Rapid Access to Cyclopentadienes Derivatives through
Gold-Catalyzed Cycloisomerization of Ynamides with
Cyclopropenes by Preferential Activation of Alkene over
Alkyne

Xing Cheng, Lei Zhu, Meijun Lin, Jianxin Chen, and Xueliang Huang

[a] Key Laboratory of Coal to Ethylene Glycol and Its Related Technology, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou, Fujian 350002, China
[b] College of Chemistry and Chemical Engineering Fujian Normal University, Fuzhou, Fujian 350007, China

Table of Contents

1. General information Section ................................................................. S2
2. Representative Optimization Studies ...................................................... S3
3. Procedures for the Preparation of Cyclopropenes ................................... S5
4. Procedure and Spectral Data of Products ............................................. S9
5. Representative synthetic application ..................................................... S19
6. X-ray crystal structures ....................................................................... S25
7. $^1$H and $^{13}$C NMR spectra of the substrates ........................................ S27
8. $^1$H and $^{13}$C NMR spectra for the products ........................................... S37
1. General information Section

Unless otherwise noted, all reactions were carried out with standard Schlenk techniques under argon. And all reagents were purchased from commercial suppliers without further purification. All solvents were distilled from appropriate drying agents prior to use. Reaction progress was monitored by thin layer chromatography (TLC) and components were visualized by observation under UV light at 254nm. Flash column chromatography was performed using silica gel 60 (200-300 mesh).

All $^1$H NMR, $^{13}$C NMR and $^{19}$F NMR spectra were given on Bruker AV-III 400 in CDCl$_3$. Chemical shifts were reported in parts per million (ppm, $\delta$), referenced to the peak of tetramethylsilane, defined at $\delta = 0.00$ ($^1$H NMR), or the solvent peak of CDCl$_3$, defined at $\delta = 77.0$ ($^{13}$C NMR); Data are reported as follows: chemical shift, multiplicity ((s = single, d = doublet, t = triplet, q = quartet, br = broad, m = multiplet), coupling constants were quoted in Hz ($J$). Splitting patterns that could not be interpreted or easily visualized were designated as multiplet (m) or broad (br). Pressed KBr disks for infrared spectra were recorded using a Bruker-VERTEX 70 FT-IR spectrometer. Wavelengths ($\nu$) are reported in cm$^{-1}$. Melting points were recorded using a SGW Melting Point thermometer (X-4). High-resolution mass spectra were obtained using a Thermo Fisher Scientific LTQ FT Ultra.
2. Representative Optimization Studies

Table S1. Optimization of the reaction conditions

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<th>yield of 4a (%)</th>
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<sup>a</sup>Conditions: ynamide 1a (0.2 mmol, 1 equiv), cyclopropane 2a (1 mmol, 5 equiv).
<sup>b</sup> Yield of the isolated product. <sup>c</sup> CH<sub>3</sub>CN replaced CH<sub>2</sub>Cl<sub>2</sub> as solvent.
General procedure: Ynamide 1a (0.20 mmol, 1.0 equiv), catalyst (x mol%) and solvent (0.7 mL) were added to an oven-dried 10 mL pressure tube equipped with a stirrer bar under argon. Cyclopropene 2a (n equiv) in 0.3 mL of solvent was added in dropwise and the resulting mixture stirred at indicated temperature. After completion of the reaction as indicated by TLC, removing the solvent under reduced pressure. The residual was purified by column chromatography (petroleum ether/ethyl acetate) on silica gel to give cyclopentadienes.
3. Procedures for the Preparation of Cyclopropenes

Preparations of 1,1-disubstituted alkenes

\[
\text{R'}\text{CH=CHR} + \text{Ph}_3\text{PCH}_3\text{Br} \xrightarrow{\text{KO'Bu}, \text{Et}_2\text{O}} \text{R'}\text{CH}-\text{CHR}
\]

Under an atmosphere of argon, potassium tert-butoxide (36 mmol, 1.2 eq) was added to a stirred mixture of methyltriphenylphosphonium bromide (36 mmol, 1.2 eq, pre-dried in a vacuum oven for 5 hr) in anhydrous Et₂O. The resulting canary yellow mixture was allowed to stir for 1 h, after which a solution of the ketone (30 mmol, 1 eq) in anhydrous Et₂O was added dropwise. The reaction was monitored by TLC for complete consumption of the starting material. The crude mixture was then passed through a pad of celite and washed with Et₂O. All volatiles were removed under reduced pressure. The crude reaction mixture was then diluted with hexanes, and passed through a pad of silica gel by eluting with hexanes. The combined hexanes eluent was collected and concentrated under reduced pressure. The alkene product was isolated by flash column chromatography with hexanes as the eluent.

Preparation of 2,2-dibromocyclopropanes

According to a modified procedure of Rubin.¹ To a vigorously stirred mixture of α-methylstyrene (27.3 mL, 0.21 mol), bromoform (40.5 mL) and cetrimide (1 g), 50% aqueous solution of NaOH (45 mL) was added dropwise. A cooling bath was used occasionally to keep the temperature of the reaction mixture in the interval of 35-40

°C. The reaction mixture was vigorously stirred for 30 hrs, then water was added. The organic phase was separated and the aqueous phase was extracted with chloroform. Combined organic phases were washed (water, 2% HCl, brine), dried (CaCl₂), filtered, and concentrated under reduced pressure. Flash column chromatography of the resulting residue on silica gel (eluent – hexanes) gave the dibromocyclopropane products.

**Synthesis of bromocyclopropanes**

![Chemical structure](image)

Bromocyclopropanes (0.1 mol) were prepared by partial reduction of the corresponding dibromocyclopropanes with EtMgBr (0.13 mol, 1.3 eq) in the presence of Ti(O\text{Pr})₄ (10 mmol, 0.1 eq) according to the reported protocol. Ethylmagnesium bromide was added dropwise to a cooled (0 °C ice bath) stirring solution of the dibromocyclopropane and Ti(O\text{Pr})₄ in Et₂O under argon. The mixture turned dark orange instantly with generation of heat (fast addition of the Grignard reagent should be avoided to prevent evaporation of solvent). The reaction mixture was stirred at rt for 4 h, then quenched with 10% aq. HCl. The organic phase was separated and the aqueous layer was extracted twice with Et₂O. The combined ethereal layers were washed consecutively with sat. NaHCO₃ and brine, then dried with Na₂SO₄, filtered and concentrated under reduced pressure. The product was purified by flash column chromatography on silica gel (eluent – petroleum ether) to afford the bromocyclopropane as a mixture of diastereomers.

**Synthesis of cyclopropenes**

![Chemical structure](image)

Cyclopropenes were prepared according to the literature protocol. A solution of bromocyclopropane (76.3 mmol) in DMSO was added to a stirring solution of
potassium t-butoxide (92 mmol, 1.2 eq) in DMSO. The mixture turned dark brown instantly and was stirred at rt overnight. It was then quenched with H₂O and extracted with ether. The ethereal layers were combined, washed with brine, dried with Na₂SO₄, filtered, and concentrated in vacuo. Flash column chromatography of the residue on silica gel (eluent – petroleum ether) afforded the cyclopropene products.

