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# $PPh_3$-促进邻炔基硝基苯合成 3-羟基-2-吲哚酮

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**摘要** 3-羟基-2-吲哚酮核心结构在合成化学和药物化学中都具有重要的意义. 发现了一种新的、有效的由邻炔基硝基芳烃制备 3-羟基-2-吲哚酮的碱促进方法, 该反应可在不含过渡金属的条件下进行. 对各种邻炔基硝基芳烃进行测定, 并以中等至良好的产率获得所需的产物. 由三苯基膦引发的 Wittig 反应和随后的偶姻重排构成了主要的反应过程.
**关键词** $PPh_3$; Wittig 反应; 3-羟基-2-吲哚酮; 邻炔基硝基

# $PPh_3$-Mediated Synthesis of 3-Hydroxy-2-oxindoles from *o*-Alkynylnitrobenzenes

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**Abstract** The 3-hydroxy-2-oxindole core structure is of considerable significance in both synthetic and medicinal chemistry. A novel and efficient base-promoted method for the preparation of 3-hydroxy-2-oxindoles from *o*-alkynylnitroarenes has been discovered. The reaction could be conducted under transition metal free conditions. Various *o*-alkynylnitroarenes were checked and the desired products were obtained in moderate to good yields. The Wittig-like reaction triggered by the $PPh_3$ and the subsequent acyloin rearrangement constituted the main reaction process.
**Keywords** $PPh_3$; Wittig reaction; 3-hydroxy-2-oxindoles; *o*-alkynylnitroarenes

## 1 Introduction

The heterocyclic compounds are very important in organic chemistry.[1] Specifically, the 3-hydroxy-2-oxindole core structure is of considerable significance in both synthetic and medicinal chemistry,[2] which can be found in a large quantity of bioactive heterocycles, natural products, and pharmaceuticals (Figure 1).[3] Moreover, it is also frequently employed as the synthetic precursors of oxindole derivatives.[4] Among those reported 3-hydroxy-2-oxindole compounds, most of them have been studied well and show promising bioactivities.[5] For example, convolutamydine A[2] is a novel alkaloid, isolated from the marine bryozoan amathia convolute, which could be used as a good inhibitor in the differentiation of HL-60 human promyelocytic leukaemia cells.[5a] Other natural compounds with the similar hydroxyoxindole skeleton such as donazaridine,[5b] fluorocarpamine,[5c] and maremycin A[5d] also have diverse bioactivities, which are listed in Figure 1. Apart from the traditional isolation from natural sources, the chemical synthetic methodology of 3-hydroxy-2-oxindoles is also quite important. Thus, many novel synthetic methods to 3-hydroxy-2-oxindoles have been developed in the past decades.[6] These reported synthetic methods are mainly focused on several typical starting materials including isatins, 2-oxindoles, and $\alpha$-ketoamides. And the 3-hydroxy-2-oxindoles could be accessed through the addition of organic metals to isatins,[7] metal reduction of

