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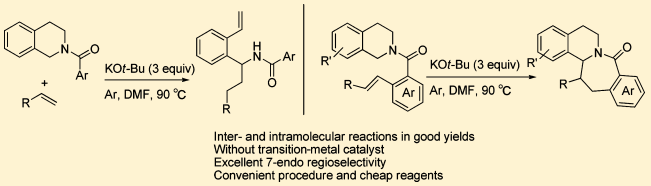
Direct Inter- and Intramolecular Addition of Amides to Arylalkenes Promoted by KO*t*-Bu/DMF

Wei-juan Wang, Xu Zhao, Lang Tong, Jia-hua Chen, Xue-jing Zhang,* and Ming Yan*

Institute of Drug Synthesis and Pharmaceutical Process, School of Pharmaceutical Sciences, Sun Yat-sen University, Guangzhou 510006, China

Supporting Information

ABSTRACT: Direct addition of tetrahydroisoquinoline derived amides to arylalkenes has been achieved in the presence of KO*t*-Bu/DMF. Both intermolecular and intramolecular reactions could occur in good yields. α-Amido alkyl radicals are proposed to be generated under the reaction conditions. The reaction is efficient for the synthesis of seven-membered nitrogen heterocycles. A homoprotoberberine was prepared conveniently via this method.



INTRODUCTION

The synthesis of nitrogen heterocycles is of great interest for synthetic and medicinal chemists because of their abundance in natural products and drugs.[1] Although many methods have been developed for the synthesis of nitrogen heterocycles, new and efficient methods are still desirable considering their structural diversity. In recent years, there have been increasing interests in the direct functionalizations of the α C−H bond of amines or amides.[2−6] The strategy provides superior advantages over the traditional methods in terms of short synthetic steps and readily available substrates. Most of these transformations proceed via the iminium intermediates generated in situ by the oxidation of amines or amides. The α-amido alkyl radicals formed by the hydrogen abstraction are also reactive intermediates for further functionalizations, but successful examples are limited because they are readily oxidized to iminium ions in the presence of oxidants.[6]

Recently, we found that KO*t*-Bu/DMF promotes the intramolecular additions of α-aryl substituted tertiary amines to alkenes or ketones.[7] The α-amino alkyl radicals were proposed to be the crucial intermediates. However, the intermolecular addition of tertiary amines to alkenes was not successful. We speculate that more electron-deficient α-amido alkyl radicals possess better reactivity with alkenes. Herein, we report inter- and intramolecular addition of tetrahydroisoquinoline derived amides to alkenes promoted by KO*t*-Bu/DMF.

RESULTS AND DISCUSSION

Initially, we examined the reaction of *N*-benzoyltetrahydroisoquinoline **1a** with styrene **2a** in the presence of KO*t*-Bu/DMF. Product **3aa** was obtained in 79% yield, together with 5% of **4** (Table 1, entry 1). The cleavage of the C−N bond of tetrahydroisoquinolines was previously reported in the presence of a strong base.[8] In the absence of the styrene **2a**, the reaction of **1a** with KO*t*-Bu/DMF gave **4** in 40% yield. We also synthesized the key intermediate 2-benzoyl-1-(2-phenylethyl)-1,2,3,4-tetrahydroisoquinoline and explored its reaction with KO*t*-Bu/DMF. The reaction gave **3aa** with excellent yield. These results obviously indicated that KO*t*-Bu promoted the cleavage of the C−N bond of **1a**. In addition, we also found that **4** did not react with styrene in the presence of KO*t*-Bu/DMF. Thus, the addition of **1a** to styrene must occur before the C−N cleavage. NaO*t*-Bu and LiO*t*-Bu were found to be completely inefficient (Table 1, entries 2 and 3).[9,10] The replacement of DMF with DMSO led to a poor yield (Table 1, entry 4). Other solvents such as DMA, toluene, dioxane, and HO*t*-Bu were incompatible (Table 1, entries 5−8). The decrease of reaction temperature led to a slightly lower yield (Table 1, entry 9). Higher reaction temperature (120 °C) did not give improved yield (Table 1, entry 10). The decrease of the loading of KO*t*-Bu and styrene led to lower yield (Table 1, entries 11−13). The radical scavenger TEMPO (2,2,6,6-tetramethylpiperidinooxy) inhibited the reaction (Table 1, entry 15). The reaction was also inhibited in the presence of oxygen (Table 1, entry 16). The results undoubtedly implicated a free radical reaction pathway.

To explore the influence of acyl groups, a number of *N*-acyl tetrahydroisoquinolines **1b**−**1h** were prepared and examined in the reaction with styrene **2a**.[11] The results are summarized in Scheme 1. When 1-(3,4-dihydroisoquinolin-2(1*H*)-yl)-2-(4-methoxyphenyl)ethanone was explored, the reaction gave **3ba** in good yield (67%). The substitution with a nitro group inhibited the reaction. Although the complete consumption of **1c** was observed, almost no expected product **3ca** could be isolated from the complicated reaction mixture. A series of *N*-heteroaryl carboxyl substrates **1d**−**1f** were also examined. *N*-1-Methyl-pyrrole-2-carboxyl tetrahydroisoquinoline **1e** gave the best yield. *N*-Pivaloyl tetrahydroisoquinoline **1h** also gave the product in good yield; however, *N*-acetyl tetrahydroisoquino-

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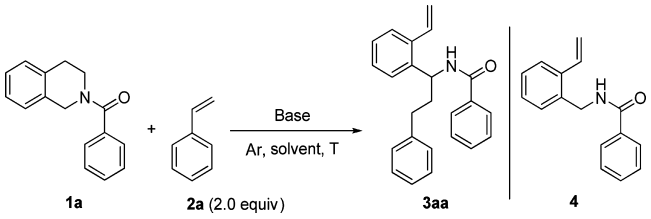
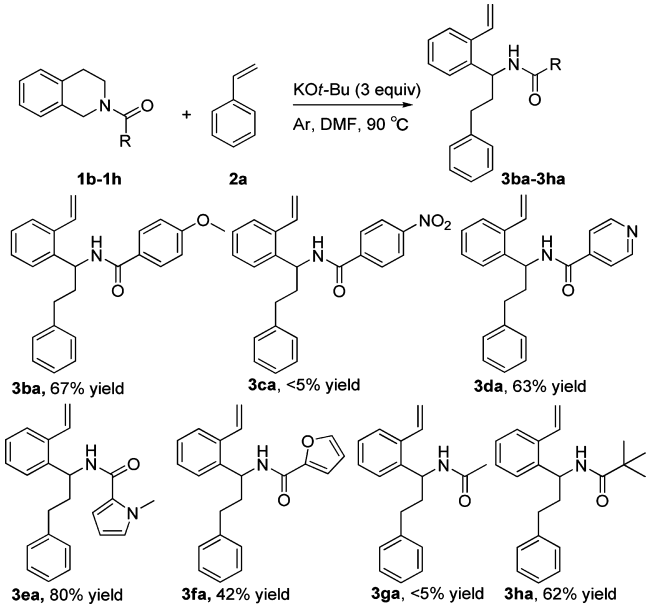
Table 1. Optimization of Reaction Conditions[a]



entry	base (equiv)	solvent	T (°C)	yield (%)[b]
1	KO*t*-Bu (3.0)	DMF	90	83 (79)
2	NaO*t*-Bu (3.0)	DMF	90	5
3	LiO*t*-Bu (3.0)	DMF	90	0
4	KO*t*-Bu (3.0)	DMSO	90	24
5	KO*t*-Bu (3.0)	DMA	90	0
6	KO*t*-Bu (3.0)	toluene	90	0
7	KO*t*-Bu (3.0)	dioxane	90	0
8	KO*t*-Bu (3.0)	HO*t*-Bu	90	0
9	KO*t*-Bu (3.0)	DMF	60	55
10	KO*t*-Bu (3.0)	DMF	120	72
11	KO*t*-Bu (1.5)	DMF	90	73
12	KO*t*-Bu (0.75)	DMF	90	37
13[c]	KO*t*-Bu (3.0)	DMF	90	62
14[d]	KO*t*-Bu (3.0)	DMF	90	78
15[e]	KO*t*-Bu (3.0)	DMF	90	0
16[f]	KO*t*-Bu (3.0)	DMF	90	trace

[a]Reaction conditions: **1a** (0.1 mmol), **2a** (0.2 mmol), base (n equiv), solvent (1.2 mL), T °C, 0.5 h. [b]Yields of **3aa** were obtained by GC with n-dodecane as the internal standard. The values in the parentheses are the isolated yields after column chromatography. [c]1.0 equiv of **2a** was used. [d]3.0 equiv of **2a** was used. [e]TEMPO (3.0 equiv) was added. [f]The reaction was carried out with an O_2 balloon.

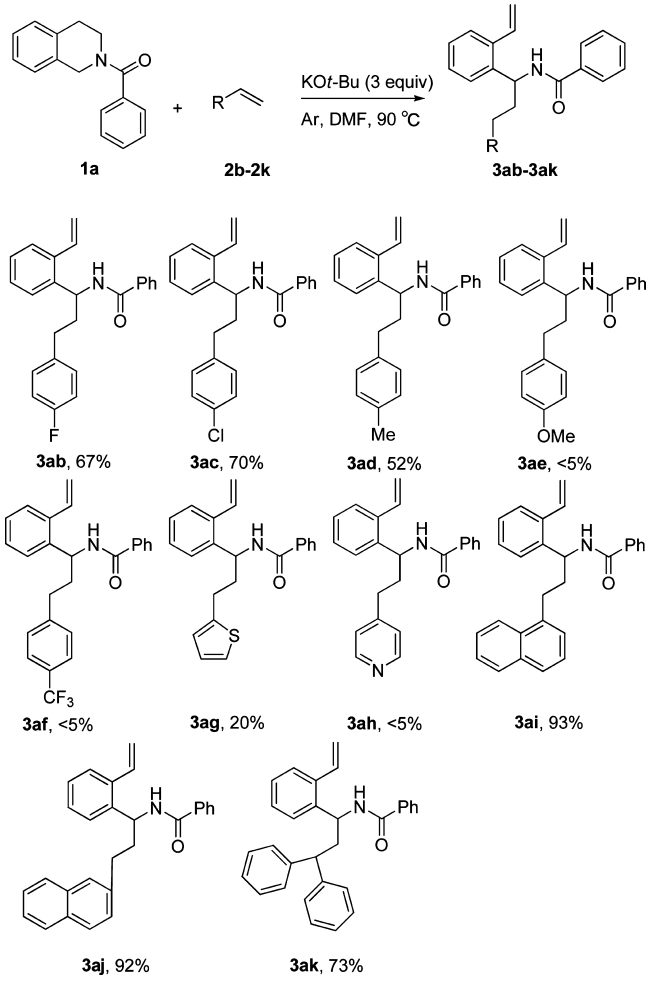
Scheme 1. Intermolecular Reaction of Tetrahydroisoquinolines 1b−1h with Styrene 2a



line only provided a trace amount of the product and most of **1g** was recovered.