(1-methylcycloprop-2-en-1-yl)benzene 2a

1H NMR (400 MHz, CDCl₃, TMS) δ 7.28 (t, J = 7.6 Hz, 2H), 7.24 (s, 2H), 7.21 (d, J = 7.6 Hz, 2H), 7.14 (t, J = 7.2 Hz, 1H), 1.62 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 149.9, 127.8, 126.0, 125.0, 115.5, 25.4, 21.8.

1-methyl-4-(1-methylcycloprop-2-en-1-yl)benzene 2q

1H NMR (400 MHz, CDCl₃, TMS) δ 7.23 (s, 2H), 7.09 (s, 4H), 2.30 (s, 3H), 1.60 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 146.9, 134.4, 128.5, 125.9, 115.7, 25.5, 21.5, 20.8.

1-chloro-4-(1-methylcycloprop-2-en-1-yl)benzene 2r

1H NMR (400 MHz, CDCl₃, TMS) δ 7.23-7.21 (m, 4H), 7.10 (d, J = 8.8 Hz, 2H), 1.59 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 148.5, 130.7, 127.8, 127.4, 115.4, 25.3, 21.5.

1-bromo-4-(1-methylcycloprop-2-en-1-yl)benzene 2s

1H NMR (400 MHz, CDCl₃, TMS) δ 7.36 (d, J = 8.4 Hz, 2H), 7.21 (s, 2H), 7.05 (d, J = 8.4 Hz, 2H), 1.58 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 149.0, 130.7, 127.8, 118.8, 115.3, 25.2, 21.5.

1-(1-methylcycloprop-2-en-1-yl)-3-(trifluoromethyl)benzene 2t

1H NMR (400 MHz, CDCl₃, TMS) δ 7.43-7.37 (m, 4H), 7.25 (s, 2H), 1.63 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 151.0, 130.2 (q, J_C-F =


31.4 Hz), 129.4 (d, $J_{C-F} = 1.2$ Hz), 128.2, 124.5 (q, $J_{C-F} = 270.4$ Hz), 122.7 (q, $J_{C-F} = 3.8$ Hz), 121.7 (q, $J_{C-F} = 3.8$ Hz), 115.1, 25.1, 21.8; $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ -62.5.

1-chloro-3-(1-methylcycloprop-2-en-1-yl)benzene 2u

$^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.20 (s, 2H), 7.17 (d, $J = 7.6$ Hz, 2H), 7.11-7.09 (m, 1H), 7.08-7.06 (m, 1H), 1.59 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 152.3, 133.9, 129.0, 126.3, 125.0, 124.2, 115.1, 25.1, 21.6.

1-chloro-2-(1-methylcycloprop-2-en-1-yl)benzene 2v

$^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.61 (s, 2H), 7.26 (dd, $J = 8.0$, 1.6 Hz, 1H), 7.21 (dd, $J = 7.6$, 2.0 Hz, 1H), 7.13 (td, $J = 7.2$, 1.2 Hz, 1H), 7.05 (td, $J = 7.6$, 1.6 Hz, 1H), 1.47 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 146.6, 133.6, 129.6, 129.3, 127.2, 127.1, 126.0, 27.3, 23.7.

2-(1-methylcycloprop-2-en-1-yl)naphthalene 2w

$^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.78 (d, $J = 8.0$ Hz, 2H), 7.74(d, $J = 8.4$ Hz, 1H), 7.68 (s, 1H), 7.45-7.37 (m, 2H), 7.33-7.29 (m, 3H), 1.73 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 147.3, 133.3, 131.4, 127.5, 127.4, 127.2, 125.8, 124.9, 124.7, 124.5, 115.7, 25.6, 22.1.

(2-(1-methylcycloprop-2-en-1-yl)ethyl)benzene 2x

$^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.30 ($J = 0.4$ Hz, 2H), 7.26-7.22 (m, 2H), 7.15-7.12 (m, 3H), 2.45-2.41 (m, 2H), 1.81-1.77 (m, 2H), 1.18 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 143.0, 128.4, 128.1, 125.4, 121.8, 41.9, 33.5, 27.1, 20.0.

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4. Procedure and Spectral Data of Products

General procedure: Ynamide 1 (0.20 mmol, 1.0 eq), IPrAuNCPhSbF$_6$ (5 mol%) and CH$_3$CN (0.7 mL) were added to an oven-dried 10 mL pressure tube equipped with a stirrer bar under argon. The cyclopropene 2 (1 mmol, 5 eq) in 0.3 mL of CH$_3$CN was added in dropwise and the resulting mixture stirred at 100 °C. After completion of the reaction as indicated by TLC, removing the solvent under reduced pressure, the residual was purified by column chromatography (petroleum ether /ethyl acetate) on silica gel to give cyclopentadiene 3.

3-(5-methyl-2,5-diphenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3a

Compound 3a was obtained as a pale yellow solid in 98% (62 mg) isolated yield, $R_f = 0.34$ (petroleum ether : ethyl acetate = 5 : 1); mp = 154-157 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.48-7.46 (m, 2H), 7.40-7.36 (m, 2H), 7.24-7.20 (m, 1H), 6.67 (d, $J = 5.6$ Hz, 1H), 6.52 (d, $J = 5.6$ Hz, 1H), 4.13-4.01 (m, 2H), 3.15-3.08 (m, 1H), 2.75-2.69 (m, 1H), 1.76 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.3, 146.0, 143.5, 139.0, 137.6, 134.0, 130.3, 128.64, 128.60, 127.9, 127.05, 126.98, 125.8, 62.4, 60.6, 46.0, 18.3; IR (KBr) 1755, 1492, 1407, 1215, 1115, 748, 701 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{21}$H$_{20}$NO$_2$, 318.1494; found 318.1488.

3-(5-methyl-5-phenyl-2-(p-tolyl)cyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3b

Compound 3b was obtained as a white solid in 97% (64 mg) isolated yield, $R_f = 0.33$ (petroleum ether : ethyl acetate = 5 : 1); mp = 42-45 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.36 (d, $J = 8.0$ Hz, 2H), 7.32-7.22 (m, 5H), 7.19 (d, $J = 8.0$ Hz, 2H), 6.66 (d, $J = 5.6$ Hz, 1H), 6.51 (d, $J = 5.6$ Hz, 1H), 4.15-4.02 (m, 2H), 3.17-3.10 (m, 1H), 2.73-2.67 (m,
1H), 2.35 (s, 3H), 1.75 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 156.4, 145.9, 142.9, 139.2, 137.8, 137.6, 131.1, 130.4, 129.4, 128.6, 127.0, 125.8, 62.4, 60.6, 46.0, 21.2, 18.4; IR (KBr) 1757, 1407, 1214, 1117, 1037, 823, 763, 703 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{22}$H$_{22}$NO$_2$, 332.1651; found 332.1644.

