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Construction of Spirocyclopropane-Linked Heterocycles Containing Both Pyrazolones and Oxindoles through Michael/Alkylation Cascade Reactions

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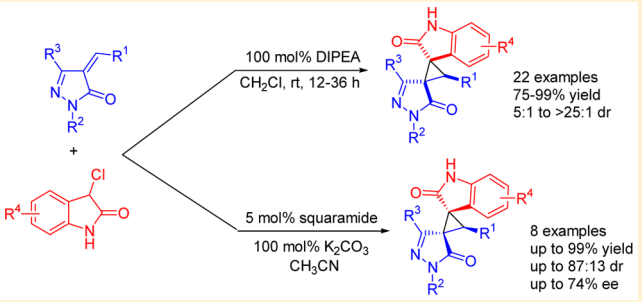
Supporting Information

ABSTRACT: An effective diastereoselective Michael/alkylation cascade reaction of arylidenepyrazolones with 3-chlorooxindoles catalyzed by DIPEA was developed. A variety of highly functionalized spiro-pyrazolone-cyclopropane-oxindoles were obtained in excellent yields (up to 99%) with good to excellent diastereoselectivities (up to >25:1 dr). Moreover, the squaramide-catalyzed asymmetric reactions of arylidenepyrazolones with 3-chlorooxindoles afforded the corresponding chiral spirocyclic heterocycles in excellent yields (up to 99%) with moderate diastereoselectivities (up to 87:13 dr) and moderate to high enantioselectivities (up to 74% *ee*).



INTRODUCTION

Pyrazolone skeletons are important structural units which have been proved to have antiinflammatory, antiviral, antitumor, and antibacterial properties.[1] For example, the spirocyclic derivative **A** has antibacterial activity,[1c] and the pyrazolone derivative **B** exhibits HIV inhibition activity (Figure 1).[1d] Because of the excellent biological properties, the synthesis of functionalized pyrazolone skeletons is of great importance in synthetic chemistry, and great efforts have been devoted in recent years.[2] In particular, many researchers have been attracted by the synthesis of spiropyrazolones, because of their potential pharmaceutical activities and the significance of synthetic methodology.[2a,3−11] In 2011, Rios and co-workers reported the synthesis of spiro-cyclohexene pyrazolones through the cascade Michael/Michael/Aldol reactions.[3] Later, the groups of Wang,[4] Wang,[5] Enders,[6] and Peng[7] also have successfully synthesized the spiro-cyclohexane pyrazolones through the cascade reactions. Furthermore, Wang[8] and Yuan[9] reported two kinds of spiro-pyrrolidine pyrazolones through the cascade reactions of isothiocyanato compounds with unsaturated pyrazolones. Most recently, our group also reported the synthesis of spiropyrazolone tetrahydroquinolines through the cascade aza-Michael/Michael addition of 2-tosylaminoenones to unsaturated pyrazolones.[10] Furthermore, other groups also have conducted good research on the synthesis of the highly valuable spiropyrazolones.[11] Although many kinds of spiropyrazolones have been effectively established, we are not aware of any reports on constructing spirocyclopropane heterocycles containing both the pyrazolones and the oxindoles.

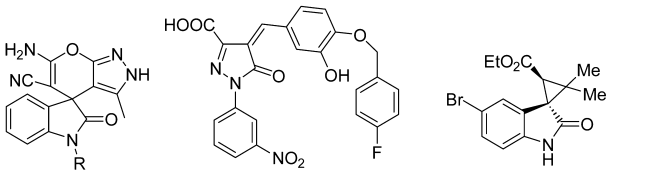


Figure 1. Biologically active compounds containing the pyrazolone and oxindole.

The spirocyclopropane heterocycles are a privileged structural core of natural products that exhibit important biological and medicinal activity.[12] Moreover, they also serve as valuable synthetic intermediates for a wide range of organic compounds.[13] In particular, the spiro-cyclopropane-oxindoles have emerged as compounds with a wide spectrum of significant biological activity (Figure 1),[14] and many researchers have been attracted by the synthesis of spiro-cyclopropane-oxindoles.[15,16a,b] Thus, the development of efficient strategies for the construction of spiro-pyrazolone-cyclopropane-oxindoles with several privileged motifs integrated together is valuable for the structural diversity of spiropyrazolones and spirooxindoles, as well as for the discovery of new drugs.

Herein, we would like to present an efficient DIPEA-catalyzed Michael/alkylation cascade reaction of 3-chlorooxindoles with arylidenepyrazolones for the construction of highly functionalized spiro-pyrazolone-cyclopropane-oxindoles in excellent yields (up to 99%) with excellent diastereoselectivities (up to >25:1 dr). Moreover, the asymmetric version of this Michael/alkylation cascade reaction has also been realized with the squaramide catalyst. The corresponding chiral spiro-

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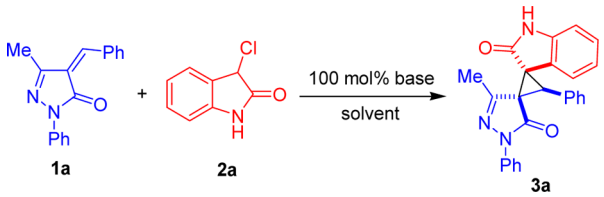
heterocyclic products with three contiguous stereocenters, including two vicinal quaternary centers, were obtained in excellent yields (up to 99%) with moderate diastereoselectivities (up to 87:13 dr) and moderate to high enantioselectivities (up to 74% *ee*).

RESULTS AND DISCUSSION

Initially, we examined the model reaction employing arylidenepyrazolone **1a** and 3-chlorooxindole **2a** as the substrates in dichloromethane at room temperature under different bases (Table 1, entries 1−7). The bases were used as

Table 1. Optimization of the Cascade Reaction Conditions[a]



entry	base	solvent	t (h)	yield[b] (%)	dr[c] (%)
1	K_2CO_3	CH_2Cl_2	18	99	82.6:17.4
2	Na_2CO_3	CH_2Cl_2	18	79	82.1:17.9
3	$NaHCO_3$	CH_2Cl_2	18	17	81.3:18.7
4	Et_3N	CH_2Cl_2	12	99	83.3:16.7
5	DBU	CH_2Cl_2	12	75	83.9:16.1
6	DIPEA	CH_2Cl_2	12	99	83.8:16.2
7	NH_4HCO_3	CH_2Cl_2	18	63	81.6:18.4
8	DIPEA	$CHCl_3$	12	99	83.6:16.4
9	DIPEA	THF	12	99	83.6:16.4
10	DIPEA	PhMe	12	99	83.0:17.0
11	DIPEA	Et_2O	12	99	83.4:16.6
12	DIPEA	CH_3CN	12	99	83.6:16.4
13	DIPEA	$ClCH_2CH_2Cl$	12	99	83.3:16.7

[a]Reactions were carried out with arylidenepyrazolone **1a** (0.11 mmol), 3-chlorooxindole **2a** (0.10 mmol), and 100 mol % base in solvent (0.5 mL) at room temperature. [b]Isolated yield after column chromatography purification. [c]Determined by chiral HPLC analysis.

both the catalysts and an acid absorbent (because hydrogen chloride was also formed in this cascade reaction). We found that the reaction proceeded swiftly under the catalysis of the potassium carbonate, Et_3N or DIPEA, and the product **3a** was obtained in excellent yield with good diastereoselectivity (Table 1, entries 1, 4, and 6). Because of the weak alkalinity, when sodium bicarbonate was used as the catalyst, **3a** was obtained only in 17% yield (Table 1, entry 3). In view of the yields and tiny differences in the diastereoselectivity, the tertiary amine catalysis of DIPEA was better than that of K_2CO_3, Na_2CO_3, $NaHCO_3$, Et_3N, and DBU. Subsequently, we attempted to optimize the reaction conditions by screening of different solvents (Table 1, entries 8−13). As can be seen, the similar results were obtained in different solvents. In consideration of tiny differences in the diastereoselectivity, dichloromethane was the best solvent. The diastereoselectivities in Table 1 were measured by chiral HPLC, and four chromatographic peaks of two diastereoisomers appeared. The tiny differences in diastereoselectivity can be distinguished using the HPLC technique. The diastereoselectivities were determined by the ratio of the sum of the two peak areas of the major diasteroisomer to the sum of two peak areas of the minor diastereoisomer. The same analytical technique for the diastereoselectivities was used in Tables 3−5 (*vide infra*).

