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Controllable Site-Selective Construction of 2- and 4-Substituted Pyrimido[1,2-*b*]indazole from 3-Aminoindazoles and Ynals

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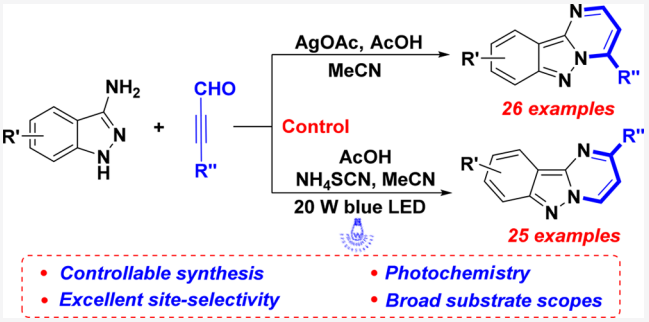
ABSTRACT: A straightforward and novel controllable site-selective construction of 2- and 4-substituted pyrimido[1,2-*b*]indazole from 3-aminoindazoles and ynals has been developed. The high regioselectivity of this reaction could be easily switched by converting different catalytic systems. In this way, a series of 2- and 4-substituted pyrimido[1,2-*b*]indazole derivatives were obtained in moderate to good yields. In addition, the photophysical properties of compound **3a** prepared by the present method were discussed.

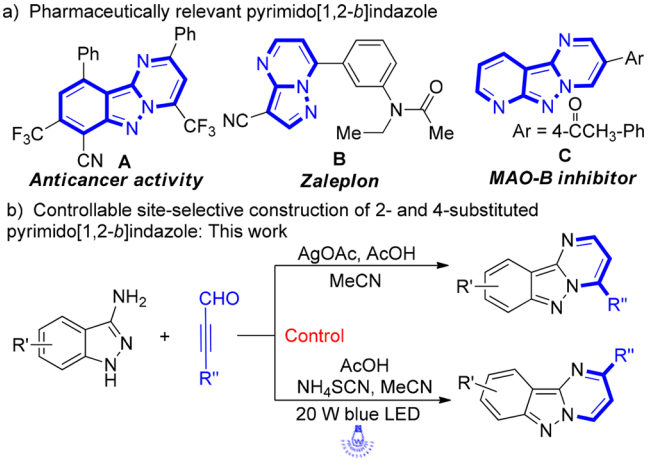


INTRODUCTION

Fused nitrogen tricyclic aromatic compounds are one of the privileged core skeletons with highly significant applications in biochemistry and pharmaceutical industry.[1,2] In particular, pyrimido[1,2-*b*]indazoles as nitrogen-rich tricyclic structural frameworks have exhibited prominent bioactivity against some diseases.[3−5] As shown in Scheme 1a, compound **A** shows anticancer activity against A-549 cell lines.[5a] Compound **B** is the commercial drug zaleplon, which has hypnotic and sedative effects in the treatment of insomnia.[5b] Compound **C** displays good anti-MAO-B activity as a competitive MAO-B inhibitor.[5c] Unfortunately, few efforts have been devoted to the development of efficient access to these compounds. Recently, the condensation of 3-aminoindazoles with carbonyl compounds was demonstrated to be an effective approach to synthesize pyrimido[1,2-*b*]indazoles derivatives.[6,7] For example, Song's group developed a Lewis acid promoted condensation of 3-aminoindazoles with 3-ethoxycyclobutanones[7a] and Gao's group discovered a NH_4I-mediated three-component reaction of 3-aminoindazoles, aromatic aldehydes, and ethyl amines.[7b] However, these tactics only produce 4-substituted pyrimido-[1,2-*b*]indazoles. The site-selective construction of 4- and 2-substituted pyrimido[1,2-*b*]indazoles from 3-aminoindazoles and carbonyl compounds by simply switching the catalytic system was rarely reported. Therefore, the development of an efficient and chemoselective strategy for the preparation of diverse pyrimido[1,2-*b*]indazoles derivatives is highly desirable.

Visible-light photocatalysis has emerged as an attractive research forefront in organic chemistry.[8] In particular, it has found widespread utility in the building of *N*-heterocycles.[9] In addition, ynals are important synthons for the synthesis of complex molecules.[10] Over the past few years, our group has successfully built various *N*-heterocycles from ynals.[11] As part of our continuing interest, we herein report our latest discovery that 4-substituted pyrimido[1,2-*b*]indazoles were efficiently obtained from 3-aminoindazoles and ynals with a Ag-catalyzed system, while 2-substituted pyrimido[1,2-*b*]indazoles were produced under 20 W blue LED irradiation (Scheme 1b).

Scheme 1. Site-Selective Construction of 2- and 4-Substituted Pyrimido[1,2-*b*]indazoles



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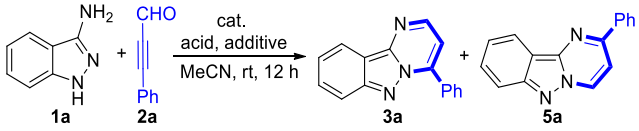
RESULTS AND DISCUSSION

Initially, we optimized the reaction conditions with 3-aminoindazole **1a** and 3-phenylpropiolaldehyde **2a** as model substrates (Table 1). Cyclization between **1a** and **2a** was not

Table 1. Optimization of Reaction Conditions[a]



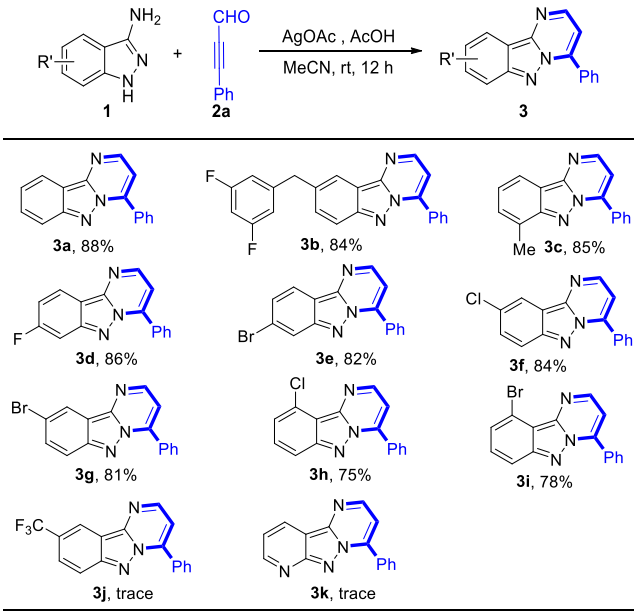
entry	catalyst	additive	yield of **3a**[b] (%)	yield of **5a**[b] (%)
1			nd	nd
2	AgOAc		68	nd
3	AgOAc	Na_2CO_3	65	nd
4	AgOAc	K_2CO_3	66	nd
5	AgOAc	AcOH	88	nd
6[c]		AcOH	21	<10
7[c]		AcOH + NH_4Cl	20	<10
8[c]		AcOH + PPh_3	14	<10
9[c]		AcOH + NH_4SCN	12	68
10[c]		PivOH + NH_4SCN	14	65
11[c]		TFA + NH_4SCN	15	45
12[c]		$BF_3{\cdot}OEt_2$ + NH_4SCN	14	64
13		AcOH+NH_4SCN	15	trace
14[c]		NH_4SCN	10	36

[a]Standard conditions: **1a** (0.3 mmol), **2a** (0.3 mmol), catalyst (3 mol %), additive (0.3 mmol), respectively, solvent (2 mL), rt, 12 h. [b]Isolated yield. [c]Irradiation with a 20 W blue LED.

achieved in the absence of any catalyst or additive (entry 1). When the catalyst AgOAc was added to the reaction, a single desired cyclization product **3a** was obtained in 68% yield (entry 2). Then the additives were evaluated. When we adopted Na_2CO_3, K_2CO_3, or AcOH as the additive, the reaction proceeded and AcOH gave the best results, in which the yield was up to 88% (entries 3−5). Interestingly, changing the metal catalyst to a photochemical system, such as irradiation with visible light, gave both the product **3a** (21%) and its isomer **5a**, though the yield of isomer **5a** is low (entry 6). Encouraged by this observation, we turned our attention to optimize photochemical conditions to produce **5a**. Under the irradiation with a 20 W blue LED, different additives were investigated. It was found that both **3a** and **5a** were formed with low yields (entries 7 and 8). When the combinations of AcOH and NH_4SCN were added, the expected product **5a** was obtained in 68% yield (entry 9). Next, we screened a series of acid such as PivOH, TFA, and $BF_3{\cdot}OEt_2$ in the presence of NH_4SCN (entries 10−12). In these conditions, both **3a** and **5a** were obtained and **5a** was the major product. The results demonstrated that AcOH and NH_4SCN served as the optimal additives in the transformation. The combination of AcOH and NH_4SCN served as the optimal additives (entry 9). Furthermore, the reaction did not take place without light irradiation (entry 13). The yield of **5a** decreased sharply when NH_4SCN was used as additive alone. These results demonstrated that visible light, AcOH, and NH_4SCN play significant roles in the transformation.