3-(2-(4-ethylphenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one $3c$

Compound $3c$ was obtained as a white solid in 99% (68.5 mg) isolated yield, $R_f = 0.39$ (petroleum ether : ethyl acetate = 5 : 1); mp = 79-80 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) δ 7.39 (d, $J = 8.0$ Hz, 2H), 7.31-7.25 (m, 4H), 7.22 (d, $J = 8.0$ Hz, 3H), 6.67 (d, $J = 5.6$ Hz, 1H), 6.50 (d, $J = 5.6$ Hz, 1H), 4.15-4.01 (m, 2H), 3.17-3.11 (m, 1H), 2.73-2.62 (m, 3H), 1.75 (s, 3H), 1.24 (t, $J = 7.6$ Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 156.4, 145.9, 144.1, 142.9, 139.2, 137.5, 131.3, 130.4, 128.6, 128.2, 127.0, 126.9, 125.8, 62.4, 60.6, 46.0, 28.5, 18.4, 15.3; IR (KBr) 2968, 1762, 1407, 1214, 1109, 1037, 838, 765, 703 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{23}$H$_{24}$NO$_2$, 346.1807; found 346.1801.

3-(2-(4-methoxyphenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one $3d$

Compound $3d$ was obtained as a pale yellow solid in 99% (69 mg) isolated yield, $R_f = 0.19$ (petroleum ether : ethyl acetate = 5 : 1); mp = 117-119 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) δ 7.41 (d, $J = 8.8$ Hz, 2H), 7.31-7.20 (m, 5H), 6.92 (d, $J = 8.8$ Hz, 2H), 6.66 (d, $J = 5.6$ Hz, 1H), 6.50 (d, $J = 5.6$ Hz, 1H), 4.15-4.02 (m, 2H), 3.81 (s, 3H), 3.14 (dd, $J = 9.2$, 16.4 Hz, 1H), 2.69 (dd, $J = 9.2$, 15.6 Hz, 1H), 1.75 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 159.2, 156.4, 145.9, 142.1, 139.3, 137.1, 130.3, 128.6, 128.4, 126.9, 126.4, 125.8, 114.1, 62.4, 60.5, 55.1, 45.9, 18.4; IR (KBr) 2836, 1755, 1607, 1512, 1407, 1118, 1029, 836, 765, 703 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{22}$H$_{22}$NO$_3$, 348.1600; found 348.1593.
3-(2-(4-fluorophenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3e

Compound 3e was obtained as a white solid in 95% (63.7 mg) isolated yield, R_f = 0.29 (petroleum ether : ethyl acetate = 5 : 1); mp = 141-142 °C; 1H NMR (400 MHz, CDCl_3, TMS) δ 7.45 (dd, J = 5.6, 8.8 Hz, 2H), 7.30-7.22 (m, 5H), 7.07 (t, J = 8.8 Hz, 2H), 6.63 (d, J = 6.0 Hz, 1H), 6.52 (d, J = 6.0 Hz, 1H), 4.16-4.05 (m, 2H), 3.14-3.08 (m, 1H), 2.80-2.74 (m, 1H), 1.75 (s, 3H); 13C NMR (100 MHz, CDCl_3) δ 162.2 (d, J_C-F = 246.4 Hz), 156.2, 146.2, 143.3, 138.9, 136.7, 130.19 (d, J_C-F = 3.4 Hz), 130.1, 128.88 (d, J_C-F = 8.0 Hz), 128.7, 127.1, 125.8, 115.7 (d, J_C-F = 21.3 Hz), 62.4, 60.5, 46.0, 18.3; 19F NMR (376 MHz, CDCl_3) δ -113.1; IR (KBr) 1756, 1602, 1510, 1407, 1115, 841, 765, 703, 526 cm^{-1}; HRMS-(DART) (m/z): [M+H]^+ calcd for C_{21}H_{19}FNO_2, 336.1400; found 336.1393.

3-(2-(4-chlorophenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3f

Compound 3f was obtained as a pale yellow solid in 99% (69.6 mg) isolated yield, R_f = 0.36 (petroleum ether : ethyl acetate = 5 : 1); mp = 119-121 °C; 1H NMR (400 MHz, CDCl_3, TMS) δ 7.40 (d, J = 8.4 Hz, 2H), 7.34 (d, J = 8.4 Hz, 2H), 7.29-7.22 (m, 5H), 6.62 (d, J = 5.6 Hz, 1H), 6.51 (d, J = 5.6 Hz, 1H), 4.16-4.04 (m, 2H), 3.14-3.08 (m, 1H), 2.82-2.76 (m, 1H), 1.74 (s, 3H); 13C NMR (100 MHz, CDCl_3) δ 156.1, 146.3, 143.9, 138.8, 136.6, 133.7, 132.6, 129.9, 128.9, 128.7, 128.5, 127.1, 125.8, 62.4, 60.6, 46.0, 18.3; IR (KBr) 1756, 1492, 1406, 1212, 1118, 834, 764, 702 cm^{-1}; HRMS-(DART) (m/z): [M+H]^+ calcd for C_{21}H_{19}ClNO_2, 352.1104; found 352.1098.

3-(2-(4-bromophenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3g

Compound 3g was obtained as a pale yellow solid in 93% (73.6 mg) isolated yield, R_f = 0.35 (petroleum ether : ethyl acetate = 5 : 1); mp = 97-99 °C; 1H NMR (400 MHz, CDCl_3, TMS) δ 7.50 (d, J = 8.4 Hz,
2H), 7.33 (d, \(J = 8.4\) Hz, 2H), 7.29-7.22 (m, 5H), 6.62 (d, \(J = 5.6\) Hz, 1H), 6.52 (d, \(J = 5.6\) Hz, 1H), 4.16-4.05 (m, 2H), 3.11 (dd, \(J = 8.8, 16.4\) Hz, 1H), 2.82-2.76 (m, 1H), 1.74 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.1, 146.3, 143.9, 138.7, 136.5, 133.0, 131.8, 129.8, 128.7, 127.1, 125.7, 121.9, 62.4, 60.6, 46.0, 18.2; IR (KBr) 1754, 1488, 1406, 1213, 1117, 830, 761, 702 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{21}\)H\(_{19}\)BrNO\(_2\), 396.0599; found 396.0589.

3-(5-methyl-2-(naphthalen-1-yl)-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3h

Compound 3h was obtained as a white solid in 93% (68 mg) isolated yield, \(R_f = 0.31\) (petroleum ether : ethyl acetate = 5 : 1); mp = 69-71°C; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.96 (d, \(J = 7.6\) Hz, 1H), 7.88-7.86 (m, 1H), 7.82 (d, \(J = 8.4\) Hz, 1H), 7.54-7.43 (m, 6H), 7.34 (t, \(J = 7.2\) Hz, 2H), 7.25 (t, \(J = 7.2\) Hz, 1H), 6.62 (d, \(J = 5.6\) Hz, 1H), 6.58 (d, \(J = 5.6\) Hz, 1H), 3.89-3.74 (m, 2H), 2.88-2.68 (m, 2H), 1.88 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 146.4, 145.5, 139.3, 133.7, 132.2, 130.9, 128.7, 128.6, 128.4, 127.0, 126.2, 125.9, 125.6, 125.2, 62.3, 60.5, 46.5, 18.9; IR (KBr) 1756, 1412, 1215, 1106, 979, 805, 780, 703 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{25}\)H\(_{22}\)NO\(_2\), 368.1651; found 368.1644.

