

Supporting Information

Straightforward Synthesis of Functionalized γ -Lactams using Impure CO₂ Stream as the Carbon Source

Yuman Qin^a, Robin Cauwenbergh^a, Suman Pradhan^a, Rakesh Maiti^a, Philippe Franck^a, and Shoubhik Das^{a*}

^aORSY Division, Department of Chemistry, Universiteit Antwerpen, Groenenborgerlaan 171, 2020 Antwerpen, Belgium.

*Correspondence and Lead Contact: Shoubhik.Das@uantwerpen.be

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1. Materials and Methods

1.1 Materials and general procedures

Commercial reagents were used without purification and reactions were run under CO₂ atmosphere with exclusion of moisture from reagents using standard techniques for manipulating air-sensitive compounds. CDCl₃ was purchased from Chemfinder.com. DMF was purchased from Acros Organics-International. [Ir(ppy)₂(dtbbpy)]PF₆ was purchased from Sigma Aldrich. KHCO₃ was purchased from Acros Organics – International.

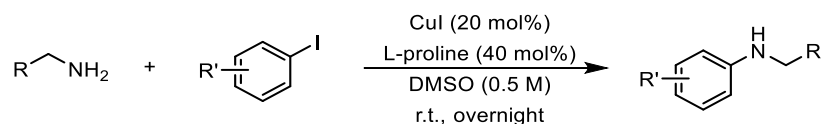
1.2 Analytical methods

Kessil lamps were purchased from Laser 2000 (UK) Ltd, with precise wavelengths (456 nm). ¹H NMR spectra (400 MHz) and ¹³C NMR spectra (100 MHz) were recorded using Bruker Avance 400 spectrometer with CDCl₃ or DMSO-*d*₆ as solvent. NMR spectra were calibrated using the solvent residual signals (CDCl₃: δ ¹H = 7.26, δ ¹³C = 77.00; DMSO-*d*₆: δ ¹H = 2.50, δ ¹³C = 39.52). The following abbreviations were used to describe peak splitting patterns when appropriate: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, dd = doublet of doublet, m = multiplet and br s = broad singlet. Analytical thin layer chromatography (TLC) was performed using pre-coated TLC sheets ALUGRAM® SIL G/UV254 (Machery-Nagel) and spots were visualized using UV light (254 nm). Flash chromatography was performed on an automated chromatography system (Biotage® or Combiflash®Rf) with on-line UV detection using commercial Silica Flash Cartridges and the indicated solvent and gradient system. High performance liquid chromatography (HPLC) of samples were prepared by dissolving 0.1–5.0 mg of the product in methanol or in acetonitrile and further diluting to a concentration of 10⁻⁵–10⁻⁶ M with 50% methanol (or acetonitrile)/50% H₂O/0.1% formic acid.

2. Starting Material Synthesis

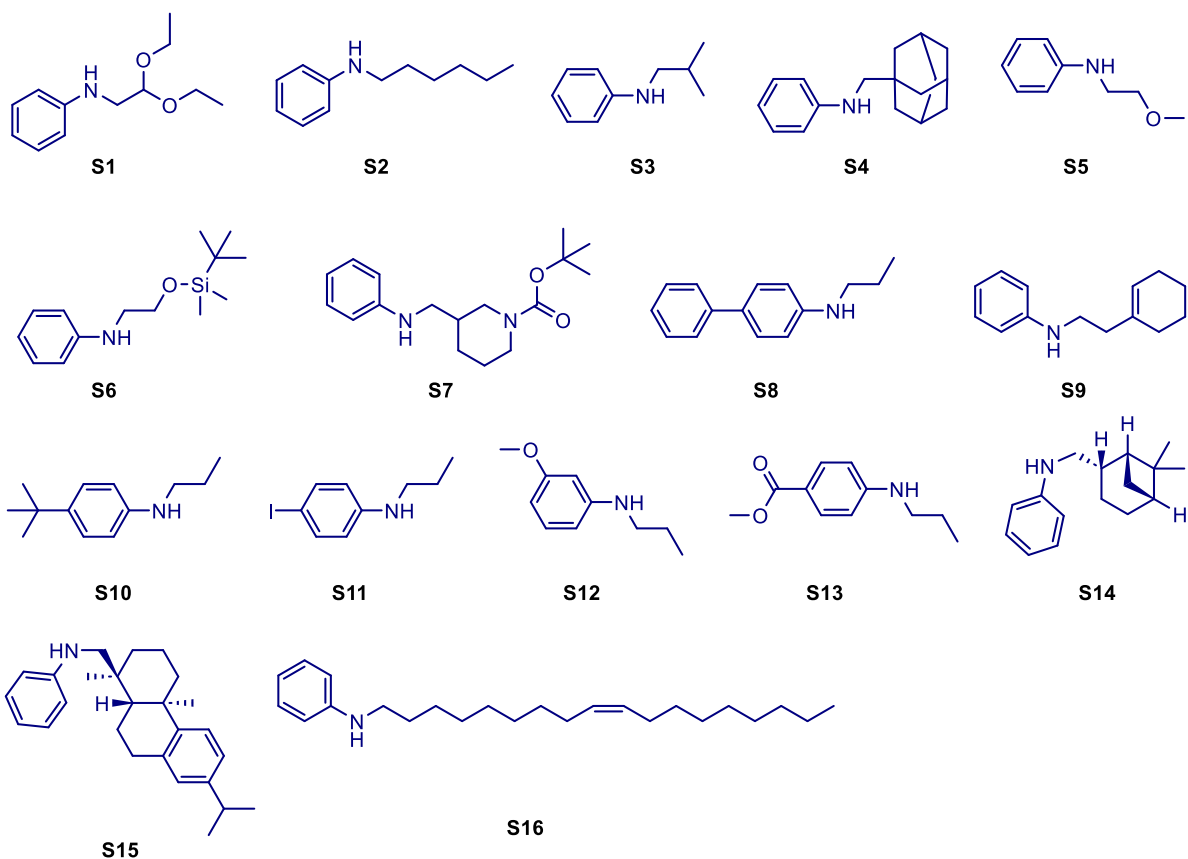
GP1 – General Procedure for Synthesis of N-alkylanilines

The synthesis of N-alkylanilines used in this work were prepared according to the methods shown below.