Having established the optimal reaction conditions, the scope of this cascade reaction was explored with a wide array of arylidenepyrazolones **1** and 3-chlorooxindoles **2**, and the results are summarized in Table 2. In general, all the reactions proceeded well to afford the desired products in good to excellent yields (75−99%) with good to excellent diastereoselectivities (5:1 to >25:1 dr). The diastereoisomeric ratios in Table 2 were determined by NMR analysis of the proton integration of the cyclopropane ring in the corresponding products **3**. The effect of substituents on 3-chlorooxindoles was first explored (Table 2, entries 1−6), and the corresponding products **3a−f** were obtained in excellent yields (99%). As for the diastereoselectivity, when the 3-chlorooxindoles contain a 4-Cl or 4-Br substituent on R^4, excellent diastereoselectivity (>25:1 dr) was obtained (Table 2, entries 5 and 6). However, when the 3-chlorooxindoles contain a substituent on other positions, only moderate diastereoselectivities were obtained (5:1 to 5.9:1 dr) (Table 2, entries 1−4 and 7).

Evidence suggests that the steric effect of 4-Cl or 4-Br improves the diastereoselectivities of the products **3e** and **3f**. Therefore, the 3,4-dichloroindolin-2-one (**2e**) was further used to perform reactions with arylidenepyrazolones. Afterward, further exploration of the substrate scope was focused on arylidenepyrazolones (Table 2, entries 8−22). It appeared that the electron-donating and electron-withdrawing substituents at different positions on arylidenepyrazolones were compatible under the optimized reaction conditions and provided the corresponding products **3h−v** in good to excellent yields (75−99%) with moderate to excellent diastereoselectivities (6:1 to >25:1 dr). Among them, the lowest diastereoselectivity was obtained by product **3p** (Table 2, entry 16), which indicated that the diastereoselectivity could be reduced by the steric effect of the substituent on the *ortho* position of the R^1 group. The single crystal of compound **3g** was obtained by recrystallization from petroleum ether/acetone, and the relative configuration of the major diastereoisomer was determined by X-ray crystallographic analysis (see the Supporting Information).

As shown in Scheme 1, a plausible reaction mechanism for the synthesis of racemic spiro-pyrazolone-cyclopropane-oxindoles has been proposed. The 3-chlorooxindoles **2** is deprotonated by the base to form enolate **A**. The Michael addition of enolate **A** with arylidenepyrazolones **1** to form the intermediate **B** through *Re* face attack at the *β*-carbon of the Michael acceptor, followed by an intramolecular nucleophilic substitution of chloride, to furnish the final spirocyclopropane product **3** as the major diastereomer. The C*α*−C*β* single bond of enolate **B** could rotate 180° before cyclization and afford the minor diastereomer **3′**, whose relative configuration is proposed by one NOESY spectra of **3g** diastereomers (see the Supporting Information). A very fast cyclization results in the formation of only two diastereomers. In the Michael addition step, the dipoles of two amide carbonyls in two heterocycles will be oriented to opposite directions to reduce the repulsion, and the *trans*-selectivity is thus obtained. Meanwhile, if the Michael addition step is from *Si* face attack, enantiomer *ent*-**3** will be formed as major diastereomer. As can be seen from the intermediate **B**, both the positions of R^3 group and R^4 group have high steric hindrance compared with other positions. Therefore, when the spirocyclopropane is formed, the groups of R^4 and R^3 will turn to the different directions because of the steric hindrance, which can be verified from the

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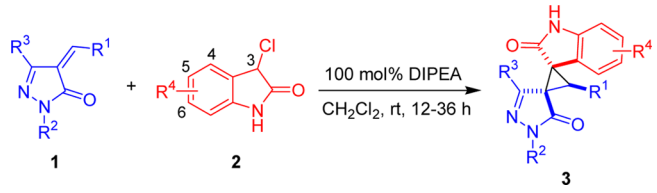
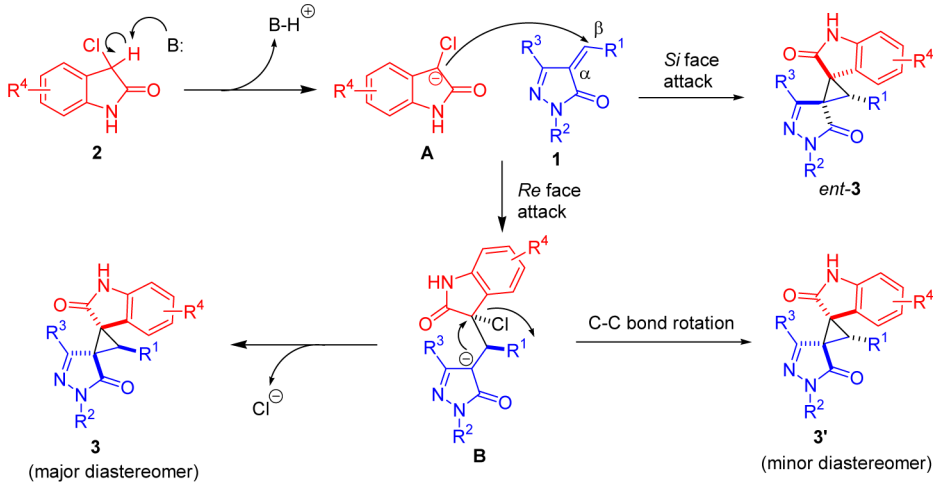
Table 2. Substrate Scope of the DIPEA-Catalyzed Cascade Reaction[a]



entry	R^1	R^2	R^3	R^4	product[b]	time (h)	yield[c] (%)	dr[d]
1	Ph (**1a**)	Ph	Me	H (**2a**)	**3a**	12	99	5:1
2	Ph (**1a**)	Ph	Me	6-F (**2b**)	**3b**	12	99	5.6:1
3	Ph (**1a**)	Ph	Me	6-Cl (**2c**)	**3c**	12	99	5.9:1
4	Ph (**1a**)	Ph	Me	6-Br (**2d**)	**3d**	12	99	5.9:1
5	Ph (**1a**)	Ph	Me	4-Cl (**2e**)	**3e**	36	99	>25:1
6	Ph (**1a**)	Ph	Me	4-Br (**2f**)	**3f**	36	99	>25:1
7	Ph (**1m**)	4-ClC_6H_4	Me	H (**2a**)	**3g**	12	95	5:1
8	4-FC_6H_4 (**1b**)	Ph	Me	4-Cl (**2e**)	**3h**	12	99	9:1
9	4-ClC_6H_4 (**1c**)	Ph	Me	4-Cl (**2e**)	**3i**	12	99	25:1
10	4-BrC_6H_4 (**1d**)	Ph	Me	4-Cl (**2e**)	**3j**	12	99	8:1
11	4-MeC_6H_4 (**1e**)	Ph	Me	4-Cl (**2e**)	**3k**	36	99	17:1
12	4-$MeOC_6H_4$ (**1f**)	Ph	Me	4-Cl (**2e**)	**3l**	12	91	>25:1
13	4-$NO_2C_6H_4$ (**1g**)	Ph	Me	4-Cl (**2e**)	**3m**	36	99	>25:1
14	3-$NO_2C_6H_4$ (**1h**)	Ph	Me	4-Cl (**2e**)	**3n**	12	99	>25:1
15	2-ClC_6H_4 (**1i**)	Ph	Me	4-Cl (**2e**)	**3o**	36	99	9:1
16	2-BrC_6H_4 (**1j**)	Ph	Me	4-Cl(**2e**)	**3p**	36	99	6:1
17	2-$MeOC_6H_4$ (**1k**)	Ph	Me	4-Cl (**2e**)	**3q**	12	99	11:1
18	3,4-$(MeO)_2C_6H_3$ (**1l**)	Ph	Me	4-Cl (**2e**)	**3r**	12	83	>25:1
19	Ph (**1m**)	4-ClC_6H_4	Me	4-Cl (**2e**)	**3s**	36	99	14:1
20	Ph (**1n**)	4-MeC_6H_4	Me	4-Cl (**2e**)	**3t**	36	96	>25:1
21	Ph (**1o**)	Ph	CF_3	4-Cl (**2e**)	**3u**	36	75	>25:1
22	Ph (**1p**)	Ph	Ph	4-Cl (**2e**)	**3v**	36	99	>25:1

[a]Reaction conditions: a mixture of arylidenepyrazolones **1** (0.22 mmol), 3-chlorooxindoles **2** (0.20 mmol), and DIPEA (100 mol %) in CH_2Cl_2 (1.0 mL) was stirred at room temperature for 12−36 h. [b]Racemate. [c]Isolated yield after column chromatography purification. [d]Determined by NMR analysis.

Scheme 1. Proposed Mechanism for the Synthesis of Spiro-pyrazolone-cyclopropane-oxindoles



X-ray single crystal structure of **3g** (see the Supporting Information). In particular, when the 3-chlorooxindoles **2** are substituted at the C-4 position, the product diastereoselectivity is better (up to >25:1dr).