3-(5-methyl-2-(naphthalen-2-yl)-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3i

Compound 3i was obtained as a pale yellow solid in 95% (70 mg) isolated yield, \(R_f = 0.29\) (petroleum ether : ethyl acetate = 5 : 1); mp = 58-60°C; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.94 (s, 1H), 7.85-7.80 (m, 3H), 7.57 (dd, \(J = 1.6, 8.4\) Hz, 1H), 7.48-7.44 (m, 2H), 7.35-7.21 (m, 5H), 6.78 (d, \(J = 6.0\) Hz, 1H), 6.56 (d, \(J = 6.0\) Hz, 1H), 4.12-4.00 (m, 2H), 3.16-3.09 (m, 1H), 2.75-2.69 (m, 1H), 1.80 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.4, 146.1, 143.9, 139.1, 137.7, 133.3, 132.8, 131.5, 130.4, 128.7, 128.4, 128.1, 127.6, 127.0, 126.4, 126.3, 126.2, 125.9, 124.8, 62.5, 60.8, 46.1, 18.5; IR (KBr) 1757, 1596, 1407, 1214, 1109, 1037, 861, 763, 705, 477 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for
3-(2-(3-chlorophenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3j

Compound 3j was obtained as a white solid in 85% (59.7 mg) isolated yield, Rf = 0.30 (petroleum ether : ethyl acetate = 5 : 1); mp = 155-157°C; ¹H NMR (400 MHz, CDCl₃, TMS) δ 7.44 (s, 1H), 7.36-7.22 (m, 8H), 6.62 (d, J = 5.6 Hz, 1H), 6.52 (d, J = 5.6 Hz, 1H), 4.18-4.06 (m, 2H), 3.16-3.10 (m, 1H), 2.86-2.80 (m, 1H), 1.75 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 156.0, 146.3, 144.4, 138.6, 136.3, 136.0, 134.5, 130.0, 129.8, 128.8, 128.0, 127.2, 125.8, 125.3, 62.5, 60.6, 46.1, 18.2; IR (KBr) 1758, 1594, 1562, 1405, 1211, 1038, 761, 705 cm⁻¹; HRMS-(DART) (m/z): [M+H]⁺ calcd for C₂₁H₁₉ClNO₂, 352.1104; found 352.1099.

3-(2-(2-chlorophenyl)-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3k

Compound 3k was obtained as a white solid in 84% (59.2 mg) isolated yield, Rf = 0.27 (petroleum ether : ethyl acetate = 5 : 1); mp = 118-119°C; ¹H NMR (400 MHz, CDCl₃, TMS) δ 7.45-7.40 (m, 2H), 7.37 (d, J = 7.2 Hz, 2H), 7.32-7.21 (m, 5H), 6.49 (d, J = 5.6 Hz, 1H), 6.43 (d, J = 5.6 Hz, 1H), 4.04-4.00 (m, 2H), 3.11-3.04 (m, 1H), 2.96-2.90 (m, 1H), 1.76 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 155.7, 145.8, 144.9, 138.6, 135.2, 133.9, 132.2, 131.1, 130.5, 129.5, 129.0, 128.7, 127.0, 126.97, 125.8, 62.4, 59.7, 45.7, 18.1; IR (KBr) 1758, 1407, 1214, 1116, 752, 703 cm⁻¹; HRMS-(DART) (m/z): [M+H]⁺ calcd for C₂₁H₁₉ClNO₂, 352.1104; found 352.1098.

3-(2-butyl-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3l

Compound 3l was obtained as a white solid in 94% (55.7 mg) isolated yield, Rf = 0.41 (petroleum ether : ethyl acetate = 5 : 1); mp = 43-44°C; ¹H NMR (400 MHz, CDCl₃, TMS) δ 7.28-7.24 (m, 2H), 7.21-7.17 (m, 3H), 6.34-6.32 (m, 2H), 4.23-4.12 (m, 2H), 3.13-3.07 (m, 1H), 3.00-2.94 (m, 1H), 2.25 (t, J = 7.2 Hz, 2H), 1.60-1.49 (m, 5H), 1.43-1.32 (m,
3-(2-cyclopropyl-5-methyl-5-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3m

Compound 3m was obtained as a white solid in 70% (39 mg) isolated yield, 
\( R_f = 0.24 \) (petroleum ether : ethyl acetate = 5 : 1); mp = 87-89ºC; 
\(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.28-7.24 (m, 2H), 7.21-7.18 (m, 3H), 6.31 (d, \( J = 5.6 \) Hz, 1H), 6.96 (d, \( J = 5.6 \) Hz, 1H), 4.25-4.14 (m, 2H), 3.25-3.19 (m, 1H), 3.02-2.96 (m, 1H), 1.62 -1.57 (m, 4H), 0.97-0.83 (m, 2H), 0.75-0.64 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 156.3, 145.9, 142.5, 140.2, 139.4, 128.5, 126.7, 126.3, 125.7, 62.3, 58.9, 46.4, 18.1, 6.1, 6.0; IR (KBr) 1758, 1412, 1215, 1112, 757, 703 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{18}\)H\(_{20}\)NO\(_2\), 282.1494; found 282.1487.

3-(5-methyl-5-phenyl-2-(thiophen-2-yl)cyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3n

Compound 3n was obtained as a yellow solid in 48% (26.3 mg) isolated yield, 
\( R_f = 0.24 \) (petroleum ether : ethyl acetate = 5 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.33 (d, \( J = 5.2 \) Hz, 1H), 7.28-7.21 (m, 6H), 7.07 (dd, \( J = 3.6, 4.8 \) Hz, 1H), 6.79 (d, \( J = 5.6 \) Hz, 1H), 6.53 (d, \( J = 5.6 \) Hz, 1H), 4.34 (dd, \( J = 8.8, 16.8 \) Hz, 1H), 4.24-4.18 (m, 1H), 3.35-3.29 (m, 1H), 2.80 (dd, \( J = 8.8, 16.8 \) Hz, 1H), 1.74 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 156.0, 146.3, 141.0, 138.9, 135.3, 132.0, 128.70, 128.67, 127.12, 126.99, 126.53, 126.45, 125.9, 62.8, 60.2, 45.3, 18.2; IR (KBr) 1756, 1404, 1213, 1112, 764, 702 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{19}\)H\(_{18}\)NO\(_2\)S, 324.1058; found 324.1052.

N-methyl-N-(5-methyl-2,5-diphenylcyclopenta-1,3-dien-1-yl)ethanesulfonamide 3o

Compound 3o was obtained as a oil in 56% (38 mg) isolated yield, 
\( R_f = 0.42 \) (petroleum ether : ethyl acetate = 5 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.49 (d, \( J = 7.2 \) Hz, 1H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 156.2, 145.6, 142.9, 139.3, 139.1, 130.1, 128.5, 126.7, 125.6, 62.2, 58.5, 46.4, 30.0, 26.8, 22.6, 18.0, 13.9; IR (KBr) 1760, 1640, 1408, 1301, 1217, 1113, 757, 702 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{19}\)H\(_{24}\)NO\(_2\), 298.1807; found 298.1802.
= 7.2 Hz, 2H), 7.41 (t, \(J = 7.2\) Hz, 2H), 7.31-7.23 (m, 6H), 6.57 (d, \(J = 5.6\) Hz, 1H), 6.47 (d, \(J = 5.6\) Hz, 1H), 2.61 (s, 3H), 2.25 (s, 3H), 1.75 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 147.6, 146.8, 140.3, 138.8, 135.0, 130.6, 128.59, 128.56, 128.1, 127.9, 127.0, 126.3, 59.9, 39.4, 37.6, 18.3; IR (KBr) 1599, 1493, 1445, 1336, 1139, 1026, 963, 894, 854, 697, 572, 517 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{20}\)H\(_{22}\)NO\(_2\)S, 340.1371; found 340.1365.