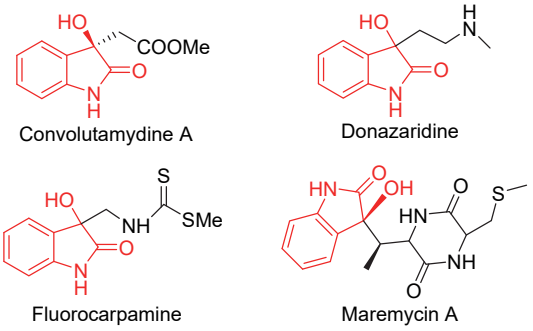


**Figure 1** Natural products and biologically active compounds containing 3-hydroxy-2-oxindole skeleton

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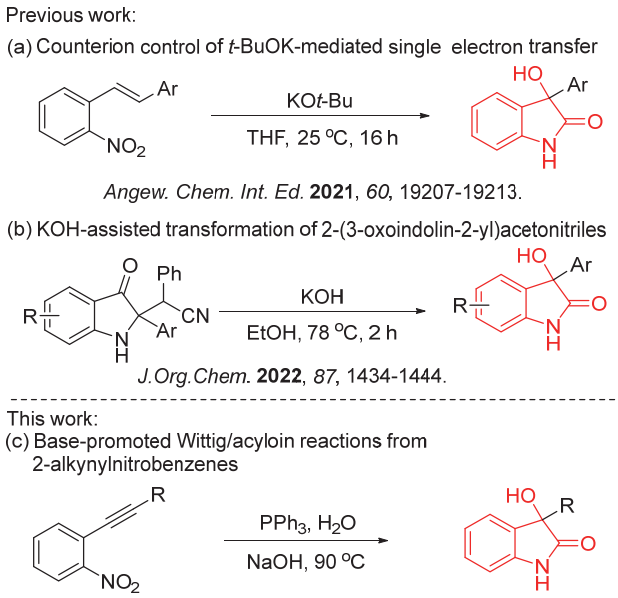
isatines,[8] Friedel-Crafts alkylation of isatines,[9] C—H oxidation of 2-oxindoles,[10] and cyclization of *α*-keto-amides.[11] And the 2-alkynl arylazides were also good alternative substrates applied in the palladium-catalyzed synthesis of 3-hydroxy-2-oxindoles.[6b] Subsequent researches to the preparation of 3-hydroxy-2-oxindoles were carried out with novel starting materials. For example, in 2021, Driver group[12] reported the *t*-BuOK-mediated synthesis of 3-hydroxy-2-oxindoles from the nitrostilbenes. This reaction included the formation of counterion coordination controls (Scheme 1, 1a). It was noted that a unique dioxygen-transfer process was occurred after changing the counterion to potassium. And the radical intermediates confirmed by the control experiments were generated in the reaction. Another typical example is the Michael Rubin's recent work. In 2022, the group[13] reported the KOH-assisted formation of 3-hydroxy-2-indoles from 2-(3-oxoindolin-2-yl)acetonitriles (Scheme 1, 1b). In the reaction, the KOH promoted the carbon-carbon bond cleavage of 2-(3-oxoindolin-2-yl)acetonitriles and the phenyl acetonitrile was then eliminated as the side product. Subsequently, a nucleophilic addition of the hydroxyl group to the C=N double bonds of 2-phenyl-3*H*-indol-3-ones and an acyloin rearrangement afforded the 3-hydroxy-2-oxindoles. Although most of the synthetic methods are novel and efficient to form the 3-hydroxy-2-oxindoles, the starting materials employed in the reaction are still quite narrow. And the metal catalysts are frequently used in the reactions. In this context, it is very important to develop novel synthetic methodologies to 3-hydroxy-2-oxindoles via diverse starting materials under metal-free conditions.



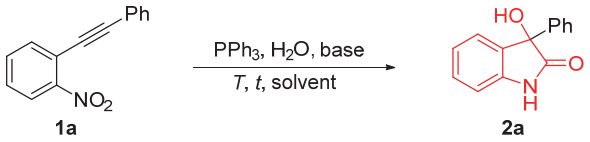

**Scheme 1** Base-promoted synthesis of 3-hydroxy-2-oxindoles under metal-free conditions

Recently, our group found that the intermediate 2-phenyl-3*H*-indol-3-ones could be obtained from the $PPh_3$-mediated transformation of *o*-alkynylnitrobenzenes, which were then employed to react with **C** and *N*-nucleophiles to generate various heterocycles.[14] However, the *O*-nucleophiles applied in the transformation of 2-alkynylnitrobenzenes were still not reported. Based on the previous work and our recent research interesting on the synthesis of heterocycles, we herein disclose a novel synthetic method to 3-hydroxy-2-oxindoles promoted by a base from 2-alkynylnitrobenzenes under metal-free conditions (Scheme 1, 1c). In this methodology, the starting material 2-alkynylnitrobenzenes are quite stable and can easily be prepared after a simple coupling reaction. In addition, the metal catalysts and harsh reaction conditions are not needed in the reaction.