To expand the synthetic potential of this cascade reaction system, we further explored the application of this reaction in asymmetric synthesis. In the past few years, bifunctional squaramide catalysts have been proved to be effective in various asymmetric reactions,[17] and we believe that squaramides would play a positive role in this reaction. Initially, the model reaction of **1a** and **2a** was performed in CH_2Cl_2 in the presence of 5 mol % catalyst loading at room temperature under different bases and organocatalysts (Figure 2), and the screening results are given in Table 3. First, when using squaramide **I** as catalyst with no base added into the reaction, the chiral product **4a** was obtained in low yield (26%) with

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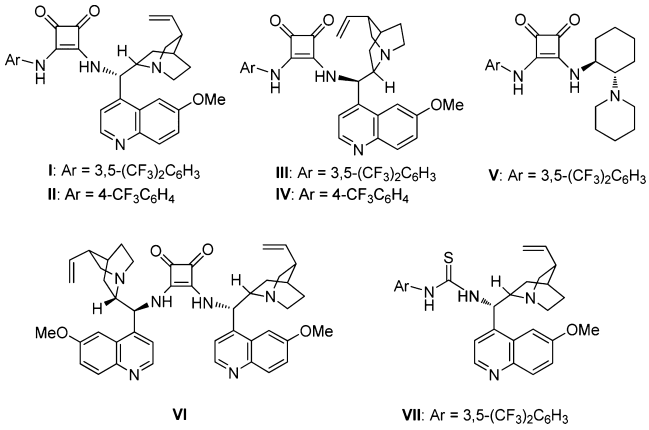
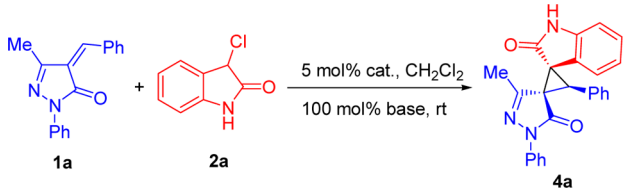


Figure 2. Structures of screened organocatalysts.

Table 3. Screening of Bases and Organocatalysts for the Asymmetric Cascade Reaction[a]



entry	catalyst	base	time (h)	yield[b] (%)	dr[c]	ee[c] (%)
1	**I**		62	26	76:24	69
2[d]	**I**	K_2CO_3	36	76	83:17	40
3	**I**	K_2CO_3	12	99	82:18	43
4	**I**	$NaHCO_3$	16	75	82:18	38
5	**I**	NH_4HCO_3	14	97	83:17	38
6	**I**	Na_2CO_3	14	98	83:17	40
7	**I**	Et_3N	12	99	84:16	5
8	**I**	DIPEA	12	99	84:16	4
9	**II**	K_2CO_3	12	99	83:17	44
10	**III**	K_2CO_3	12	99	83:17	30
11	**IV**	K_2CO_3	12	98	83:17	29
12	**V**	K_2CO_3	12	99	83:17	19
13	**VI**	K_2CO_3	12	99	83:17	32
14	**VII**	K_2CO_3	12	81	83:17	29

[a]Reaction conditions: unless noted otherwise, a mixture of **1a** (0.11 mmol), **2a** (0.10 mmol), and base (100 mol %) in CH_2Cl_2 (0.5 mL) was stirred at room temperature for the indicated time. [b]Isolated yield after column chromatography purification. [c]Determined by chiral HPLC analysis. [d]30 mo% K_2CO_3 was used.

moderate enantioselectivity (Table 3, entry 1). Then, K_2CO_3 was used with 30 and 100 mol %, respectively, as a kind of acid absorbent. The product yield was enhanced at the same time, but the enantioselectivity was reduced (Table 3, entries 2 and 3). As can be seen from the above results, the hydrogen chloride produced by this cascade reaction could greatly reduce the product yield, and 100 mol % base was needed as the acid absorbent (as shown in Scheme 1, the hydrogen chloride was formed after Michael/alkylation cascade reaction). At the same time, the base could catalyze this reaction smoothly, so the background reaction seems unavoidable. This cascade reaction in the asymmetric version was a real challenge.

Afterward, a series of bases and chiral organocatalysts were evaluated (Table 3, entries 3−14). Generally, similar yields and diastereoselectivities were obtained with slightly different enantioselectivities. Better enantioselectivities were obtained when the inorganic bases were used rather than organic bases in this asymmetric reaction (Table 3, entries 3−8). According to the theoretical analysis and the observation during our experiment, this result is partly attributed to the different solubilities between inorganic bases and organic bases. When the organic bases were used, they could be more easily dissolved in the organic solvent than inorganic bases, and the background reaction would start before the chiral organocatalysts playing a catalytic role. Several other squaramide and other bifunctional chiral organocatalysts **II**−**VII** were also screened to evaluate their ability to promote the reaction in the presence of 5 mol % catalyst loading at room temperature in dichloromethane with 100 mol % K_2CO_3 (Table 3, entries 9−14). In comprehensive consideration of the yield, diastereoselectivity, and enantioselectivity, the combination of K_2CO_3 and catalyst **II** gave the best results and was chosen for further optimization (Table 3, entry 9).

With the optimal organocatalyst and acid absorbent in hand, we further investigated the effect of several pure or mixed solvents on this reaction (Table 4, entries 1−12). Generally, with the enhancement of solvent polarity, the enantioselectivity of product **4a** was increased, and excellent yield was also obtained. Acetonitrile was observed to be the best solvent for this asymmetric cascade reaction (Table 4, entry 10). A completely racemic product was obtained when one-third water was added into CH_3CN (Table 4, entry 11). When the catalyst loading was increased to 10 mol %, to our surprise, no better enantioselectivity was obtained (Table 4, entry 13). Reducing the catalyst loading also could not improve the enantioselectivity (Table 4, entry 14). Then, the temperature effect was also evaluated (Table 4, entries 15−16). When the temperature was dropped to −15 °C, the enantioselectivity of product **4a** was increased from 74% to 81% *ee*, but the diastereoselectivity was decreased to 60:40 dr. Consequently, the optimal reaction conditions for this asymmetric cascade reaction were obtained: with 5 mol % of catalyst **II** and 100 mol % K_2CO_3 in CH_3CN at room temperature.

With the optimal reaction conditions in hand, the scope of the reaction was investigated by varying the substituents on both arylidenepyrazolones and 3-chlorooxindoles. First, when 3-chlorooxindole **2a** was used, various arylidenepyrazolones were tested (Table 5, entries 1−5). Generally, excellent yields (98−99%), moderate to good enantioselectivities, (47−74% *ee*) and similar diastereoselectivities (84:16 to 87:13 dr) were obtained for all of the enantiomeric diastereomers. Nevertheless, when the R^3 substituent was changed from methyl to phenyl, three pairs of enantiomers were generated and the corresponding mixture was too complex and could not be separated for further characterization. This phenomenon may be ascribed to the steric effect of the phenyl substituent. Further exploration of the substrate scope was focused on the 3-chlorooxindoles **2** (Table 5, entries 6−8). It was found that excellent yields were maintained (91−98%), but the enantioselectivity became lower (40−54% *ee*). It is worth mentioning that, when the 3,4-dichloroindolin-2-one (**2e**) or 4-bromo-3-chloroindolin-2-one (**2f**) was used as the substrate, the diastereoselectivities obtained using DIPEA as catalyst (Table 2, entries 5 and 6) were higher than using chiral organocatalyst **II** (Table 5, entries 6 and 7). This phenomenon illustrated that the combination mode between the chiral organocatalyst and substrate may has a certain degree of contradiction with the optimal conformation.

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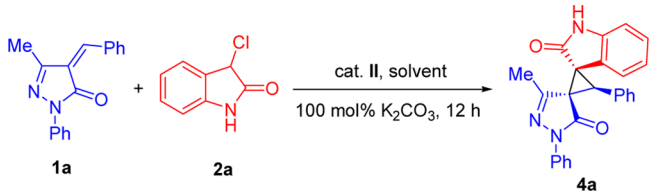
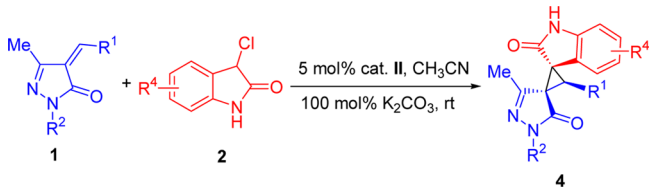
Table 4. Optimization of the Asymmetric Cascade Reaction Conditions[a]



entry	solvent	catalyst loading (mol %)	T (°C)	yield[b] (%)	dr[c]	ee[c] (%)
1	CH_2Cl_2	5	rt	99	83:17	44
2	$CHCl_3$	5	rt	99	82:18	32
3	$ClCH_2CH_2Cl$	5	rt	99	82:18	50
4	Et_2O	5	rt	62	74:26	20
5	THF	5	rt	99	82:18	53
6	PhMe	5	rt	99	82:18	11
7	dioxane	5	rt	85	78:22	51
8	CH_3COCH_3	5	rt	98	84:16	60
9	EtOAc	5	rt	99	82:18	65
10	CH_3CN	5	rt	98	84:16	74
11	CH_3CN:H_2O (3:1)	5	rt	99	85:15	0
12	CH_3CN:EtOAc (1:1)	5	rt	99	82:18	63
13	CH_3CN	10	rt	97	84:16	73
14	CH_3CN	2	rt	98	84:16	65
15[d]	CH_3CN	5	−15	98	60:40	81
16	CH_3CN	5	50	58	83:17	37

[a]Reaction conditions: unless noted otherwise, a mixture of **1a** (0.11 mmol), **2a** (0.10 mmol), catalyst **II**, and K_2CO_3 (100 mol %) in solvent (0.5 mL) was stirred for 12 h. [b]Isolated yield after column chromatography purification. [c]Determined by chiral HPLC analysis. [d]Reaction for 18 h.