(4R)-3-(5-methyl-2,5-diphenylcyclopenta-1,3-dien-1-yl)-4-phenyloxazolidin-2-one 3p

Compound 3p was obtained as a pale yellow oil in 85% (100.5 mg) isolated yield, \(R_f = 0.34\) (petroleum ether : ethyl acetate = 5 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.41-7.40 (m, 4H), 7.16-7.11 (m, 7H), 6.96 (d, \(J = 8.0\) Hz, 2H), 6.54 (d, \(J = 7.2\) Hz, 2H), 6.42 (d, \(J = 5.6\) Hz, 1H), 6.32 (d, \(J = 5.6\) Hz, 1H), 4.81 (t, \(J = 8.0\) Hz, 1H), 4.37 (t, \(J = 8.0\) Hz, 1H), 4.25 (dd, \(J_1 = 8.4\) Hz, \(J_2 = 8.0\) Hz, 1H), 3.95 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.4, 146.3, 142.4, 138.5, 138.3, 136.8, 135.0, 130.0, 128.5, 128.42, 128.40, 128.1, 127.9, 127.8, 126.9, 126.7, 126.4, 70.2, 60.2, 46.0, 21.0; IR (KBr) 2961, 1741, 1394, 1251, 1037, 745, 700 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{27}\)H\(_{23}\)NNaO\(_2\), 416.1626; found 416.1620.

3-(5-methyl-2-phenyl-5-(p-tolyl)cyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3q

Compound 3q was obtained as a pale yellow solid in 71% (47.2 mg) isolated yield, \(R_f = 0.34\) (petroleum ether : ethyl acetate = 5 : 1); mp = 82-83 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.47-7.45 (m, 2H), 7.39-7.35 (m, 2H), 7.30-7.26 (m, 1H), 7.18 (d, \(J = 8.0\) Hz, 2H), 7.08 (d, \(J = 8.0\) Hz, 2H), 6.64 (d, \(J = 5.6\) Hz, 1H), 6.48 (d, \(J = 5.6\) Hz, 1H), 4.13-4.02 (m, 2H), 3.15-3.09 (m, 1H), 2.81-2.75 (m, 1H), 2.30 (s, 3H), 1.73 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.1, 143.4, 137.4, 136.5, 135.8, 134.0, 130.0, 129.3, 128.6, 127.8, 127.0, 125.6, 62.4, 60.2, 46.0, 20.9, 18.3; IR (KBr) 1758, 1511, 1407, 1212, 818, 746, 698, 522 cm\(^{-1}\); HRMS-(DART) (m/z): [M+H]\(^+\) calcd for C\(_{22}\)H\(_{22}\)NO\(_2\), 332.1651; found 332.1645.
3-(5-(4-chlorophenyl)-5-methyl-2-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3r

Compound 3r was obtained as a pale yellow solid in 99% (71 mg) isolated yield, Rf = 0.32 (petroleum ether : ethyl acetate = 5 : 1); mp = 145-146 ºC; 1H NMR (400 MHz, CDCl₃, TMS) δ 7.46 (d, J = 7.2 Hz, 2H), 7.40 (t, J = 7.6 Hz, 2H), 7.32 (t, J = 7.2 Hz, 1H), 7.27-7.22 (m, 4H), 6.68 (d, J = 5.6 Hz, 1H), 6.48 (d, J = 5.6 Hz, 1H), 4.18-4.07 (m, 2H), 3.20-3.14 (m, 1H), 2.84-2.78 (m, 1H), 1.74 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 156.3, 145.7, 143.2, 137.9, 137.7, 133.8, 132.7, 130.6, 128.7, 128.1, 127.4, 127.1, 62.4, 60.1, 46.1, 18.4; IR (KBr) 1753, 1490, 1406, 1211, 1012, 827, 750, 697 cm⁻¹; HRMS-(DART) (m/z): [M+H]⁺ calcd for C₂₁H₁₉ClNO₂, 352.1104; found 352.1099.

3-(5-(4-bromophenyl)-5-methyl-2-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3s

Compound 3s was obtained as a pale yellow solid in 98% (77.8 mg) isolated yield, Rf = 0.30 (petroleum ether : ethyl acetate = 5 : 1); mp = 149-150 ºC; 1H NMR (400 MHz, CDCl₃, TMS) δ 7.47-7.45 (m, 2H), 7.41-7.37 (m, 4H), 7.33-7.29 (m, 1H), 7.18 (d, J = 8.4 Hz, 2H), 6.67 (d, J = 5.6 Hz, 1H), 6.48 (d, J = 5.6 Hz, 1H), 4.18-4.07 (m, 2H), 3.21-3.14 (m, 1H), 2.85-2.79 (m, 1H), 1.74 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 156.3, 145.6, 143.2, 138.3, 138.0, 133.8, 131.7, 130.7, 128.7, 128.1, 127.8, 127.1, 120.8, 62.4, 60.2, 46.1, 18.4; IR (KBr) 1763, 1487, 1407, 1117, 1009, 825, 749, 522 cm⁻¹; HRMS-(DART) (m/z): [M+H]⁺ calcd for C₂₁H₁₉BrNO₂, 396.0599; found 396.0594.

3-(5-methyl-2-phenyl-5-(3-(trifluoromethyl)phenyl)cyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3t

Compound 3t was obtained as a white solid in 88% (68.1 mg) isolated yield, Rf = 0.33 (petroleum ether : ethyl acetate = 5 : 1); mp = 112-114 ºC; 1H NMR (400 MHz, CDCl₃, TMS) δ 7.55 (s, 1H), 7.43-7.38 (m, 3H), 7.34-7.30 (m, 1H), 6.71 (d, J = 5.6 Hz, 1H), 6.52 (d, J = 5.6 Hz, 1H), 4.17-4.04 (m, 2H), 3.20-3.14 (m, 1H), 2.75-2.69 (m, 1H), 2.60-2.53 (m, 3H).
1.80 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.3, 145.4, 143.1, 140.5, 138.4, 133.7, 131.0, 130.9 (q, $J_{C-F}$ = 31.8 Hz), 129.48 (d, $J_{C-F}$ = 1.0 Hz), 129.1, 128.8, 128.2, 127.1, 124.0 (q, $J_{C-F}$ = 270.9 Hz), 123.9 (q, $J_{C-F}$ = 3.8 Hz), 122.6 (q, $J_{C-F}$ = 3.8 Hz), 62.4, 60.4, 46.1, 18.4; $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ -62.5; IR (KBr) 1758, 1493, 1404, 1331, 1036, 979, 807, 747, 700 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{22}$H$_{19}$F$_3$NO$_2$, 386.1368; found 386.1362.