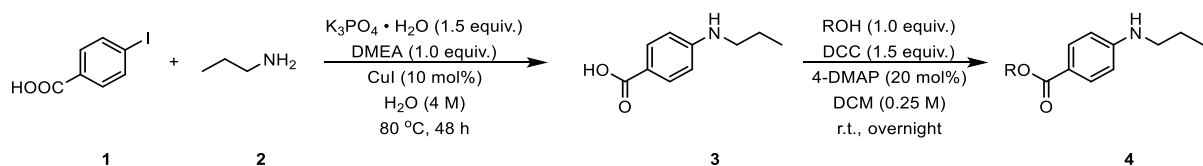
An oven-dried Schlenk flask equipped with a stirring bar was charged with CuI (1 mmol, 0.20 equiv.) and L-proline (2 mmol, 0.40 equiv.). The flask was then evacuated and backfilled with N₂ for 3 times. The DMSO (10 mL, 0.5M) and PhI (5 mmol, 1.0 equiv.) were sequentially added. The resulting solution was stirred for 5 min and the color turned out to blue. Then the amine (7.5 mmol, 1.5 equiv.) was added to the solution. The resulting mixture was stirred under N₂ at room temperature overnight. The reaction was quenched and diluted by water (20 mL) and EtOAc (20 mL). The layers were separated, and the aqueous layer was extracted with EtOAc (3 × 20mL). The combined organic layers were dried (Na₂SO₄), filtered and concentrated. The crude was purified by column chromatography.

List of N-alkylanilines:



GP2 – General Procedure for Synthesis of complex N-alkylanilines

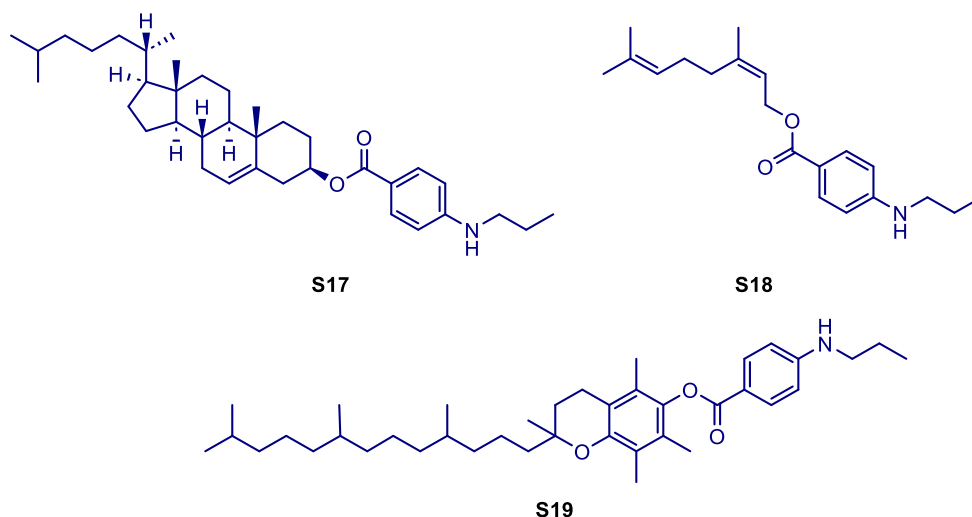
The synthesis of complex N-alkylanilines used in this work were prepared according to the methods shown below.



A 50 mL Schlenk flask equipped with a stirring bar was charged with *p*-Iodobenzoic acid (10 mmol, 1.0 equiv.), K₃PO₄·H₂O (15mmol, 1.5 equiv.), and CuI (1.0 mmol, 10 mol%). The flask was then evacuated and backfilled with N₂ for 3 times. Subsequently, *n*-Propyl amine (15mol, 1.5 equiv.), DMEA (2-Dimethylaminoethanol, 10 mol, 1.0 equiv.), and water (2.5 mL, 4M) were added under N₂. The flask was transferred to oil bath (80°C) to react for 48 h. After the reaction finished, the resulting mixture was cooled to room temperature and quenched by ice water. The concentrated HCl was dropwise added to the solution until the pH up to 5. Extracted the solution with ethyl acetate (50 mL × 4) and collected the organic layer. The combined organic phase was dried with MgSO₄ and concentrated under reduced pressure. The final residue (**3**) was obtained in 80 % yield and can be used to next step without purification.

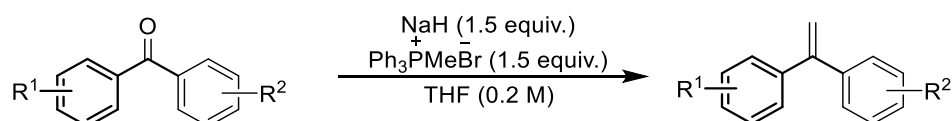
A 50 mL Schlenk flask equipped with a stir bar was charged with **3** (7.5 mol, 1.5 equiv.), natural product alcohol (5 mol, 1.0 equiv.), DCC (N,N'-Dicyclohexylcarbodiimide, 7.5 mol, 1.5 equiv.), 4-DMAP (4-Dimethylaminopyridine, 1.0 mol, 20 mol%) and DCM (20 mL, 0.25 M). The reaction was stirred for overnight at room temperature. The flask was opened, filtered the reaction mixture and washed the residue with DCM. The solution was collected and concentrated under reduced pressure. The product **4** was purified by flash chromatography.

List of complex N-alkylanilines



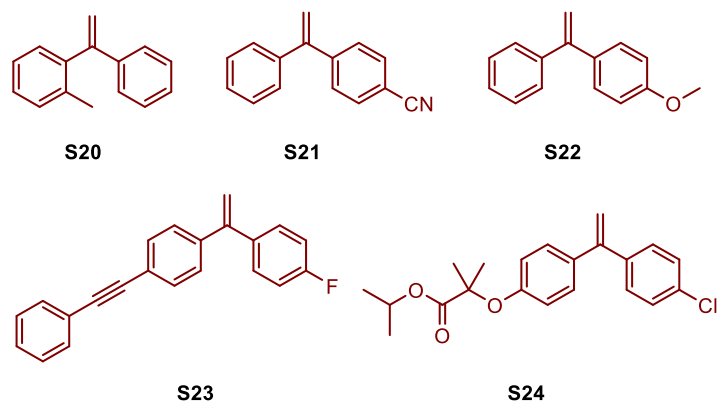
GP3 – General procedure for synthesis of alkenes

The synthesis of alkenes used in this work were prepared according to the methods shown below.