After determining the optimal reaction conditions, the scope of this Ag-catalyzed cyclization of different 3-aminoindazoles was evaluated (Scheme 2). Benzyl-substituted 3-aminoindazole

Scheme 2. Construction of 4-Substituted Pyrimido[1,2-*b*]indazoles from Various 3-Aminoindazoles[a]



[a]Reaction conditions: **1** (0.3 mmol), **2a** (0.3 mmol), AgOAc (3 mol %), AcOH (0.3 mmol), solvent (2 mL), rt, 12 h. Isolated yield.

proved to be a good substrate, giving product **3b** in a 84% yield. Product **3c** could also be obtained with a nice yield from 7-methyl-1*H*-indazol-3-amine. Moreover, a variety of halogen-substituted 3-aminoindazoles were surveyed, and the results showed that the yields remained at a high level no matter where the halogen is (**3d**−**3i**). However, the 5-(trifluoromethyl)-1*H*-indazol-3-amine and 1*H*-pyrazolo[3,4-*b*]pyridin-3-amine proved to be unsuitable to yield the corresponding products **3j** and **3k**, which may attribute to the strong electron-withdrawing properties of CF_3 and the pyridine ring.

To further explore the versatility of this established protocol, our attention was then shifted to investigate the reactivity of multifarious ynals (Scheme 3). Ynals bearing various substituents such as −Me, $-OCH_3$, −F, −Cl, −Br, −CHO, and $-COCH_3$ at the *para*-position of the phenyl ring provided the desired cyclization products with good yields (**4a**−**4g**, 72−89% yields). Similarly, substituents on other positions of benzene ring had little influence, giving products **4h**−**4k** in 79−86% yields. Under these Ag-catalyzed conditions, a disubstituted substrate, 3-(3,4-dimethylphenyl)propiolaldehyde, was also suitable (**4l**, 82%). Importantly, thiophene-derived ynal also underwent this transformation to provide **4m** in satisfactory yield. It was found that linear aliphatic ynals were well tolerated in this reaction to supply **4n**−**4q** in 85−88% yields.

Next, we were committed to expand the adaptability of substrates to synthesize 2-substituted pyrimido[1,2-*b*]indazoles via visible-light-induced cyclization. First, 3-aminoindazoles with different substituents were put into the reaction to complete this process (Scheme 4). The refined structure of **5a** was confirmed by X-ray crystallography analysis (CCDC 2050287). To our delight, assorted halogen-substituted substrates achieved the expected products **5b**−**5g** in medium to good yields under blue LED irradiation. In addition, the 3-aminoindazoles with methyl and benzyl substituents could provide **5h** and **5i** in 70% and 65% yields, respectively.

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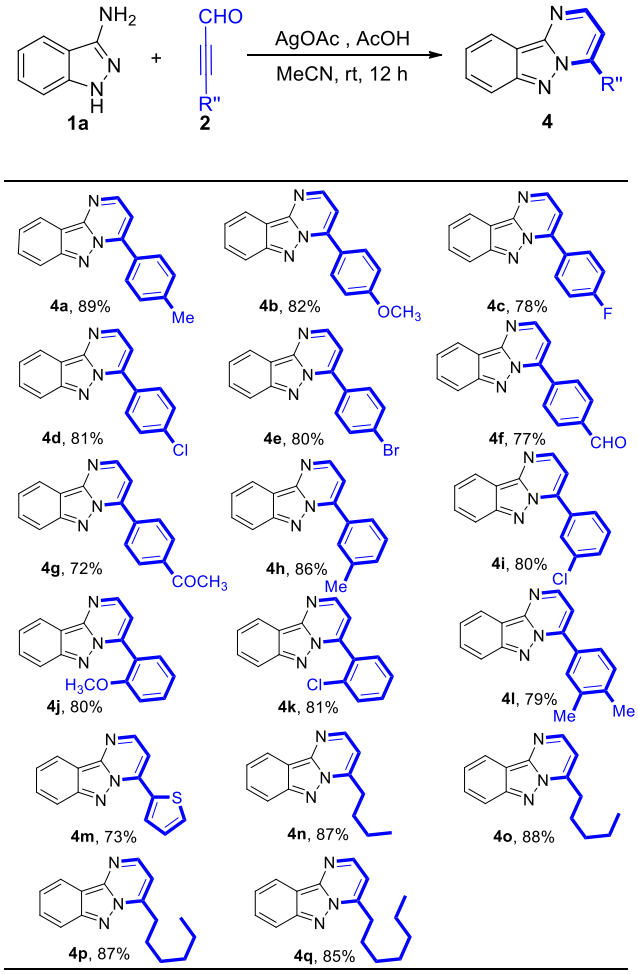
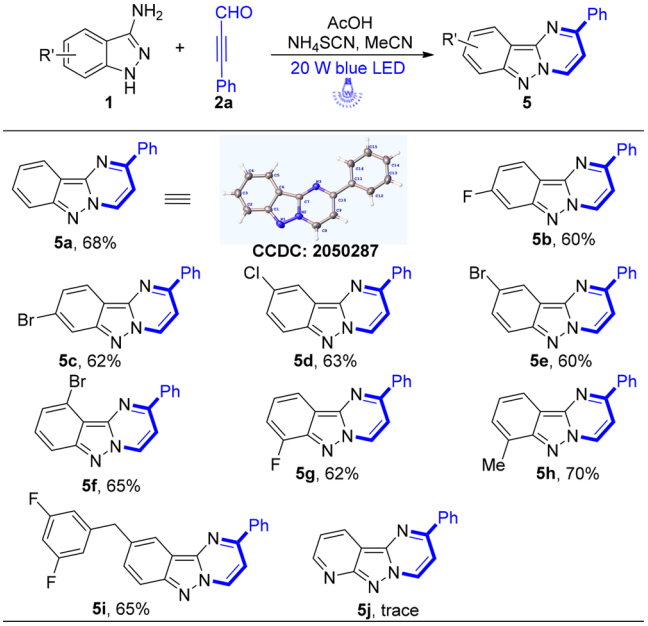
Scheme 3. Construction of 4-Substituted Pyrimido[1,2-*b*]indazoles from Various Ynals[a]



[a]Reaction conditions: **1a** (0.3 mmol), **2** (0.3 mmol), AgOAc (3 mol %), AcOH (0.3 mmol), solvent (2 mL), rt, 12 h. Isolated yield.

Scheme 4. Construction of 2-Substituted Pyrimido[1,2-*b*]indazoles from Various 3-Aminoindazoles[a]



[a]Reaction conditions: **1** (0.3 mmol), **2a** (0.3 mmol), AcOH (0.3 mmol), NH_4SCN (0.3 mmol), MeCN (2 mL), and irradiation with a 20 W blue LED for 12 h. Isolated yield. In all cases, **3** was also detected, and the ratio of **3** and **5** was about 1:6.

However, the 2-substituted product **5j** could not be obtained from 1*H*-pyrazolo[3,4-*b*]pyridin-3-amine.

Then a dozen substituted ynals were employed to consummate the integrity of our strategy for producing 2-substituted pyrimido[1,2-*b*]indazoles (Scheme 5). For the ynals bearing electron-withdrawing or electron-donating groups at the *para*-position, the reaction occurred smoothly with nice yields of products **6a**–**6f**. The reaction also performed well with substituents at the *ortho*- and *meta*-positions of ynals (**6g**–**6j**, 60–70%). In addition, ynal with two methyls at the benzene ring was a good candidate for the site-selective cyclization and rendered the target product **6k** in 63% yield. Notably, 3-(thiophene-2-yl)propiolaldehyde could also be efficiently converted to 2-substituted products **6l** in 60% yield. Also, when it comes to linear aliphatic ynals such as hept-2-ynal, oct-2-ynal, non-2-ynal, and dec-2-ynal, the results were still satisfactory (**6m**–**6p**, 65–69%).

To prove the practical applicability of the current controllable site-selective cyclization, the reaction was scaled up by 10 times under the identified conditions. To our delight, when 3 mmol of **1a** was employed to produce 4- and 2-substituted pyrimido[1,2-*b*]indazoles, the corresponding products could still be accessed in 85% and 62% yields, respectively (Scheme 6).

On the basis of the experimental results and the literature reports,[7,12] the possible reaction mechanisms were proposed in Scheme 7. First, for the formation of **3a**, the condensation of **1a** and **2a** yielded the intermediate **I**, which underwent the 6-*endo-dig* cyclization activated by a Ag catalyst to form the final product. For the formation of **5a**, the control experiments were operated to afford mechanism insight for photoinduced the construction of 2-substituted pyrimido[1,2-*b*]indazoles. Only a trace amount of product **5a** was detected when 3 equiv of the radical scavengers BHT and TEMPO were added to the standard conditions, respectively, which indicated the free radical may be formed in the reaction system. First, the irradiation of **1a** produced free radical intermediate **III**, and the subsequent radical addition of **III** to substrate ynal **2a** provided an alkenyl radical **IV**. Subsequently, intermediate **VI** was obtained after radical intermediate **V** was reduced in the presence of NH_4SCN and acid. The additive NH_4SCN may be acted as a reductant to reduce the alkenyl radical. Finally, intramolecular nucleophilic cyclization of intermediate **V** gave the cyclization intermediate **VII**, which suffers isomerization to produce the final product **5a**.

In order to understand the spectral properties of pyrimido-[1,2-*b*]-indazoles prepared by present method, a series of photophysical experiments of compound **3a** were carried out (Table 2 and Figure 1). According to the results, compound **3a** displayed strong absorption (λ_{abs}) at a wavelength of 350 nm and emission (λ_{em}) in the region (514–521 nm) in DCM, DMSO, EA, MeCN, and DMF. Strikingly, **3a** had the highest absorption intensity in DMSO and the highest fluorescence emission intensity when using EA as solvent.