## 2 Results and discussion

At the beginning, we focus our attention on the reaction of 1-nitro-2-(phenylethynyl)benzene (**1a**) and $H_2O$ to examine the reaction conditions (Table 1). Initially, it was revealed that adding 1 equiv. of **1a**, 0.1 mL of $H_2O$, and 5 equiv. of $PPh_3$ to 1 equiv. of NaOH in 1,4-dioxane (1 mL) at 90 ℃ for 12 h gave the good result (Entry 1). Under these reaction conditions, the desired product 3-hydroxy-3-phenylindolin-2-one (**2a**) was afforded in 65% yield. And the structure of the product **2a** was confirmed by comparing the NMR data with the reported results.[6b]

**Table 1** Optimization of the reaction conditions[a]




**1a** **2a**

| Entry | Base/equiv. | Solvent | $PPh_3$/equiv. | *T*/℃ | Yield[b]/% |
|---|---|---|---|---|---|
| 1 | NaOH (1) | 1,4-Dioxane | 5 | 90 | 65 |
| 2 | NaOH (3) | 1,4-Dioxane | 5 | 90 | 75 |
| 3 | NaOH (5) | 1,4-Dioxane | 5 | 90 | 77 |
| 4 | NaOH (3) | $CH_3CN$ | 5 | 90 | 82 |
| 5 | NaOH (3) | DMF | 5 | 90 | N.D.[c] |
| 6 | NaOH (3) | DMSO | 5 | 90 | N.D.[c] |
| 7 | NaOH (3) | Toluene | 5 | 90 | 22 |
| 8 | NaOH (3) | EtOH | 5 | 90 | 52 |
| 9 | NaOH (3) | THF | 5 | 90 | 35 |
| 10 | $Cs_2CO_3$ (3) | $CH_3CN$ | 5 | 90 | 70 |
| 11 | $K_2CO_3$ (3) | $CH_3CN$ | 5 | 90 | 69 |
| 12 | DBU (3) | $CH_3CN$ | 5 | 90 | 43 |
| 13 | — | $CH_3CN$ | 5 | 90 | N.D.[c] |
| 14 | NaOH (3) | $CH_3CN$ | 3 | 90 | 61 |
| 15 | NaOH (3) | $CH_3CN$ | 5 | 50 | 45 |
| 16 | NaOH (3) | $CH_3CN$ | 5 | 90 | 13[d] |
| 17 | NaOH (3) | $CH_3CN$ | 5 | 90 | 76[e] |

[a] Reaction conditions: **1a** (0.1 mmol), $H_2O$ (0.1 mL), $PPh_3$, base, solvent (1 mL), under $N_2$, 12 h. [b] Isolated yield. [c] No desired product was detected. [d] No $H_2O$ was used. [e] Open to air.

Subsequently, the product yield was improved obviously to 75% by increasing the loading amount of NaOH to 3 equiv. (Entry 2). However, there was no big change in the

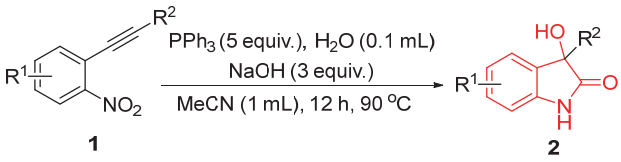
  

product yield with 5 equiv. of NaOH (Entry 3). In addition, the reaction was repeated on changing the solvent from 1,4-dioxane to $CH_3CN$, *N*,*N*-dimethylformamide (DMF), dimethyl sulfoxide (DMSO), toluene, EtOH or THF under the similar reaction conditions (Entries 4～9). It was found that the solvent $CH_3CN$ gave the best product yield in 82%. Other solvents, such as DMF and DMSO led to no reaction and toluene, EtOH and THF provided product in low yields of 22%～52%. Then, various inorganic and organic bases were also investigated (Entries 10～12). It was found that the slight low product yields of 70% and 69% were obtained by using $Cs_2CO_3$ and $K_2CO_3$ as the base instead of NaOH. However, the organic base 1,5-dizzabicyclo[5.4.0]undecen-5-ene (DBU) afforded the desired product in low yield of 43%. Interestingly, the desired product was not detected when the reaction was performed without a base (Entry 13). When 3 equiv. of $PPh_3$ was employed in the reaction, the product **2a** was still obtained while the yield decreased to 61% (Entry 14). Next, repeating the reaction at 50 ℃ gave the desired product **2a** in 45% yield (Entry 15). When the reaction was conducted in the absence of water, it still could offer the product but with only 13% yield (Entry 16). Finally, the reaction was carried out without the $N_2$ protection, a slight low yield of 76% was obtained (Entry 17). Based on the above preliminary studies, the reaction of **1a** with $H_2O$ in the presence of 5.0 equiv. of $PPh_3$ and 3.0 equiv. of NaOH in $CH_3CN$ at 90 ℃ for 12 h was regarded as the best reaction conditions.