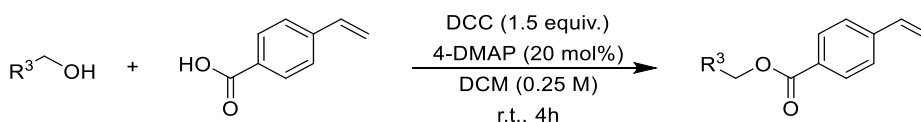
A 50 mL Schlenk flask equipped with a stirring bar was charged with methyltriphenylphosphonium bromide (1.5 equiv.) in THF, NaH (1.5 equiv.) was added under argon at 0 °C and stirred for 30 min. Then the ketone in THF was added drop wise and stirred overnight. The reaction was quenched by water in ice bath. Extracted the mixture with ethyl acetate (50mL x 3) and combined the organic phase. The organic phase dried over anhydrous Na₂SO₄ and concentrated in vacuo. The residue was purified by silica gel column chromatography to afford pure styrene (85-99% yield).

List of alkenes



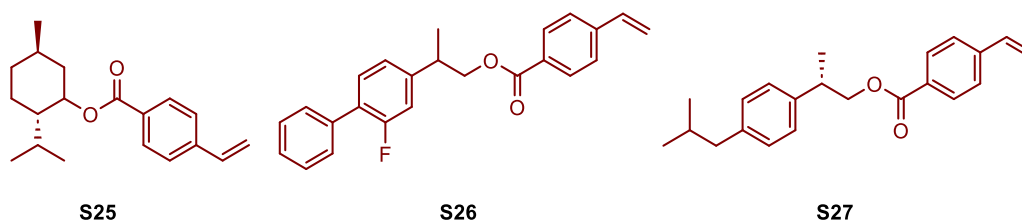
GP4 – General procedure for synthesis of complex alkenes

The synthesis of complex alkenes used in this work were prepared according to the methods shown below.



A 50 mL Schlenk flask equipped with a stir bar was charged with 4-vinylbenzoic acid (7.5 mol, 1.5 equiv.), nature product alcohol (5 mol, 1.0 equiv.), DCC (7.5 mol, 1.5 equiv.), 4-DMAP (1.0 mol, 20 mol%) and DCM (20 mL, 0.25 M). The reaction was stirred for 4h at room temperature. The flask was opened, filtered the reaction mixture and washed the residue with DCM. The solution was collected and concentrated under reduced pressure. The final product was purified by flash chromatography.

List of complex alkenes



3. Experimental Procedures

3.1 Setup for the photoredox synthesis of γ -lactam

The reaction setup is depicted in **Fig. S1**. The reaction setup consists of a Kessil lamp ($\lambda = 456$ nm), cooling of the setup was performed by two commercially available 120 mm computer fans to keep the temperature around 27 °C. The light intensity was measured by Ophir StarLite power meter with 3A probe head. The light intensity of Kessil lamp ($\lambda = 456$ nm) was 0.35 W/cm² and the distance between tube and light is 3 cm. The CO₂ was provided by a balloon filled with pure CO₂ gas and the distance between lamp and reaction tube was 2~3 cm.

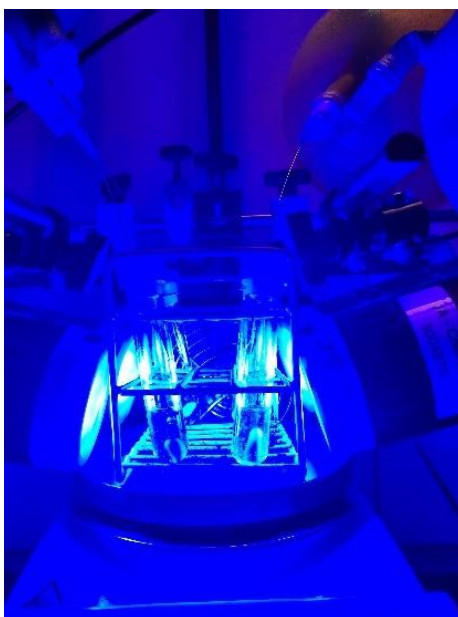
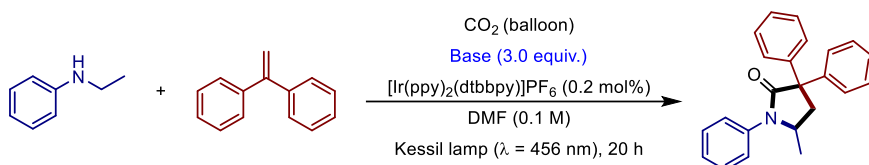


Fig. S1. Set up for the photoredox synthesis of γ -lactam

3.2 Optimization of conditions for reaction under visible-light irradiation

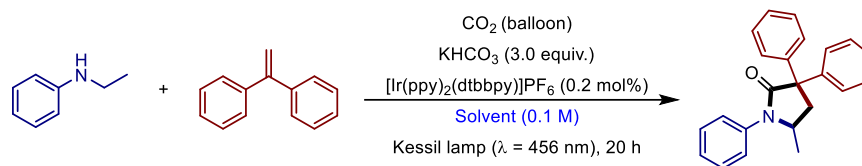
In a 10 mL vial equipped with a rubber plunger, 1,1-diphenylethylene (0.2 mmol), N-ethylaniline (0.24 mmol), $[\text{Ir}(\text{dtbbpy})(\text{ppy})_2]\text{PF}_6$ (0.2 mol%) and base (n mol%) were dissolved in solvent (2.0 mL). The mixture was bubbled with CO_2 (10 min) and irradiated with a 40 W Kessil lamp ($\lambda = 456 \text{ nm}$, full intensity) for 20 h. After irradiation of 20 h, 1.0 mL of HCl solution (0.1 M) was added to the reaction. The resulting solution was extracted with EtOAc ($5 \times 3 \text{ mL}$). Yields were calculated by crude ^1H NMR with 1,3,5-trimethoxybenzene as the internal standard.