Table 5. Substrate Scope of the Asymmetric Cascade Reaction[a]



entry	R^1	R^2	R^4	product	time (h)	yield[b] (%)	dr[c]	ee[c] (%)
1	Ph (**1a**)	Ph	H (**2a**)	**4a**	12	98	84:16	74
2	4-ClC_6H_4 (**1c**)	Ph	H (**2a**)	**4b**	12	98	86:14	69
3	2-BrC_6H_4 (**1j**)	Ph	H (**2a**)	**4c**	36	99	87:13	47
4	3-$O_2NC_6H_4$ (**1h**)	Ph	H (**2a**)	**4d**	12	98	86:14	61
5	Ph (**1m**)	4-ClC_6H_4	H (**2a**)	**4e**	12	99	85:15	72
6	Ph (**1a**)	Ph	4-Cl (**2e**)	**4f**	36	96	2.4:1[d]	45
7	Ph (**1a**)	Ph	4-Br (**2f**)	**4g**	36	98	2.6:1[d]	40
8	Ph (**1a**)	Ph	6-Cl (**2c**)	**4h**	36	91	85:15	54

[a]Reaction conditions: a mixture of **1** (0.11 mmol), **2** (0.10 mmol), and catalyst **II** (5 mol %) in CH_3CN (0.5 mL) was stirred at room temperature for 12−36 h. [b]Isolated yield after column chromatography purification. [c]Determined by chiral HPLC analysis. [d]Determined by NMR spectroscopy analysis.

CONCLUSION

In summary, we have successfully developed a new DIPEA-catalyzed diastereoselective cascade reaction of arylidenepyrazolones with 3-chlorooxindoles, and the corresponding cascade Michael/alkylation products were obtained in excellent yields (up to 99%) with high to excellent diastereoselectivities (up to >25:1 dr). This reaction provided a facile and straightforward access to highly functionalized spiro-pyrazolone-cyclopropane-oxindole derivatives which contain vicinal quaternary carbons constrained in a highly substituted cyclopropane ring. Moreover, an asymmetric version of this Michael/alkylation reaction has also been realized with the squaramide catalyst. The corresponding chiral spirocyclic heterocycles with three contiguous stereocenters, including two vicinal quaternary centers, were obtained in excellent yields (up to 99%) with moderate diastereoselectivities (up to 87:13 dr) and moderate to high enantioselectivities (up to 74% *ee*).

EXPERIMENTAL SECTION

General Information. Commercially available compounds were used without further purification. Column chromatography was carried out using silica gel (200−300 mesh). Melting points were measured with a melting point apparatus without correction. The ^{1}H NMR spectra were recorded with a 400 MHz spectrometer, while ^{13}C NMR spectra were recorded at 100 MHz. Infrared spectra were obtained with an FT-IR spectrometer. The high-resolution ESI-MS spectra were obtained with a Fourier transform mass spectrometer. Optical

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rotations were measured with a polarimeter at the indicated concentration with the units of g per 100 mL. The enantiomeric excesses of the products were determined by chiral HPLC on Daicel Chiralpak AD-H or IB columns.

Materials. Substrates **1**[8b] and 3-chlorooxindoles **2**[16] were synthesized by following the reported procedures. The squaramide organocatalysts were prepared by following the reported procedures.[18]

General Procedure for DIPEA-Catalyzed Cascade Reaction of Arylidenepyrazolones with 3-Chlorooxindoles. To a vial containing arylidenepyrazolones **1** (0.22 mmol) and DIPEA (25.9 mg, 0.2 mmol) in CH_2Cl_2 (1.0 mL) was added 3-chlorooxindoles **2** (0.2 mmol) at room temperature. The resulting reaction mixture was kept under vigorous stirring until the consumption of 3-chlorooxindoles **2** (monitored by TLC analysis). After completion of the reaction, the crude product was column chromatographed on silica gel (petroleum ether/EtOAc 3:1) to give the corresponding products **3** as mixtures of diastereomers for which NMR data for the major isomer only were provided.

According to this General Procedure. *2,4-Dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3a**).* Obtained as a white solid (78.0 mg, 99% yield), mp 126−132 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.15 (s, 1H), 7.81 (dd, J_1 = 1.0 Hz, J_2 = 8.6 Hz, 2H), 7.33−7.29 (m, 5H), 7.19−7.06 (m, 5H), 6.82 (d, J = 8.0 Hz, 2H), 4.57 (s, 1H), 2.52 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 174.0, 165.3, 156.5, 141.3, 138.0, 130.3, 130.2, 128.9, 128.7, 128.2, 128.1, 128.0, 124.9, 121.4, 120.2, 118.9, 109.4, 49.5, 49.1, 39.4, 17.8 ppm. IR (KBr): ν_{max} 3260, 3059, 3029, 1711, 1620, 1594, 1499, 1469, 1393, 1367, 1335, 1296, 1121, 1025, 906, 737, 692 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{20}N_3O_2$ $[M + H]^+$ 394.15500, found 394.15518.

*2,4-Dihydro-2,3′-diphenyl-6″-fluoro-5-methyl-2″-oxo-dispiro-[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3b**).* Obtained as a white solid (82.0 mg, 99% yield), mp 129−134 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.02 (s, 1H), 7.81 (d, J = 8.0 Hz, 2H), 7.35−7.31 (m, 5H), 7.15−7.05 (m, 4H), 6.58−6.50 (m, 2H), 4.54 (s, 1H), 2.51 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 174.2, 165.3, 163.3 ($^1J_{C-F}$ = −246.5 Hz), 156.5, 142.6 ($^3J_{C-F}$ = 11.8 Hz), 138.0, 131.7 (d, $^3J_{C-F}$ = 9.4 Hz), 130.3, 128.7, 128.3, 128.2, 127.8, 125.1, 118.9, 115.5 ($^4J_{C-F}$ = 2.9 Hz), 108.0 ($^2J_{C-F}$ = 21.6 Hz), 98.0 ($^2J_{C-F}$ = 27.0 Hz), 49.2, 49.0, 39.3, 17.7 ppm. IR (KBr): ν_{max} 3236, 3006, 2990, 1735, 1713, 1624, 1596, 1499, 1460, 1367, 1297, 1276, 1261, 1144, 1120, 964, 841, 750, 693 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}FN_3O_2$ $[M + H]^+$ 412.14558, found 412.14531; m/z calcd. for $C_{25}H_{18}FN_3NaO_2$ $[M + Na]^+$ 434.12753, found 434.12695.

*6″-Chloro-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro-[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3c**).* Obtained as a white solid (85.0 mg, 99% yield), mp 135−139 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.19 (s, 1H), 7.80 (d, J = 8.0 Hz, 2H), 7.34−7.28 (m, 5H), 7.13 (t, J = 7.4 Hz, 1H), 7.08−7.05 (m, 3H), 6.82−6.80 (m, 2H), 4.56 (s, 1H), 2.51 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 174.0, 165.2, 156.4, 142.3, 137.9, 135.0, 131.1, 130.2, 128.7, 128.3, 128.2, 127.7, 125.1, 121.5, 119.0, 118.5, 110.0, 49.2, 49.1, 39.4, 17.7 ppm. IR (KBr): ν_{max} 3006, 2989, 1733, 1711, 1613, 1595, 1498, 1485, 1447, 1327, 1276, 1261, 1200, 1128, 920, 764, 750, 725, 691 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11580; calcd. for $C_{25}H_{18}ClN_3NaO_2$ $[M + Na]^+$ 450.09798, found 450.09800.

*6″-Bromo-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro-[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3d**).* Obtained as a white solid (94.0 mg, 99% yield), mp 124−127 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.96 (s, 1H), 7.80 (d, J = 7.6 Hz, 2H), 7.35−7.29 (m, 5H), 7.13 (t, J = 7.4 Hz, 1H), 7.06−7.04 (m, 2H), 6.98 (s, 3H), 4.56 (s, 1H), 2.51 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 165.2, 156.4, 142.4, 137.9, 131.4, 130.2, 128.7, 128.30, 128.27, 127.7, 125.1, 124.5, 123.0, 119.1, 119.0, 112.8, 49.12, 49.11, 39.4, 17.7 ppm. IR (KBr): ν_{max} 3006, 2989, 1733, 1712, 1609, 1596, 1498, 1480, 1448, 1366, 1276, 1261, 1130, 907, 764, 750, 691 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}BrN_3O_2$ $[M + H]^+$ 472.06552, found 472.06504; m/z calcd. for $C_{25}H_{18}BrN_3NaO_2$ $[M + Na]^+$ 494.04746, found 494.04753.