In summary, we have disclosed a direct, efficient, and controllable site-selective method to synthesize 2- and 4-

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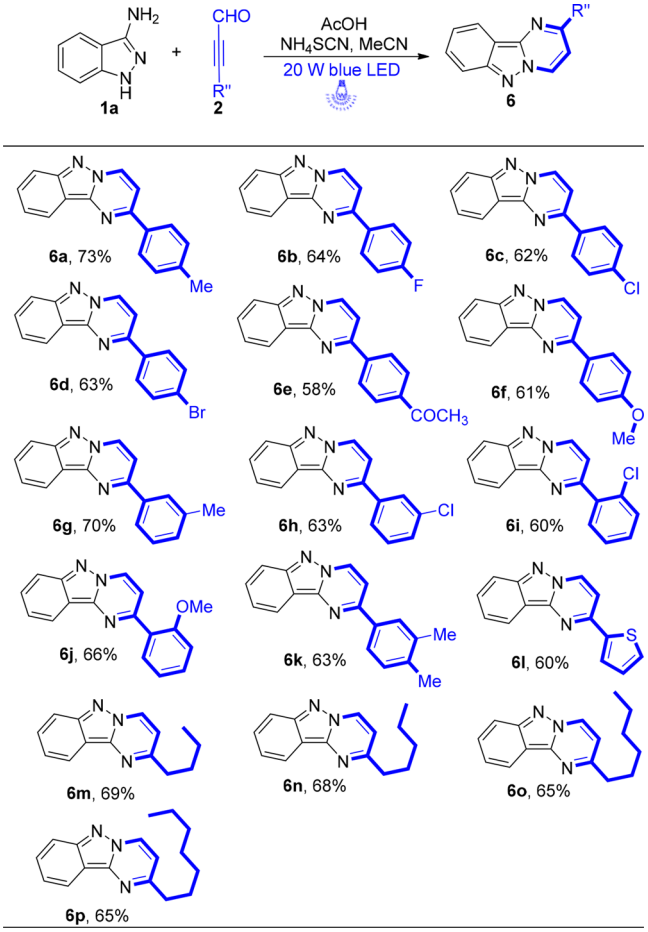
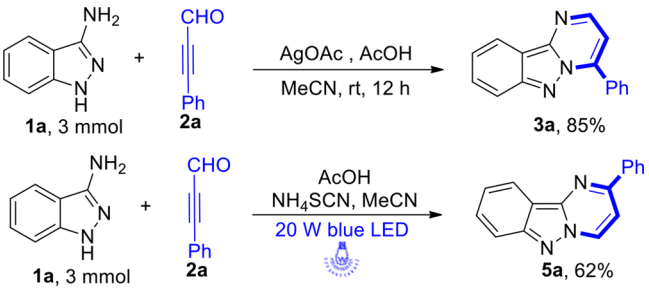
Scheme 5. Construction of 2-Substituted Pyrimido[1,2-*b*]indazoles from Various Ynals[a]



[a]Reaction conditions: **1a** (0.3 mmol), **2** (0.3 mmol), AcOH (0.3 mmol), NH_4SCN (0.3 mmol), MeCN (2 mL), and irradiation with a 20 W blue LED for 12 h. Isolated yield. In all cases, **4** was also detected, and the ratio of **4** and **6** was approximately 1:6.

Scheme 6. Large-Scale Synthesis



substituted pyrimido[1,2-*b*]indazoles from 3-aminoindazoles and ynals. By controlling the conditions, various 2- and 4-substituted pyrimido[1,2-*b*]indazole derivatives were easily constructed. Meanwhile, this protocol is applicable to large-scale synthesis. In addition, a series of photophysical experiments were completed to research spectral properties of the products.

EXPERIMENTAL SECTION

General Methods. ^1H and ^{13}C NMR spectra were recorded using a Bruker DRX-400 spectrometer using $CDCl_3$ as solvent. Chemical shifts were recorded in parts per million (ppm, δ) relative to tetramethylsilane (δ 0.00) or chloroform (δ = 7.26, singlet). The HRMS experiments were carried out on a high-resolution mass spectrometer (HR-ESI-MS and HR-GC−MS). Melting points were determined with a Büchi Melting Point B-545 instrument. Compound **5a** was collected at 100 K on a Rigaku Oxford Diffraction Supernova Dual Source, Cu at Zero equipped with an AtlasS2 CCD using Cu Kα radiation.

Photochemical experiments were carried out on a PL-SX100A Model Multichannel photochemical reaction instrument (the light source is 20 W blue LED, the working current is 0.5−1.7 A, the input power is 120 W, the temperature is controlled by circulating water cooling, and the stirring speed is 0−1500 r/min). The material of the irradiation vessel is borosilicate glass and is 3 cm away from the light source. UV−vis absorption spectra were recorded on a Shimadzu UV-2600 spectrophotometer. Fluorescence data measurements were carried out on a Thermo Scientific Lumina Model Fluorescence spectrometer (power maximum: 240 W, frequency range: 50/60 Hz, AC voltage: 100−240 V).

All compounds **1** are commercially available. Compounds **2** are known and prepared according to the literature methods.[13]

General Procedure. *Synthesis of Products 3 According to the Following Procedure.* As exemplified for **3a**: A 25 mL sealed tube was charged with a stirring bar, and 3-aminoindazole **1a** (0.040 g, 0.3 mmol), 3-phenylpropiolaldehyde **2a** (0.039 g, 0.3 mmol), AgOAc (0.002 g, 0.03 equiv), AcOH (0.018 g, 0.3 mmol), and MeCN (2 mL) were added. The reaction was stirred at room temperature for 12 h. The reaction mixture was then diluted with EtOAc and water and extracted with EtOAc. The combined organic extracts were dried over Na_2SO_4. The solvent was removed with a rotary evaporator. The residue was purified by flash column chromatography (eluent: PE/EtOAc = 3/1, v/v) to give product **3a** (0.065 g, 88% yield).

Scheme 7. Plausible Mechanistic Pathway

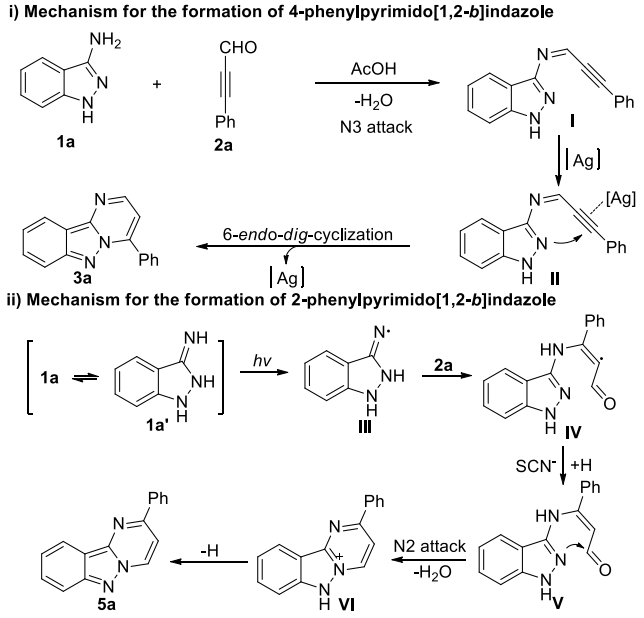


Table 2. Spectroscopic Data of Compound 3a in Different Solvents

solvent	DCM	DMSO	EA	MeCN	DMF
λ_{abs}[a] (nm)	350	350	349	347	350
λ_{em}[b] (nm)	512	519	521	514	520
λ_{abs}[c] (ε in L mol^{-1} cm^{-1})	32033	33190	26661	20655	33110

[a]Longest wavelength absorption maximum. [b]Excited at the longest wavelength absorption maximum. [c]The extinction coefficients.

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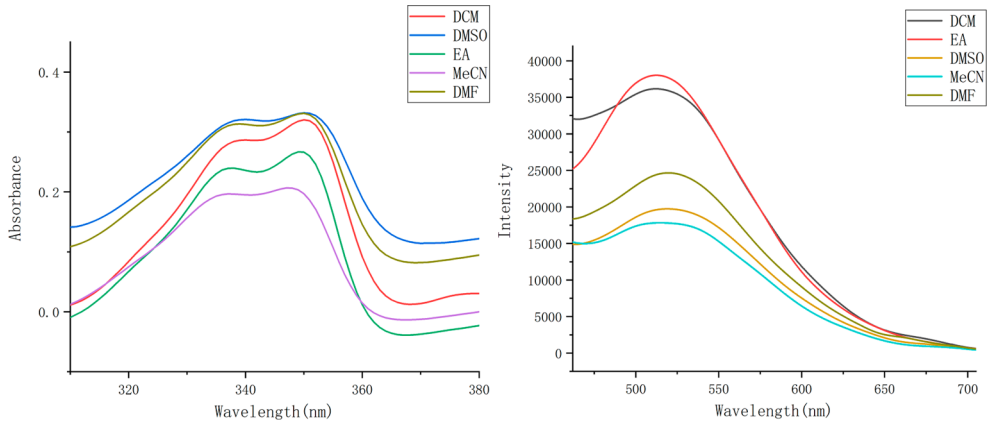

Figure 1. Absorption and Emission Spectra of Compound **3a**.

Synthesis of Products ***5*** *According to the Following Procedure.* As exemplified for **5a**: A 25 mL sealed tube was charged with a stirring bar, and 3-aminoindazole **1a** (0.040g, 0.3 mmol), 3-phenylpropiolaldehyde **2a** (0.039 g, 0.3 mmol), AcOH (0.018 g, 0.3 mmol), NH_4SCN (0.023 g, 0.3 mmol), and MeCN (2 mL) were added. The reaction was irradiated with a 20 W blue LED at room temperature stirring for 12 h. The reaction mixture was then diluted with EtOAc and water and extracted with EtOAc. The combined organic extracts were dried over Na_2SO_4. The solvent was removed with a rotary evaporator. The residue was purified by flash column chromatography (eluent: PE/EtOAc = 2/1, v/v) to give product **5a** (0.050 g, 68% yield).