3-([5-(3-chlorophenyl)-5-methyl-2-phenylcyclopenta-1,3-dien-1-yl]oxazolidin-2-one 3u

Compound 3u was obtained as a yellow solid in 96% (67.8 mg) isolated yield, R$_f$ = 0.29 (petroleum ether : ethyl acetate = 5 : 1); mp = 132-134 ºC; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.48-7.45 (m, 2H), 7.41-7.38 (m, 2H), 7.34-7.28 (m, 2H), 7.25-7.18 (m, 3H), 6.68 (d, $J$ = 6.0 Hz, 1H), 6.48 (d, $J$ = 6.0 Hz, 1H), 4.18-4.07 (m, 2H), 3.22-3.15 (m, 1H), 2.83-2.77 (m, 1H), 1.74 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 156.3, 145.4, 143.0, 141.4, 138.1, 134.4, 133.7, 130.8, 129.9, 128.7, 128.2, 127.2, 127.1, 126.1, 124.1, 62.4, 60.3, 46.1, 18.3; IR (KBr) 1756, 1593, 1479, 1408, 1213, 1116, 1038, 754, 699 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{21}$H$_{19}$ClNO$_2$, 352.1104; found 352.1099.

3-([5-(2-chlorophenyl)-5-methyl-2-phenylcyclopenta-1,3-dien-1-yl]oxazolidin-2-one 3v

Compound 3v was obtained as a white solid in 90% (63.1 mg) isolated yield, R$_f$ = 0.22 (petroleum ether : ethyl acetate = 5 : 1); mp = 161-162 ºC; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.62 (dd, $J$ = 1.2, 7.6 Hz, 1H), 7.47-7.45 (m, 2H), 7.41-7.37 (m, 1H), 7.33-7.19 (m, 4H), 6.69 (d, $J$ = 5.6 Hz, 1H), 6.34 (d, $J$ = 5.6 Hz, 1H), 4.20-4.13 (m, 1H), 4.09-4.03 (m, 1H), 3.45-3.39 (m, 1H), 3.08-3.01 (m, 1H), 1.81 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 155.8, 142.5, 140.0, 138.5, 137.3, 134.7, 134.1, 131.5, 131.0, 129.2, 128.6, 128.5, 127.7, 127.3, 127.0, 62.4, 60.1, 44.9, 22.7; IR (KBr) 1755, 1405, 1211, 1115, 1041, 748, 699 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{21}$H$_{19}$ClNO$_2$, 352.1104; found 352.1099.
3-(5-methyl-5-(naphthalen-2-yl)-2-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3w

Compound 3w was obtained as a pale yellow solid in 80% (59 mg) isolated yield, Rf = 0.29 (petroleum ether : ethyl acetate = 5 : 1); mp = 64-67 °C; 1H NMR (400 MHz, CDCl3, TMS) δ 7.87 (s, 1H), 7.83 (d, J = 7.2 Hz, 1H), 7.78 (d, J = 7.6 Hz, 1H), 7.68 (d, J = 8.4 Hz, 1H), 7.52-7.45 (m, 4H), 7.43-7.39 (m, 2H), 7.32 (t, J = 7.2 Hz, 1H), 7.21 (dd, J = 1.6, 8.4 Hz, 1H), 6.74 (d, J = 5.6 Hz, 1H), 6.55 (d, J = 5.6 Hz, 1H), 4.09-3.94 (m, 2H), 3.13-3.07 (m, 1H), 2.79-2.73 (m, 1H), 1.88 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 156.3, 146.1, 143.6, 138.3, 136.8, 134.1, 133.8, 132.5, 130.7, 128.8, 128.1, 128.0, 127.8, 127.4, 127.2, 126.2, 125.9, 124.6, 124.3, 62.4, 60.7, 46.0, 18.2; IR (KBr) 1759, 1407, 1210, 1113, 1038, 745, 478 cm⁻¹; HRMS-(DART) (m/z): [M+H]+ calcd for C25H22NO2, 368.1652; found 368.1645.

3-(5-methyl-5-phenethyl-2-phenylcyclopenta-1,3-dien-1-yl)oxazolidin-2-one 3x

Compound 3x was obtained as a colourless oil in 81% (55.7 mg) isolated yield, Rf = 0.38 (petroleum ether : ethyl acetate = 5 : 1); 1H NMR (400 MHz, CDCl3, TMS) δ 7.45-7.43 (m, 2H), 7.41-7.37 (m, 2H), 7.32-7.28 (m, 1H), 7.23 (d, J = 7.2 Hz, 2H), 7.19-7.12 (m, 3H), 6.56 (d, J = 5.6 Hz, 1H), 6.34 (d, J = 5.6 Hz, 1H), 4.31-4.27 (m, 2H), 3.53 (t, J = 8.0 Hz, 2H), 2.72-2.64 (m, 1H), 2.56-2.48 (m, 1H), 2.08-1.94 (m, 2H), 1.34 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 156.9, 143.8, 142.7, 141.3, 138.7, 134.3, 130.0, 128.7, 128.4, 128.2, 127.9, 127.2, 125.6, 62.5, 38.4, 31.2, 21.1; IR (KBr) 1755, 1409, 1212, 1115, 1039, 753, 700 cm⁻¹; HRMS-(DART) (m/z): [M+H]⁺ calcd for C23H24NO2, 346.1807; found 346.1802.

3-(4-(1-phenylvinyl)-3,4-dihydronaphthalen-2-yl)oxazolidin-2-one 4a

Compound 4a was obtained as a colourless oil in 35% (22 mg) isolated yield, Rf = 0.48 (petroleum ether : ethyl acetate = 3 : 1); 1H NMR (400 MHz, CDCl3, TMS) δ 7.52-7.50 (m, 1H), 7.40-7.32 (m, 4H), 7.28-7.23 (m, 4H), 6.98 (s, 1H), 5.62 (d, J = 3.2 Hz, 1H), 5.16 (d, J = 2.4 Hz, 1H), 4.51 (dd, J = 6.0, 8.8 Hz, 1H), 4.25-4.13 (m, 2H), 3.65-3.52 (m, 2H), 3.23-3.08 (m, 2H); 13C NMR
(100 MHz, CDCl$_3$) $\delta$ 157.1, 151.3, 144.3, 139.5, 136.2, 135.4, 129.1, 128.8, 128.44, 128.38, 127.4, 126.9, 125.5, 121.0, 104.0, 61.6, 47.5, 43.7, 35.0; IR (KBr) 2922, 1749, 1557, 1398, 1243, 1039, 753, 698 cm$^{-1}$; HRMS-(DART) (m/z): [M+Na]$^+$ calcd for C$_{21}$H$_{19}$NNaO$_2$, 340.1313; found 340.1309.

5. Representative synthetic application

Ynamide 1 (0.50 mmol, 1.0 eq), IPrAuNCPhSbF$_6$ (5 mol%) and CH$_3$CN (1 mL) were added to an oven-dried 10 mL pressure tube equipped with a stirrer bar under argon, the cyclopropene 2 (1.5 mmol, 3 eq) was added in dropwise and the resulting mixture stirred at 100 $^\circ$C. After completion of the reaction as indicated by TLC, 12 M HCl (340 $\mu$l, 8 equiv) was added, the reaction mixture was stirred at 100 $^\circ$C for 3 h. Removing the solvent under reduced pressure, the residual was purified by column chromatography (petroleum ether/ethyl acetate 40:1) on silica gel to give cyclopent-2-enone 6.