Furthermore, we examined the intermolecular reactions of *N*-benzoyltetrahydroisoquinoline **1a** with alkenes **2b−2k**, and the results are summarized in Scheme 2.[12] The reaction of 4-fluoro and 4-chloro styrenes **2b** and **2c** gave products **3ab** and **3ac** in

Scheme 2. Reaction of *N*-Benzoyltetrahydroisoquinoline 1a with Alkenes 2b−2k



good yields. The substitution on styrene with a methyl group led to lower yields, while the reaction of 4-methoxyl styrene **2e** mainly gave the ring-opening product **4**. The reaction of 4-trifluoromethyl **2f** did not provide the product **3af**.[13] The reaction of 2-vinylthiophene **2g** gave the product **3ag** in 20% yield. The reaction of 4-vinylpyridine **2h** led to a poor result.[13] The reaction of 1-vinylnaphthalene **2i** and 2-vinylnaphthalene **2j** afforded the products **3ai** and **3aj** in excellent yields. α,α-Diphenylethylene **2k** is also applicable. The product **3ak** was obtained in good yield.

The intramolecular reactions of tetrahydroisoquinoline derivatives **5a−5i** were also investigated (Scheme 3). We were pleased to find that the 7-endo cyclization occurred exclusively, and seven-membered products **6a−6i** were obtained in good yields. We treated the product **6a** with KO*t*-Bu/DMF at 150 °C. No ring-opening product was observed even after 24 h. The fact demonstrates that the products **6a−6i** with a fused-ring structure are resistant to the base-promoted C−N cleavage. The reaction proceeds well with β-methyl, β-propyl, and α-methyl alkenes. Surprisingly, the ring-opening reaction did not occur in these cases. β,β-Dimethyl, cyclohexyl, and cyclopentyl alkenes are also suitable substrates. Spirocyclic products **6f−6g** were obtained in good yields. The *para*- and *meta*-methyl substitutions at the phenyl ring were also examined. The reaction provided the expected products **6h** and **6i** in comparable yields with **6a**.

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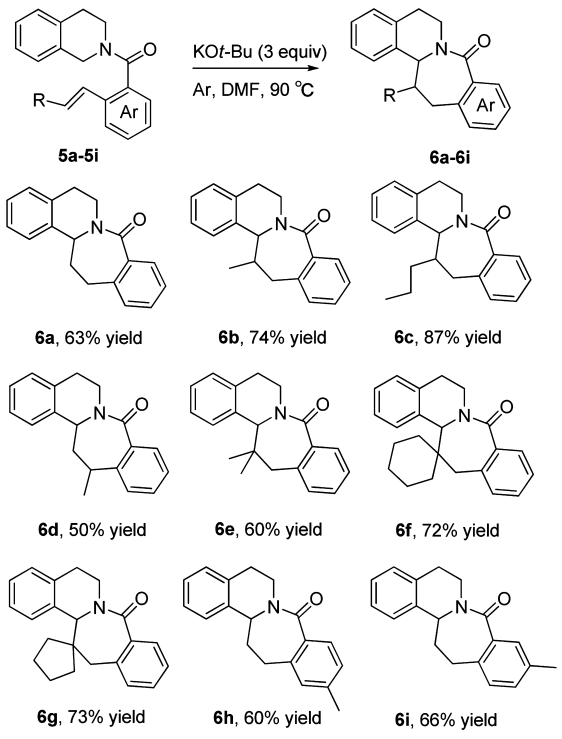
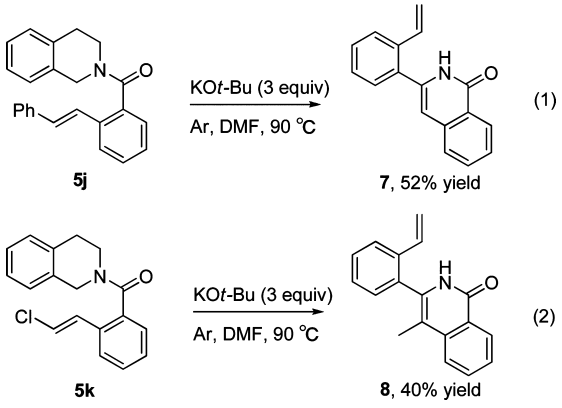
Scheme 3. Intramolecular Cyclization of Tetrahydroisoquinoline Derivatives 5a−5i



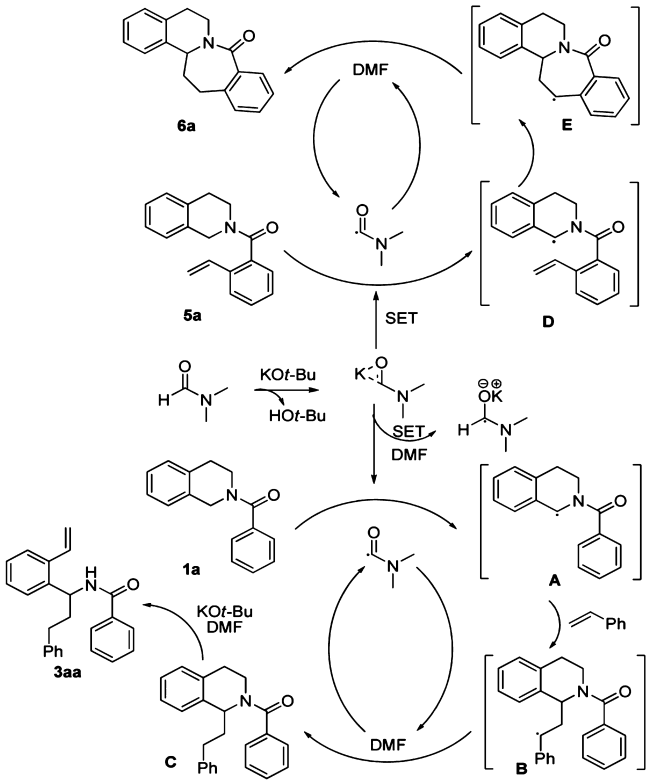
The reaction of β-phenyl alkene **5j** gave the debenzylation and ring-opening product **7** in moderate yield. The byproduct toluene was detected in the reaction mixture via GC-MS analysis. To the best of our knowledge, such a debenzylation was not reported previously.[13] On the other hand, β-chloro alkene **5k** underwent a dechlorination and ring-opening reaction to give product **8** (Scheme 4).[14]

Scheme 4. Intramolecular Cyclization of Tetrahydroisoquinoline Derivatives 5j−5k



On the basis of the experiment data and our previous study,[7] the reaction mechanism of intermolecular and intramolecular addition of amides to alkenes is proposed (Scheme 5). The DMF radical generated in the KO*t*-Bu/DMF system abstracts a hydrogen from **1a** to provide α-amido alkyl radical **A**.[15] **A** adds to alkene to give a radical intermediate **B**, which abstracts a hydrogen from DMF. The intermediate **C** undergoes a base-promoted C−N cleavage reaction to provide the final product **3aa**.[8] In the case of intramolecular reaction, the product **6a** is probably resistant to the base-promoted C−N cleavage due to its fused-ring structure.

Scheme 5. Proposed Reaction Mechanism



Furthermore, the reaction was applied to the synthesis of a homoprotoberberine bearing a fused tetrahydroisoquinoline and azepine structure (Scheme 6). Dimethoxy substituted tetrahydroisoquinoline **5l** was treated under the standard reaction conditions. The cyclization product **6l** was obtained in excellent yield. After a reduction, a homoprotoberberine **9** was produced in good yield. The method represents a new strategy for the synthesis of these biologically interesting natural products.[16,17]

CONCLUSIONS

In summary, we have developed inter- and intramolecular additions of tetrahydroisoquinoline derived amides and alkenes promoted by KO*t*-Bu/DMF. α-Substituted amides could be conveniently prepared in moderate to good yields. In addition, the intramolecular reaction provided a new synthetic pathway for seven-membered nitrogen heterocycles. The method is demonstrated to be highly efficient for the synthesis of homoprotoberberines. A radical cyclization mechanism is suggested on the basis of experiment data and previous study. Further expanding the substrate scope and applying to the synthesis of drugs and natural products are currently underway in our laboratory.

EXPERIMENTAL SECTION

General Information. The ^{1}H NMR spectra were recorded on a 400 MHz spectrometer, and resonances (δ) are given in parts per million (ppm) relative to the singlets at δ 0.0 and δ 7.26 for tetramethylsilane and chloroform, respectively. Peaks are labeled as single (s), broad singlet (br), doublet (d), triplet (t), double doublet (dd), and multiplet (m), and all coupling constants (J) are absolute values given in hertz (Hz). ^{13}C NMR spectra were recorded at 75

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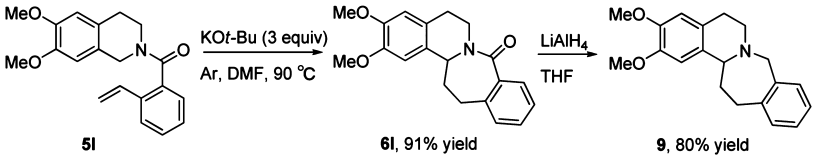
Scheme 6. Synthesis of a Homoprotoberberine



MHz with complete proton decoupling. Chemical shifts are reported in ppm relative to the central line of the heptalet at 77.0 ppm for $CDCl_3$. High-resolution mass spectra (HRMS) were acquired using an electron spray ionization time-of-flight (ESI-TOF) mass spectrometer in positive mode. The IR spectra were recorded as thin films with KBr and reported in wavenumbers (cm^{-1}). Melting points were determined with a commercially available melting point apparatus. All reagents were used without further purification as received from commercial suppliers unless otherwise noted. All solvents were dried and distilled prior to use according to the standard protocols.

General Procedure for the Preparation of Substrates (1a–1h, 5l′, 5h′, and 5i′). Compound **1** was synthesized according to a known procedure.[18] To a solution of benzoic acid (1230.0 mg, 10 mmol) and triethylamine (1.53 mL, 11 mmol) in CH_2Cl_2 (20.0 mL) was added pivaloyl chloride (1.36 mL, 11 mmol) at 0 °C. The reaction mixture was stirred at room temperature for 1 h. To this solution was slowly added a mixture of triethylamine (1.53 mL, 11 mmol) and 1,2,3,4-tetrahydroisoquinoline (1.38 mL, 11 mmol) at 0 °C. The reaction mixture was stirred at room temperature for 0.5 h. Then, the reaction mixture was quenched with water. The organic layer was washed with 10% HCl (aq), saturated $NaHCO_3$ (aq), and brine. The organic layer was dried over $MgSO_4$ and removed under reduced pressure. The residue was purified by column chromatography (petroleum ether:EtOAc = 5:1) to give **1a** as a colorless oil (2017.1 mg, 85%).

*(3,4-Dihydroisoquinolin-2(1H)-yl)(1-methyl-1H-pyrrol-2-yl)methanone (**1e**).* White solid (1562.0 mg, 65%), mp 100.1–101.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.21–7.15 (m, 3H), 7.12 (d, J = 3.1 Hz, 1H), 6.74–6.68 (m, 1H), 6.43 (dd, J = 3.8, 1.6 Hz, 1H), 6.11 (dd, J = 3.8, 2.6 Hz, 1H), 4.88 (s, 2H), 3.96 (t, J = 5.9 Hz, 2H), 3.80 (s, 3H), 2.95 (t, J = 5.9 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 163.3, 134.6, 133.3, 128.8, 126.7, 126.6, 126.5, 126.4, 125.2, 113.0, 107.0, 35.8, 29.2. IR (KBr) ν/cm^{-1}: 3113, 2923, 1615, 1530, 1434, 1244, 748. HRMS (ESI) calculated for $C_{15}H_{17}N_2O$ $[M + H]^+$: 241.1335, found: 241.1335.