With the optimized reaction conditions in hand, the scope of this reaction was next investigated by examining a series of substituted *o*-alkynylnitroarenes **1** and the corresponding results are summarized in Table 2. This revealed that electron-withdrawing and electron-donating groups on the aromatic ring of *o*-alkynylnitroarenes **1** gave the desired products **2b**～**2g** in moderate to good yields. In addition, various substituted aryl groups on the alkyne carbon of substrates **1** were also tested and the desired products **2h**～**2l** were obtained in 45%～89% yields. When the substituted groups $R^1$ and $R^2$ were both changed, the corresponding products were still obtained in yields of 46%～75% (**2m**～**2q**). On the other hand, changing the $R^2$ group from the substituted aromatic group to the alky group led to the formation of desired products **2r**～**2t** in relatively low yields of 53%～81%. Finally, the substituted group on the terminal carbon changed to hetero aryl group ($R^2$= 2-thiophenyl) afforded the desired product **2u** in 50% yield.

According to the above experimental results and our previous work,[14] a possible mechanism is tentatively proposed in Scheme 2 for converting 1-nitro-2-(phenylethynyl)benzene (**1a**) to 3-hydroxy-2-oxindole (**2a**), although it is highly speculative. As depicted in Scheme 2, the C(sp)—C(sp) triple bond of **1a** could be attacked by $PPh_3$ followed by an intramolecular cyclization to form species **A**. After a ring-opening of **A**, the phosphorus ylide intermediate **B** was afforded.[15] Subsequently, a Wittig-like intramolecular cyclization gave an active four-membered ring **C**. After a ring collapse of **C**, the intermediate 2-phenyl-3*H*-indol-3-one **D** was generated and the side product O=$PPh_3$ was also formed, which could be detected by thin-layer chromatography (TLC).[14] Next, a Man-