Scale-up Experiment. An oven-dried 50 mL Schlenk flask was charged with a stirring bar, and 3-aminoindazole **1a** (0.399 g, 3 mmol), 3-phenylpropiolaldehyde **2a** (0.390 g, 3 mmol), AgOAc (0.015 g, 0.3 equiv), AcOH (0.180 g, 3 mmol), and MeCN (15 mL) were added. The reaction was stirred at room temperature for 12 h. The reaction mixture was then diluted with EtOAc and water and extracted with EtOAc. The combined organic extracts were dried over anhydrous Na_2SO_4, filtered, and concentrated. The solvent was removed with a rotary evaporator. The residue was purified by flash column chromatography (eluent: PE/EtOAc = 3/1, v/v) to give product **3a** (0.625 g, 85% yield).

An oven-dried 50 mL Schlenk flask was charged with a stirring bar, and 3-aminoindazole **1a** (0.399 g, 3 mmol), 3-phenylpropiolaldehyde **2a** (0.390 g, 3 mmol), AcOH (0.180 g, 3 mmol), NH_4SCN (0.228 g, 3 mmol), and MeCN (15 mL) were added. The reaction was irradiated with a 20W blue LED at room temperature stirring for 24 h. The reaction mixture was then diluted with EtOAc and water and extracted with EtOAc. The combined organic extracts were dried over anhydrous Na_2SO_4, filtered, and concentrated. The solvent was removed with a rotary evaporator. The residue was purified by flash column chromatography (eluent: PE/EtOAc = 2/1, v/v) to give product **5a** (0.415 g, 62% yield).

Fluorescence Experimental Procedure. To compound **3a** (0.0245g) was added 1 mL of DMSO in an EP tube, and the dissolved solution was transferred to a 100 mL volumetric bottle, diluted with DMSO to scale, shaken well, and set aside. The above solution (1 mL) was transferred it to a 10 mL volumetric bottle, diluted to scale, and then mixed into 10^{-6} mol·L^{-1} standard reserve solution for a fluorescence test. The fluorophotometer was preheated and initialized, and the fluorescence intensity was measured according to the excitation and emission fluorescence spectrometry. The fluorescence intensity of compound **3a** was determined in different solvents, and the above experimental steps were repeated.

4-Phenylpyrimido[1,2-b]indazole ***3a*** *(88%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3a**. Yellow solid, mp 160.2−160.8 °C. 64.7 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.63 (d, J = 4.4 Hz, 1H), 8.35 (d, J = 8.3 Hz, 1H), 8.16 (dt, J = 5.0, 3.0 Hz, 2H), 7.86 (d, J = 8.7 Hz, 1H), 7.63−7.55 (m, 4H), 7.33−7.28 (m, 1H), 7.24 (d, J = 4.6 Hz, 1H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 151.1, 145.2, 145.1, 145.1, 131.4, 131.2, 121.0, 129.5, 128.9, 121.0, 120.9, 116.5, 113.5, 111.2. HRMS MALDI (m/z): calcd for $C_{16}H_{11}N_3$ [M + H]$^+$ 246.1031, found 246.1037.

9-(3,5-Difluorobenzyl)-4-phenylpyrimido[1,2-b]indazole ***3b*** *(84%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3b**. Yellow solid, mp 158.7−159.6 °C. 93.4 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.61 (d, J = 4.4 Hz, 1H), 8.20−8.04 (m, 3H), 7.81 (d, J = 8.8 Hz, 1H), 7.58 (dd, J = 5.3, 1.9 Hz, 3H), 7.41 (dd, J = 8.8, 1.7 Hz, 1H), 7.25−7.22 (m, 1H), 6.75 (d, J = 6.1 Hz, 2H), 6.64 (tt, J = 9.0, 2.3 Hz, 1H), 4.11 (s, 2H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 164.3 (d, J = 12.9 Hz), 161.9 (d, J = 12.9 Hz), 150.1, 145.2, 145.1, 145.1 (t, J = 24.6 Hz), 132.2, 131.7, 131.3, 131.2, 129.4, 128.9, 120.0, 117.1, 113.5, 111.8 (d, J = 24.8 Hz), 111.8 (d, J = 11.7 Hz), 111.2, 101.7 (t, J = 25.4 Hz), 41.8. HR-GC−MS (m/z): calcd for $C_{23}H_{15}F_2N_3$ [M]$^+$ 371.1234, found 371.1234.

7-Methyl-4-phenylpyrimido[1,2-b]indazole ***3c*** *(85%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3c**. Yellow solid, mp 165.5−166.7 °C. 66.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.64 (s, 1H), 8.36−8.27 (m, 2H), 8.19 (d, J = 8.2 Hz, 1H), 7.65−7.58 (m, 3H), 7.40 (d, J = 6.8 Hz, 1H), 7.29 (d, J = 4.3 Hz, 1H), 7.26−7.23 (m, 1H), 2.72 (s, 3H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 151.1, 145.5, 145.1, 144.8, 131. 5, 131.2, 129.7, 129.1, 128.8, 126.6, 121.3, 118.2, 113.1, 110.9, 16.9. HR-GC−MS (m/z): calcd for $C_{17}H_{13}N_3$ [M]$^+$ 259.1109, found 259.1098.

8-Fluoro-4-phenylpyrimido[1,2-b]indazole ***3d*** *(86%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3d**. Yellow solid, mp 178.9−179.5 °C. 67.9 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.68 (d, J = 4.2 Hz, 1H), 8.31 (dd, J = 8.9, 5.5 Hz, 1H), 8.16 (dd, J = 6.6, 2.9 Hz, 2H), 7.63−7.58 (m, 3H), 7.43 (dd, J = 10.1, 1.9 Hz, 1H), 7.29 (d, J = 4.4 Hz, 1H), 7.08 (td, J = 9.0, 1.9 Hz, 1H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 165. 5, 163.0, 151.7 (d, J = 13.8 Hz), 145.8 (d, J = 39.8 Hz), 131.4, 131.2, 129.5, 129.0, 123.0 (d, J = 11.3 Hz), 112.2, 112.0, 111.2, 110.6, 100.4 (d, J = 24.4 Hz). HRMS MALDI (m/z): calcd for $C_{16}H_{10}FN_3$ [M + H]$^+$ 264.0937, found 264.0940.

8-Bromo-4-phenylpyrimido[1,2-b]indazole ***3e*** *(82%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3e**. Yellow solid, mp 203.8−204.6 °C. 83.4 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.69 (d, J = 4.4 Hz, 1H), 8.23−8.12 (m, 3H), 8.03 (s, 1H), 7.63 (dd, J = 9.4, 5.6 Hz, 3H), 7.38 (dd, J = 8.7, 0.7 Hz, 1H), 7.33 (d, J = 4.4 Hz, 1H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 151.7, 146.0, 145.7, 145.2, 131.5, 131.1, 129. 6, 129.0, 124.7, 124.3, 122.3, 119.1, 112.2, 111.7. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ [M + H]$^+$ 340.1332, found 340.1327.

1-(2-(4-Fluorophenyl)indolizin-3-yl)-2-phenylethane-1,2-dione ***3f*** *(84%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3f**. Yellow solid, mp 213.2−214.2 °C. 70.3 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.70 (d, J = 4.4 Hz, 1H), 8.32 (d, J = 1.8 Hz, 1H), 8.17 (dd, J = 6.5, 3.1 Hz, 2H), 7.80 (d, J = 9.1 Hz, 1H), 7.65−7.60 (m, 3H), 7.55 (dd, J = 9.1, 2.0 Hz, 1H), 7.32 (d, J = 4.4 Hz, 1H). ^{13}C{^{1}H} NMR (101 MHz, $CDCl_3$): δ 149.4,

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145.8, 144.6, 131.5, 131.1, 129.6, 129.0, 126.5, 112.0, 118.2, 114.1, 111.7. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0642.

9-Bromo-4-phenylpyrimido[1,2-b]indazole **3g** *(81%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3g**. Yellow solid, mp 201.1−201.9 °C. 78.5 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.71 (d, J = 4.4 Hz, 1H), 8.50 (d, J = 1.6 Hz, 1H), 8.17 (dd, J = 6.5, 3.0 Hz, 2H), 7.75 (d, J = 9.1 Hz, 1H), 7.67 (dd, J = 9.1, 1.7 Hz, 1H), 7.63 (dd, J = 5.0, 1.7 Hz, 2H), 7.34 (d, J = 4.4 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 149.5, 145.9, 144.4, 133. 5, 131.5, 131.1, 129. 6, 129.0, 123.4, 118.4, 114.9, 114.0, 111.8. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0138.

10-Chloro-4-phenylpyrimido[1,2-b]indazole **3h** *(75%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3h**. Yellow solid, mp 205.1−205.9 °C. 62.8 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.82 (t, J = 5.5 Hz, 1H), 8.15 (dd, J = 6.4, 2.8 Hz, 2H), 7.76 (d, J = 8.6 Hz, 1H), 7.61 (dd, J = 9.3, 5.6 Hz, 3H), 7.51 (t, 1H), 7.34 (d, J = 4.4 Hz, 1H), 7.29 (d, J = 7.3 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.8, 146.1, 145.5, 144.5, 131.4, 131.1, 129.9, 129.5, 128.9, 127. 7, 121.4, 115.3, 111.7, 111.2. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0649.

10-Bromo-4-phenylpyrimido[1,2-b]indazole **3i** *(78%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **3i**. Yellow solid, mp 178.8−179.4 °C. 75.6 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.86 (d, J = 4.4 Hz, 1H), 8.20−8.13 (m, 2H), 7.83 (d, J = 8.4 Hz, 1H), 7.68−7.59 (m, 3H), 7.52 (d, J = 7.1 Hz, 1H), 7.49−7.43 (m, 1H), 7.38 (d, J = 4.4 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.9, 145.9, 145.6, 144.9, 131.5, 131.2, 130.3, 129.6, 129.0, 124.9, 116.0, 115.0, 112.5, 111.9. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0136.