*4″-Chloro-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro-[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3e**).* Obtained as a white solid (85.0 mg, 99% yield), mp 139−142 °C. ^{1}H NMR (400 MHz, DMSO-d_6): δ 10.6 (s, 1H), 7.68 (d, J = 8.0 Hz, 2H), 7.50−7.44 (m, 3H), 7.30−7.22 (m, 5H), 7.03−7.01 (m, 2H), 6.84 (d, J = 7.6 Hz, 1H), 5.47 (s, 1H), 2.09 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6): δ 171.1, 159.2, 144.1, 143.2, 137.5, 134.6, 133.4, 131.4, 129.5, 128.23, 128.16, 127.8, 125.4, 123.1, 122.9, 117.2, 109.3, 104.7, 101.5, 50.0, 13.3 ppm. IR (KBr): ν_{max} 3005, 2987, 1737, 1692, 1616, 1533, 1499, 1453, 1276, 1261, 1169, 1149, 883, 764, 751, 691 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11556.

*4″-Bromo-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro-[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3f**).* Obtained as a white solid (94.0 mg, 99% yield), mp 146−151 °C. ^{1}H NMR (400 MHz, DMSO-d_6): δ 10.51 (s, 1H), 7.66 (d, J = 8.0 Hz, 2H), 7.48 (t, J = 7.8 Hz, 2H), 7.38−7.34 (m, 2H), 7.29−7.24 (m, 4H), 7.00 (t, J = 3.6 Hz, 2H), 6.88−6.83 (m, 1H), 5.47 (s, 1H), 2.08 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6): δ 171.1, 159.3, 144.3, 143.1, 137.5, 134.5, 133.5, 129.5, 128.2, 128.1, 127.8, 126.1, 125.4, 124.5, 119.9, 117.2, 109.6, 104.7, 102.0, 50.0, 13.3 ppm. IR (KBr): ν_{max} 3006, 2988, 1743, 1614, 1583, 1538, 1505, 1446, 1374, 1276, 1261, 1167, 764, 750, 697 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}BrN_3O_2$ $[M + H]^+$ 472.06552, found 472.06485.

*2-(4-Chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-3′-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3g**).* Obtained as a white solid (81.7 mg, 95% yield), mp 129−133 °C. ^{1}H NMR (400 MHz, acetone-d_6): δ 9.92 (s, 1H), 7.88−7.84 (m, 2H), 7.37−7.31 (m, 5H), 7.21 (dt, J_1 = 1.2 Hz, J_2 = 7.6 Hz, 1H), 7.17−7.15 (m, 2H), 7.09 (d, J = 7.2 Hz, 1H,), 6.96 (d, J = 7.6 Hz, 1H), 6.78 (dt, J_1 = 1.2 Hz, J_2 = 7.8 Hz, 1H), 4.63 (s, 1H), 2.51 (s, 3H) ppm. ^{13}C NMR (100 MHz, acetone-d_6): δ 174.3, 167.4, 159.4, 144.7, 139.3, 132.4, 132.0, 131.7, 130.8, 130.7, 130.5, 130.4, 129.8, 129.5, 122.1, 121.3, 111.2, 51.8, 50.9, 41.0, 19.0 ppm. IR (KBr): ν_{max} 3006, 2990, 1712, 1619, 1593, 1491, 1470, 1365, 1335, 1294, 1276, 1261, 1091, 827, 764, 750, 696 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11541.

*4″-Chloro-2,4-dihydro-3′-(4-fluorophenyl)-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3h**).* Obtained as a white solid (89.0 mg, 99% yield), mp 157−160 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.59 (s, 1H), 7.71 (d, J = 8.0 Hz, 2H), 7.37 (t, J = 7.8 Hz, 2H), 7.24−7.16 (m, 2H), 7.09 (d, J = 8.4 Hz, 1H), 7.06−7.02 (m, 2H), 6.87 (t, J = 8.4 Hz, 2H), 6.59 (d, J = 7.6 Hz, 1H), 5.41 (s, 1H), 2.12 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.6, 162.5 ($^1J_{C-F}$ = −245.6 Hz), 159.8, 143.8, 142.6, 137.9, 132.6, 130.6 ($^4J_{C-F}$ = 3.1 Hz), 130.0 ($^3J_{C-F}$ = 8.1 Hz), 129.2, 125.5, 124.2, 123.9, 118.3, 115.3 ($^2J_{C-F}$ = 21.4 Hz), 109.1, 104.9, 101.48, 101.47, 50.29, 13.5 ppm. IR (KBr): ν_{max} 3006, 2989, 1746, 1729, 1618, 1589, 1539, 1508, 1453, 1386, 1276, 1261, 1170, 838, 764, 750, 688 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{18}ClFN_3O_2$ $[M + H]^+$ 446.10661, found 446.10545.

*4″-Chloro-3′-(4-chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3i**).* Obtained as a white solid (92.0 mg, 99% yield), mp 142−145 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.75 (s, 1H), 7.71 (d, J = 7.6 Hz, 2H), 7.37 (t, J = 8.0 Hz, 2H), 7.23−7.15 (m, 4H), 7.08 (d, J = 8.4 Hz, 1H), 7.00 (d, J = 8.4 Hz, 2H), 6.58 (d, J = 7.6 Hz, 1H), 5.40 (s, 1H), 2.11 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.5, 159.9, 143.8, 142.6, 137.8, 133.9, 133.5, 132.6, 132.5, 129.7, 129.2, 128.5, 125.5, 124.2, 123.8, 118.3, 109.2, 104.6, 101.4, 50.3, 13.4 ppm. IR (KBr): ν_{max} 3005, 2987, 1739, 1617, 1592, 1574, 1535, 1491, 1453, 1276, 1168, 1149, 1091, 833, 764, 751, 689 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{18}Cl_2N_3O_2$ $[M + H]^+$ 462.07706, found 462.07547.

*3′-(4-Bromophenyl)-4″-chloro-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3j**).* Obtained as a white solid (101.0 mg, 99% yield), mp 152−156 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.60 (s, 1H), 7.71 (d, J = 8.4 Hz, 2H), 7.39−7.31 (m, 4H), 7.26−7.16 (m, 2H), 7.10 (d, J = 8.0 Hz, 1H), 6.95 (d, J = 8.4 Hz, 2H), 6.60 (d, J = 8.0 Hz, 1H), 5.39 (s, 1H), 2.12 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.4, 159.9, 143.8, 142.5,

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137.9, 134.1, 132.65, 132.59, 131.5, 130.1, 129.2, 125.5, 124.3, 123.9, 122.2, 118.3, 109.2, 104.5, 101.3, 50.4, 13.5 ppm. IR (KBr): ν_{max} 3006, 2989, 1742, 1617, 1593, 1535, 1502, 1488, 1453, 1386, 1310, 1276, 1261, 1168, 1011, 751, 689 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}BrClN_3O_2$ $[M + H]^+$ 506.02654, found 506.02547.

4″-Chloro-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-3′-(p-tolyl)-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3k**). Obtained as a white solid (88.0 mg, 99% yield), mp 154−157 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.52 (s, 1H), 7.71 (dd, J_1 = 0.8 Hz, J_2 = 8.8 Hz, 2H), 7.37 (t, *J* = 7.8 Hz, 2H), 7.22−7.15 (m, 2H), 7.08 (dd, J_1 = 0.8 Hz, J_2 = 8.4 Hz, 1H), 6.98−6.92 (m, 4H), 6.59 (dd, J_1 = 0.6 Hz, J_2 = 7.8 Hz, 1H), 5.41 (s, 1H), 2.19 (s, 3H), 2.14 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 159.8, 144.0, 142.7, 138.0, 137.7, 132.5, 132.4, 131.8, 129.1, 129.0, 128.2, 125.3, 124.2, 124.1, 118.2, 109.1, 105.1, 101.6, 50.7, 21.0, 13.5 ppm. IR (KBr): ν_{max} 3006, 2989, 1740, 1617, 1593, 1534, 1513, 1501, 1452, 1385, 1313, 1298, 1276, 1261, 1169, 1149, 823, 764, 751, 689 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{26}H_{21}ClN_3O_2$ $[M + H]^+$ 442.13168, found 442.13137.