**Table 2** Range of *o*-alkynylnitroarenes **1**[a]

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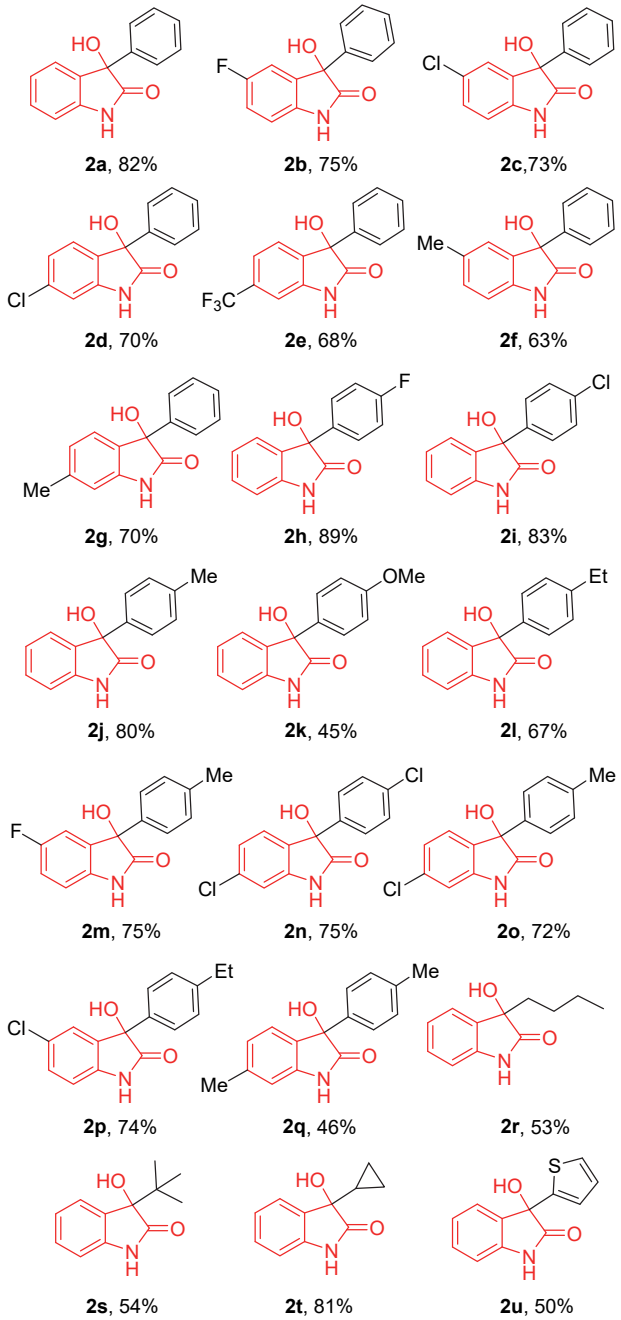
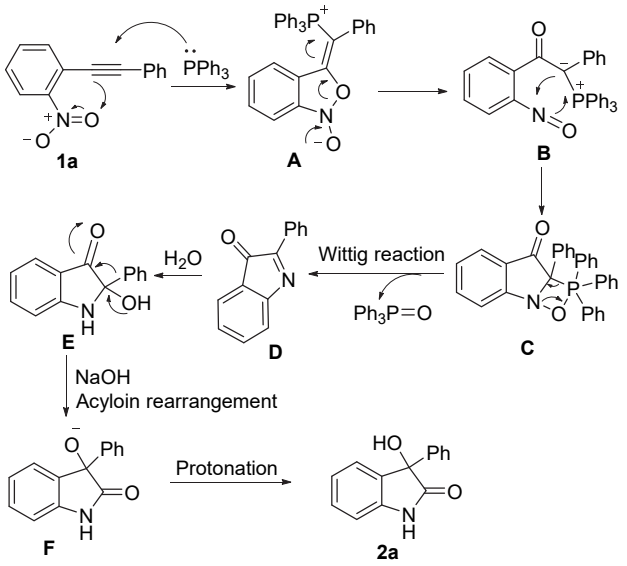



[a] Reaction conditions: **1** (0.1 mmol), $H_2O$ (0.1 mL), $PPh_3$ (0.5 mmol), NaOH (0.3 mmol), $CH_3CN$ (1 mL), under $N_2$, 12 h. Isolated yield.




**Scheme 2** A plausible reaction mechanism

nich addition of $H_2O$ to 2-phenyl-3*H*-indol-3-one **D** resulted in the formation of 2-hydroxy-2-phenylindolin-3-one **E**. The deprotonation of **E** promoted by the NaOH and the following acyloin rearrangement afforded the alkoxyl anion **F**. Finally, the desired product 3-hydroxy-3-phenylindolin-2-one (**2a**) was obtained after a protonation process.

## 3 Conclusions

In summary, a novel base-promoted synthesis of 3-hydroxy-2-oxindoles from *o*-alkynylnitrobenzenes has been developed. In the reactions, a wide range of *o*-alkynylnitroarenes were examined and the desired products 3-hydroxy-2-oxindoles were afforded in moderate to good yields. The reaction does not need any metal catalysts and can be proceeded under mild reaction conditions. Moreover, *o*-alkynylnitroarenes used as the starting materials were easily prepared after a simple coupling reaction. Finally, further research on the application of this synthetic methodology is currently undergoing in our group.