Table S1. Screening of different base



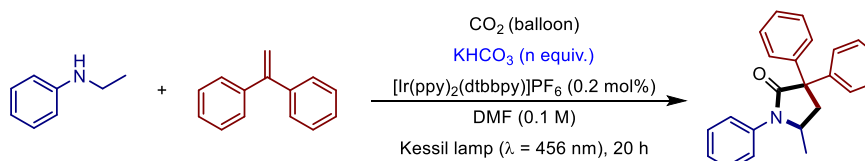
Entry	Base (3.0 equiv.)	Yield (%)
1	K_2CO_3	73
2	Na_2CO_3	68
3	Li_2CO_3	76
4	Cs_2CO_3	56
5	KOAc	30
6	K_3PO_4	76
7	$t\text{BuOK}$	55
8	KHCO_3	81
9	DABCO	0
10	Et_3N	0
11	quinuclidine	0

Table S2. Screening of different solvent



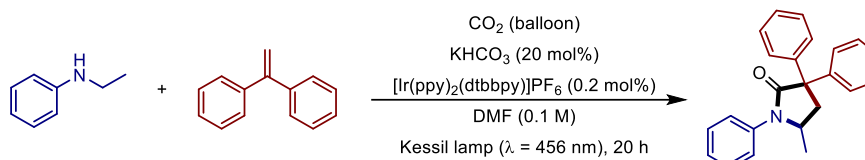
Entry	Solvent (0.1 M)	Yield (%)
1	DMF	81
2	DMA	78
3	DMSO	70
4	MeCN	0
5	DCE	0
6	1,4-Dioxane	0
7	EtOH	0
8	Toluene	0
9	THF	0

Table S3. Screening of different KHCO₃ loading



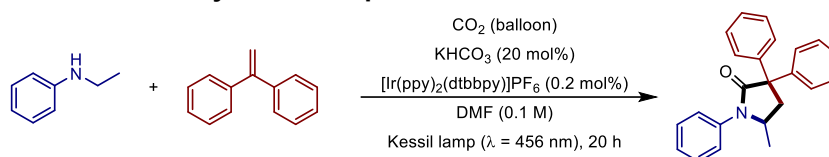
Entry	KHCO ₃ (n equiv.)	Yield (%)
1	2.0	80
2	1.5	81
3	1.0	80
4	0.2	82

Table S4. Screening of reaction temperature



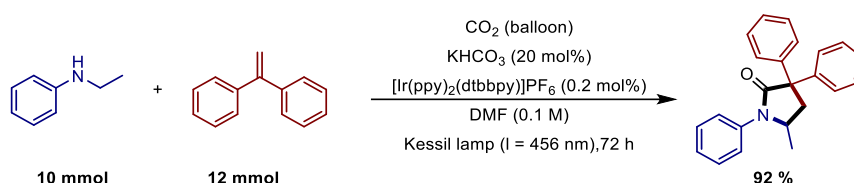
Entry	Temperature (°C)	Yield (%)
1	rt	98
2	50	70

3.3 Standard procedure for the synthesis of γ -lactam



A dry 10 mL vial equipped with a stirring bar was charged with the 1,1-Diphenylethylene (0.2 mmol), N-Ethylaniline (0.24 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (0.2 mol%), and KHCO_3 (20 mol%), then the solvent DMF (0.1 M) was added. The tube was capped with a rubber plunger, then the mixture was bubbled with CO_2 balloon (10 min). After the reaction mixture was thoroughly bubbled, the vial was placed approximately 3 cm from Kessil 456 nm lights, and the mixture was stirred under irradiation with fan for 20 hours. After that, the mixture was diluted with HCl solution (0.1 M, 2.0 mL) and EtOAc (2.0 mL). 1,3,5-Trimethoxybenzene was added, and the layers were separated. The aqueous layer was extracted with EtOAc (2.0 mL x 3) and the combined organic layers were evaporated under reduced pressure (40 °C water bath). The yield was analyzed by ^1H NMR spectroscopy.

3.4 Gram-scale reaction

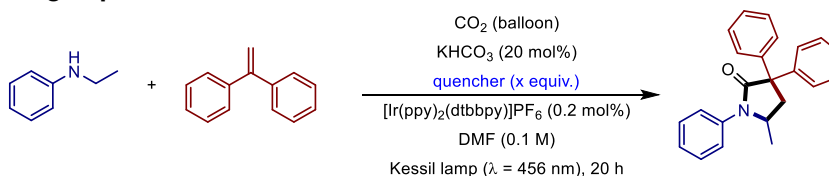


The oven-dried two necks flask (150 mL) containing a stirring bar was charged with 1,1-Diphenylethylene (1.8 mL, 10 mmol), N-Ethylaniline (1.9 mL, 12 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (25 mg, 6 μmol , 0.1 mol %), KHCO_3 (200mg, 20 mol%) and DMF (50 mL, 0.2 M). The flask was then bubbled with CO_2 for 10 min and equipped with a CO_2 balloon. The reaction was stirred at room temperature and irradiated with two 40 W kessil lights (456 nm, 3 cm away, with cooling fan to keep the reaction temperature at 25–30 °C) for 72h. The resulting mixture was quenched by 20 mL of 0.1N HCl (aq.) and diluted with 30 mL of EtOAc and then stirred for 2 min and extracted by EtOAc four times and the combined organic phases were concentrated in vacuo. The residue was purified by silica gel flash column chromatography to give the pure desired product in 92% yield.

3.5 Quenching experiments

In an oven-dried 10 mL vial containing a stirring bar, 1,1-Diphenylethylene (0.2 mmol), N-Ethylaniline (0.24 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (0.2 mol%), and KHCO_3 (20 mol%), quencher (x equiv.) then the solvent DMF (0.1 M) was added subsequently. The tube was capped with a rubber plunger. A CO_2 balloon was equipped to bubble for 10 min and keep the CO_2 atmosphere, then resulting mixture was stirred for 20 h under irradiation. The results shown in Table S5, when 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO) were applied to the reaction mixture, the yield dramatically decreased, which was the evidence of the radical pathway. No product was observed when CuCl_2 was used as the quencher, indicating the presence of SET (single electron transfer) step during the reaction.

Table S5. Quenching experiments



Entry	Quencher	Equiv.	Yield (%)	Conclusion
1	TEMPO	1.0	30	Radical
2	TEMPO	2.0	0	Radical
3	CuCl_2	1.0	0	SET

3.6 Stern-Volmer fluorescence quenching experiments

Fluorescence quenching experiments were measured on a SILVER-Nova-25 zAP-D spectrometer. The complex $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ was excited, and the emission spectrum $\lambda_{\text{max}} = 470 \text{ nm}$ was recorded. The luminescence of $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ at $\lambda_{\text{max}} = 470 \text{ nm}$ was readily quenched with N-Ethylaniline. The results shown in **Fig. S2**.