*2-(6,7-Dimethoxy-1,2,h3,4-tetrahydroisoquinoline-2-carbonyl) Benzaldehyde (**5l′**).* White solid (2765.6 mg, 85%), mp 139.7–140.6 °C. Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 10.08 (s, 1H), 10.03 (s, 0.7H), 7.97 (m, 1.7H), 7.71–7.64 (m, 1.7H), 7.60 (td, J = 7.6, 1.0 Hz, 1.7H), 7.44–7.36 (m, 1.7H), 6.68 (d, J = 10.6 Hz, 1.7H), 6.59 (s, 1H), 6.31 (s, 0.7H), 4.91 (s, 2H), 4.26 (s, 1.4H), 4.07 (t, J = 6.0 Hz, 1.4H), 3.89 (s, 2.9H), 3.86 (d, J = 3.9 Hz, 5.4H), 3.75 (s, 2H), 3.43 (t, J = 5.9 Hz, 2H), 2.95 (t, J = 5.9 Hz, 1.4H), 2.69 (t, J = 5.8 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 190.6, 190.5, 168.5, 168.2, 148.1, 148.0(6)[19], 147.9, 147.7, 147.7, 138.7, 138.6, 134.2(9)[19], 134.2(7)[19], 132.9, 132.8, 130.4, 129.5(1)[19], 129.5, 127.1, 127.0, 126.5, 125.3, 124.4, 123.7, 111.8, 111.4, 109.4, 108.7, 56.0(1)[19], 59.9(9)[19], 55.9(6)[19], 55.9(2)[19], 48.7, 44.7, 44.0, 40.1, 28.8, 27.9. IR (KBr) ν/cm^{-1}: 3030, 2930, 2820, 2720, 1650, 1530, 1450, 750. HRMS (ESI) calculated for $C_{19}H_{20}NO_4$ $[M + H]^+$: 326.1381, found: 326.1387.

General Procedure for the Intermolecular Reaction of 1a–1l and 2a–2k Promoted by KO*t*-Bu/DMF. To a dried 10 mL reaction tube was added **1a** (23.5 mg, 0.1 mmol), KO*t*-Bu (33.7 mg, 0.3 mmol), **2a** (23.0 μL, 0.2 mmol), and DMF (1.0 mL). The mixture was stirred at 90 °C for 0.5 h under an argon atmosphere. After being cooled down to room temperature, the reaction mixture was diluted with CH_2Cl_2 (10 mL) and washed with water (10 mL × 2). After being washed with brine and dried over $MgSO_4$, the organic layer was removed under reduced pressure. The residue was purified by column chromatography (petroleum ether:EtOAc = 10:1) to give **3aa** as a white solid (27.0 mg, yield: 79%).

*N-(3-Phenyl-1-(2-vinylphenyl)propyl)benzamide (**3aa**).* White solid (27.0 mg, 79%), mp 124.5–125.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74–7.60 (m, 2H), 7.54–7.44 (m, 2H), 7.39 (dd, J = 10.2, 4.6 Hz, 2H), 7.36–7.27 (m, 4H), 7.18 (dd, J = 6.8, 3.4 Hz, 3H), 7.15–7.06 (m, 1H), 6.32 (d, J = 7.8 Hz, 1H), 5.62 (dd, J = 17.2 Hz, 1H), 5.55 (dd, J = 14.6, 7.7 Hz, 1H), 5.34 (dd, J = 1.4 Hz, 1H), 2.79–2.59 (m, 2H), 2.36–2.16 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.5, 141.4, 139.0, 137.2, 134.5, 134.4, 131.5, 128.5, 128.4, 128.1, 127.7, 127.0, 126.9, 126.0, 125.3, 117.1, 50.1, 37.6, 32.7. IR (KBr) ν/cm^{-1}: 3285, 3065, 3024, 2855, 2924, 2950, 1603, 1578, 1552, 1490, 1451, 1432, 1369, 1313, 984, 925, 777, 749, 701. HRMS (ESI) calculated for $C_{24}H_{23}NNaO$ $[M + Na]^+$: 364.1672, found: 364.1671.

*4-Methoxy-N-(3-phenyl-1-(2-vinylphenyl)propyl)benzamide (**3ba**).* White solid (24.9 mg, 67%), mp 147.8–149.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.64 (d, J = 8.7 Hz, 2H), 7.47 (dd, J = 5.9, 2.9 Hz, 1H), 7.33 (d, J = 5.0 Hz, 1H), 7.30–7.20 (m, 4H), 7.16 (s, 4H), 6.84 (d, J = 8.7 Hz, 2H), 6.44 (d, J = 7.7 Hz, 1H), 5.60 (d, J = 17.2 Hz, 1H), 5.52 (d, J = 7.0 Hz, 1H), 5.30 (d, J = 10.9 Hz, 1H), 3.79 (s, 3H), 2.76–2.54 (m, 2H), 2.31–2.10 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.1, 162.2, 141.5, 139.3, 137.1, 134.5, 128.8, 128.5, 128.4, 128.1, 127.6, 126.9, 126.7, 126.0, 125.4, 117.0, 113.7, 55.4, 50.0, 37.6, 32.7. IR (KBr) ν/cm^{-1}: 3288, 3028, 2934, 2838, 1627, 1606, 1532, 1504, 1313, 1253, 1177, 1028, 988, 926, 845, 763. HRMS (ESI) calculated for $C_{25}H_{26}NO_2$ $[M + H]^+$: 372.1958, found: 372.1958.

*N-(3-Phenyl-1-(2-vinylphenyl)propyl)isonicotinamide (**3da**).* White solid (21.6 mg, 63%), mp 124.5–125.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.64 (d, J = 5.9 Hz, 2H), 7.50 (dd, J = 5.3, 3.7 Hz, 1H), 7.46 (dd, J = 4.5, 1.5 Hz, 2H), 7.35–7.25 (m, 5H), 7.22–7.14 (m, 3H), 7.09 (dd, J = 17.2, 10.9 Hz, 1H), 6.58 (d, J = 7.8 Hz, 1H), 5.62 (dd, J = 17.2, 1.3 Hz, 1H), 5.53 (dd, J = 14.6, 7.6 Hz, 1H), 5.34 (dd, J = 10.9, 1.3 Hz, 1H), 2.75–2.61 (m, 2H), 2.34–2.17 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.9, 150.3, 141.6, 141.2, 138.6, 137.1, 134.2, 128.6, 128.4, 128.1, 127.9, 127.0, 126.2, 125.4, 121.0, 117.4, 50.4, 37.2, 32.7. IR (KBr) ν/cm^{-1}: 3303, 3061, 3024, 2927, 2862, 1640, 1599, 1545, 1490, 1325, 991, 931, 754, 700. HRMS (ESI) calculated for $C_{23}H_{23}N_2O$ $[M + H]^+$: 343.1797, found: 343.1805.

*1-Methyl-N-(3-phenyl-1-(2-vinylphenyl)propyl)-1H-pyrrole-2-carboxamide (**3ea**).* White solid (27.5 mg, 80%), mp 113.2–114.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.52–7.44 (m, 1H), 7.35–7.26 (m, 3H), 7.24 (d, J = 6.8 Hz, 2H), 7.18 (t, J = 7.1 Hz, 3H), 7.09 (dd, J = 17.2, 10.9 Hz, 1H), 6.69 (d, J = 1.8 Hz, 1H), 6.45 (dd, J = 3.9, 1.6 Hz, 1H), 6.14–5.99 (m, 2H), 5.61 (dd, J = 17.2, 1.4 Hz, 1H), 5.44 (dd, J = 14.6, 7.7 Hz, 1H), 5.32 (dd, J = 10.9, 1.4 Hz, 1H), 3.91 (s, 3H), 2.80–2.67 (m, 1H), 2.67–2.57 (m, 1H), 2.24–2.08 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.0, 141.4, 139.4, 136.9, 134.4, 128.5, 128.4, 128.0, 127.9, 127.5, 126.9, 126.0, 125.7, 125.2, 117.0, 111.3, 107.1, 49.3, 37.9, 36.7, 32.7. IR (KBr) ν/cm^{-1}: 3317, 3025, 2924, 2857, 1614, 1538, 1510, 1464, 1412, 1258, 1143, 1007, 909, 750, 728, 670. HRMS (ESI) calculated for $C_{23}H_{25}N_2O$ $[M + H]^+$: 345.1961, found: 345.1960.

*N-(3-Phenyl-1-(2-vinylphenyl)propyl)benzamide (**3fa**).* White solid (13.9 mg, 42%), mp 122.8–123.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.48 (dd, J = 7.1, 1.9 Hz, 1H), 7.40 (dd, J = 1.7, 0.7 Hz, 1H), 7.35 (dd, J = 7.5, 1.6 Hz, 1H), 7.29 (m, 2H), 7.25 (m, 2H), 7.17 (dd, J = 7.2, 5.3 Hz, 3H), 7.09 (dt, J = 12.8, 11.9 Hz, 2H), 6.58 (d, J = 8.2 Hz, 1H), 6.47 (dd, J = 3.5, 1.8 Hz, 1H), 5.60 (dd, J = 17.2, 1.5 Hz, 1H), 5.50 (dd, J = 14.8, 8.1 Hz, 1H), 5.32 (dd, J = 10.9, 1.4 Hz, 1H), 2.75–2.59 (m, 2H), 2.30–2.13 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 157.5, 147.9, 143.8, 141.2, 138.8, 137.1, 134.3, 128.4, 128.3, 128.1, 127.7, 126.9, 126.0, 125.3, 117.2, 114.4, 112.2, 50.0, 37.8, 32.7. IR (KBr) ν/cm^{-1}: 3300, 3030, 2930, 2850, 1640, 1590, 1471, 991, 912,

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690, 750. HRMS (ESI) calculated for $C_{22}H_{22}NO_2$.$(M + H)^+$: 332.1645, found: 332.1648.

*N-(3-Phenyl-1-(2-vinylphenyl)propyl)pivalamide (**3ha**).* White solid (19.9 mg, 62%), mp 117.5−118.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 (dd, J = 4.9, 2.8 Hz, 1H), 7.30−7.20 (m, 5H), 7.16 (t, J = 8.6 Hz, 3H), 7.03 (dd, J = 17.2, 10.9 Hz, 1H), 5.86 (d, J = 7.6 Hz, 1H), 5.59 (dd, J = 17.2, 1.4 Hz, 1H), 5.36−5.23 (m, 2H), 2.72−2.50 (m, 2H), 2.19−2.02 (m, 2H), 1.15 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 177.4, 141.5, 139.3, 137.1, 134.5, 128.5, 128.4, 128.0, 127.5, 126.9, 126.0, 125.1, 116.9, 49.4, 38.7, 37.6, 32.7, 27.6. IR (KBr) ν/cm^{-1}: 3341, 3084, 3063, 3027, 2988, 2964, 2926, 2869, 1625, 1396, 1362, 1209, 918, 754, 700. HRMS (ESI) calculated for $C_{22}H_{28}NO$ $(M + H)^+$: 322.2159, found: 322.2165.