## 4 Experimental section

### 4.1 General considerations

Unless specified, all reagents and starting materials were purchased from commercial sources and used as received. Solvents were purified following standard literature procedures. Analytical TLC was performed using pre-coated silica gel plate. Visualization was achieved by UV light (254 nm). Flash chromatography was performed using silica gel and a gradient solvent system (ethyl acetate/petrol ether as eluant). $^1$H NMR and $^{13}$C NMR spectra were measured on Bruker Avance III HD 400 and 600 MHz spectrometers. Chemical shifts ($\delta$) were recorded with tetramethylsilane (TMS) as the internal reference standard. The HRMS spectra were obtained on an Agilent 6520B Q-TOF high-resolution mass spectrometer. All the starting materials 1-nitro-2-(phenylethynyl)benzenes (**1**) were prepared by reported methods.[16-17]

### 4.2 General experimental procedure for the synthesis of product **2**

To a 10 mL of flask was added **1** (0.1 mmol, 1 equiv.), $PPh_3$ (0.5 mmol, 5 equiv.), $H_2O$ (0.1 mL), NaOH (0.3 mmol, 3 equiv.) and MeCN (1 mL). The reaction solution was then stirred at 90 ℃ under $N_2$ and monitored by TLC analysis. On completion, the reaction mixture was directly subjected to purification by flash column chromatography on silica gel to give the desired product **2**. (eluent: petrol ether/ethyl acetate, $V$∶$V$=10∶1～1∶1).

Hydroxy-3-phenylindolin-2-one (**2a**):[6b] 82% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.40 (s, 1H), 7.36～7.22 (m, 6H), 7.10 (d, $J$=6.3 Hz, 1H), 7.00～6.94 (m, 1H), 6.90 (d, $J$=7.8 Hz, 1H), 6.62 (s, 1H).

5-Fluoro-3-hydroxy-3-phenylindolin-2-one (**2b**):[6b] 75% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.41 (s, 1H), 7.36～7.24 (m, 5H), 7.12～7.06 (m, 1H), 6.95 (dd, $J$=8.0, 2.7 Hz, 1H), 6.90 (dd, $J$=8.5, 4.3 Hz, 1H), 6.74 (s, 1H).

5-Chloro-3-hydroxy-3-phenylindolin-2-one (**2c**):[6b] 73% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.56 (s, 1H), 7.36～7.24 (m, 6H), 7.11 (d, $J$=2.2 Hz, 1H), 6.92 (d, $J$=8.3 Hz, 1H), 6.79 (s, 1H).

6-Chloro-3-hydroxy-3-phenylindolin-2-one (**2d**):[6b] 70% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.57 (s, 1H), 7.33～7.30 (m, 2H), 7.29～7.26 (m, 3H), 7.10 (d, $J$=8.0 Hz, 1H), 7.01 (dd, $J$=7.9, 1.9 Hz, 1H), 6.92 (d, $J$=1.9 Hz, 1H), 6.73 (s, 1H).

3-Hydroxy-3-phenyl-6-(trifluoromethyl)indolin-2-one (**2e**):[6b] 68% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.71 (s, 1H), 7.36～7.26 (m, 7H), 7.13 (s, 1H), 6.86 (s, 1H).

3-Hydroxy-5-methyl-3-phenylindolin-2-one (**2f**):[6b] 63% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.30 (s, 1H), 7.34～7.22 (m, 5H), 7.04 (d, $J$=7.9 Hz, 1H), 6.90 (s, 1H), 6.79 (d, $J$=7.8 Hz, 1H), 6.57 (s, 1H), 2.21 (s, 3H).

3-Hydroxy-6-methyl-3-phenylindolin-2-one (**2g**):[6b] 70% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.34 (s, 1H), 7.31～7.28 (m, 2H), 7.28～7.24 (m, 3H), 6.96 (d, $J$=7.5 Hz, 1H), 6.77 (d, $J$=7.5 Hz, 1H), 6.71 (s, 1H), 6.53 (s, 1H), 2.29 (s, 3H)

3-(4-Fluorophenyl)-3-hydroxyindolin-2-one (**2h**):[6b] 89% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.40 (s, 1H), 7.34～7.28 (m, 2H), 7.29～7.23 (m, 1H), 7.17～7.10 (m, 3H), 7.02～6.96 (m, 1H), 6.91 (d, $J$=7.7 Hz, 1H), 6.67 (s, 1H).