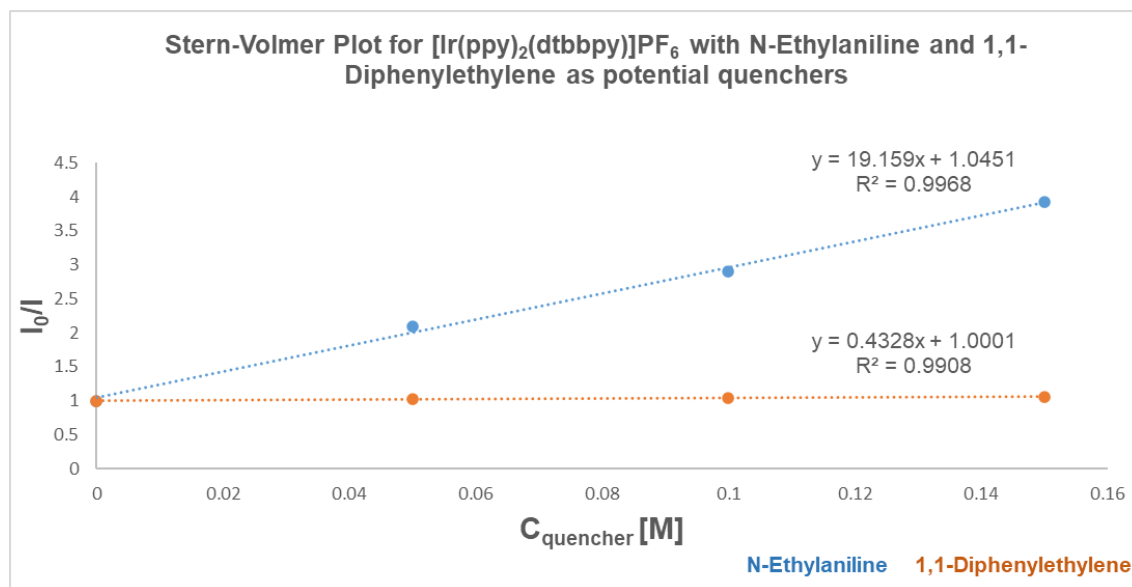
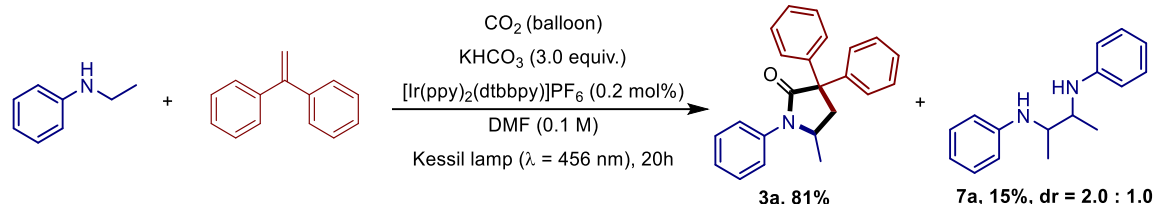
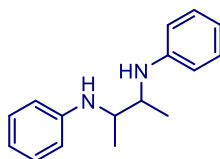


Fig. S2. Luminescence quenching experiments

3.7 Intercepting the α -amino radical



N^2, N^3 -diphenylbutane-2,3-diamine (7a)



Colorless oil. **mixture of diastereomers and rotamers.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.22 – 7.12 (m, 13H), 6.71 (ddt, $J = 8.0, 7.3, 0.9 \text{ Hz}$, 5H), 6.68 – 6.62 (m, 8H), 6.62 – 6.55 (m, 4H), 3.73 (q, $J = 5.9 \text{ Hz}$, 2H), 3.66 – 3.54 (m, 10H), 1.22 (d, $J = 5.5 \text{ Hz}$, 12H), 1.19 (d, $J = 6.2 \text{ Hz}$, 6H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 147.59, 147.56, 129.38, 129.34, 117.60, 117.53, 113.77, 113.56, 52.59, 52.26, 17.01, 16.27. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{16}\text{H}_{21}\text{N}_2$, 241.1700; found, 241.1702.

3.8 Intercepting the carbanion intermediate with D_2O

A dry 10 mL vial equipped with a stirring bar was charged with the 1,1-Diphenylethylene (0.2 mmol), N-Ethylaniline (0.24 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (0.2 mol%), and KHCO_3 (20 mol%), then D_2O (x equiv.) and the solvent DMF (0.1 M) was added. The tube was capped with a rubber plunger, then the mixture was bubbled with N_2 balloon (10 min). After the reaction mixture was thoroughly bubbled, the vial was placed approximately 3 cm from Kessil 456 nm lights. The lights were switched on and the mixture was stirred under irradiation with fan for 20 hours. The tube was opened, and the mixture was diluted with HCl solution (0.1 M, 2.0 mL) and EtOAc (2.0 mL). 1,3,5-Trimethoxybenzene was added, and the layers

were separated. The aqueous layer was extracted with EtOAc (2.0 mL x 3) and the combined organic layers were evaporated under reduced pressure (40 °C water bath). The crude was solubilised in CDCl₃ and analyzed by ¹H NMR spectroscopy to determine the yield (**Fig. S3**). The results with different equivalent of D₂O shown in **Table S6**.

Table S6. The isotope labelling experiments with D₂O

$ \begin{array}{c} \text{N}_2 \\ \text{KHCO}_3 \text{ (20 mol\%)} \\ \text{[Ir(ppy)}_2\text{(dtbbpy)]PF}_6 \text{ (0.2 mol\%)} \\ \text{DMF (0.1 M)} \\ \text{Kessil lamp } (\lambda = 456 \text{ nm}), 20\text{h} \end{array} $		
Entry	D ₂ O (equiv.)	H/D Yield (%)
1	0	82 (0 D)
2	5	86 (53 D)
3	10	98 (90 D)