*N-(3-(4-Fluorophenyl)-1-(2-vinylphenyl)propyl)benzamide (**3ab**).* White solid (24.1 mg, 67%), mp 106.7−108.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 (d, J = 7.3 Hz, 2H), 7.55−7.45 (m, 2H), 7.40 (t, J = 7.5 Hz, 2H), 7.37−7.27 (m, 3H), 7.19−7.06 (m, 3H), 6.95 (t, J = 8.7 Hz, 2H), 6.33 (d, J = 7.7 Hz, 1H), 5.62 (dd, J = 17.2, 1.2 Hz, 1H), 5.53 (d, J = 7.3 Hz, 1H), 5.33 (dd, J = 10.9, 1.2 Hz, 1H), 2.75−2.56 (m, 2H), 2.33−2.22 (m, 1H), 2.22−2.11 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.5, 162.6 (d, J = 242), 138.7, 137.3, 136.9 (d, J = 3), 134.4, 134.3, 131.5, 129.8(d, J = 8), 128.6, 128.1, 127.8, 127.1, 126.9, 125.3, 117.3, 115.2 (d, J = 21), 49.8, 37.7, 32.9. IR (KBr) ν/cm^{-1}: 3335, 3276, 3059, 2924, 2851, 1634, 1536, 1509, 1491, 1450, 1315, 1224, 994, 914, 829, 755, 747, 692. HRMS (ESI) calculated for $C_{24}H_{23}FNO$ $[M + H]^+$: 360.1751, found: 360.1758.

*N-(3-(4-Chlorophenyl)-1-(2-vinylphenyl)propyl)benzamide (**3ac**).* White solid (25.1 mg, 70%), mp 128.3−129.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.73−7.64 (m, 2H), 7.50−7.44 (m, 2H), 7.39 (t, J = 7.4 Hz, 2H), 7.34−7.30 (m, 1H), 7.29−7.27 (m, 1H), 7.27−7.19 (m, 3H), 7.11 (m, 3H), 6.27 (d, J = 7.5 Hz, 1H), 5.60 (dd, J = 17.2, 1.4 Hz, 1H), 5.53 (dd, J = 14.8, 7.5 Hz, 1H), 5.33 (dd, J = 10.9, 1.3 Hz, 1H), 2.72−2.57 (m, 2H), 2.33−2.22 (m, 1H), 2.22−2.12 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.5, 139.8, 138.7, 137.3, 134.4, 134.3, 131.8, 131.6, 129.8, 128.6, 128.5, 128.1, 127.8, 127.1, 126.9, 125.3, 117.3, 49.9, 37.4, 32.1. IR (KBr) ν/cm^{-1}: 3310, 3057, 2927, 2852, 1633, 153.8, 1491, 1450, 990, 909, 820, 751, 697. HRMS (ESI) calculated for $C_{24}H_{23}ClNO$ $[M + H]^+$: 376.1459, found: 376.1463.

*N-(3-p-Tolyl-1-(2-vinylphenyl)propyl)benzamide (**3ad**).* White solid (18.5 mg, 52%), mp 128.1−128.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.70−7.61 (m, 2H), 7.52−7.43 (m, 2H), 7.43−7.26 (m, 5H), 7.14 (dd, J = 17.2, 11.0 Hz, 1H), 7.08 (s, 4H), 6.31 (d, J = 7.9 Hz, 1H), 5.62 (dd, J = 17.2, 1.4 Hz, 1H), 5.54 (dd, J = 14.5, 7.7 Hz, 1H), 5.34 (dd, J = 10.9, 1.4 Hz, 1H), 2.73−2.61 (m, 2H), 2.31 (s, 3H), 2.27−2.13 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.6, 139.2, 138.3, 137.1, 135.5, 134.5, 131.4, 129.2, 128.5, 128.3, 128.1, 127.6, 127.0, 126.9, 125.4, 117.1, 50.2, 37.6, 32.3, 21.0. IR (KBr) ν/cm^{-1}: 3311, 3063, 2962, 2915, 2853, 1634, 1545, 1491, 1325, 989, 929, 812, 768, 693. HRMS (ESI) calculated for $C_{25}H_{26}NO$ $[M + H]^+$: 356.2002, found: 356.2009.

*N-(3-(Thiophen-2-yl)-1-(2-vinylphenyl)propyl)benzamide (**3ag**).* Yellow solid (6.9 mg, 20%), mp 120.1−120.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74−7.64 (m, 2H), 7.52−7.44 (m, 2H), 7.42−7.32 (m, 3H), 7.31−7.28 (m, 1H), 7.26 (d, J = 8.1 Hz, 1H), 7.20−7.13 (m, 1H), 7.13−7.09 (m, 1H), 6.90 (dd, J = 5.1, 3.5 Hz, 1H), 6.81 (d, J = 2.5 Hz, 1H), 6.42 (d, J = 7.8 Hz, 1H), 5.60 (m, 2H), 5.35 (dd, J = 10.9, 1.3 Hz, 1H), 2.98−2.83 (m, 2H), 2.40−2.21 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.6, 144.1, 138.7, 137.2, 134.4, 134.3, 131.5, 128.5, 128.1, 127.8, 127.1, 127.0, 126.9, 125.4, 124.5, 123.3, 117.3, 49.9, 37.7, 26.9. IR (KBr) ν/cm^{-1}: 3314, 3065, 2924, 2852, 1634, 1578, 1540, 1491, 1450, 1324, 991, 930, 773, 696. HRMS (ESI) calculated for $C_{22}H_{22}NOS$ $(M + H)^+$: 348.1412, found: 348.1417.

*N-(3-(Naphthalen-1-yl)-1-(2-vinylphenyl)propyl)benzamide (**3ai**).* White solid (36.4 mg, 93%), mp 145.1−146.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 (dd, J = 5.3, 4.3 Hz, 1H), 7.83 (dd, J = 6.8, 2.7 Hz, 1H), 7.70 (t, J = 7.1 Hz, 3H), 7.54−7.26 (m, 11H), 7.17 (dd, J = 17.2, 10.9 Hz, 1H), 6.37 (d, J = 7.8 Hz, 1H), 5.71−5.56 (m, 2H), 5.31 (dd, J = 10.9, 1.3 Hz, 1H), 3.27−3.14 (m, 1H), 3.13−3.01 (m, 1H), 2.49−2.24 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.6, 139.0, 137.5, 137.4, 134.5, 133.9, 131.7, 131.5, 128.8, 128.6, 128.1, 127.8, 127.1, 126.9, 126.8, 126.0, 125.9, 125.6, 125.5, 125.3, 123.6, 117.3, 50.4, 37.2, 29.9. IR (KBr) ν/cm^{-1}: 3295, 3052, 2925, 2855, 1635, 1631, 1601, 1313, 990, 914, 774, 751. HRMS (ESI) calculated for $C_{28}H_{26}NO$ $[M + H]^+$: 392.2009, found: 392.2009.

*N-(3-(Naphthalen-2-yl)-1-(2-vinylphenyl)propyl)benzamide (**3aj**).* White solid (36.0 mg, 92%), mp 138.7−139.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 (m, 3H), 7.62 (dd, J = 7.4, 6.1 Hz, 3H), 7.51 (dd, J = 7.0, 2.1 Hz, 1H), 7.47−7.40 (m, 3H), 7.38−7.29 (m, 5H), 7.27−7.22 (m, 1H), 7.19−7.11 (m, 1H), 6.37 (d, J = 7.9 Hz, 1H), 5.67−5.56 (m, 2H), 5.32 (dd, J = 10.9, 1.4 Hz, 1H), 2.94−2.76 (m, 2H), 2.43−2.25 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.5, 138.9, 137.2, 134.4, 134.3, 133.7, 132.1, 131.4, 128.5, 128.1(1),[19] 128.1, 127.7, 127.6, 127.5, 127.2, 127.0, 126.9, 126.5, 126.0, 125.4, 125.3, 117.2, 50.2, 37.4, 32.9. IR (KBr) ν/cm^{-1}: 3289, 3057, 2924, 2854, 1635, 1600, 1533, 1313, 989, 908, 774, 749, 695. HRMS (ESI) calculated for $C_{28}H_{26}NO$ $[M + H]^+$: 392.2010, found: 392.2009.

*N-(3,3-Diphenyl-1-(2-vinylphenyl)propyl)benzamide (**3ak**).* White solid (30.5 mg, 73%), mp 179.5−180.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.63−7.56 (m, 2H), 7.46 (dd, J = 9.5, 5.1 Hz, 2H), 7.37 (t, J = 7.5 Hz, 2H), 7.28 (dd, J = 6.7, 4.3 Hz, 6H), 7.24 (dd, J = 6.2, 4.5 Hz, 4H), 7.18 (tdd, J = 6.8, 4.6, 2.0 Hz, 3H), 6.75 (dd, J = 17.2, 10.9 Hz, 1H), 6.30 (d, J = 7.5 Hz, 1H), 5.52 (dd, J = 17.2, 1.4 Hz, 1H), 5.44 (dd, J = 14.1, 7.7 Hz, 1H), 5.17 (dd, J = 10.9, 1.4 Hz, 1H), 3.95 (t, J = 7.6 Hz, 1H), 2.80−2.73 (m, 1H), 2.62−2.52 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.3, 144.5, 143.7, 138.9, 137.0, 134.3, 134.2, 131.5, 128.7, 128.6, 128.0, 127.7, 126.9, 126.5, 125.4, 117.0, 49.3, 48.3, 41.6. IR (KBr) ν/cm^{-1}: 3299, 3058, 3025, 1636, 1538, 1493, 1311, 993, 911, 756, 749, 697. HRMS (ESI) calculated for $C_{30}H_{28}NO$ $[M + H]^+$: 418.2156, found: 418.2165.

*N-(2-Vinylbenzyl)benzamide (**4**).* White solid (9.5 mg, 40%), mp 99.7−100.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.79−7.68 (m, 2H), 7.55 (d, J = 7.9 Hz, 1H), 7.51−7.45 (m, 1H), 7.44−7.36 (m, 2H), 7.30 (dt, J = 8.7, 7.4 Hz, 3H), 7.01 (dd, J = 17.3, 11.0 Hz, 1H), 6.26 (s, 1H), 5.70 (dd, J = 17.3, 1.2 Hz, 1H), 5.36 (dd, J = 11.0, 1.2 Hz, 1H), 4.70 (d, J = 5.2 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 167.1, 137.2, 134.7, 134.4, 133.8, 131.5, 129.6, 128.6, 128.3, 128.1, 126.9, 126.3, 116.9, 42.3. IR (KBr) ν/cm^{-1}: 3341, 3058, 2921, 1640, 1578, 1548, 1480, 1310, 981, 917, 768, 695. HRMS (ESI) calculated for $C_{16}H_{16}NO$ $[M + H]^+$: 238.1226, found: 238.1225.

General Procedure for the Preparation of 5a−5g, 5j−5l. Compound **5a** was synthesized according to a known procedure.[20] A mixture of $MePPh_3Br$ (1970.0 mg, 5.5 mmol) and KO*t*-Bu (650.0 mg, 5.75 mmol) in dry THF (10 mL) was stirred at room temperature for 1 h. After addition of **5a′** (1330.0 mg, 5 mmol), the reaction mixture was stirred at room temperature for 1 h. The solvent was then evaporated under reduced pressure. The residue was purified by column chromatography (petroleum ether:EtOAc = 10:1) over silica gel to give **5a** as a colorless oil (1053.3 mg, yield: 80%).