3-(4-Chlorophenyl)-3-hydroxyindolin-2-one (**2i**):[6b] 83% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.43 (s, 1H), 7.38 (d, $J$=8.4 Hz, 2H), 7.31～7.24 (m, 3H), 7.11 (d, $J$=7.4 Hz, 1H), 7.00～6.96 (m, 1H), 6.91 (d, $J$=7.8 Hz, 1H), 6.72 (s, 1H).

3-Hydroxy-3-(*p*-tolyl)indolin-2-one (**2j**):[6b] 80% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.33 (s, 1H), 7.27～7.22 (m, 1H), 7.16 (d, $J$=7.8 Hz, 2H), 7.13～7.07 (m, 3H), 7.00～6.93 (m, 1H), 6.89 (d, $J$=7.7 Hz, 1H), 6.52 (s,

1H), 2.26 (s, 3H).

3-Hydroxy-3-(4-methoxyphenyl)indolin-2-one (**2k**):[6b] 45% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.31 (s, 1H), 7.27～7.21 (m, 1H), 7.19 (d, $J$=9.3 Hz, 2H), 7.11 (d, $J$=7.3 Hz, 1H), 7.00～6.94 (m, 1H), 6.91～6.84 (m, 3H), 6.49 (s, 1H), 3.72 (s, 3H).

3-(4-Ethylphenyl)-3-hydroxyindolin-2-one (**2l**): 67% yield, yellow liquid. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.35 (s, 1H), 7.27～7.21 (m, 1H), 7.18 (d, $J$=8.4 Hz, 2H), 7.14 (d, $J$=8.3 Hz, 2H), 7.09 (d, $J$=7.4 Hz, 1H), 6.98～6.93 (m, 1H), 6.89 (d, $J$=7.7 Hz, 1H), 6.54 (s, 1H), 2.55 (q, $J$=7.6 Hz, 2H), 1.16～1.12 (m, 3H); $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$: 179.1, 143.5, 142.4, 139.3, 134.3, 129.6, 127.9, 126.0, 125.3, 122.5, 110.3, 77.7, 28.3, 16.1; HRMS (ESI) calcd for $C_{16}H_{15}NNaO_2$ [M + Na]$^+$ 276.0995, found 276.0996.

5-Fluoro-3-hydroxy-3-(*p*-tolyl)indolin-2-one (**2m**):[18] 75% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.38 (s, 1H), 7.17 (d, $J$=8.3 Hz, 2H), 7.12 (d, $J$=8.1Hz, 2H), 7.11～7.04 (m, 1H), 6.96～6.92 (m, 1H), 6.91～6.87 (m, 1H), 6.67 (s, 1H), 2.26 (s, 3H).

6-Chloro-3-(4-chlorophenyl)-3-hydroxyindolin-2-one (**2n**):[6a] 75% yield. $^1$H NMR (600 MHz, DMSO-$d_6$) $\delta$: 10.62 (s, 1H), 7.39 (d, $J$=8.6 Hz, 2H), 7.28 (d, $J$=8.6 Hz, 2H), 7.11 (d, $J$=8.0 Hz, 1H), 7.05～7.01 (m, 1H), 6.93 (d, $J$=1.9 Hz, 1H), 6.84 (s, 1H).

6-Chloro-3-hydroxy-3-(*p*-tolyl)indolin-2-one (**2o**): 72% yield, yellow solid. m.p. 184.6～187.5 ℃; $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.52 (s, 1H), 7.19～7.05 (m, 5H), 7.03～6.98 (m, 1H), 6.91 (d, $J$=1.9 Hz, 1H), 6.65 (s, 1H), 2.26 (s, 3H); $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$: 178.9, 144.0, 138.5, 137.3, 133.8, 133.2, 129.2, 126.7, 125.8, 122.2, 110.4, 77.2, 21.1; HRMS (ESI) calcd for $C_{15}H_{12}ClNNaO_2$ [M+Na]$^+$ 296.0449, found 296.0449.