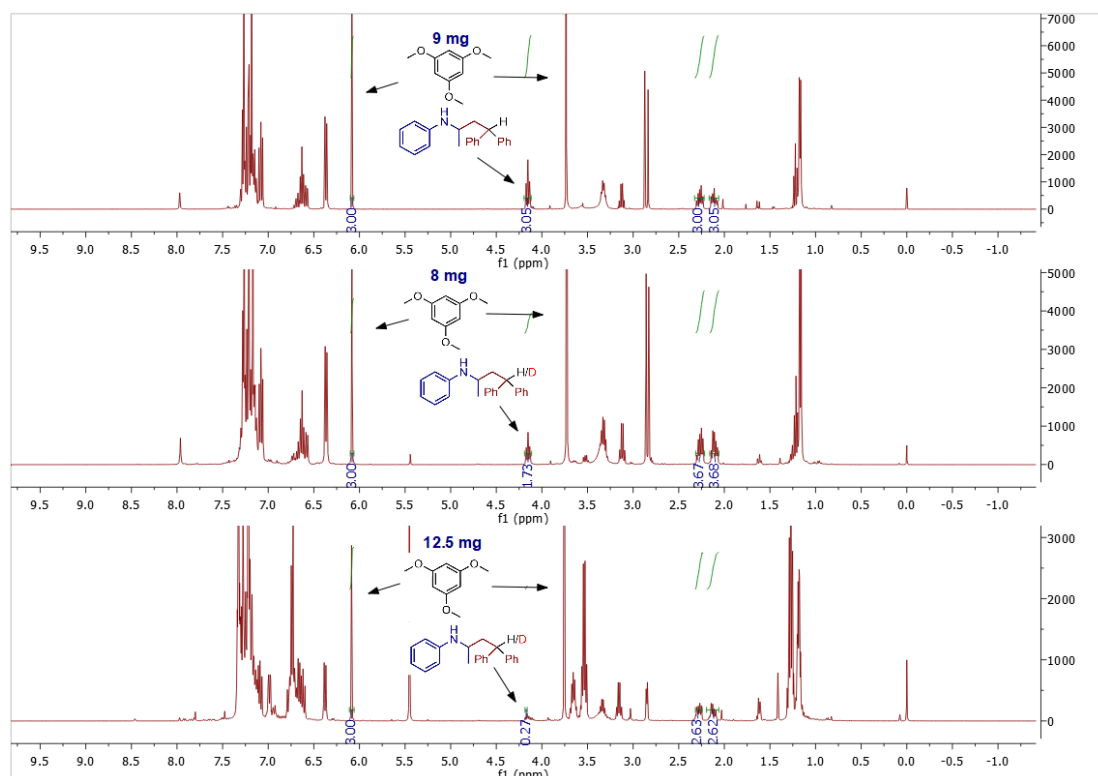
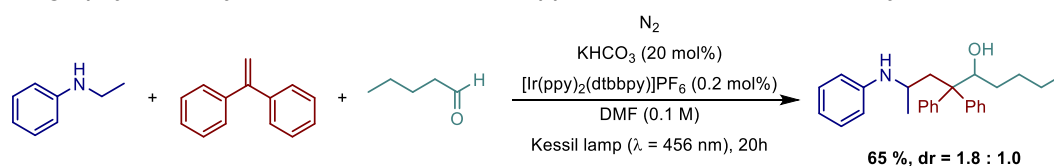


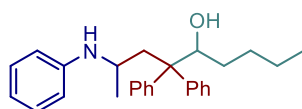
Fig. S3. Crude ¹H NMR for D₂O isotope experiments

3.9 Intercepting the carbanion intermediate with aldehyde

Following the general procedure, 1,1-Diphenylethylene (0.2 mmol), N-Ethylaniline (0.24 mmol), [Ir(ppy)₂(dtbbpy)]PF₆ (0.2 mol%), and KHCO₃ (20 mol%), pentanal (0.4 mmol) then the solvent DMF (0.1 M) was added and reacted for 20 h under N₂ atmosphere. The product was isolated by flash column chromatography in 65% yield. This result further supported the existence of benzylic carbanion.



4,4-diphenyl-2-(phenylamino)undecan-5-ol (7b)

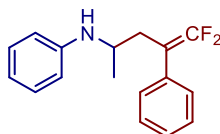


Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.37 (ddd, J = 8.1, 6.7, 1.4 Hz, 5.6H), 7.30 (td, J = 8.2, 7.7, 3.8 Hz, 6H), 7.27 – 7.21 (m, 11H), 7.21 – 7.15 (m, 5.6H), 7.15 – 7.09 (m, 3.6H), 7.06 (dd, J = 8.5, 7.2 Hz, 2H), 6.74 (tt, J = 7.3, 1.1 Hz, 1.8H), 6.65 (tt, J = 7.3, 1.1 Hz, 1H), 6.51 – 6.46 (m, 3.6H), 6.31 – 6.24 (m, 2H), 4.44 (dd, J = 10.3, 1.3 Hz, 2.8H), 3.27 (td, J = 6.3, 4.8 Hz, 1H), 3.20 – 3.14 (m, 1.8H), 2.77 (dd, J = 14.6, 8.5 Hz, 2H), 2.48 – 2.35 (m, 1.8H), 2.19 (dd, J = 14.5, 1.6 Hz, 1.8H), 1.56 (dddd, J = 14.8, 8.4, 4.2, 2.5 Hz, 2H), 1.51 – 1.39 (m, 3.8H), 1.31 – 1.14 (m, 8.4H), 0.98 (t, J = 6.0 Hz, 8.4H), 0.79 (dt, J = 14.5, 7.1 Hz, 8.4H). ^{13}C NMR (100 MHz, CDCl_3) δ 146.80, 146.68, 146.02, 145.92, 145.20, 144.20, 129.79, 129.26, 129.23, 129.18, 129.02, 128.95, 127.94, 127.87, 127.67, 127.61, 126.27, 126.04, 126.00, 119.07, 117.80, 115.63, 114.10, 75.50, 74.18, 56.24, 55.80, 47.94, 47.77, 46.62, 45.23, 33.54, 33.13, 29.16, 29.10, 22.97, 22.74, 22.68, 22.54, 14.07, 14.01. HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{27}\text{H}_{34}\text{NO}$, 388.2635; found, 388.2647.

3.10 Defluorinative alkylation of α -(Trifluoromethyl)-styrene

A dry 10 mL vial equipped with a stirring bar was charged with the (3,3,3-trifluoroprop-1-en-2-yl)benzene (0.2 mmol), N-Ethylaniline (0.24 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (0.2 mol%), and KHCO_3 (20 mol%), then the solvent DMF (0.1 M) was added. The tube was capped with a rubber plunger, then the mixture was bubbled with N_2 balloon (10 min). After that, the vial was placed approximately 3 cm from Kessil 456 nm lights and reacted for 20 h. The product was isolated by flash column chromatography in 93% yield. This result provided a solid existence for the existence of benzylic carbanion.