4-(p-Tolyl)pyrimido[1,2-b]indazole **4a** *(89%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4a**. Yellow solid, mp 127.9−128.7 °C. 69.2 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.63 (d, J = 4.2 Hz, 1H), 8.35 (d, J = 8.3 Hz, 1H), 8.08 (d, J = 8.0 Hz, 2H), 7.85 (d, J = 9.5 Hz, 1H), 7.65−7.57 (m, 1H), 7.40 (d, J = 7.9 Hz, 2H), 7.31 (t, 1H), 7.25 (d, J = 3.6 Hz, 1H), 2.46 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.1, 145.5, 145.1, 141.7, 129.9, 129.6, 129.4, 128.5, 121.0, 120.9, 116.6, 113.5, 111.0, 21.7. HRMS MALDI (m/z): calcd for $C_{17}H_{13}N_3$ $[M + H]^+$ 260.1188, found 260.1187.

4-(4-Methoxyphenyl)pyrimido[1,2-b]indazole **4b** *(82%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4b**. Yellow solid, mp 121.4−122.4 °C. 67.7 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.61 (d, J = 4.4 Hz, 1H), 8.34 (d, J = 8.3 Hz, 1H), 8.21 (d, J = 8.8 Hz, 2H), 7.86 (d, J = 8.7 Hz, 1H), 7.61 (t, 1H), 7.30 (t, 1H), 7.23 (d, J = 4.5 Hz, 1H), 7.09 (d, J = 8.8 Hz, 2H), 3.89 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 161.9, 151.1, 145.3, 145.1, 131.3, 129.9, 123.5, 121.0, 120.9, 116.6, 114.3, 113.5, 110.5, 55.6, 29.8. HRMS MALDI (m/z): calcd for $C_{17}H_{13}N_3O$ $[M + H]^+$ 276.1137 found: 276.1141.

4-(4-Fluorophenyl)pyrimido[1,2-b]indazole **4c** *(78%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4c**. Yellow solid, mp 171.4−172.2 °C. 61.6 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.65 (s, 1H), 8.35 (d, J = 8.2 Hz, 1H), 8.22 (dd, J = 8.7, 5.3 Hz, 2H), 7.86 (d, J = 8.7 Hz, 1H), 7.63 (t, 1H), 7.36−7.27 (m, 3H), 7.25 (d, J = 4.9 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 165.6, 163.1, 151.1, 145.1, 144.2, 131.8 (d, J = 8.7 Hz), 130.1, 127.4 (d, J = 3.3 Hz), 121.1 (d, J = 24.0 Hz), 116.6, 116.1 (d, J = 21.9 Hz), 113.5, 111.1. HRMS MALDI (m/z): calcd for $C_{16}H_{10}FN_3$ $[M + H]^+$ 264.0937, found 264.0938.

4-(4-Chlorophenyl)pyrimido[1,2-b]indazole **4d** *(81%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4d**. Yellow solid, mp 141.1−142.3 °C. 67.8 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.57 (d, J = 4.4 Hz, 1H), 8.31 (d, J = 8.3 Hz, 1H), 8.09 (d, J = 8.4 Hz, 2H), 7.82 (d, J = 8.7 Hz, 1H), 7.60 (t, 1H), 7.52 (d, J = 8.5 Hz, 2H), 7.28 (dd, J = 15.3, 7.9 Hz, 1H), 7.16 (d, J = 4.4 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.0, 145.1, 144.9, 143.9, 137.3, 130.8, 130.1, 129.7, 129.1, 121.2, 120.9, 116.5, 113.5, 111.0. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0643.

4-(4-Bromophenyl)pyrimido[1,2-b]indazole **4e** *(80%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4e**. Yellow solid, mp 152.9−153.9 °C. 77.5 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.63 (d, J = 4.4 Hz, 1H), 8.33 (d, J = 8.3 Hz, 1H), 8.06 (d, J = 8.5 Hz, 2H), 7.84 (d, J = 8.7 Hz, 1H), 7.72 (d, J = 8.5 Hz, 2H), 7.62 (t, 1H), 7.32 (t, 1H), 7.23 (d, J = 4.5 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.1, 145.1, 145.0, 144.0, 133.1, 132.2, 131.0, 130.1, 125.8, 121.3, 120.9, 116.5, 113.5, 111.0. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + Na]^+$ 324.0136, found 324.0135.

4-(Pyrimido[1,2-b]indazol-4-yl)benzaldehyde **4f** *(77%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4f**. Yellow solid, mp 166.2−167.4 °C. 74.6 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 10.16 (s, 1H), 8.74 (d, J = 4.3 Hz, 1H), 8.39 (dd, J = 7.7, 5.6 Hz, 3H), 8.14 (d, J = 8.2 Hz, 2H), 7.87 (t, J = 10.1 Hz, 1H), 7.69−7.63 (m, 1H), 7.37 (dd, J = 9.6, 5.4 Hz, 2H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 191.6, 151.2, 145.0, 137.9, 137.0, 130.4, 130.3, 130.1, 121.6, 121.0, 116. 7, 111.7. HRMS MALDI (m/z): calcd for $C_{17}H_{11}N_3O$ $[M + H]^+$ 324.0980, found 324.0982.

1-(4-(Pyrimido[1,2-b]indazol-4-yl)phenyl)ethanone **4g** *(72%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4g**. Yellow solid, mp 211.1−212.3 °C. 62.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.72 (d, J = 4.4 Hz, 1H), 8.34 (dd, J = 22.2, 8.3 Hz, 3H), 8.19 (d, J = 8.3 Hz, 2H), 7.88 (d, J = 8.7 Hz, 1H), 7.70−7.62 (m, 1H), 7.36 (t, J = 6.3 Hz, 2H), 2.70 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 197.5, 151.2, 145.2, 145.0, 143.9, 138. 8, 135.6, 130.3, 129.9, 128.8, 121.4, 121.0, 116.6, 113.6, 111.5, 29.8, 27.0. HRMS MALDI (m/z): calcd for $C_{18}H_{13}N_3O$ $[M + H]^+$ 288.1137, found 288.1137.

4-(m-Tolyl)pyrimido[1,2-b]indazole **4h** *(86%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4h**. Yellow solid, mp 137.3−138.1 °C. 66.9 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.66 (d, J = 4.4 Hz, 1H), 8.36 (d, J = 8.3 Hz, 1H), 7.95 (d, J = 7.2 Hz, 2H), 7.88 (d, J = 8.7 Hz, 1H), 7.65−7.59 (m, 1H), 7.50 (t, J = 8.0 Hz, 1H), 7.40 (d, J = 7.6 Hz, 1H), 7.34−7.28 (m, 1H), 7.28−7.23 (m, 1H), 2.49 (s, 3H).$^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.2, 145.6, 145.2, 145.1, 138.7, 132.1, 131.4, 130.0, 129.9, 128.9, 126.7, 121.0, 121.0, 116.7, 113. 6, 111.4, 21.7. HRMS MALDI (m/z): calcd for $C_{17}H_{13}N_3$ $[M + H]^+$ 260.1188 found: 260.1195.

4-(3-Chlorophenyl)pyrimido[1,2-b]indazole **4i** *(80%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4i**. Yellow solid, mp 109.1−109.7 °C. 67.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.65 (d, J = 4.4 Hz, 1H), 8.34 (d, J = 8.3 Hz, 1H), 8.19 (s, 1H), 8.06 (d, J = 7.0 Hz, 1H), 7.86 (d, J = 8.7 Hz, 1H), 7.63 (t, 1H), 7.58−7.48 (m, 2H), 7.33 (t, 1H), 7.25 (d, J = 3.6 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.1, 145.1, 145.0, 143.6, 134.9, 133.0, 131.3, 130.2, 130.2, 129.5, 127. 7, 121.3, 120.9, 116.6, 113.6, 111.3. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0640.

4-(2-Methoxyphenyl)pyrimido[1,2-b]indazole **4j** *(81%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4j**. Yellow solid, mp 164.1−165.5 °C. 66.9 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.66 (d, J = 4.3 Hz, 1H), 8.36 (d, J = 8.3 Hz, 1H), 7.84 (d, J = 8.7 Hz, 1H), 7.69 (dd, J = 7.5, 1.3 Hz, 1H), 7.62−7.52 (m, 2H), 7.33−7.23 (m, 2H), 7.20−7.08 (m, 2H), 3.78 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 157.5, 151.0, 144.7, 144.6, 143.6, 132.4, 130.9, 129.7, 120.9, 120.9, 120.8, 120.7, 116.8, 113.7, 113.3, 112.0, 55.9. HRMS MALDI (m/z): calcd for $C_{17}H_{13}N_3O$ $[M + H]^+$ 276.1137, found 276.1134.

4-(2-Chlorophenyl)pyrimido[1,2-b]indazole **4k** *(79%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4k**. Yellow solid, mp 153.1−154.1 °C. 66.1 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.70 (d, J = 4.3 Hz, 1H), 8.38 (d, J = 8.3 Hz, 1H), 7.86 (d, J = 8.7 Hz, 1H), 7.66−7.58 (m, 3H), 7.56−7.45 (m, 2H), 7.33 (t, 1H), 7.24 (t, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.2, 144.6, 144. 6, 143.1, 133.7, 131.9, 131.3, 130.9, 130.5, 130.0, 127.3, 121.3, 120.8, 116.8, 113.7, 113.1. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0643.