5-methyl-2,5-diphenylcyclopent-2-enone 6a

Compound 6a was obtained as a yellow solid in 80% (99.6 mg) isolated yield, R$_f$ = 0.55 (petroleum ether : ethyl acetate =15 : 1); mp = 79-80 $^\circ$C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.89 (t, $J$ = 2.8 Hz, 1H), 7.77-7.75 (m, 2H), 7.41-7.28 (m, 7H), 7.23-7.19 (m, 1H), 3.14 (dd, $J$ = 2.8, 19.6 Hz, 1H), 2.88 (dd, $J$ = 2.8, 19.6 Hz, 1H), 1.61 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 209.2, 156.4, 143.7, 141.3, 131.7, 128.55, 128.47, 128.4, 127.1, 126.6, 125.9, 51.9, 45.2, 24.4.

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5-methyl-5-phenyl-2-(p-tolyl)cyclopent-2-enone 6b

Compound 6b was obtained as a pale yellow solid in 73% (95.4 mg) isolated yield, $R_f = 0.58$ (petroleum ether : ethyl acetate =15 : 1); mp = 104-105 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.85 (t, $J = 2.8$ Hz, 1H), 7.67(d, $J = 8.4$ Hz, 2H), 7.32-7.28 (m, 4H), 7.25-7.19 (m, 3H), 3.13 (dd, $J = 2.8$, 19.6 Hz, 1H), 2.87 (dd, $J = 2.8$, 19.6 Hz, 1H), 2.36 (s, 3H), 1.61 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 209.3, 155.5, 143.8, 141.2, 138.4, 129.1, 128.8, 128.5, 127.0, 126.5, 125.9, 51.9, 45.2, 24.4, 21.3; IR (KBr) 1698, 1303, 824, 748, 700 cm$^{-1}$; HRMS-(DART) (m/z): [M+Na]$^+$ calcd for C$_{19}$H$_{18}$NaO, 285.1255; found 285.1250.

2-(4-methoxyphenyl)-5-methyl-5-phenylcyclopent-2-enone 6c

Compound 6c was obtained as a white solid in 78% (108.4 mg) isolated yield, $R_f = 0.32$ (petroleum ether : ethyl acetate =15 : 1); mp = 98-99 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.78 (t, $J = 2.8$ Hz, 1H), 7.75-7.73 (m, 2H), 7.30-7.29 (m, 4H), 7.22-7.18 (m, 1H), 6.93-6.89 (m, 2H), 3.79 (s, 3H), 3.09 (dd, $J = 2.8$, 19.6 Hz, 1H), 2.83 (dd, $J = 2.8$, 19.6 Hz, 1H), 1.59 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 209.4, 159.8, 154.5, 143.8, 140.5, 128.5, 128.3, 126.5, 124.3, 113.8, 55.2, 51.8, 45.1, 24.3; IR (KBr) 1699, 1510, 1260, 749, 698 cm$^{-1}$; HRMS-(DART) (m/z): [M+H]$^+$ calcd for C$_{19}$H$_{19}$O$_2$, 279.1385; found 279.1380.

2-(4-fluorophenyl)-5-methyl-5-phenylcyclopent-2-enone 6d

Compound 6d was obtained as a yellow solid in 74% (94.5 mg) isolated yield, $R_f = 0.51$ (petroleum ether : ethyl acetate =15 : 1); mp = 50-51 °C; $^1$H NMR (400 MHz, CDCl$_3$, TMS) $\delta$ 7.86 (t, $J = 3.2$ Hz, 1H), 7.79-7.75 (m, 2H), 7.34-7.30 (m, 4H), 7.25-7.20 (m, 1H), 7.11-7.06 (m, 2H), 3.15 (dd, $J = 3.2$, 20.0 Hz, 1H), 2.89 (dd, $J = 3.2$, 20.0 Hz, 1H), 1.62 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 209.2, 162.9 (d, $J_{C-F} = 246.6$ Hz), 156.0, 143.6, 140.3, 128.9 (d, $J = 8.0$ Hz), 128.6, 127.8 (d, $J = 3.2$ Hz), 126.7, 125.9, 115.4 (d, $J_{C-F} = 21.3$ Hz), 51.9, 45.2, 24.5; $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ -112.8; IR (KBr) 1704, 1508, 833,
699, 572 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)FNaO, 289.1005; found 289.0999.

2-(4-chlorophenyl)-5-methyl-5-phenylcyclopent-2-enone 6e

Compound 6e was obtained as a yellow solid in 76% (106.3 mg) isolated yield, \(R_f = 0.51\) (petroleum ether : ethyl acetate = 15 : 1); mp = 78-79 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.90 (t, \(J = 3.2\) Hz, 1H), 7.72 (d, \(J = 8.4\) Hz, 2H), 7.37-7.31 (m, 6H), 7.25-7.20 (m, 1H), 3.15 (dd, \(J = 3.2, 20.0\) Hz, 1H), 2.89 (dd, \(J = 3.2, 20.0\) Hz, 1H), 1.61 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 209.0, 156.6, 143.5, 140.1, 134.4, 130.1, 128.65, 128.61, 128.4, 126.7, 125.9, 51.9, 45.2, 24.5; IR (KBr) 1703, 1492, 1092, 829, 699 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)ClNaO, 305.0709; found 305.0704.

2-(3-chlorophenyl)-5-methyl-5-phenylcyclopent-2-enone 6f

Compound 6f was obtained as a yellow solid in 74% (104 mg) isolated yield, \(R_f = 0.45\) (petroleum ether : ethyl acetate = 15 : 1); mp = 71-72 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.86 (t, \(J = 2.8\) Hz, 1H), 7.78 (s, 1H), 7.65-7.62 (m, 1H), 7.29-7.27 (m, 6H), 7.22-7.17 (m, 1H), 3.10 (dd, \(J = 2.8, 20.0\) Hz, 1H), 2.84 (dd, \(J = 2.8, 20.0\) Hz, 1H), 1.58 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 208.7, 157.5, 143.4, 139.8, 134.2, 133.3, 129.6, 128.5, 128.4, 127.0, 126.6, 125.8, 125.1, 51.8, 45.1, 24.3; IR (KBr) 1702, 1561, 734, 698 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)ClNaO, 305.0709; found 305.0704.