*(3,4-Dihydroisoquinolin-2(1H)-yl)(2-vinylphenyl)methanone (**5a**).* Colorless oil (1053.3 mg, 80%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (t, J = 8.2 Hz, 1.6H), 7.37 (m, 1.6H), 7.30 (m, 1.6H), 7.21 (m, 6H), 7.11 (dd, J = 11.5, 6.8 Hz, 1.6H), 6.74 (m, 2.2H), 5.74 (m, 1.6H), 5.28 (m, 1H), 5.22 (d, J = 11.0 Hz, 0.6H), 4.95 (d, J = 15.5 Hz, 2H), 4.32 (s, 1.2H), 4.05 (m, 1.2H), 3.41 (t, J = 5.9 Hz, 2H), 2.97 (t, J = 5.4 Hz, 1.2H), 2.75 (t, J = 5.7 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.1, 169.8, 135.5, 135.4, 134.6, 134.4, 133.9, 133.6, 133.4, 132.8, 132.7, 129.2, 129.1, 128.9, 128.7, 128.1, 128.0, 126.9, 126.8, 126.7, 126.6, 126.5, 126.4, 126.3, 126.0, 125.6, 125.5, 116.8, 116.7, 48.7, 44.5, 44.2, 39.9, 29.5, 28.5. IR (KBr) v/cm^{-1}: 3022, 3057, 2927, 2852, 1633, 1538, 1491, 1450, 990, 909, 820, 751, 697. HRMS (ESI) calculated for $C_{18}H_{18}NO$ $[M + H]^+$: 264.1375, found: 264.1383.

*(3,4-Dihydroisoquinolin-2(1H)-yl)(2-(prop-1-enyl)phenyl)-methanone (**5b**).* Colorless oil (1109.4 mg, 80%). Atropisomer and *Z*/*E* isomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.48 (m, 2.2H), 7.37 (m, 3.6H), 7.33 (d, J = 7.5 Hz, 3H), 7.28 (m, 6.5H), 7.20 (m, 8.8H), 7.15 (m, 5.9H), 7.10 (dd, J = 9.8, 5.8 Hz, 5.3H), 6.81 (t, J = 7.0 Hz, 1.8H), 6.40 (m, 3.8H), 6.20 (m, 2.6H), 5.81 (m, 1.6H), 5.65 (m, 1.1H), 4.92 (m, 5.1H), 4.30 (d, J = 7.2 Hz, 3.1H), 4.03 (m, 3.7H), 3.40 (m, 4.8H), 2.95 (mz, 3.8H), 2.73 (d, J = 5.4 Hz, 5.1H), 1.84 (dd, J = 7.1, 1.7 Hz, 3.5H), 1.81 (dd, J = 6.6, 1.4 Hz, 2.9H), 1.71 (dd, J = 7.1, 1.7 Hz, 3H),

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1.63 (dd, J = 6.5, 1.4 Hz, 1.9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.3, 170.2, 169.9, 169.8, 136.4, 136.3, 134.8, 134.7, 134.6, 134.5, 134.4, 134.1, 133.9, 133.0, 132.8, 129.5, 128.7, 128.6(8)[19], 128.6(5)[19], 128.6, 128.5, 127.6, 127.5, 127.1, 127.0, 126.9, 126.8, 126.6, 126.5, 126.4, 126.3, 126.2, 126.1, 126.0, 125.8, 125.6, 125.5, 48.8, 48.6, 44.4, 44.3, 44.2, 44.1, 39.9, 39.8, 29.4, 28.5, 18.8, 18.5, 14.6, 14.5. IR (KBr) ν/cm^{-1}: 3022, 2960, 2933, 2870, 2850, 1636, 1450, 1429, 1368, 1299, 964, 752. HRMS (ESI) calculated for $C_{19}H_{20}NO$ $[M + H]^+$: 278.1531, found: 278.1539.

*(3,4-Dihydroisoquinolin-2(1H)-yl)(2-(pent-1-enyl)phenyl)-methanone (**5c**).* Colorless oil (992.6 mg, 65%). Atropisomer and Z/E isomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (m, 1H), 7.38−7.34 (m, 2.2H), 7.33 (dd, J = 6.3, 3.2 Hz, 2H), 7.29 (dd, J = 6.2, 3.3 Hz, 1H), 7.27 (d, J = 1.2 Hz, 1H), 7.24 (dd, J = 7.3, 1.3 Hz, 2H), 7.22−7.17 (m, 5.3H), 7.15 (dd, J = 7.2, 3.4 Hz, 4H), 7.08 (q, J = 4.0 Hz, 3H), 6.83−6.76 (m, 1H), 6.47−6.10 (m, 4H), 5.71 (m, 1H), 5.59 (m, 0.72H), 4.87 (m, 3.5H), 4.30 (s, 2.4H), 3.98 (s, 2H), 3.40 (d, J = 3.6 Hz, 3.5H), 2.95 (dt, J = 12.1, 6.0 Hz, 2.6H), 2.73 (t, J = 5.8 Hz, 3.6H), 2.33−2.16 (m, 2.7H), 2.16−2.04 (m, 2.3H), 1.96 (m, 1H), 1.42 (m, 3.8H), 1.34−1.20 (m, 2.6H), 0.95−0.77 (m, 8.6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.4, 170.3, 170.0, 169.9, 136.4, 136.3, 134.9, 134.8(2)[19], 134.8, 134.7(4)[19], 134.7, 134.6(4)[19], 134.6, 134.5, 134.4, 134.3, 134.1, 133.9(4)[19], 133.9, 132.9, 132.8, 129.4(4)[19], 129.4(2)[19], 129.1, 129.0, 128.9(5)[19], 128.9(2)[19], 128.7, 128.6, 128.5, 127.0, 126.8, 126.7, 126.6, 126.5(6)[19], 126.5, 126.4, 126.3(4)[19], 126.3, 126.2(6)[19], 126.2(4)[19], 126.2(2)[19], 126.1, 126.0, 125.9, 125.8, 125.7, 125.6, 48.7, 48.6, 44.4, 44.3, 44.2, 39.9, 39.8, 35.2, 35.1, 30.7, 30.6, 29.5, 29.4, 28.5, 23.1, 22.9, 22.4, 22.1, 14.0, 13.9, 13.7, 13.6. IR (KBr) ν/cm^{-1}: 3030, 2962, 3935, 2877, 2854, 1632, 1510, 1450, 1430, 970, 751. HRMS (ESI) calculated for $C_{21}H_{24}NO$ $[M + H]^+$: 306.1845, found: 306.1852.

*(3,4-Dihydroisoquinolin-2(1H)-yl)(2-(prop-1-en-2-yl)phenyl)-methanone (**5d**).* Colorless oil (693.4 mg, 50%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38−7.34 (m, 1H), 7.34−7.31 (m, 1.7H), 7.30 (dd, J = 4.4, 3.0 Hz, 1.7H), 7.29−7.27 (m, 1H), 7.27−7.26 (m, 0.7H), 7.26−7.22 (m, 1H), 7.21 (dd, J = 6.1, 3.0 Hz, 0.7H), 7.19−7.16 (m, 1.7H), 7.16−7.11 (m, 2.7H), 7.09 (dd, J = 11.2, 4.9 Hz, 2H), 6.82 (d, J = 7.4 Hz, 0.7H), 5.15−5.11 (m, 1H), 5.08 (d, J = 0.7 Hz, 1H), 4.98 (dd, J = 3.0, 1.5 Hz, 0.7H), 4.96 (s, 0.7H), 4.67 (s, 0.7H), 4.34 (s, 1.7H), 4.15−4.00 (m, 0.7H), 3.90−3.74 (m, 0.7H), 3.42 (m, 2H), 2.91 (d, J = 5.5 Hz, 1.7H), 2.75 (s, 2H), 2.10 (s, 3H), 1.97 (s, 2H), 1.31 (s, 0.7H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.8, 170.3, 143.7, 143.3, 140.6, 140.5, 134.8, 134.6, 133.9, 132.8, 132.7, 129.0, 128.9, 128.6, 128.0, 127.9, 127.5, 127.4, 126.8(3)[19], 126.8, 126.7(8)[19], 126.7(6)[19], 126.7, 126.6, 126.5, 126.3, 126.2, 125.9, 116.1, 116.0, 48.9, 44.5, 44.3, 39.8, 29.5, 28.2, 23.6, 23.5. IR (KBr) ν/cm^{-1}: 3063, 2960, 2870, 2850, 1630, 1530, 1480, 1360, 890, 750. HRMS (ESI) calculated for $C_{19}H_{20}NO$ $[M + H]^+$: 278.1532, found: 278.1539.

*(3,4-Dihydroisoquinolin-2(1H)-yl)(2-(2-methylprop-1-enyl)-phenyl)methanone (**5e**).* Colorless oil (947.0 mg, 65%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38−7.32 (m, 2H), 7.27 (m, 5.4H), 7.21 (t, J = 7.0 Hz, 3H), 7.18−7.13 (m, 2.7H), 7.13−7.07 (m, 2H), 6.80 (d, J = 7.1 Hz, 1H), 6.23 (s, 0.9H), 6.07 (s, 1H), 5.00 (s, 0.9H), 4.84 (s, 0.9H), 4.39 (s, 1H), 4.26 (d, J = 3.5 Hz, 1.8H), 3.60 (s, 1H), 3.38 (d, J = 3.5 Hz, 1.8H), 3.01−2.85 (m, 2H), 2.72 (d, J = 4.2 Hz, 2H), 1.82 (s, 5.4H), 1.59 (d, J = 1.1 Hz, 3H), 1.45 (d, J = 1.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.6, 170.1, 137.5, 137.4, 136.3, 136.2, 135.3, 135.1, 134.5, 133.9, 133.0, 132.9(7)[19], 129.8, 129.6, 129.0, 128.6, 128.5, 126.8, 126.6, 126.5(7)[19], 126.5(5)[19], 126.5, 126.6, 126.1, 126.0, 125.7, 122.2, 121.7, 77.4, 77.1, 76.7, 48.7, 44.2, 44.1, 39.8, 29.4, 28.7, 26.5, 25.7, 19.5, 19.1. IR (KBr) ν/cm^{-1}: 3063, 2972, 2929, 2870, 2852, 1635, 1483, 1450, 1428, 1369, 1335, 1300, 850, 751. HRMS (ESI) calculated for $C_{20}H_{22}NO$ $[M + H]^+$: 292.1686, found: 292.1696.