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4-(3,4-Dimethylphenyl)pyrimido[1,2-b]indazole **4l** *(82%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4l**. Yellow solid, mp 168.9−169.7 °C. 67.2 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.62 (d, J = 4.3 Hz, 1H), 8.34 (d, J = 8.3 Hz, 1H), 7.89 (dd, J = 17.2, 9.4 Hz, 3H), 7.61 (t, 1H), 7.36−7.27 (m, 2H), 7.23 (t, 1H), 2.37 (s, 3H), 2.35(s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.1, 145.7, 145.1, 140.5, 137.3, 130.4, 130.1, 129.9, 128.9, 127.0, 120.9, 120.9, 116.7, 113.5, 111.0, 20.1, 20.0. HRMS MALDI (m/z): calcd for $C_{18}H_{15}N_3$ $[M + H]^+$ 274.1344, found 274.1344.

4-(Thiophene-2-yl)pyrimido[1,2-b]indazole **4m** *(73%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4m**. Yellow solid, mp 156.6−157.8 °C. 55.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.51 (d, J = 4.7 Hz, 1H), 8.32 (dd, J = 12.1, 6.1 Hz, 2H), 7.90 (d, J = 8.6 Hz, 1H), 7.69 (d, J = 5.0 Hz, 1H), 7.62 (t, 1H), 7.48 (d, J = 4.8 Hz, 1H), 7.29 (t, 1H), 7.21 (t, J = 4.5 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 150.8, 145.1, 144.0, 138.3, 132.7, 131.5, 131.2, 130.1, 127.6, 121.0, 121.0, 116.5, 113.4, 107.2. HRMS MALDI (m/z): calcd for $C_{14}H_9N_3S$ $[M + H]^+$ 252.0595, found 252.0596.

4-Butylpyrimido[1,2-b]indazole **4n** *(87%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4n**. Yellow solid, mp 51.4−52.3 °C. 58.7 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.51 (d, J = 4.3 Hz, 1H), 8.30 (dd, J = 8.2, 1.2 Hz, 1H), 7.88 (dd, J = 8.6, 1.2 Hz, 1H), 7.62 (ddd, J = 8.4, 6.7, 1.3 Hz, 1H), 7.34−7.25 (m, 1H), 7.00 (dd, J = 5.0, 2.3 Hz, 1H), 3.32 (t, J = 7.3 Hz, 2H), 1.89 (pd, J = 7.6, 1.6 Hz, 2H), 1.52 (h, J = 7.4 Hz, 2H), 1.01 (t, J = 7.3 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 150.7, 148.7, 144.9, 143.9, 129. 8, 120.8, 120.7, 116.2, 113. 6, 109.6, 30. 5, 27.5, 22.5, 13.9. HR-GC−MS (m/z): calcd for $C_{14}H_{15}N_3$ $[M]^+$ 225.1266, found 225.1261.

4-Pentylpyrimido[1,2-b]indazole **4o** *(88%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4o**. Yellow oil, 63.1 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.56 (s, 1H), 8.32 (d, J = 8.2 Hz, 1H), 7.89 (d, J = 8.6 Hz, 1H), 7.63 (t, J = 7.6 Hz, 1H), 7.32−7.24 (m, 1H), 7.05 (s, 1H), 3.39−3.28 (m, 2H), 1.99−1.86 (m, 2H), 1.54−1.35 (m, 5H), 0.94 (t, J = 6.9 Hz, 4H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 150.8, 148.8, 144.9, 144.1, 129. 9, 120.9, 120.7, 116.3, 113.7, 109.8, 31.5, 30.8, 25.2, 22.5, 14.0. HRMS MALDI (m/z): calcd for $C_{15}H_{17}N_3$ $[M + H]^+$ 240.1501, found 240.1506.

4-Hexylpyrimido[1,2-b]indazole **4p** *(87%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4p**. Yellow solid, mp 51.4−52.3 °C. 66.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.52 (d, J = 4.6 Hz, 1H), 8.31 (d, J = 8.3 Hz, 1H), 7.88 (d, J = 8.7 Hz, 1H), 7.69−7.55 (m, 1H), 7.28 (t, J = 7.5, 1H), 7.01 (q, J = 4.1 Hz, 1H), 3.32 (dd, J = 9.9, 5.3 Hz, 2H), 1.92 (p, J = 7.6, 2H), 1.53−1.31 (m, 6H), 0.90 (t, J = 7.9, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 150.7, 148.7, 144.8, 143.9, 129.8, 120.8, 120.6, 116.2, 113.6, 109.6, 31.7, 30.7, 29.3, 29.1, 25.4, 22.6, 14.1. HR-GC−MS (m/z): calcd for $C_{16}H_{19}N_3$ $[M]^+$ 253.1579, found 253.1578.

4-Heptylpyrimido[1,2-b]indazole **4q** *(85%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **4q**. Yellow solid, mp 34.8−35.7 °C. 68.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.52 (d, J = 4.3 Hz, 1H), 8.31 (d, J = 8.2 Hz, 1H), 7.88 (d, J = 8.6 Hz, 1H), 7.67−7.55 (m, 1H), 7.28 (t, J = 8.4, 1H), 7.02 (d, J = 4.4 Hz, 1H), 3.32 (t, J = 7.7 Hz, 2H), 1.92 (p, J = 7.7 Hz, 2H), 1.50−1.23 (m, 8H), 0.88 (t, J = 7.6 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 150.7, 148.7, 144.8, 143.9, 129.8, 120.8, 120.6, 116.2, 113.6, 109.6, 31.7, 30.7, 29.3, 29.1, 25.4, 22.6, 14.1. HR-GC−MS (m/z): calcd for $C_{17}H_{21}N_3$ $[M]^+$ 267.1735, found 267.1729.

2-Phenylpyrimido[1,2-b]indazole **5a** *(68%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5a**. Yellow solid, mp 139.5−140.7 °C. 50.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.97 (d, J = 7.3 Hz, 1H), 8.38 (d, J = 8.3 Hz, 1H), 8.24−8.19 (m, 2H), 7.83 (d, J = 8.7 Hz, 1H), 7.68−7.61 (m, 2H), 7.59−7.48 (m, 3H), 7.31 (ddd, J = 8.1, 6.7, 0.7 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 152.9, 151.6, 143.8, 137.0, 133.9, 130.5, 130.2, 129.2, 127.3, 121.2, 121.0, 116.3, 113.9, 109.0. HRMS MALDI (m/z): calcd for $C_{16}H_{11}N_3$ $[M + H]^+$ 246.1031, found 246.1036.

8-Fluoro-2-phenylpyrimido[1,2-b]indazole **5b** *(60%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5b**. Yellow solid, mp 228.2−229.4 °C. 47.3 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.96 (d, J = 7.3 Hz, 1H), 8.34 (dd, J = 8.9, 5.5 Hz, 1H), 8.22 (d, J = 7.1 Hz, 2H), 7.66 (d, J = 7.3 Hz, 1H), 7.59−7.49 (m, 3H), 7.40 (dd, J = 10.0, 1.8 Hz, 1H), 7.08 (td, J = 9.0, 1.8 Hz, 1H).$^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 164.4 (d, J = 247.0 Hz), 153.8, 136.9, 134.1, 130.7, 129.3, 127.4, 123.2 (d, J = 11.2 Hz), 111.9 (d, J = 27.6 Hz), 108.8, 100.2 (d, J = 24.4 Hz). HRMS MALDI (m/z): calcd for $C_{16}H_{10}FN_3$ $[M + H]^+$ 264.0937, found 264.0935.

8-Bromo-2-phenylpyrimido[1,2-b]indazole **5c** *(62%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5c**. Yellow solid, mp 167.5−168.7 °C. 60.1 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.72 (d, J = 4.4 Hz, 1H), 8.22 (d, J = 8.7 Hz, 1H), 8.17 (dd, J = 6.4, 2.9 Hz, 2H), 8.05 (s, 1H), 7.65−7.61 (m, 3H), 7.40 (dd, J = 8.7, 1.0 Hz, 1H), 7.35 (d, J = 4.5 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.8, 146.1, 131.5, 131.1, 129.6, 129.0, 124. 8, 124.3, 122.4, 119.2, 111.7. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0135.

9-Chloro-2-phenylpyrimido[1,2-b]indazole **5d** *(63%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5d**. Yellow solid, mp 238.2−239.2 °C. 52.7 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.96 (d, J = 7.3 Hz, 1H), 8.35 (d, J = 1.6 Hz, 1H), 8.22 (d, J = 6.8 Hz, 2H), 7.77 (d, J = 9.1 Hz, 1H), 7.69 (d, J = 7.3 Hz, 1H), 7.55 (tt, J = 14.2, 7.1 Hz, 4H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 153.4, 136.8, 134.2, 131.2, 130.7, 129.3, 127.3, 126.4, 120.2, 117.8, 109.4. HRMS MALDI (m/z): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0645.

9-Bromo-2-phenylpyrimido[1,2-b]indazole **5e** *(60%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5e**. Yellow solid, mp 169.7−170.9 °C. 58.1 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.70 (d, J = 4.4 Hz, 1H), 8.50 (s, 1H), 8.17 (dd, J = 6.5, 2.8 Hz, 2H), 7.75 (d, J = 9.1 Hz, 1H), 7.69−7.58 (m, 4H), 7.32 (d, J = 4.4 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 149.5, 145.8, 144.4, 133.4, 131.5, 131.1, 129. 6, 129.0, 123.4, 118.4, 114.9, 114.0, 111.8. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0135.

