.0 Hz, 1 H), 8.06–8.12 (m, 2 H), 8.63 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.2, 22.7, 28.4, 32.0, 34.7, 122.7, 124.8, 126.8, 128.65, 128.7, 129.5, 130.5, 133.4, 138.6, 150.8, 160.2, 171.7.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{19}H_{21}N_2$: 277.1705; found: 277.1719.

4-Pentyl-2-(*p*-tolyl)quinazoline (4za)

Yield: 43.6 mg (75%); yellow liquid.

IR (KBr): 2852, 1570, 1546, 1454, 1340, 1351, 725 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.94 (t, *J* = 7.0 Hz, 3 H), 1.40–1.51 (m, 4 H), 1.94–2.01 (m, 2 H), 2.44 (s, 3 H), 3.30 (t, *J* = 7.6 Hz, 2 H), 7.32 (d, *J* = 8.0 Hz, 2 H), 7.53 (t, *J* = 8.2 Hz, 1 H), 7.82 (t, *J* = 7.6 Hz, 1 H), 8.04–8.10 (m, 2 H), 8.52 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.2, 21.7, 22.7, 28.4, 32.0, 34.7, 122.6, 124.7, 126.6, 128.6, 128.7, 129.4, 133.3, 135.9, 140.6, 150.9, 160.3, 171.5.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{23}N_2$: 291.1861; found: 291.1878.

2-(4-Bromophenyl)-4-(*p*-tolyl)quinazoline (6)

Yield: 60.0 mg (80%); white solid; mp 186–188 °C.

IR (KBr): 2920, 1728, 1614, 1536, 1340, 1166, 799 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 2.49 (s, 3 H), 7.38 (d, *J* = 8.0 Hz, 2 H), 7.53 (t, *J* = 7.6 Hz, 1 H), 7.62 (d, *J* = 8.4 Hz, 2 H), 7.76 (d, *J* = 8.0 Hz, 2 H), 7.86 (t, *J* = 8.0, 7.2 Hz, 1 H), 8.09–8.13 (m, 2 H), 8.55 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.5, 121.8, 125.2, 127.1, 128.9, 129.1, 129.3, 130.2, 130.3, 131.7, 133.6, 134.7, 137.3, 140.3, 151.9, 159.3, 168.4.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{21}H_{15}BrN_2Na$: 397.0316; found: 397.0322.

4-Methyl-2-(*p*-tolyl)quinazoline (4zb)[5h]

Yield: 31.8 mg (68%); yellow solid; mp 99–101 °C.

^1H NMR (400 MHz, $CDCl_3$): δ = 2.37 (s, 3 H), 2.93 (s, 3 H), 7.24 (d, *J* = 8.0 Hz, 2 H), 7.47–7.50 (m, 1 H), 7.77 (ddd, *J* = 8.0, 7.6, 1.4 Hz, 1 H), 7.97–8.01 (m, 2 H), 8.43 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.5, 22.0, 123.0, 125.0, 126.6, 128.5, 129.2, 129.3, 133.4, 135.6, 140.6, 150.5, 160.3, 168.1.

4-Ethyl-2-phenylquinazoline (4zc)[5i]

Yield: 34.2 mg (73%); white liquid; mp 44–46 °C.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.53 (t, *J* = 7.2 Hz, 3 H), 3.37 (q, *J* = 7.5 Hz, 2 H), 7.48–7.56 (m, 4 H), 7.81–7.85 (m, 1 H), 8.06–8.10 (m, 2 H), 8.64–8.67 (m, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.3, 26.7, 121.3, 123.4, 125.7, 127.5, 127.6, 128.4, 129.3, 132.2, 137.5, 149.6, 159.1, 171.0.

4-Isopropyl-2-phenylquinazoline (4zd)[4b]

Yield: 28.8 mg (58%); white solid; mp 64–66 °C.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.50 (d, *J* = 6.8 Hz, 6 H), 3.91–3.98 (m, 1 H), 7.48–7.57 (m, 4 H), 7.81–7.85 (m, 1 H), 8.07–8.09 (m, 1 H), 8.13–8.15 (m, 1 H), 8.67–8.70 (m, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 30.2, 120.7, 123.1, 125.6, 127.4, 127.6, 128.6, 129.3, 132.0, 137.6, 150.0, 159.0, 174.4.