2-(2-chlorophenyl)-5-methyl-5-phenylcyclopent-2-enone 6g

Compound 6g was obtained as a yellow oil in 64% (90.2 mg) isolated yield, \(R_f = 0.43\) (petroleum ether : ethyl acetate = 15 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \(\delta\) 7.87 (t, \(J = 2.8\) Hz, 1H), 7.42-7.40 (m, 1H), 7.36-7.29 (m, 5H), 7.26-7.19 (m, 3H), 3.17 (dd, \(J = 2.8, 19.6\) Hz, 1H), 2.93 (dd, \(J = 2.8, 19.6\) Hz, 1H), 1.62 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 208.2, 160.4, 143.5, 140.9, 133.1, 131.0, 130.8, 129.7, 129.3, 128.5, 126.55, 126.48, 125.9, 50.9, 45.8, 24.4; IR (KBr) 1702, 1044, 752, 698 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)ClNaO, 305.0709; found 305.0704.
2-butyl-5-methyl-5-phenylcyclopent-2-enone 6h

Compound 6h was obtained as a yellow oil in 84% (95.5 mg) isolated yield, \( R_f = 0.66 \) (petroleum ether : ethyl acetate = 15 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.34-7.32 (m, 1H), 7.31-7.24 (m, 4H), 7.21-7.17 (m, 1H), 3.01-2.94 (m, 1H), 2.76-2.69 (m, 1H), 2.26-2.22 (m, 2H), 1.55-1.47 (m, 5H), 1.40-1.31 (m, 2H), 0.92 (t, \( J = 7.2 \) Hz, 1H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 211.4, 154.9, 144.5, 144.0, 128.4, 126.4, 125.8, 50.7, 45.7, 29.8, 24.8, 24.4, 22.4, 13.8; IR (KBr) 1705, 1496, 1445, 762, 699 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{16}\)H\(_{20}\)NaO, 251.1412; found 251.1406.

5-(4-chlorophenyl)-5-methyl-2-phenylcyclopent-2-enone 6i

Compound 6i was obtained as a pale yellow solid in 78% (110 mg) isolated yield, \( R_f = 0.43 \) (petroleum ether : ethyl acetate =15 : 1); mp = 83.5-84.5 ºC; \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.85 (t, \( J = 2.8 \) Hz, 1H), 7.75-7.73 (m, 2H), 7.39-7.30 (m , 3H), 7.26-7.20 (m, 4H), 3.04 (dd, \( J = 2.8, 19.6 \) Hz, 1H), 2.83 (dd, \( J = 2.8, 19.6 \) Hz, 1H), 1.56 (s, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 208.6, 156.3, 142.2, 141.0, 132.3, 131.4, 128.53, 128.51, 128.4, 127.4, 127.0, 51.4, 44.9, 24.5; IR (KBr) 1702, 1493, 1095, 823, 695 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)ClNaO, 305.0709; found 305.0704.

5-(4-bromophenyl)-5-methyl-2-phenylcyclopent-2-enone 6j

Compound 6j was obtained as a yellow oil in 83% (135.1 mg) isolated yield, \( R_f = 0.38 \) (petroleum ether : ethyl acetate =15 : 1); \(^1\)H NMR (400 MHz, CDCl\(_3\), TMS) \( \delta \) 7.83 (t, \( J = 2.8 \) Hz, 1H), 7.41-7.29 (m, 5H), 7.18-7.15 (m, 2H), 3.02 (dd, \( J = 2.8, 20.0 \) Hz, 1H), 2.81 (dd, \( J = 2.8, 20.0 \) Hz, 1H), 1.54 (s, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 208.5, 156.4, 142.7, 140.9, 131.44, 131.36, 128.5, 128.3, 127.7, 127.0, 120.4, 51.4, 44.8, 24.4; IR (KBr) 1700, 1490, 1008, 745, 694 cm\(^{-1}\); HRMS-(DART) (m/z): [M+Na]\(^+\) calcd for C\(_{18}\)H\(_{15}\)BrNaO, 349.0204; found 349.0198.
5-(3-chlorophenyl)-5-methyl-2-phenylcyclopent-2-enone 6k

Compound 6k was obtained as a yellow oil in 80% (112.8 mg) isolated yield, Rf = 0.45 (petroleum ether : ethyl acetate =15 : 1); 1H NMR (400 MHz, CDCl3, TMS) δ 7.85 (t, J = 2.8 Hz, 1H), 7.76-7.74 (m, 2H), 7.39-7.31 (m, 4H), 7.23-7.15 (m, 3H), 3.05 (dd, J = 2.8, 19.6 Hz, 1H), 2.83 (dd, J = 2.8, 19.6 Hz, 1H), 1.57 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 208.4, 156.4, 145.7, 141.1, 134.3, 131.4, 129.7, 128.5, 128.4, 127.0, 126.7, 126.3, 124.2, 51.6, 44.9, 24.4; IR (KBr) 1704, 1595, 750, 695 cm⁻¹; HRMS-(DART) (m/z): [M+Na]⁺ calcd for C_{18}H_{15}ClNaO, 305.0709; found 305.0704.

Ynamide 1a (0.30 mmol, 1.0 eq), IPrAuNCPhSbF6 (5 mol%) and CH₃CN (1.0 mL) were added to an oven-dried 10 mL pressure tube equipped with a stirrer bar under argon, the cyclopropene 2a (0.9 mmol, 3.0 eq) and styrene (0.9 mmol, 3.0 equiv) was added dropwise and the resulting mixture stirred at 100 °C. After completion of the reaction as indicated by TLC, removing the solvent under reduced pressure, the residual was purified by column chromatography on silica gel.

((E)-1-((1S, 2S)-2-Phenylcyclopropyl)prop-1-en-2-yl)benzene 5

Compound 5 was obtained as a colourless oil in 35% (79 mg) isolated yield, Rf = 0.5 (petroleum ether); 1H NMR (400 MHz, CDCl3, cis isomer): 7.28-7.10 (m, 10H), 5.10 (d, J = 9.2 Hz, 1H), 2.43 (dd, J = 8.4, 15.2 Hz, 1H), 2.13 (s, 3H), 2.10-2.02 (m, 1H), 1.41-1.35 (m, 1H), 1.06-1.02 (m, 1H); (trans isomer, only clearly assignable signals are listed): 5.32 (d, J = 9.2 Hz, 1H), 2.01-1.97 (m, 1H), 1.97-1.87 (m, 1H), 1.34-1.29 (m, 1H), 1.15-1.11 (m, 1H). 13C NMR (100 MHz, CDCl3, cis isomer): 143.6, 138.9, 135.2, 129.0, 128.01, 127.96, 127.6, 126.3, 125.9, 125.3, 23.6, 18.9, 16.2, 13.0; (trans isomer, only clearly assignable signals are listed): 130.9,

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128.3, 128.2, 126.5, 125.7, 125.6, 25.6, 24.4, 17.6, 16.24.
6. X-ray crystal structures

General procedure for preparation of the crystal: The product (40 mg) was dissolved in ethyl acetate. The filtered through a pad of filter paper. The filtrate was then transferred into several test-tubes by different volumes. To these solution were added petroleum ether in dropwise. The samples prepared in this way were allowed to evaporate slowly at room temperature, which would eventually give colorless crystals on the surface of the tubes.

Colorless granular-shaped crystals 3a was obtained from mixed solution (PE : EA =10:1).

X-ray structure of 3a. Hydrogen atoms have been omitted for clarity. CCDC 1478721.

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7. $^1$H and $^{13}$C NMR spectra of the substrates

![NMR Spectra of 2a](image-url)
8. $^1$H and $^{13}$C NMR spectra for the products

![NMR spectra for products 3a](image)
3b
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$\text{N}$
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$\text{O}$
$\text{P}$
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$\text{3p NOE}$
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