10-Bromo-2-phenylpyrimido[1,2-b]indazole **5f** *(65%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5f**. Yellow solid, mp 151.7−152.9 °C. 63.0 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.75−8.71 (m, 1H), 8.34 (dd, J = 12.8, 6.6 Hz, 3H), 7.86 (d, J = 7.1 Hz, 1H), 7.63 (d, J = 5.1 Hz, 3H), 7.43−7.38 (m, 1H), 7.19 (t, J = 7.7 Hz, 1H).$^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 149.4, 146.1, 146.0, 145. 9, 132.8, 131.6, 130.9, 129.8, 128.9, 121.7, 120.4, 114.7, 111.8, 110.3. HRMS MALDI (m/z): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0138.

7-Fluoro-2-phenylpyrimido[1,2-b]indazole **5g** *(62%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **5g**. Yellow solid, mp 139.6−140.8 °C. 48.9 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.00 (d, J = 7.4 Hz, 1H), 8.26 (d, J = 6.9 Hz, 2H), 7.73 (d, J = 7.4 Hz, 1H), 7.63−7.48 (m, 5H), 6.93 (dd, J = 10.1, 7.4 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 136.7, 134.0, 130.8, 130.6 (d, J = 7.9 Hz), 129.3, 127.4, 112.2 (d, J = 4.7 Hz), 109.2, 104.9 (d, J = 17.7 Hz). HRMS MALDI (m/z): calcd for $C_{16}H_{10}FN_3$ $[M + H]^+$ 264.0937, found 264.0936.

7-Methyl-2-phenylpyrimido[1,2-b]indazole **5h** *(70%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **5h**. Yellow solid, mp 137.9−138.7 °C. 54.4 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.97 (d, J = 7.3 Hz, 1H), 8.20 (d, J = 7.8 Hz, 3H), 7.59 (d, J = 7.4 Hz, 1H), 7.56−7.45 (m, 3H), 7.38 (d, J = 6.7 Hz, 1H), 7.21 (t, J = 7.5 Hz, 1H), 2.73 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 152.6, 151.8, 143.9, 137.0, 133.9, 130.3, 129.2, 129.1, 127.1, 126.0, 121.1, 118.5, 113. 5, 108.6, 17.0. HR-GC−MS (m/z): calcd for $C_{17}H_{13}N_3$ $[M]^+$ 259.1109, found 259.1109.

9-(3,5-Difluorobenzyl)-2-phenylpyrimido[1,2-b]indazole **5i** *(65%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **5i**. Yellow solid, mp 165.8−166.7 °C. 72.3 mg. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.95 (s, 1H), 8.27−8.10 (m, 3H), 7.77 (d, J = 8.8 Hz, 1H), 7.63−7.40 (m, 5H), 6.76 (d, J = 7.4 Hz, 2H), 6.65 (t, J = 9.1 Hz, 1H), 4.13 (s, 2H). $^{13}C\{^1H\}$ NMR (101

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MHz, $CDCl_3$): δ 164.3 (d, *J* = 12.8 Hz), 161.9 (d, *J* = 12.8 Hz), 152.8, 145.3 (t, *J* = 8.8 Hz), 136.9, 133.9, 132.1, 131.9, 130.4, 129.1, 127.2, 120.3, 116.7, 113.9, 111.7 (d, *J* = 24.9 Hz), 108.8, 101.7 (t, *J* = 25.3 Hz), 41.8. HR-GC−MS (*m*/*z*): calcd for $C_{23}H_{15}F_2N_3$ $[M]^+$ 371.1234, found 371.1239.

2-(p-Tolyl)pyrimido[1,2-b]indazole ***6a*** *(73%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6a**. Yellow solid, mp 157.7−158.9 °C. 56.7 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.96 (d, *J* = 7.3 Hz, 1H), 8.37 (d, *J* = 8.2 Hz, 1H), 8.12 (d, *J* = 8.1 Hz, 2H), 7.82 (d, *J* = 8.7 Hz, 1H), 7.63 (t, *J* = 7.2 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.30 (t, 1H), 2.45 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 153.1, 151.9, 143.9, 140. 9, 134.3, 133.9, 130.1, 130.0, 127.2, 121.3, 120.8, 116.2, 113.9, 108.8, 21.6. HRMS MALDI (*m*/*z*): calcd for $C_{17}H_{13}N_3$ $[M + H]^+$ 260.1188, found 260.1189.

2-(4-Fluorophenyl)pyrimido[1,2-b]indazole ***6b*** *(64%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6b**. Yellow solid, mp 169.0−169.8 °C. 50.5 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.99 (d, *J* = 7.3 Hz, 1H), 8.36 (d, *J* = 8.3 Hz, 1H), 8.23 (dd, *J* = 8.4, 5.5 Hz, 2H), 7.84 (d, *J* = 8.7 Hz, 1H), 7.63 (dd, *J* = 15.2, 7.2 Hz, 2H), 7.32 (t, *J* = 7.5 Hz, 1H), 7.23 (d, *J* = 8.5 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 165.7, 163.2, 151.9 (d, *J* = 21.3 Hz), 134.0, 133.3, 130.3, 129.3 (d, *J* = 8.6 Hz), 121.1 (d, *J* = 10.7 Hz), 116.4 (d, *J* = 6.6 Hz), 116.2, 113. 9, 108.6. HRMS MALDI (*m*/*z*): calcd for $C_{16}H_{10}FN_3$ $[M + H]^+$ 264.0937, found 264.0938.

2-(4-Chlorophenyl)pyrimido[1,2-b]indazole ***6c*** *(62%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6c**. Yellow solid, mp 150.1−151.0 °C. 72.3 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 9.02 (d, *J* = 6.8 Hz, 1H), 8.38 (d, *J* = 8.3 Hz, 1H), 8.19 (d, *J* = 8.4 Hz, 2H), 7.85 (d, *J* = 8.7 Hz, 1H), 7.66 (t, 2H), 7.54 (d, *J* = 8.4 Hz, 2H), 7.34 (t, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.7, 136.8, 135.5, 134.1, 130.4, 129.5, 128.6, 121.3, 121.2, 116.3, 108.7. HRMS MALDI (*m*/*z*): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0648.

2-(4-Bromophenyl)pyrimido[1,2-b]indazole ***6d*** *(63%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6d**. Yellow solid, mp 148.9−149.9 °C. 61.0 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 9.00 (d, *J* = 7.3 Hz, 1H), 8.37 (d, *J* = 8.2 Hz, 1H), 8.11 (d, *J* = 8.3 Hz, 2H), 7.84 (d, *J* = 8.7 Hz, 1H), 7.71−7.60 (m, 4H), 7.33 (t, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 152.0, 151.6, 143.8, 135.9, 134.0, 132.4, 130.3, 128. 8, 125.2, 121.3, 121.2, 116.4, 114.0, 108.6. HRMS MALDI (*m*/*z*): calcd for $C_{16}H_{10}BrN_3$ $[M + H]^+$ 324.0136, found 324.0136.

1-(4-(Pyrimido[1,2-b]indazol-2-yl)phenyl)ethanone ***6e*** *(58%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6e**. Yellow solid, mp 171.7−172.8 °C. 50.0 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 9.04 (d, *J* = 7.2 Hz, 1H), 8.41 (d, *J* = 8.2 Hz, 1H), 8.34 (d, *J* = 8.0 Hz, 2H), 8.14 (d, *J* = 8.1 Hz, 2H), 7.87 (d, *J* = 8.6 Hz, 1H), 7.73 (d, *J* = 7.1 Hz, 1H), 7.67 (t, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 2.69 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 197.7, 151.1, 141.1, 138.1, 134.0, 130.4, 129.2, 127.4, 121.5, 121.2, 116.5, 109.0, 27.0. HRMS MALDI (*m*/*z*): calcd for $C_{18}H_{13}N_3O$ $[M + H]^+$ 288.1137, found 288.1137.

2-(4-Methoxyphenyl)pyrimido[1,2-b]indazole ***6f*** *(61%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6f**. Yellow solid, mp 139.2−140.4 °C. 50.3 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.93 (d, *J* = 7.4 Hz, 1H), 8.36 (d, *J* = 8.2 Hz, 1H), 8.19 (d, *J* = 8.6 Hz, 2H), 7.81 (d, *J* = 8.6 Hz, 1H), 7.62 (dd, *J* = 11.7, 7.5 Hz, 2H), 7.29 (t, *J* = 6.3 Hz, 1H), 7.06 (d, *J* = 8.6 Hz, 2H), 3.90 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 161.7, 152.8, 151.9, 143.8, 133.9, 130.1, 129.6, 128.8, 121.3, 120.7, 116.2, 114.6, 113.8, 108.5, 55.6. HRMS MALDI (*m*/*z*): calcd for $C_{17}H_{13}N_3O$ $[M + H]^+$ 276.1137, found 276.1142.

2-(m-Tolyl)pyrimido[1,2-b]indazole ***6g*** *(70%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6g**. Yellow solid, mp 151.0−152.2 °C. 54.4 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.98 (d, *J* = 7.3 Hz, 1H), 8.40 (d, *J* = 8.3 Hz, 1H), 8.07 (s, 1H), 7.99 (d, *J* = 7.7 Hz, 1H), 7.84 (d, *J* = 8.7 Hz, 1H), 7.65 (dd, *J* = 13.6, 7.7 Hz, 2H), 7.45 (t, *J* = 7.6 Hz, 1H), 7.32 (t, 2H), 2.50 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 153.2, 151.9, 143.8, 139.0, 137.0, 133.9, 131.3, 130.2, 129.1, 128.0, 124.5, 121.3, 120.9, 116.2, 113.9, 109.2, 21.7. HRMS MALDI (*m*/*z*): calcd for $C_{17}H_{13}N_3$ $[M + H]^+$ 260.1188, found 260.1191.