4-Cyclopropyl-2-phenylquinazoline (4ze)[4b]

Yield: 31.0 mg (63%); white solid; mp 103–105 °C.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.23–1.27 (m, 2 H), 1.51–1.56 (m, 2 H), 2.73–2.82 (m, 1 H), 7.44–7.59 (m, 4 H), 7.82–7.85 (m, 1 H), 8.04 (d, *J* = 8.4 Hz, 1 H), 8.27 (d, *J* = 8.4 Hz, 1 H), 8.58–8.60 (m, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.0, 11.9, 122.0, 123.3, 125.6, 127.37, 127.4, 128.3, 129.2, 132.2, 137.5, 149.4, 158.9, 171.0.

4-Cyclopentyl-2-phenylquinazoline (4zf)[4b]

Yield: 40.6 mg (74%); white solid; mp 79–81 °C.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.78–1.82 (m, 2 H), 1.92–2.01 (m, 2 H), 2.15–2.22 (m, 4 H), 4.01–4.08 (m,1 H), 7.47–7.55 (m, 4 H),7.79–7.83 (m, 1 H), 8.05 (d, *J* = 8.4 Hz, 1 H), 8.13–8.15 (m, 1 H), 8.66–8.68 (m, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 25.3, 31.6, 41.5, 121.5, 123.6, 125.5, 127.4, 127.6, 128.4, 129.3, 132.0, 137.6, 149.8, 158.8, 173.3.

4-(1-Methyl-1*H*-indol-2-yl)-2-phenylquinazoline (4zg)

Yield: 35.5 mg (53%); yellow solid; mp 165–167 °C.

IR (KBr): 1697, 1563, 1538, 1321, 773 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 4.12 (s, 3 H), 7.08 (s, 1 H), 7.21 (t, *J* = 8.0 Hz, 1 H), 7.39 (t, *J* = 8.0 Hz, 1 H), 7.51–7.61 (m, 5 H), 7.73 (d, *J* = 8.0 Hz, 1 H), 7.90 (t, *J* = 8.0 Hz, 1 H), 8.14 (d, *J* = 8.4 Hz, 1 H), 8.45 (d, *J* = 8.4 Hz, 1 H), 8.67 (d, *J* = 9.2 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 31.9, 109.4, 110.1, 120.4, 121.6, 122.7, 123.9, 127.2, 127.30, 127.34, 128.59, 128.6, 129.2, 130.6, 133.7, 134.5, 138.2, 139.3, 152.3, 159.7, 160.3.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{23}H_{18}N_3$: 336.1501; found: 336.1512.

4-(5-Methylfuran-2-yl)-2-(*p*-tolyl)quinazoline (4zh)

Yield: 43.8 mg (73%); yellow solid; mp 92–94 °C.

IR (KBr): 1579, 1379, 1330, 1508, 1021, 796 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3 H), 2.33 (s, 3 H), 6.09–6.10 (m, 1 H), 7.18 (d, *J* = 8.0 Hz, 2 H), 7.34–7.38 (m, 1 H), 7.43 (d, *J* = 3.2 Hz, 1 H), 7.61–7.65 (m, 1 H), 7.87 (d, *J* = 8.4 Hz, 1 H), 8.42 (d, *J* = 8.4 Hz, 2 H), 8.69 (d, *J* = 8.4 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.2, 20.4, 107.9, 116.3, 118.3, 125.6, 125.7, 127.4, 127.9, 128.1, 132.1, 134.5, 139.4, 151.5, 151.6, 153.8, 155.3, 159.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{17}N_2O$: 301.1341; found: 301.1340.

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Supporting Information

Supporting information for this article is available online at http://dx.doi.org/10.1055/s-0035-1562504.

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