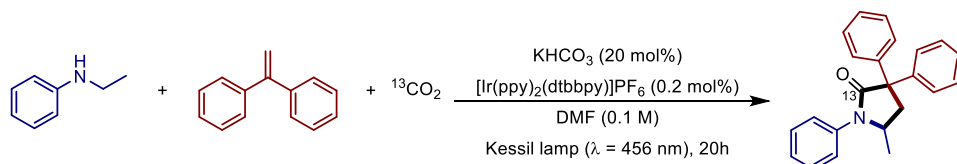
N-(5,5-difluoro-4-phenylpent-4-en-2-yl)aniline (7c)



Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.40 – 7.32 (m, 2H), 7.34 – 7.27 (m, 3H), 7.10 (dd, J = 8.6, 7.3 Hz, 2H), 6.73 – 6.59 (m, 1H), 6.40 (dd, J = 8.6, 1.1 Hz, 2H), 3.53 – 3.41 (m, 1H), 3.35 (br s, 1H), 2.84 – 2.68 (m, 1H), 2.43 (dddd, J = 14.3, 7.6, 2.5, 1.4 Hz, 1H), 1.17 (d, J = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 147.02, 129.23, 128.55, 128.40 (t, J = 3.6, 3.1 Hz), 127.53, 117.24, 113.20, 47.15 (dd, J = 3.7, 2.9, 2.8 Hz), 35.13 (d, J = 1.6 Hz), 20.39. ^{19}F NMR (376 MHz, CDCl_3) δ -90.77 – -91.30 (m). HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{17}\text{H}_{18}\text{NF}$, 274.1402; found, 274.1396.

3.11 $^{13}\text{CO}_2$ labelling experiment

The result of the $^{13}\text{CO}_2$ -labeling experiment supports the proposed mechanism. When the reaction was carried out under $^{13}\text{CO}_2$ atmosphere, the ^{13}C labeled product was observed by HR-MS (Fig. S4). The result is consistent with the proposed mechanism, in which the carbonyl group in γ -lactam arises from the CO_2 molecule.



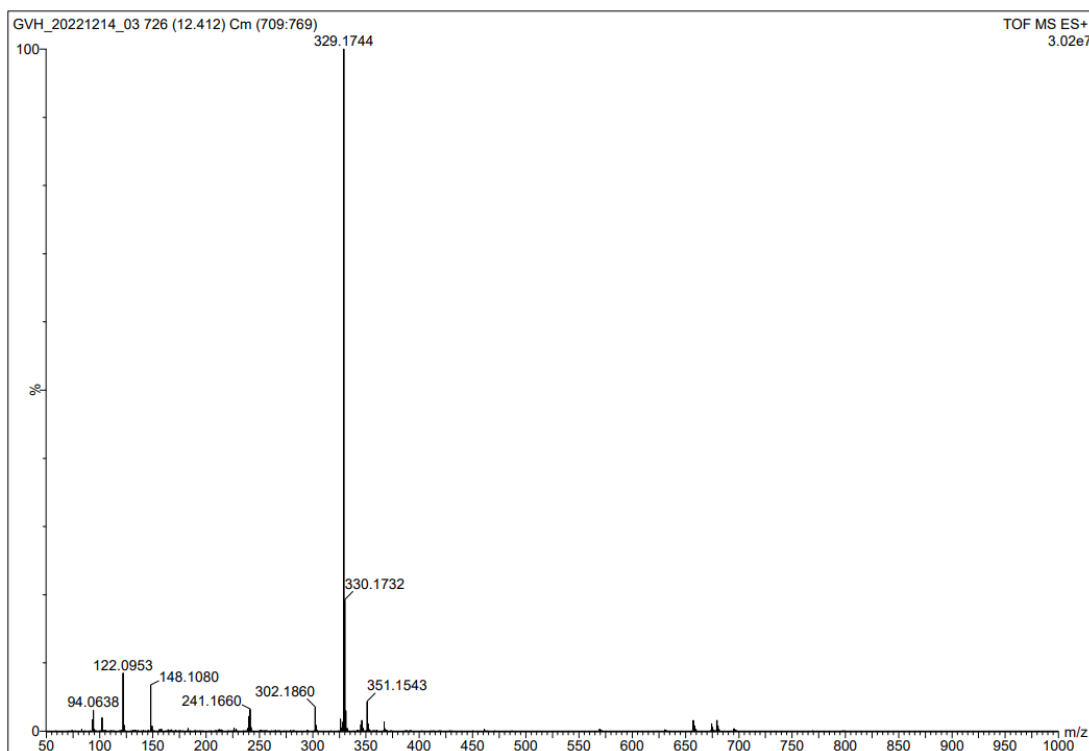


Fig. S4. HR-MS for $^{13}\text{CO}_2$ labelling experiment

3.12 Light on-off experiments

To eight 10 mL vials equipped with a magnetic stir bar were added 1,1-Diphenylethylene (0.2 mmol), N-Ethylaniline (0.24 mmol), $[\text{Ir}(\text{ppy})_2(\text{dtbbpy})]\text{PF}_6$ (0.2 mol%), KHCO_3 (20 mol%) and DMF (1.0 mL) respectively, the tubes were sealed and equipped with CO_2 balloon for bubbling and keeping the CO_2 atmosphere. The reaction mixture was stirred at room temperature under kessil light (456 nm). Turn on/off the light every 2 hours and quenched one reaction with 0.1 M HCl at the same time until all the reactions were quenched. Each reaction mixture was extracted with ethyl acetate (3 x 2 mL). The combined organic layers were concentrated under reduced pressure (40 °C water bath). The yields were determined ^1H NMR using 1,3,5-Trimethoxybenzene as an internal standard. As shown in **Fig. S5**, the reaction in the absence of Kessil light showed an extremely slow reaction rate, which highlights the importance of light irradiation.