5-Chloro-3-(4-ethylphenyl)-3-hydroxyindolin-2-one (**2p**): 74% yield, yellow solid. m.p. 120.3～122.0 ℃; $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.52 (s, 1H), 7.32～7.27 (m, 1H), 7.23～7.13 (m, 4 H), 7.10 (d, $J$=2.1Hz, 1H), 6.91 (d, $J$=8.3 Hz, 1H), 6.71 (s, 1H), 2.56 (q, $J$=7.6 Hz, 2H), 1.14 (t, $J$=7.6 Hz, 3H); $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$: 178.7, 143.8, 141.3, 138.6, 136.3, 129.5, 128.1, 126.4, 125.8, 125.2, 111.9, 77.7, 28.3, 16.1; HRMS (ESI) calcd for $C_{16}H_{14}ClNNaO_2$ [M+Na]$^+$ 310.0605, found 310.0604.

3-Hydroxy-6-methyl-3-(*p*-tolyl)indolin-2-one (**2q**): 46% yield, yellow solid. m.p. 200.2～203.9 ℃; $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.29 (s, 1H), 7.17～7.06 (m, 4 H), 6.95 (d, $J$=7.5 Hz, 1H), 6.76 (d, $J$=7.5 Hz, 1H), 6.70 (s, 1H), 6.45 (s, 1H), 2.29 (s, 3H), 2.25 (s, 3H); $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$: 179.3, 142.5, 139.3, 139.2, 136.9, 131.4, 129.0, 125.9, 125.0, 122.9, 110.9, 77.5, 21.8, 21.1; HRMS (ESI) calcd for $C_{16}H_{15}NNaO_2$ [M + Na]$^+$ 276.0995, found 276.0995.

3-Butyl-3-hydroxyindolin-2-one (**2r**):[19] 53% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.19 (s, 1H), 7.30～7.14 (m, 2H), 7.00～6.92 (m, 1H), 6.79 (d, $J$=7.6 Hz, 1H), 5.80 (s, 1H), 1.80～1.70 (m, 2H), 1.17 (q, $J$=7.6 Hz, 2H), 1.08～0.95 (m, 1H), 0.93 (d, $J$=6.7 Hz, 1H), 0.76 (t, $J$=7.3 Hz, 3H).

3-(Tert-butyl)-3-hydroxyindolin-2-one (**2s**):[6b] 54% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.10 (s, 1H), 7.23 (d, $J$=7.4 Hz, 1H), 7.22～7.13 (m, 1H), 6.97～6.87 (m, 1H), 6.75 (d, $J$=7.7 Hz, 1H), 5.65 (s, 1H), 0.94 (s, 9H).

3-Cyclopropyl-3-hydroxyindolin-2-one (**2t**): 81% yield, yellow solid. m.p. 158.3～160.7 ℃; $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.15 (s, 1H), 7.23～7.14 (m, 2H), 6.97～6.89 (m, 1H), 6.78 (d, $J$=7.7 Hz, 1H), 5.82 (s, 1H), 1.19～1.10 (m, 1H), 0.57～0.48 (m, 1H), 0.44～0.34 (m, 1H), 0.32～0.24 (m, 1H), 0.13～0.05 (m, 1H); $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$: 179.7, 142.0, 131.8, 129.3, 124.5, 121.8, 109.9, 75.1, 17.9, 1.0, -0.1; HRMS (ESI) calcd for $C_{11}H_{11}NNaO_2$ [M+Na]$^+$ 212.0682, found 212.0681.

3-Hydroxy-3-(thiophen-2-yl)indolin-2-one (**2u**):[6a] 50% yield. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$: 10.41 (s, 1H), 7.47 (d, $J$=4.6 Hz, 1H), 7.36～7.23 (m, 2H), 7.07～6.97 (m, 1H), 6.96～6.81 (m, 3H), 6.70 (s, 1H).

**Supporting Information** NMR spectra of compounds **2a**～**2u**. The Supporting Information is available free of charge via the Internet at http://sioc-journal.cn/.

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