4″-Chloro-2,4-dihydro-3′-(4-methoxyphenyl)-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3l**). Obtained as a white solid (83.2 mg, 91% yield), mp 130−134 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.51 (s, 1H), 7.72 (dd, J_1 = 1.0 Hz, J_2 = 8.6 Hz, 2H), 7.37 (t, *J* = 8.0 Hz, 2H), 7.23−7.15 (m, 2H), 7.08 (d, *J* = 8.4 Hz, 1H), 6.97 (d, *J* = 8.8 Hz, 2H), 6.70 (d, *J* = 8.4 Hz, 2H), 6.61 (d, *J* = 8.0 Hz, 1H), 5.40 (s, 1H), 3.65 (s, 3H), 2.14 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 159.8, 159.3, 143.9, 142.7, 138.0, 132.5, 132.4, 129.4, 129.1, 126.6, 125.3, 124.2, 124.1, 118.2, 113.7, 109.1, 105.2, 101.6, 54.9, 50.4, 13.5 ppm. IR (KBr): ν_{max} 3005, 2834, 1738, 1615, 1595, 1534, 1511, 1452, 1385, 1302, 1276, 1250, 1170, 1033, 834, 752, 689, 670 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{26}H_{21}ClN_3O_3$ $[M + H]^+$ 458.12660, found 458.12543.

4″-Chloro-2,4-dihydro-5-methyl-3′-(4-nitrophenyl)-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3m**). Obtained as a white solid (93.6 mg, 99% yield), mp 148−151 °C. ^1H NMR (400 MHz, DMSO-d_6): δ 10.7 (s, 1H), 8.19 (d, *J* = 8.8 Hz, 2H),7.68 (d, *J* = 7.6 Hz, 2H), 7.51−7.47 (m, 3H), 7.33 (d, *J* = 8.8 Hz, 2H), 7.28−7.24 (m, 2H), 6.89 (d, *J* = 7.2 Hz, 1H), 5.60 (s, 1H), 2.12 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6): δ 170.8, 159.3, 147.2, 143.8, 143.2, 142.9, 137.4, 133.6, 131.5, 129.7, 129.5, 125.5, 123.4, 123.3, 122.7, 117.3, 109.5, 104.2, 101.2, 49.5, 13.3 ppm. IR (KBr): ν_{max} 3066, 2927, 1739, 1615, 1593, 1518, 1500, 1453, 1346, 1310, 1260, 1168, 1150, 857, 834, 754, 690, 668 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}ClN_4O_4$ $[M + H]^+$ 473.10111, found 473.09975.

4″-Chloro-2,4-dihydro-5-methyl-3′-(3-nitrophenyl)-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3n**). Obtained as a white solid (94.0 mg, 99% yield), mp 139−144 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.56 (s, 1H), 8.07−8.04 (m, 1H), 7.96 (s, 1H), 7.71 (d, *J* = 8.4 Hz, 2H), 7.40−7.36 (m, 4H), 7.28−7.18 (m, 2H), 7.13 (d, *J* = 8.4 Hz, 1H), 6.63 (d, *J* = 7.6 Hz, 1H), 5.51 (s, 1H), 2.13 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.1, 160.0, 148.2, 143.6, 142.3, 137.7, 137.6, 134.5, 133.1, 132.6, 129.4, 129.2, 125.7, 124.5, 123.5, 123.3, 123.2, 118.3, 109.4, 104.0, 101.1, 50.4, 13.5 ppm. IR (KBr): ν_{max} 3006, 2989, 1745, 1617, 1594, 1530, 1501, 1453, 1349, 1276, 1261, 1171, 926, 764, 750, 706 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}ClN_4O_4$ $[M + H]^+$ 473.10111, found 473.10058.

4″-Chloro-3′-(2-chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3o**). Obtained as a white solid (92.0 mg, 99% yield), mp 80−84 °C. ^1H NMR (400 MHz, DMSO-d_6 + $CDCl_3$): δ 10.71 (s, 1H), 7.68 (dd, J_1 = 0.8 Hz, J_2 = 8.8 Hz, 2H), 7.51−7.31 (m, 7H), 7.26 (t, *J* = 7.4 Hz, 1H), 7.17 (d, *J* = 7.6 Hz, 1H), 6.84 (dd, J_1 = 0.8 Hz, J_2 = 7.8 Hz, 1H), 5.83 (s, 1H), 2.03 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6 + $CDCl_3$): δ 170.6, 159.3, 144.2, 143.0, 137.4, 133.2, 132.6, 131.6, 131.3, 129.6, 129.5, 129.1, 128.8, 126.8, 125.4, 123.9, 122.9, 117.2, 109.3, 104.7, 100.9, 46.6, 13.2 ppm. IR (KBr): ν_{max} 3006, 2989, 1740, 1615, 1593, 1533, 1499, 1452, 1387, 1305, 1276, 1261, 1169, 1149, 1049, 1024, 1004, 951, 884, 764, 750, 690 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}Cl_2N_3O_2$ $[M + H]^+$ 462.07706, found 462.07659.

3′-(2-Bromophenyl)-4″-chloro-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3p**). Obtained as a white solid (101.0 mg, 99% yield), mp 78−80 °C. ^1H NMR (400 MHz, DMSO-d_6): δ 10.71 (s, 1H), 7.69 (dd, J_1 = 1.0 Hz, J_2 = 8.6 Hz, 2H), 7.53 (dd, J_1 = 1.2 Hz, J_2 = 8.0 Hz, 1H), 7.51−7.44 (m, 3H), 7.41 (d, *J* = 8.0 Hz, 2H), 7.28−7.21 (m, 2H), 7.16 (dd, J_1 = 0.8 Hz, J_2 = 8.2 Hz, 1H), 6.84 (dd, J_1 = 0.8 Hz, J_2 = 8.0 Hz, 1H), 5.81 (s, 1H), 2.01 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6): δ 170.6, 159.2, 144.3, 142.9, 137.4, 134.2, 133.2, 132.5, 132.0, 131.5, 129.9, 129.5, 127.3, 125.4, 123.9, 123.7, 122.9, 117.2, 109.3, 105.1, 100.9, 48.8, 13.1 ppm. IR (KBr): ν_{max} 3006, 2989, 1733, 1615, 1594, 1535, 1499, 1453, 1372, 1276, 1261, 1170, 1045, 1026, 883, 764, 750, 690 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}BrClN_3O_2$ $[M + H]^+$ 506.02654, found 506.02557.

4″-Chloro-2,4-dihydro-3′-(2-methoxyphenyl)-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3q**). Obtained as a white solid (91.0 mg, 99% yield), mp 134−138 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.69 (s, 1H), 7.72 (d, *J* = 7.6 Hz, 2H), 7.36 (t, *J* = 8.2 Hz, 3H), 7.18−7.08 (m, 3H), 7.04 (d, *J* = 8.0 Hz, 1H), 6.86 (t, *J* = 7.4 Hz, 1H), 6.59 (t, *J* = 8.6 Hz, 2H), 5.65 (s, 1H), 3.16 (s, 3H), 2.19 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.9, 159.7, 157.3, 143.9, 142.8, 138.1, 132.0, 131.5, 129.8, 129.1120.2, 118.1, 109.4, 108.6, 104.8, 101.5, 54.3, 45.2, 13.7 ppm. IR (KBr): ν_{max} 3005, 2990, 1739, 1616, 1597, 1533, 1499, 1490, 1453, 1387, 1310, 1276, 1260, 1170, 1109, 1028, 883, 751, 690 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{26}H_{21}ClN_3O_3$ $[M + H]^+$ 458.12660, found 458.12607.

4″-Chloro-2,4-dihydro-3′-(3,4-dimethoxyphenyl)-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3r**). Obtained as a white solid (81.4 mg, 83% yield), mp 133−137 °C. ^1H NMR (400 MHz, DMSO-d_6 + $CDCl_3$): δ 10.53 (s, 1H), 7.67 (dd, J_1 = 1.0 Hz, J_2 = 8.6 Hz, 2H), 7.50−7.43 (m, 3H), 7.28−7.21 (m, 2H), 6.87−6.82 (m, 2H), 6.55 (dd, J_1 = 2.0 Hz, J_2 = 8.4 Hz, 1H), 6.51 (d, *J* = 2.0 Hz, 1H), 5.40 (s, 1H), 3.73 (s, 3H), 3.57 (s, 3H), 2.11 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6 + $CDCl_3$): δ 171.3, 159.2, 148.5, 148.2, 144.1, 143.2, 137.5, 133.3, 131.3, 129.5, 126.4, 125.4, 123.1, 122.8, 120.4, 117.2, 111.5, 111.3, 109.1, 104.9, 101.6, 55.2, 55.1, 49.8, 13.4 ppm. IR (KBr): ν_{max} 3271, 2931, 2834, 1738, 1615, 1592, 1534, 1514, 1452, 1260, 1233, 1171, 1139, 1025, 931, 752, 690, 621 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{27}H_{23}ClN_3O_4$ $[M + H]^+$ 488.13716, found 488.13663.