*(2-(Cyclohexylidenemethyl)phenyl)(3,4-dihydroisoquinolin-2(1H)-yl)methanone (**5f**).* Colorless oil (1209.2 mg, 70%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36−7.30 (m, 2H), 7.27 (d, J = 6.4 Hz, 3H), 7.21 (t, J = 8.2 Hz, 5H), 7.13 (m, 6H), 6.82 (d, J = 7.3 Hz, 1H), 6.19 (s, 1H), 6.08 (s, 1H), 5.06 (m, 1H), 4.77 (m, 1H), 4.28 (m, 3H), 3.72 (s, 1H), 3.39 (d, J = 5.0 Hz, 2H), 2.93 (s, 2H), 2.74 (t, J = 5.6 Hz, 2H), 2.30 (d, J = 5.8 Hz, 2H), 2.18 (s, 4H), 2.05 (m, 3H), 1.83 (s, 1H), 1.52 (m, 10H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.6, 170.0, 145.2, 145.1, 136.4, 136.3, 134.9, 134.8, 134.5, 134.0, 132.9(4)[19], 132.9(1)[19], 130.0, 129.8, 129.0, 128.5, 128.4, 126.6(1)[19], 126.6, 126.5(8)[19], 126.5, 126.2, 126.1(5)[19], 126.1, 125.9, 119.1, 118.7, 48.6, 44.3, 44.1, 39.7, 37.4, 37.1, 29.7, 29.6, 29.4, 28.7, 28.5, 28.3, 27.9, 27.7, 26.5, 26.4. IR (KBr) ν/cm^{-1}: 3061, 3023, 2926, 2851, 1637, 1482, 1447, 1428, 1299, 1257, 1148, 843, 749. HRMS (ESI) calculated for $C_{23}H_{26}NO$ $[M + H]^+$: 332.2001, found: 332.2009.

*(2-(Cyclopentylidenemethyl)phenyl)(3,4-dihydroisoquinolin-2(1H)-yl)methanone (**5g**).* Colorless oil (1111.0 mg, 70%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 (d, J = 7.9 Hz, 1H), 7.38 (d, J = 7.7 Hz, 1H), 7.36−7.29 (m, 2H), 7.22−7.16 (m, 6H), 7.13 (m, 3H), 7.06 (m, 3H), 6.75 (d, J = 7.4 Hz, 1H), 6.35−6.29 (m, 1H), 6.22−6.15 (m, 1H), 4.93 (m, 2H), 4.42−4.30 (m, 1H), 4.26 (s, 2H), 3.69−3.59 (m, 1H), 3.37 (t, J = 5.8 Hz, 2H), 3.03−2.84 (m, 3H), 2.71 (t, J = 5.8 Hz, 2H), 2.55−2.38 (m, 4H), 2.27 (m, 4H), 1.78 (m, 4H), 1.51−1.28 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.6, 170.1, 149.5, 149.4, 135.8, 135.7, 135.4, 134.4, 133.9, 133.1, 133.0, 129.0, 128.7, 128.6, 128.0, 127.9, 126.6, 126.5(7)[19], 126.5, 126.3, 126.2, 126.1, 126.0, 125.7, 117.3, 117.0, 48.7, 44.4, 44.1, 39.8, 35.6, 34.9, 31.3, 30.9, 29.4, 28.7, 27.0, 26.7, 25.5, 25.3. IR (KBr) ν/cm^{-1}: 3060, 3023, 2950, 2866, 1635, 1480, 1449, 1428, 1299, 1256, 1148, 832,749. HRMS (ESI) calculated for $C_{22}H_{24}NO$ $[M + H]^+$: 318.1845, found: 318.1852.

*(E)-(3,4-Dihydroisoquinolin-2(1H)-yl)(2-styrylphenyl)methanone (**5j**).* White solid (1272.9 mg, 75%), mp 82.3−85.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.69 (m, 0.7H), 7.38 (m, 1.7H), 7.33−7.23 (m, 5.1H), 7.23−7.15 (m, 8.5H), 7.15−7.05 (m, 5.1H), 7.01 (m, 2.1H), 6.76 (dd, J = 15.8, 7.5 Hz, 0.7H), 6.66−6.57 (m, 1H), 6.53 (m, 0.7H), 5.14−4.79 (m, 2H), 4.36 (d, J = 11.9 Hz, 1.4H), 4.13 (s, 1H), 3.97 (d, J = 5.4 Hz, 1H), 3.45 (d, J = 5.7 Hz, 2H), 2.94 (m, 1.4H), 2.72 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.2, 170.1, 169.8, 169.7, 136.9, 136.7, 136.6, 136.5, 136.4, 135.7, 135.6, 134.6, 134.5, 134.4(4)[19], 134.4(3)[19], 134.2, 133.9, 133.8, 132.9, 132.8, 132.7, 132.0, 131.5, 131.3, 129.8, 129.4, 129.3, 129.1, 129.0, 128.9(1)[19], 128.9, 128.7, 128.6(9)[19], 128.6(4)[19], 128.6, 128.4, 128.2, 128.0, 127.9, 127.8, 127.6, 127.5, 127.4(5)[19], 127.3, 127.1, 126.9, 126.8(7)[19], 126.8(4)[19], 126.8, 126.7(7)[19], 126.6(5)[19], 126.5(6)[19], 126.4, 126.3(7)[19], 126.3, 126.0, 125.9, 125.7, 125.6, 125.0, 48.9, 48.8, 44.6, 44.5, 44.3, 44.2, 40.1, 39.9, 29.8, 29.5, 29.4, 28.6. IR (KBr) v/cm^{-1}: 3023, 2925, 2841, 1634, 1495, 1448, 1429, 1256, 962, 762. HRMS (ESI) calculated for $C_{24}H_{22}NO$ $[M + H]^+$: 340.1689, found: 340.1696.

*(E)-(2-(2-Chlorovinyl)phenyl)(3,4-dihydroisoquinolin-2(1H)-yl)-methanone (**5k**).* Colorless oil (893.4 mg, 60%). Atropisomer and Z/E isomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95−7.87 (m, 0.7H), 7.47−7.05 (m, 12H), 6.92−6.56 (m, 3H), 6.30 (d, J = 8.1 Hz, 0.4H), 6.15 (d, J = 8.0 Hz, 0.3H), 4.92 (s, 2H), 4.32 (d, J = 9.6 Hz, 1.4H), 4.01 (m, 1.4H), 3.42 (dd, J = 12.4, 6.4 Hz, 2H), 2.97 (dd, J = 14.3, 6.2 Hz, 1.4H), 2.75 (d, J = 5.3 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 169.7, 169.6, 169.3, 169.2, 136.5, 136.4, 135.1, 135.0, 134.5, 134.4, 133.8, 133.7, 132.7, 132.6, 132.5, 131.7, 131.6, 130.1, 130.0, 129.6, 129.5, 129.4(5)[19], 129.4, 129.1, 128.9, 128.8, 128.7, 128.4, 128.3(8)[19], 127.0, 126.9, 126.8, 127.7(8)[19], 126.7, 126.6(4)[19], 126.6, 126.4, 126.3(8)[19], 126.3(6)[19], 126.1, 126.0(6)[19], 126.0, 125.9, 125.8, 121.4, 121.3, 120.0, 48.8(8)[19], 48.8(6)[19], 44.6, 44.5, 44.3, 44.2, 29.5, 29.4, 28.5. IR (KBr) v/cm^{-1}: 3067, 2926, 1634, 1430, 1299, 1258, 979, 750. HRMS (ESI) calculated for $C_{18}H_{17}ClNO$ $[M + H]^+$: 298.0988, found: 298.0993.

*(6,7-Dimethoxy-3,4-dihydroisoquinolin-2(1H)-yl)(2-vinylphenyl)-methanone (**5l**).* Colorless oil (1293.6 mg, 80%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.61 (t, J = 7.3 Hz, 1.7H), 7.38 (t, J = 7.5 Hz, 1.7H), 7.34−7.28 (m, 1.7H), 7.24 (t, J = 8.0 Hz, 1.7H), 6.80−6.64 (m, 3.4H), 6.59 (s, 1H), 6.33 (s, 0.7H), 5.75 (m, 1.7H), 5.30 (d, J = 11.1 Hz, 1H), 5.24 (d, J = 11.0 Hz, 0.7H), 4.88 (m, 2H), 4.26 (s, 1.4H), 4.13−4.02 (m, 0.7H), 4.01−3.93 (m, 0.7H), 3.90−3.82 (m, 8.2H), 3.75 (s, 2H), 3.42 (t, J = 5.9 Hz, 2H), 2.90 (s, 1.4H), 2.68 (t, J = 5.7 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.0, 169.7, 148.0, 147.9, 147.8, 147.7, 135.5, 135.4, 134.3, 133.5, 133.4, 129.1, 129.0, 128.0, 126.5, 126.4, 126.2, 125.6, 125.5, 125.4, 124.6, 124.4, 116.7, 116.6, 111.6, 111.4, 109.4, 108.8, 56.0, 48.4, 44.6, 43.8, 39.9, 28.9, 28.1.

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IR (KBr) ν/cm^{-1}: 3061, 2934, 2835, 1632, 1518, 1485, 1450, 1432, 1012, 918, 754. HRMS (ESI) calculated for $C_{20}H_{22}NO_3$ [M + H]$^+$: 324.1587, found: 324.1594.

General Procedure for the Preparation of 5h and 5i. A mixture of potassium vinyltrifluoroborate (1000.0 mg, 7.5 mmol), $PdCl_2$ (17.8 mg, 0.1 mmol), PPh_3 (78.7 mg, 0.3 mmol), Cs_2CO_3 (3930.0 mg, 15 mmol), and **5h′** (1650.0 mg, 5 mmol) in THF/H_2O (9:1, 10 mL) was stirred and heated at 85 °C in a sealed tube. After 22 h, the reaction mixture was cooled to room temperature and diluted with H_2O (15 mL). After extraction with CH_2Cl_2 (15 mL × 3) and evaporation in vacuo, the crude product was obtained. The crude was purified by silica gel chromatography (petroleum ether:EtOAc = 10:1) to give **5h** as a colorless oil (1250.0 g, yield: 90%).[21]

*(3,4-Dihydroisoquinolin-2(1H)-yl)(4-methyl-2-vinylphenyl)-methanone (**5h**).* Colorless oil (1178.8 mg, 85%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41 (d, J = 9.0 Hz, 1.7H), 7.21 (t, J = 6.9 Hz, 3H), 7.17 (d, J = 4.1 Hz, 2.7H), 7.14 (d, J = 2.3 Hz, 2.1H), 7.11 (s, 1.7H), 6.85 (d, J = 7.5 Hz, 0.7H), 6.70 (m, 1.7H), 5.74 (m, 1.7H), 5.27 (m, 1H), 5.20 (m, 0.7H), 4.94 (d, 2H), 4.33 (d, 1.4H), 4.00 (s, 1.4H), 3.43 (t, J = 5.9 Hz, 2H), 2.97 (t, J = 5.7 Hz, 1.4H), 2.76 (t, J = 5.8 Hz, 2H), 2.39 (s, 5.1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.4, 170.0, 139.0, 138.9, 134.7, 134.3, 133.9, 133.7, 133.6, 133.2, 132.9, 132.8, 132.8, 132.7, 129.1, 129.0, 128.8, 128.7, 128.6, 126.8, 126.7, 126.6, 126.5(2)a, 126.5, 126.3, 126.1, 126.0, 125.9, 116.3, 116.2, 48.7, 44.5, 44.2, 39.9, 29.5, 28.5, 21.4. IR(KBr) ν/cm^{-1}: 3030, 2960, 2930, 2870, 2850, 1636, 1584, 1496, 1431, 1256, 990, 930, 820, 735. HRMS (ESI) calculated for $C_{19}H_{20}NO$ [M + H]$^+$: 278.1531, found: 278.1539.