2-(4-Methoxyphenyl)pyrimido[1,2-b]indazole ***6h*** *(63%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6h**. Yellow solid, mp 165.1−165.7 °C. 52.7 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.93 (d, *J* = 7.4 Hz, 1H), 8.36 (d, *J* = 8.2 Hz, 1H), 8.19 (d, *J* = 8.6 Hz, 2H), 7.81 (d, *J* = 8.6 Hz, 1H), 7.62 (dd, *J* = 11.7, 7.5 Hz, 2H), 7.29 (t, *J* = 6.3 Hz, 1H), 7.06 (d, *J* = 8.6 Hz, 2H), 3.90 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 161.7, 152.8, 151.9, 143.8, 133.9, 130.1, 129.6, 128.8, 121.3, 120.7, 116.2, 114.6, 113.8, 108.5, 55.6. HRMS MALDI (*m*/*z*): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0641.

2-(2-Chlorophenyl)pyrimido[1,2-b]indazole ***6i*** *(60%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6i**. Yellow solid, mp 158.0−158.8 °C. 50.2 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 9.00 (d, *J* = 7.2 Hz, 1H), 8.36 (d, *J* = 8.3 Hz, 1H), 7.84 (dt, *J* = 8.8, 7.8 Hz, 2H), 7.69−7.60 (m, 2H), 7.53 (dd, *J* = 7.3, 1.2 Hz, 1H), 7.48−7.39 (m, 2H), 7.35−7.30 (m, 1H).$^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.7, 137.2, 132.9, 132.4, 131.9, 131.9, 130.8, 130.8, 130. 6, 130.5, 130.1, 127.5, 127.5, 121.2, 121.0, 121.0, 116.3, 114.0, 113.3. HRMS MALDI (*m*/*z*): calcd for $C_{16}H_{10}ClN_3$ $[M + H]^+$ 280.0642, found 280.0648.

2-(2-Methoxyphenyl)pyrimido[1,2-b]indazole ***6j*** *(66%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6j**. Yellow solid, mp 157.1−157.9 °C. 54.5 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.92 (d, *J* = 7.3 Hz, 1H), 8.37 (d, *J* = 8.3 Hz, 1H), 8.14 (d, *J* = 7.6 Hz, 1H), 7.91 (d, *J* = 7.3 Hz, 1H), 7.83 (d, *J* = 8.7 Hz, 1H), 7.62 (t, 1H), 7.46 (t, *J* = 7.7 Hz, 1H), 7.29 (t, *J* = 7.5 Hz, 1H), 7.17 (t, *J* = 7.5 Hz, 1H), 7.04 (d, *J* = 8.3 Hz, 1H), 3.92 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 157.6, 152.6, 151.5, 143.8, 132.5, 131.6, 131.4, 129.9, 126.8, 121.5, 121.2, 120.7, 116.1, 113.9, 113.8, 111. 7, 55.8. HRMS MALDI (*m*/*z*): calcd for $C_{17}H_{13}N_3O$ $[M + H]^+$ 276.1137, found 276.1142.

2-(3,4-Dimethylphenyl)pyrimido[1,2-b]indazole ***6k*** *(63%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6k**. Yellow solid, mp 188.5−189.7 °C. 51.6 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.97 (d, *J* = 7.4 Hz, 1H), 8.39 (d, *J* = 8.3 Hz, 1H), 8.03 (s, 1H), 7.93 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.82 (d, *J* = 8.7 Hz, 1H), 7.67−7.60 (m, 2H), 7.33−7.27 (m, 2H), 2.41 (s, 3H), 2.36 (s, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 153.2, 151.8, 143.8, 139.6, 137.5, 134.6, 133.8, 130. 5, 130.0, 128.3, 124.7, 121.3, 120.7, 116.2, 113.8, 108.9, 20.1, 19.9. HRMS MALDI (*m*/*z*): calcd for $C_{18}H_{15}N_3$ $[M + H]^+$ 274.1344, found 274.1344.

2-(Thiophene-2-yl)pyrimido[1,2-b]indazole ***6l*** *(60%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6l**. Yellow solid, mp 151.6−152.6 °C. 39.3 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.88 (d, *J* = 7.3 Hz, 1H), 8.33 (d, *J* = 8.3 Hz, 1H), 7.80 (d, *J* = 8.7 Hz, 1H), 7.74 (d, *J* = 3.5 Hz, 1H), 7.61 (t, 1H), 7.52 (dd, *J* = 9.9, 6.2 Hz, 2H), 7.29 (t, *J* = 7.0 Hz, 1H), 7.17 (t, *J* = 4.3 Hz, 1H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 151.9, 148.4, 143.4, 143.0, 133.8, 130.2, 130.0, 128.6, 127.2, 121.4, 120.9, 116.3, 113.6, 108.1. HRMS MALDI (*m*/*z*): calcd for $C_{14}H_9N_3S$ $[M + H]^+$ 252.0595, found 252.0592.

2-Butylpyrimido[1,2-b]indazole ***6m*** *(69%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **6m**. Yellow solid, mp 35.9−36.8 °C. 46.5 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.85 (d, *J* = 7.1 Hz, 1H), 8.31 (dt, *J* = 8.3, 1.0 Hz, 1H), 7.80 (d, *J* = 8.7 Hz, 1H), 7.60 (ddd, *J* = 8.5, 6.8, 1.2 Hz, 1H), 7.31−7.26 (m, 1H), 7.07 (d, *J* = 7.1 Hz, 1H), 2.99 (t, *J* = 7.4 Hz, 2H), 1.89−1.74 (m, 2H), 1.53−1.43 (m, 2H), 0.99 (t, *J* = 7.3 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 159.9, 151.5, 143.4, 133.5, 129.8, 120.9, 120.4, 115.9, 112.9, 111.9, 38.1, 31.5, 22.5, 14.0. HR-GC−MS (*m*/*z*): calcd for $C_{14}H_{15}N_3$ $[M]^+$ 225.1266, found 225.1266.

2-Pentylpyrimido[1,2-b]indazole ***6n*** *(68%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 2/1, v/v) afforded **6n**. Yellow solid, mp 58.7−59.8 °C. 53.0 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.84 (d, *J* = 7.1 Hz, 1H), 8.30 (d, *J* = 8.3 Hz, 1H), 7.79 (d, *J* = 8.7 Hz, 1H), 7.60 (t, 1H), 7.26 (dd, *J* = 9.2, 5.8 Hz, 1H), 7.06 (d, *J* = 7.1 Hz, 1H), 3.00−2.93 (m, 2H), 1.90−1.78 (m, 2H), 1.46−1.35

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(m, 4H), 0.92 (t, J = 7.0 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 160.0, 151.6, 143.5, 133. 6, 129.8, 121.0, 120.5, 116.0, 113.0, 112.0, 38.4, 31.6, 29.1, 22.6, 14.1. HRMS MALDI (m/z): calcd for $C_{15}H_{17}N_3$ $[M + H]^+$ 240.1501, found 240.1506.

2-Hexylpyrimido[1,2-b]indazole ***6o*** *(65%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **6o**. Yellow liquid, 49.3 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.87 (d, J = 7.0 Hz, 1H), 8.31 (d, J = 8.2 Hz, 1H), 7.80 (d, J = 8.7 Hz, 1H), 7.61 (ddd, J = 8.3, 6.6, 1.2 Hz, 1H), 7.28 (d, J = 7.7 Hz, 1H), 7.09 (d, J = 7.1 Hz, 1H), 2.99 (t, J = 7.2 Hz, 2H), 1.90−1.83 (m, 2H), 1.47−1.29 (m, 8H), 0.89 (t, J = 7.2 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 160.0, 151.5, 133.5, 129.8, 120. 9, 120.4, 115.9, 112.9, 112.0, 38.4, 31. 7, 29.4, 29.1, 22.6, 14.1. HR-GC−MS (m/z): calcd for $C_{16}H_{19}N_3$ $[M]^+$ 253.1579, found 253.1579.

2-Heptylpyrimido[1,2-b]indazole ***6p*** *(65%).* Flash column chromatography on silica gel (eluent: PE/EtOAc = 3/1, v/v) afforded **6p**. Yellow solid, mp 65.3−66.2 °C. 52.0 mg. ^1H NMR (400 MHz, $CDCl_3$): δ 8.84 (d, J = 7.0 Hz, 1H), 8.30 (d, J = 8.2 Hz, 1H), 7.79 (d, J = 8.7 Hz, 1H), 7.60 (ddd, J = 8.5, 6.8, 1.2 Hz, 1H), 7.34−7.25 (m, 1H), 7.05 (dd, J = 7.2, 1.5 Hz, 1H), 2.97 (t, J = 6.7 Hz, 2H), 1.83 (q, J = 7.7 Hz, 2H), 1.43−1.27 (m, 8H), 0.88 (t, J = 6.7 Hz, 3H). $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$): δ 160.0, 151.5, 143.4, 133.5, 129.7, 120.9, 120.4, 115.9, 112. 9, 111.9, 38.3, 31.7, 29.4, 29.3, 29.1, 22.6, 14.1. HR-GC−MS (m/z): calcd for $C_{17}H_{21}N_3$ $[M]^+$ 267.1735, found 267.1730.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acs.joc.1c01094.

^1H and ^{13}C NMR spectra, and X-ray crystallaographic data of **5a** (PDF)

Accession Codes

CCDC 2050287 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge via www.ccdc.cam.ac.uk/data_request/cif, or by emailing data_request@ccdc.cam.ac.uk, or by contacting The Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB2 1EZ, UK; fax: +44 1223 336033.

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Notes

The authors declare no competing financial interest.

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