4″-Chloro-2-(4-chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-3′-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3s**). Obtained as a white solid (92.0 mg, 99% yield), mp 149−152 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.14 (s, 1H), 7.66 (d, *J* = 9.2 Hz, 2H), 7.33 (d, *J* = 9.2 Hz, 2H), 7.26 (t, *J* = 8.2 Hz, 1H), 7.19−7.18 (m, 3H), 7.12 (d, *J* = 8.0 Hz, 1H), 7.06−7.03 (m, 2H), 6.62 (d, *J* = 8.0 Hz, 1H), 5.44 (s, 1H), 2.14 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.4, 159.8, 144.4, 142.5, 136.6, 134.8, 132.7, 132.6, 130.7, 129.2, 128.4, 128.3, 128.1, 124.3, 124.0, 119.4, 109.1, 105.1, 101.7, 51.0, 13.6 ppm. IR (KBr): ν_{max} 3251, 3006, 2991, 1739, 1616, 1592, 1530, 1452, 1409, 1303, 1276, 1261, 1169, 1149, 1091, 828, 765, 750, 698 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{25}H_{18}Cl_2N_3O_2$ $[M + H]^+$ 462.07706, found 462.07587.

4″-Chloro-2,4-dihydro-5-methyl-2″-oxo-3′-phenyl-2-(p-tolyl)-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3t**). Obtained as a white solid (84.6 mg, 96% yield), mp 69−73 °C. ^1H NMR (400 MHz, DMSO-d_6 + $CDCl_3$): δ 10.55 (s, 1H), 7.55 (d, *J* = 8.4 Hz, 2H), 7.44 (t, *J* = 8.2 Hz, 1H), 7.28−7.26 (m, 5H), 7.22 (d, *J* = 8.0 Hz, 1H), 7.02−7.00 (m, 2H), 6.83 (d, *J* = 7.6 Hz, 1H), 5.46 (s, 1H), 2.31 (s, 3H), 2.08 (s, 3H) ppm. ^{13}C NMR (100 MHz, DMSO-d_6 + $CDCl_3$): δ 171.1, 159.0, 144.1, 142.8, 135.2, 134.63, 134.62, 133.3, 131.3, 129.9, 128.21, 128.15, 127.8, 123.1, 122.9, 117.2, 109.3, 104.5, 101.4, 50.0, 20.3, 13.3 ppm. IR (KBr): ν_{max} 2986, 2923, 2895, 1738, 1616, 1591, 1536, 1510, 1452, 1262, 1169, 1089, 1041, 935, 884, 817, 764, 698 cm^{-1}. HRMS (ESI): *m/z* calcd. for $C_{26}H_{21}ClN_3O_2$ $[M + H]^+$ 442.13168, found 442.13122.

4″-Chloro-2,4-dihydro-2,3′-diphenyl-2″-oxo-5-trifluoromethyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3u**). Obtained as a white solid (72.3 mg, 75% yield), mp 78−81 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.09 (s, 1H), 7.80 (d, *J* = 7.6 Hz, 2H), 7.43 (t, *J* = 8.0 Hz, 2H), 7.31−7.24 (m, 2H), 7.19−7.12 (m, 4H), 7.05−7.03 (m, 2H), 6.66 (d, *J* = 8.0 Hz, 1H), 5.56 (s, 1H) ppm. ^{13}C

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NMR (100 MHz, $CDCl_3$): δ 172.1, 160.0, 142.5, 137.3, 136.5 (q, $^2J_{C-F}$ = 39.4 Hz), 133.7, 132.9, 132.7, 129.4, 128.4, 128.3, 128.2, 127.1, 124.4, 123.4, 120.6 (q, $^1J_{C-F}$ = −267.8), 119.2, 109.3, 104.84, 104.82, 102.0, 51.3 ppm. IR (KBr): ν_{max} 3244, 3006, 2990, 1735, 1618, 1593, 1537, 1454, 1401, 1276, 1260, 1176, 1122, 1043, 764, 750, 698 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{16}ClF_3N_3O_2$ $[M + H]^+$ 482.08777, found 482.08611.

*4″-Chloro-2,4-dihydro-2″-oxo-2,5,3′-triphenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**3v**).* Obtained as a white solid (97.5 mg, 99% yield), mp 149−153 °C. ^1H NMR (400 MHz, $CDCl_3$): δ 8.31 (s, 1H), 7.87 (d, J = 7.6 Hz, 2H), 7.59−7.56 (m, 2H), 7.43−7.39 (m, 2H), 7.24−7.15 (m, 5H), 7.11−7.04 (m, 6H), 6.59 (d, J = 7.2 Hz, 1H), 5.62 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 160.5, 145.4, 142.5, 138.1, 134.7, 132.51, 132.48, 132.3, 129.2, 128.8, 128.2, 128.1, 128.0, 126.4, 125.7, 124.5, 124.2, 118.5, 109.3, 103.7, 101.7, 52.2 ppm. IR (KBr): ν_{max} 3023, 2990, 1738, 1616, 1592, 1573, 1529, 1490, 1453, 1375, 1275, 1261, 1171, 764, 750, 692, 673 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{30}H_{21}ClN_3O_2$ $[M + H]^+$ 490.13168, found 490.12976.

General Procedure for the Asymmetric Cascade Reaction of Arylidenepyrazolones with 3-Chlorooxindoles. To a vial containing arylidenepyrazolones **1** (0.11 mmol), K_2CO_3 (13.8 mg, 0.1 mmol), and squaramide **II** (2.8 mg, 0.005 mmol) in CH_3CN (0.5 mL) was added 3-chlorooxindoles **2** (0.1 mmol) at room temperature. The resulting reaction mixture was kept under vigorous stirring until the consumption of 3-chlorooxindoles **2** (monitored by TLC analysis). After completion of the reaction, the crude product was column chromatographed on silica gel (petroleum ether/EtOAc 3:1) to give the corresponding products **4** as mixtures of diastereomers for which NMR data for the major isomer only were provided.

According to this General Procrdure. *(+)-2,4-Dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4a**).* Obtained as a white solid (38.5 mg, 98% yield), mp 118−121 °C. HPLC (Daicel Chiralpak AD-H, n-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 20.6 min, t_{major} = 8.7 min; minor diastereoisomer: t_{minor} = 10.0 min, t_{major} = 17.8 min; 84:16 dr, 74% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +287.8 (c 1.71, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.61 (s, 1H), 7.81 (dd, J_1 = 1.2 Hz, J_2 = 8.8 Hz, 2H), 7.35−7.29 (m, 5H), 7.23−7.07 (m, 5H), 6.86 (d, J = 7.6 Hz, 2H), 4.57 (s, 1H), 2.51 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 165.3, 156.6, 141.2, 138.1, 130.33, 130.26, 128.9, 128.7, 128.2, 128.11, 128.08, 124.9, 121.4, 120.2, 118.9, 109.3, 49.5, 49.1, 39.4, 17.8 ppm; IR (KBr): ν_{max} 3274, 3062, 1733, 1714, 1619, 1596, 1499, 1471, 1395, 1368, 1336, 1298, 1264, 1233, 1122, 1025, 754, 739, 693 cm^{-1}; HRMS (ESI): m/z calcd. for $C_{25}H_{20}N_3O_2$ $[M + H]^+$ 394.15500, found 394.15571.

*(+)-3′-(4-Chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4b**).* Obtained as a white solid (42.0 mg, 98% yield), mp 127−132 °C. HPLC (Daicel Chiralpak AD-H, n-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 31.8 min, t_{major} = 9.3 min; minor diastereoisomer: t_{minor} = 11.7 min, t_{major} = 20.1 min; 86:14 dr, 69% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +180.9 (c 1.77, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.67 (s, 1H), 7.80 (d, J = 8.0 Hz, 2H), 7.34−7.28 (m, 4H), 7.23−7.11 (m, 3H), 7.01 (d, J = 8.0 Hz, 2H), 6.87 (t, J = 7.8 Hz, 2H), 4.49 (s, 1H), 2.49 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.5, 165.1, 156.4, 141.2, 138.0, 134.1, 131.7, 130.0, 129.1, 128.7, 128.5, 126.7, 125.0, 121.6, 120.0, 118.8, 109.5, 49.2, 49.0, 38.5, 17.8 ppm; IR (KBr): ν_{max} 3006, 2989, 1712, 1620, 1594, 1496, 1470, 1276, 1261, 1089, 1016, 907, 764, 750 cm^{-1}; HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11615.