*(3,4-Dihydroisoquinolin-2(1H)-yl)(5-methyl-2-vinylphenyl)-methanone (**5i**).* Colorless oil (1178.8 mg, 85%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.48 (t, J = 8.2 Hz, 1.7H), 7.19 (dd, J = 7.0, 4.5 Hz, 3H), 7.15 (d, J = 5.0 Hz, 2.7H), 7.09 (d, J = 6.4 Hz, 2.1H), 7.04 (d, J = 10.2 Hz, 1.7H), 6.82 (d, J = 7.4 Hz, 0.7H), 6.67 (m, 1.7H), 5.68 (t, J = 17.2 Hz, 1.7H), 5.26−5.19 (m, 1H), 5.15 (d, J = 11.4 Hz, 0.7H), 4.93 (d, 2H), 4.32 (d, 1.4H), 4.07 (d, J = 5.7 Hz, 0.7H), 3.99−3.86 (m, 0.7H), 3.42 (t, J = 5.9 Hz, 2H), 2.96 (d, J = 3.5 Hz, 1.4H), 2.75 (t, J = 5.3 Hz, 2H), 2.34 (s, 3H), 2.32 (s, 2.1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.3, 169.9, 138.1, 135.5, 135.3, 134.6, 133.9, 133.4, 133.3, 132.9, 132.8, 131.6, 131.5, 130.1, 130.0, 128.9, 128.7, 126.9, 126.8, 126.7(5)[19], 126.7(3)[19], 126.6, 126.0, 125.5, 125.4, 115.7, 115.6, 48.6, 44.4, 44.2, 39.9, 29.5, 28.5, 21.2, 21.1. IR (KBr) ν/cm^{-1}: 3021, 2922, 2860, 1636, 1583, 1495, 1436, 1259, 1207, 987, 930, 827, 751. HRMS (ESI) calculated for $C_{19}H_{20}NO$ [M + H]$^+$: 278.1533, found: 278.1539.

General Procedure for the Intramolecular Cyclization Reaction of 5a−5k Promoted by KO*t*-Bu/DMF. To a dried 10 mL reaction tube was added **5a** (26.3 mg, 0.1 mmol), KO*t*-Bu (33.7 mg, 0.3 mmol), and DMF (1.0 mL). The mixture was stirred at 90 °C for 0.5 h under an argon atmosphere. After being cooled down to room temperature, the reaction mixture was diluted with CH_2Cl_2 (10 mL) and washed with water (10 mL × 2) and brine (10 mL × 1). After being dried over $MgSO_4$, the organic layer was removed under reduced pressure. The residue was purified by column chromatography (petroleum ether:EtOAc = 5:1) to give **6a** as a white solid (16.6 mg, yield: 63%).

*5,6,14,14a-Tetrahydrobenzo[5,6]azepino[2,1-a]isoquinolin-8-(13H)-one (**6a**).* White solid (16.6 mg, 63%), mp 129.0−129.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.70 (m, 1H), 7.39 (m, 2H), 7.18 (m, 4H), 6.95 (d, J = 7.1 Hz, 1H), 4.50 (dd, J = 12.3, 5.3 Hz, 1H), 3.92 (dd, J = 8.9, 4.0 Hz, 2H), 2.99 (m, 3H), 2.76 (dd, J = 13.7, 6.4 Hz, 1H), 2.16 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.6, 137.4, 136.1, 136.1, 135.2, 131.0, 128.8, 128.4, 128.3, 127.2, 127.0, 126.7, 126.1, 55.5, 39.8, 39.5, 30.9, 29.0. IR (KBr) ν/cm^{-1}: 2927, 2910, 2861, 1639, 1603, 1457, 1425, 1230, 749. HRMS (ESI) calculated for $C_{18}H_{18}NO$ [M + H]$^+$: 264.1383, found: 264.1380.

*11-Methyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6b**).* White solid (20.5 mg, 74%), mp 132.3−133.1 °C. Cis isomer: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (d, J = 7.7 Hz, 1H), 7.17 (m, 4H), 7.03 (s, 1H), 6.97 (d, J = 7.0 Hz, 1H), 4.51 (dd, J = 12.3, 5.4 Hz, 1H), 3.92 (s, 2H), 2.96 (s, 3H), 2.71 (dd, J = 13.7, 6.1 Hz, 1H), 2.40 (s, 3H), 2.15 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.8, 141.2, 137.4, 136.3, 135.3, 133.7, 129.0, 128.9, 128.3, 127.8, 126.9, 126.6, 126.1, 55.6, 39.9, 39.6, 30.9, 29.0, 21.5. Trans isomer: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (dd, J = 7.4, 1.5 Hz, 1H), 7.46−7.34 (m, 2H), 7.22 (dd, J = 10.0, 2.5 Hz, 2H), 7.16 (m, 2H), 6.87 (d, J = 7.4 Hz, 1H), 4.38 (m, 1H), 3.88 (d, J = 11.3 Hz, 1H), 3.36−3.15 (m, 2H), 3.12−3.00 (m, 1H), 2.99−2.90 (m, 1H), 2.51 (d, J = 13.3 Hz, 1H), 2.26−2.12 (m, 1H), 0.87 (d, J = 6.7 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 171.1, 136.6, 136.0, 135.7, 135.0, 130.6, 129.6, 128.6, 128.2, 127.7, 127.5, 127.2, 126.1, 62.8, 42.9, 42.7, 39.0, 28.8, 16.4. IR (KBr) ν/cm^{-1}: 3033, 2960, 2930, 2871, 1635, 1603, 1400, 1380, 771, 756. HRMS (ESI) calculated for $C_{19}H_{20}NO$ [M + H]$^+$: 278.1539, found: 278.1538.

*14-Propyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6c**).* White solid (26.6 mg, 87%), mp 158.3−159.5 °C. Cis isomer: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.69 (dd, J = 7.5, 1.3 Hz, 1H), 7.41 (td, J = 7.4, 1.4 Hz, 1H), 7.34 (dt, J = 7.5, 3.8 Hz, 1H), 7.23 (d, J = 7.3 Hz, 1H), 7.19−7.11 (m, 3H), 7.03−6.95 (m, 1H), 4.74−4.63 (m, 2H), 3.42−3.32 (m, 1H), 3.01 (m, 1H), 2.95−2.86 (m, 2H), 2.64−2.56 (m, 1H), 2.49 (m, 1H), 1.55−1.42 (m, 1H), 1.28−1.14 (m, 3H), 0.83 (t, J = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.4, 137.5, 136.1, 135.6, 134.2, 130.8, 128.8, 128.7, 128.3, 127.2, 126.6, 126.5, 125.9, 58.1, 47.8, 39.2, 37.5, 33.2, 29.2, 20.5, 14.0. Trans isomer: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.73 (dd, J = 7.4, 1.5 Hz, 1H), 7.44−7.35 (m, 2H), 7.24 (d, J = 4.0 Hz, 2H), 7.19−7.12 (m, 2H), 6.88 (d, J = 7.4 Hz, 1H), 4.36 (m, 1H), 3.91 (d, J = 11.3 Hz, 1H), 3.22 (m, 1H), 3.14−3.02 (m, 2H), 2.93 (m, 1H), 2.78 (d, J = 13.5 Hz, 1H), 2.03−1.92 (m, 1H), 1.61−1.49 (m, 1H), 1.22−1.03 (m, 3H), 0.80 (t, J = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 171.1, 136.8, 136.1, 136.0, 135.0, 130.6, 129.5, 128.7, 128.6, 127.7, 127.5, 127.1, 126.0, 62.0, 48.1, 42.9, 34.1, 30.6, 28.9, 20.7, 14.1. IR (KBr) ν/cm^{-1}: 3000, 2941, 2927, 2868, 2852, 1632, 1570, 1459, 1419, 1255, 741. HRMS (ESI) calculated for $C_{21}H_{24}NO$ [M + H]$^+$: 306.1846, found: 306.1852.

*13-Methyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6d**).* White solid (13.9 mg, 50%), mp 135.3−136.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.67 (dd, J = 7.5, 1.3 Hz, 1H), 7.49 (td, J = 7.6, 1.4 Hz, 1H), 7.39−7.30 (m, 2H), 7.21−7.12 (m, 3H), 6.95 (d, J = 7.2 Hz, 1H), 4.44 (dd, J = 12.6, 5.1 Hz, 1H), 4.01−3.86 (m, 2H), 3.27−3.16 (m, 1H), 2.97 (t, J = 6.0 Hz, 2H), 2.24 (m, 1H), 1.82 (m, 1H), 1.40 (d, J = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.5, 140.6, 136.3, 136.0, 135.1, 130.9, 128.4, 128.3, 127.0, 126.9, 126.7, 126.1, 123.8, 55.8, 49.0, 39.5, 33.4, 29.0, 17.1. IR (KBr) ν/cm^{-1}: 3025, 2959, 2924, 2854, 1642, 1602, 1456, 1416, 1301, 757. HRMS (ESI) calculated for $C_{19}H_{20}NO$ [M + H]$^+$: 278.1539, found: 278.1541.

*14,14-Dimethyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6e**).* White solid (17.5 mg, 60%), mp 138.4−140.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.75 (dd, J = 7.5, 1.2 Hz, 1H), 7.43 (td, J = 7.4, 1.5 Hz, 1H), 7.37 (dt, J = 7.5, 3.8 Hz, 1H), 7.25−7.16 (m, 3H), 7.15−7.09 (m, 1H), 6.83 (d, J = 7.6 Hz, 1H), 4.39−4.28 (m, 1H), 4.15 (s, 1H), 3.34 (m, 1H), 3.27−3.16 (m, 1H), 3.00 (d, J = 13.1 Hz, 1H), 2.92−2.84 (m, 1H), 2.43 (d, J = 13.1 Hz, 1H), 0.95 (s, 3H), 0.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.3, 136.8, 136.6, 135.9, 133.1, 130.7, 129.1, 128.9, 128.8, 128.0, 127.4, 127.1, 125.8, 64.9, 47.3, 45.4, 42.4, 28.6, 25.1, 23.0. IR (KBr) ν/cm^{-1}: 3058, 2925, 2902, 2844, 1623, 1597, 1435, 1395, 1375, 1301, 759. HRMS (ESI) calculated for $C_{20}H_{22}NO$ [M + H]$^+$: 292.1696, found: 292.1695.

*13,14a-Dihydro-5H-spiro[benzo[5,6]azepino[2,1-a]isoquinoline-14,1′-cyclohexan]-8(6H)-one (**6f**).* White solid (23.9 mg, 72%), mp 223.3−224.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.73 (d, J = 6.9 Hz, 1H), 7.39 (m, 2H), 7.22 (t, J = 7.3 Hz, 2H), 7.15 (m, 2H), 6.81 (d, J = 7.5 Hz, 1H), 4.26 (dd, J = 12.8, 5.2 Hz, 1H), 4.04 (s, 1H), 3.37 (m, 1H), 3.27−3.14 (m, 2H), 2.86 (dd, J = 15.3, 3.5 Hz, 1H), 2.62 (d, J = 13.3 Hz, 1H), 1.791.59 (m, 4H), 1.46 (m, 2H), 1.25 (m, 2H), 0.93−0.80 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.1, 137.4, 136.9, 136.1, 132.8, 130.7, 129.7, 129.2, 128.7, 127.8, 127.5, 127.1, 125.7, 66.4, 48.3, 42.6, 38.3, 31.3, 29.0, 28.5, 25.6, 22.2, 21.1. IR (KBr) ν/cm^{-1}: 3031, 3001, 2933, 2863, 1630, 1601, 1457, 1395, 757, 722.