*(+)-3′-(2-Bromophenyl)-2,4-dihydro-5-methyl-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4c**).* Obtained as a white solid (47.0 mg, 99% yield), mp 124−126 °C. HPLC (Daicel Chiralpak AD-H + IB, n-hexane/2-propanol = 85:15, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 23.6 min, t_{major} = 13.5 min; minor diastereoisomer: t_{minor} = 18.7 min, t_{major} = 21.6 min; 87:13 dr, 47% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +145.3 (c 1.48, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.81 (s, 1H), 7.76 (d, J = 8.0 Hz, 2H), 7.57 (d, J = 7.6 Hz, 1H), 7.39 (d, J = 8.0 Hz, 1H), 7.32 (t, J = 7.8 Hz, 2H), 7.25−7.21 (m, 3H), 7.16−7.10 (m, 2H), 6.91−6.86 (m, 2H), 4.34 (s, 1H), 2.53 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.4, 165.4, 156.4, 141.3, 138.1, 133.0, 132.2, 129.83, 129.75 129.1, 128.7, 128.6, 126.7, 125.6, 125.0, 121.7, 120.6, 119.2, 109.5, 50.2, 48.9, 40.0, 17.8 ppm; IR (KBr): ν_{max} 3006, 2989, 1730, 1711, 1620, 1594, 1499, 1470, 1275, 1261, 764, 750, 690 cm^{-1}; HRMS (ESI): m/z calcd. for $C_{25}H_{19}BrN_3O_2$ $[M + H]^+$ 472.06552, found 472.06559.

*(+)-2,4-Dihydro-5-methyl-3′-(3-nitrophenyl)-2″-oxo-2-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4d**).* Obtained as a white solid (43.0 mg, 98% yield), mp 137−140 °C. HPLC (Daicel Chiralpak AD-H + IB, n-hexane/2-propanol = 85:15, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 40.9 min, t_{major} = 31.7 min; minor diastereoisomer: t_{minor} = 24.8 min, t_{major} = 26.9 min; 86:14 dr, 61% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +181.5 (c 1.78, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.68 (s, 1H), 8.21 (d, J = 8.0 Hz, 1H), 7.99 (s, 1H), 7.77 (d, J = 7.6 Hz, 2H), 7.50 (t, J = 7.8 Hz, 1H), 7.44 (d, J = 8.0 Hz, 1H), 7.33 (t, J = 8.0 Hz, 2H), 7.24 (t, J = 7.8 Hz, 1H), 7.15−7.09 (m, 2H), 6.92−6.84 (m, 2H), 4.57 (s, 1H), 2.51 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.0, 165.0, 156.1, 147.9, 141.4, 137.8, 136.6, 130.5, 129.5, 129.2, 128.9, 128.8, 125.4, 125.3, 123.2, 121.9, 119.6, 119.0, 109.8, 48.9, 48.8, 37.9, 17.8 ppm; IR (KBr): ν_{max} 3006, 2989, 1730, 1710, 1620, 1595, 1530, 1499, 1470, 1395, 1349, 1299, 1276, 1261, 907, 764, 750, 691 cm^{-1}; HRMS (ESI): m/z calcd. for $C_{25}H_{19}N_4O_4$ $[M + H]^+$ 439.14008, found 439.14040; m/z calcd. for $C_{25}H_{18}N_4NaO_4$ $[M + Na]^+$ 461.12203, found 461.12220.

*(+)-2-(4-Chlorophenyl)-2,4-dihydro-5-methyl-2″-oxo-3′-phenyl-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4e**).* Obtained as a white solid (42.5 mg, 99% yield), mp 130−133 °C. HPLC (Daicel Chiralpak AD-H, n-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 22.2 min, t_{major} = 9.7 min; minor diastereoisomer: t_{minor} = 11.3 min, t_{major} = 26.9 min; 85:15 dr, 72% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +221.0 (c 1.91, CH_2Cl_2); ^1H NMR (400 MHz, acetone-d_6): δ 9.91 (s, 1H), 7.85 (d, J = 7.6 Hz, 2H), 7.41−7.33 (m, 5H), 7.23−7.16 (m, 3H), 7.09 (d, J = 7.6 Hz, 1H), 6.96 (d, J = 7.2 Hz, 1H), 6.78 (t, J = 7.4 Hz, 1H), 4.62 (s, 1H), 2.50 (s, 3H) ppm; ^{13}C NMR (100 MHz, acetone-d_6): δ 174.3, 167.4, 159.4, 144.7, 139.3, 132.4, 132.1, 131.7, 130.8, 130.7, 130.4, 129.8, 129.6, 122.2, 122.1, 121.3, 111.2, 51.8, 50.9, 41.0, 19.0 ppm; IR (KBr): ν_{max} 3164, 3088, 1720, 1618, 1594, 1493, 1471, 1368, 1337, 1299, 1237, 1124, 1094, 1010, 830, 755, 741, 717, 697 cm^{-1}; HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11691.

*(+)-4″-Chloro-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4f**).* Obtained as a white solid (41.0 mg, 96% yield), mp 158−161 °C. HPLC (Daicel Chiralpak AD-H, n-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 15.5 min, t_{major} = 6.7 min; minor diastereoisomer: t_{minor} = 12.4 min, t_{major} = 14.2 min; 2.4:1 dr, 45% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +9.1 (c 0.7, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.22 (s, 1H), 7.73−7.70 (m, 2H), 7.40−7.35 (m, 2H), 7.22−7.17 (m, 5H), 7.10−7.05 (m, 3H), 6.60 (d, J = 7.6 Hz, 1H), 5.45 (s, 1H), 2.15 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.4, 159.9, 144.0, 142.6, 138.0, 135.0, 132.6, 132.5, 129.2, 128.39, 128.36, 128.3, 128.0, 125.4, 124.2, 118.3, 109.1, 104.9, 101.5, 51.0, 13.6 ppm; IR (KBr): ν_{max} 3252, 2922, 1738, 1618, 1593, 1536, 1502, 1453, 1387, 1261, 1169, 1148, 884, 764, 751, 697 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11444.

*(+)-4″-Bromo-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxo-dispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4g**).* Obtained as a white solid (46.3 mg, 98% yield), mp 149−152 °C. HPLC (Daicel Chiralpak AD-H, n-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 18.6 min, t_{major} = 7.0 min; minor diastereoisomer: t_{minor} = 12.3 min, t_{major} = 15.9 min; 2.6:1 dr, 40% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +21.3 (c 1.08, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ 8.25 (s,

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1H), 7.71 (d, J = 7.6 Hz, 2H), 7.39−7.35 (m, 2H), 7.26 (d, J = 8.4 Hz, 1H), 7.20−7.18 (m, 3H), 7.16−7.13 (m, 2H), 7.06−7.04 (m, 2H), 6.64 (d, J = 7.6 Hz, 1H), 5.47 (s, 1H), 2.15 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.4, 159.9, 143.9, 142.8, 138.0, 134.9, 132.6, 129.2, 128.41, 128.35, 128.0, 127.2, 125.9, 125.4, 120.6, 118.3, 109.6, 105.0, 102.0, 51.1, 13.6 ppm; IR (KBr): ν_{max} 3060, 2926, 1738, 1613, 1598, 1535, 1501, 1447, 1384, 1311, 1300, 1262, 1168, 1141, 955, 907, 884, 777, 753, 732, 691 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}BrN_3O_2$ $[M + H]^+$ 472.06552, found 472.06392.

*(+)-6″-Chloro-2,4-dihydro-2,3′-diphenyl-5-methyl-2″-oxodispiro[pyrazol-4,1′-cyclopropane-3′,3″-indolin]-3-one (**4h**).* Obtained as a white solid (39.1 mg, 91% yield), mp 127−131 °C. HPLC (Daicel Chiralpak AD-H, *n*-hexane/2-propanol = 90:10, flow rate 1.0 mL/min, detection at 254 nm): major diastereoisomer: t_{minor} = 22.1 min, t_{major} = 9.1 min; minor diastereoisomer: t_{minor} = 11.1 min, t_{major} = 15.9 min; 85:15 dr, 54% ee for the major diastereoisomer; $[\alpha]_D^{20}$ = +162.7 (*c* 1.92, CH_2Cl_2); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.77 (s, 1H), 7.81 (d, J = 7.6 Hz, 2H), 7.35−7.29 (m, 5H), 7.13 (t, J = 7.4 Hz, 1H), 7.06 (d, J = 8.0 Hz, 3H), 6.85−6.81 (m, 2H), 4.56 (s, 1H), 2.50 (s, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.7, 165.2, 156.4, 142.3, 138.0, 135.0, 131.2, 130.3, 128.7, 128.31, 128.27, 127.7, 125.1, 121.5, 118.9, 118.6, 110.0, 49.2, 49.0, 39.4, 17.7 ppm; IR (KBr): ν_{max} 3220, 3032, 1733, 1713, 1614, 1498, 1486, 1367, 1295, 1244, 1129, 1072, 908, 756, 740, 692 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{25}H_{19}ClN_3O_2$ $[M + H]^+$ 428.11603, found 428.11702.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge on the ACS Publications website at DOI: 10.1021/acs.joc.5b01940.

X-ray crystallographic data of **3g** (CIF)

Copies of ^{1}H and ^{13}C NMR spectra of new compounds, HPLC chromatograms, the crystal structure of compound **3g**, and the H−H NOESY spectra of **3g** diastereomers (PDF)

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Notes

The authors declare no competing financial interest.

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