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HRMS (ESI) calculated for $C_{23}H_{26}NO$ $[M + H]^+$: 332.2009, found: 332.2013.

*13,14a-Dihydro-5H-spiro[benzo[5,6]azepino[2,1-a]isoquinoline-14,1′-cyclopentan]-8(6H)-one (**6g**).* White solid (23.2 mg, 73%), mp 195.1−197.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (dd, J = 7.5, 1.4 Hz, 1H), 7.43 (td, J = 7.4, 1.5 Hz, 1H), 7.38 (td, J = 7.5, 1.1 Hz, 1H), 7.26−7.20 (m, 2H), 7.19−7.10 (m, 2H), 6.87 (d, J = 7.6 Hz, 1H), 4.40 (s, 1H), 4.27 (m, 1H), 3.31 (m, 1H), 3.14−3.04 (m, 1H), 2.88 (m 2H), 2.68 (m, 1H), 1.77−1.63 (m, 2H), 1.53 (m, 2H), 1.42 (m, 3H), 1.11−1.02 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 171.8, 137.8, 136.9, 136.0, 133.1, 130.7, 129.3, 129.1, 128.7, 127.7, 127.5, 127.2, 126.0, 62.7, 57.0, 42.6, 42.2, 32.8, 31.2, 28.7, 23.5, 21.9. IR (KBr) ν/cm^{-1}: 2956, 2873, 1631, 1601, 1457, 1399, 761. HRMS (ESI) calculated for $C_{22}H_{24}NO$ $[M + H]^+$: 318.1852, found: 318.1854.

*11-Methyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6h**).* White solid (16.6 mg, 60%), mp 175.1−176.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (d, J = 7.7 Hz, 1H), 7.22−7.12 (m, 4H), 7.03 (s, 1H), 6.97 (d, J = 7.0 Hz, 1H), 4.51 (dd, J = 12.3, 5.4 Hz, 1H), 3.96−3.85 (m, 2H), 3.04−2.91 (m, 3H), 2.71 (dd, J = 13.7, 6.1 Hz, 1H), 2.40 (s, 3H), 2.25−2.09 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.8, 141.2, 137.4, 136.3, 135.3, 133.3, 129.0, 128.9, 128.3, 127.8, 126.9, 126.6, 126.1, 55.6, 39.9, 39.6, 30.9, 29.0, 21.5. IR (KBr) ν/cm^{-1}: 2960, 2930, 2870, 2850, 1630, 1608, 1500, 1450, 840. HRMS (ESI) calculated for $C_{19}H_{20}NO$ $[M + H]^+$: 278.1539, found: 278.1539.

*10-Methyl-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one(**6i**).* White solid (18.3 mg, 66%), mp 140.3−140.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.52 (s, 1H), 7.24−7.12 (m, 4H), 7.10 (d, J = 7.6 Hz, 1H), 6.96 (d, J = 7.1 Hz, 1H), 4.51 (dd, J = 12.2, 5.4 Hz, 1H), 3.92 (s, 2H), 2.97 (d, J = 5.6 Hz, 3H), 2.73 (dd, J = 13.8, 6.1 Hz, 1H), 2.37 (s, 3H), 2.21−2.07 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.8, 136.9, 136.2, 135.9, 135.3, 134.4, 131.6, 129.3, 128.3, 128.2, 126.9, 126.7, 126.1, 55.6, 39.8, 39.5, 30.4, 29.0, 21.0. IR (KBr) ν/cm^{-1}: 3305, 2933, 2837, 1629, 1606, 1531, 1504, 1453, 1252, 1177, 1030, 844, 763. HRMS (ESI) calculated for $C_{19}H_{20}NO$ $[M + H]^+$: 278.1539, found: 278.1539.

*2,3-Dimethoxy-5,6,14,14a-tetrahydrobenzo[5,6]azepino[2,1-a]-isoquinolin-8(13H)-one (**6l**).* White solid (29.4 mg, 91%), mp 149.0−150.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.70 (dd, J = 7.5, 1.3 Hz, 1H), 7.41 (m, 2H), 7.22 (d, J = 7.3 Hz, 1H), 6.70 (s, 1H), 6.47 (s, 1H), 4.45 (dd, J = 12.2, 5.3 Hz, 1H), 4.02−3.95 (m, 1H), 3.89 (d, J = 11.1 Hz, 3H), 3.84 (dd, J = 9.1, 3.7 Hz, 1H), 3.76 (d, J = 16.7 Hz, 3H), 3.06−2.98 (m, 1H), 2.92−2.87 (m, 2H), 2.77 (dd, J = 13.6, 6.2 Hz, 1H), 2.26−2.09 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.5, 147.9, 147.7, 137.3, 136.2, 130.9, 128.7, 128.2, 127.7, 127.2, 127.1, 111.3, 109.3, 56.0, 55.9, 55.1, 39.6, 39.1, 30.8, 28.5. IR (KBr) ν/cm^{-1}: 3030, 2962, 2931, 2870, 2853, 1630, 1598, 1457, 1420, 752. HRMS (ESI) calculated for $C_{20}H_{22}NO_3$ $[M + H]^+$: 324.1588, found: 324.1594.

*3-(2-Vinylphenyl)isoquinolin-1(2H)-one (**7**).* White solid (12.9 mg, 52%), mp 177.2−178.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.23 (s, 1H), 8.39 (d, J = 8.0 Hz, 1H), 7.72−7.61 (m, 2H), 7.56 (d, J = 7.8 Hz, 1H), 7.52−7.42 (m, 3H), 7.41−7.35 (m, 1H), 6.83 (dd, J = 17.4, 11.0 Hz, 1H), 6.51 (s, 1H), 5.75 (dd, J = 17.4, 0.7 Hz, 1H), 5.31 (dd, J = 11.0, 0.7 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 163.1, 138.7, 137.9, 136.5, 134.5, 133.4, 132.8, 129.7, 129.3, 128.1, 127.5, 126.8, 126.6, 126.4, 125.0, 117.0, 107.4. IR (KBr) ν/cm^{-1}: 3171, 3056, 1666, 1632, 1609, 992, 894, 827, 754. HRMS (ESI) calculated for $C_{17}H_{14}NO$ $(M + H)^+$: 248.1070, found: 248.1071.

*4-Methyl-3-(2-vinylphenyl)isoquinolin-1(2H)-one (**8**).* White solid (10.5 mg, 40%), mp 224.8−225.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.99 (s, 1H), 8.43 (d, J = 8.1 Hz, 1H), 7.73 (m, 3H), 7.56−7.49 (m, 1H), 7.48−7.42 (m, 1H), 7.40−7.34 (m, 1H), 7.34−7.28 (m, 1H), 6.57 (m, 1H), 5.80−5.65 (m, 1H), 5.27−5.12 (m, 1H), 2.05 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.3, 138.5, 136.8, 135.2, 133.8, 133.6, 132.7, 130.0, 129.6, 128.0, 127.9, 126.5, 125.6, 125.5, 123.5, 116.4, 110.4, 13.5. IR (KBr) ν/cm^{-1}: 3440, 3015, 2961, 2869, 1638, 1606, 992, 913, 763. HRMS (ESI) calculated for $C_{18}H_{16}NO$ $[M + H]^+$: 262.1221, found: 262.1226.

*2,3-Dimethoxy-5,6,8,13,14,14a-hexahydrobenzo[5,6]azepino-[2,1-a]isoquinoline (**9**).* White solid (24.8 mg, 80%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.20−7.10 (m, 4H), 6.55 (d, J = 13.1 Hz, 2H), 4.46 (d, J = 14.7 Hz, 1H), 4.23−4.15 (m, 1H), 3.95 (d, J = 14.8 Hz, 1H), 3.84 (s, 3H), 3.81 (s, 3H), 3.24−3.14 (m, 1H), 3.00−2.90 (m, 1H), 2.88−2.81 (m, 1H), 2.69−2.62 (m, 1H), 2.61−2.50 (m, 2H), 1.97−1.86 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$):δ 147.5, 147.0, 142.4, 138.7, 132.2, 129.6, 128.4, 127.5, 126.0, 125.9, 111.4, 109.9, 65.4, 60.5, 56.0, 55.8, 42.6, 35.0, 31.2, 29.0.[16c]

*(1-Phenethyl-3,4-dihydroisoquinolin-2(1H)-yl)(phenyl)-methanone (Intermediate **C**).* Colorless oil (48.0 mg, 70%). Atropisomer. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.08 (m, 1H), 7.56 (m, 0.5H), 7.43 (m, 8H), 7.25 (m, 4H), 7.15 (m, 6H), 7.08 (d, J = 7.0 Hz, 1H), 7.03 (d, J = 7.0 Hz, 0.5H), 6.87 (d, J = 7.1 Hz, 0.5H), 5.93 (dd, J = 9.3, 5.0 Hz, 1H), 4.86 (d, J = 5.1 Hz, 1H), 3.79 (m, 1H), 3.51 (m, 1H), 3.37 (m, 0.5H), 3.16 (m, 0.5H), 2.88 (m, 3H), 2.69 (m, 1.5H), 2.42 (m, 0.5H), 2.22 (m, 2.5H), 1.98 (m, 0.5H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 171.1, 170.6, 141.8, 141.0, 137.5, 137.1, 136.7, 136.4, 133.9, 133.4, 133.0, 130.1, 129.9, 129.5, 129.4, 128.9, 128.7, 128.5, 128.4, 128.2, 127.6, 127.2, 127.0, 126.7, 126.5, 126.2, 126.1, 126.0, 58.2, 52.4, 41.1, 39.1, 38.6, 35.8, 32.8, 29.7, 29.4, 28.0. HRMS (ESI) calculated for $C_{24}H_{23}NO$ $[M + H]^+$: 342.1850, found: 342.1852.[22]

■ ASSOCIATED CONTENT

Ⓢ Supporting Information

The tentative reaction mechanism for the formation of compounds **7** and **8** and ^{1}H and ^{13}C NMR spectra of compounds **3aa−3ak**, **3ba−3ha**, **6a−6i**, **6l**, **7−9** and intermediate **C**. This material is available free of charge via the Internet at http://pubs.acs.org.

■ AUTHOR INFORMATION

Corresponding Authors

*E-mail: yanming@mail.sysu.edu.cn (M.Y.).
*E-mail: zhangxj33@mail.sysu.edu.cn (X.-j.Z.).

Notes

The authors declare no competing financial interest.

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(11) We also examined the reaction of *N*-benzylbenzamide and *N*,*N*-dibenzylbenzamide with styrene; no addition product was obtained.

(12) Other alkenes, such as cyclohexene, norbornene, octene, methyl cinnamate, nitrostyrene, and *cis*-stilbene, were also tested, but only ring-opening product **4** was obtained. The reaction of methyl acrylate gave the polymeric products.

(13) For the reactions of **2f** with **1a**, we found that most of the starting materials **1a** and **2f** were recovered. For the reactions of **2h** with **1a**, starting material **1a**, ring-opening side product **4** and **2h** were observed in the reaction mixture. So far, we are not clear about why these alkenes cannot give the expected products.

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