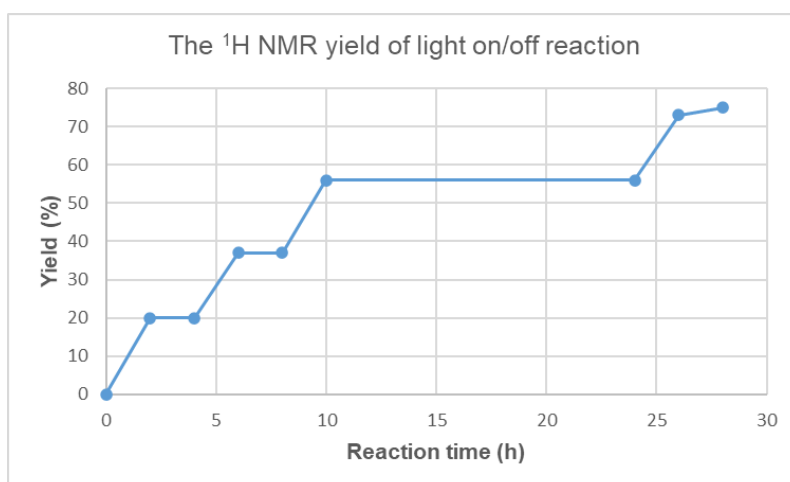


Fig. S5. The yield of light on/off experiments

3.13 Time course experiments

During the gram-scale reaction, 0.5 mL of the reaction mixture was taken out for ^1H NMR analysis after 12h, 24h, 48h, and 72h. As shown in **Fig. S5**, the yield of γ -lactam continuously increased with the time and the crude ^1H NMR yields were followed in **Fig. S6**.

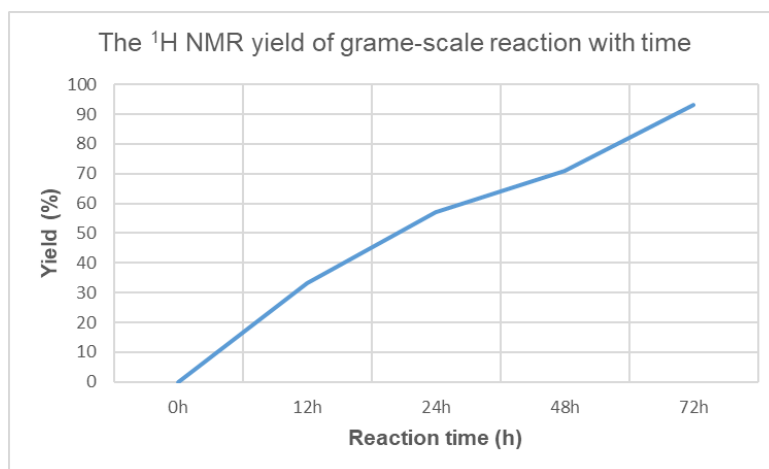


Fig. S6 The yield of time course experiments

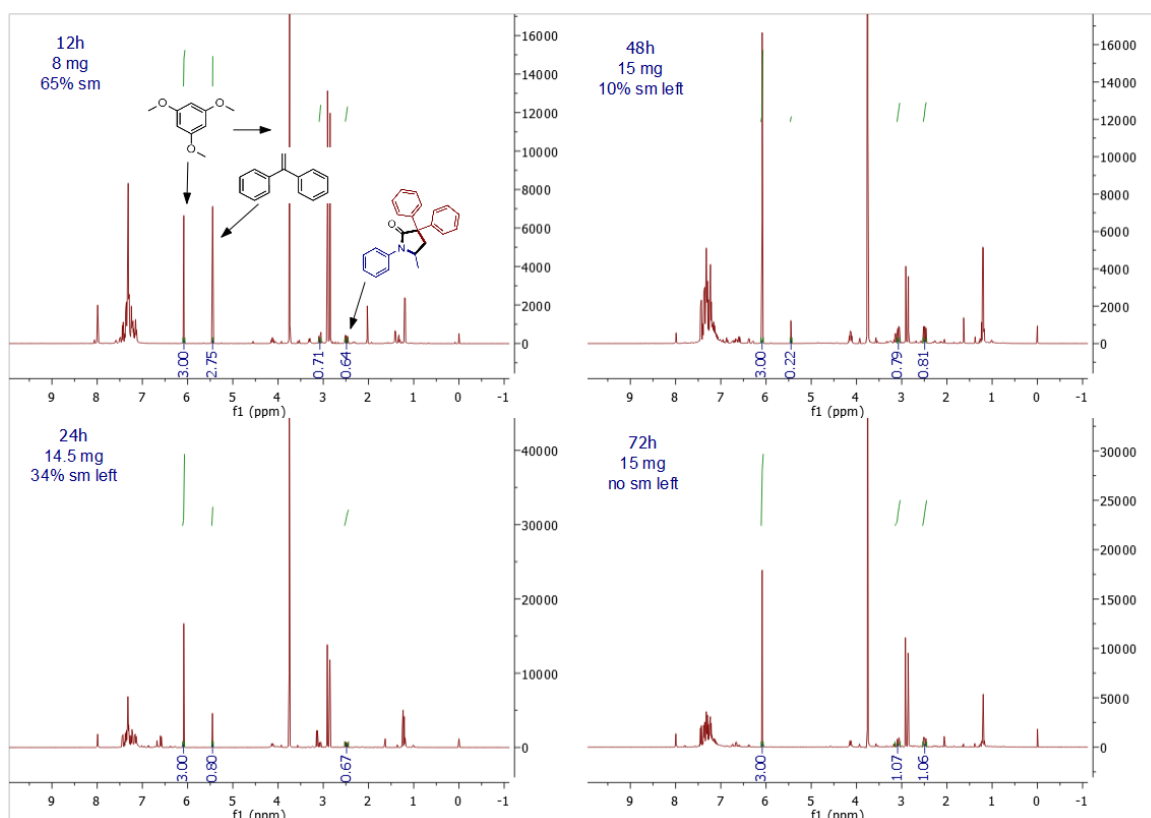
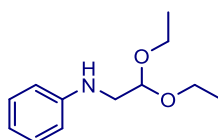


Fig. S7. The crude ^1H NMR of time course experiments of gram scale

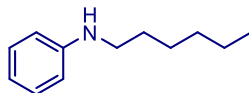
4. Characterization of Starting Materials and Products.

N-(2,2-diethoxyethyl)aniline (S1)



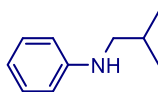
Colorless oil. **¹H NMR** (400 MHz, CDCl₃) δ 7.17 (t, J = 5.5 Hz, 2H), 6.71 (td, J = 7.3, 1.1 Hz, 1H), 6.63 (d, J = 7.8 Hz, 2H), 4.68 (t, J = 5.5 Hz, 1H), 3.87 (br s, 1H), 3.72 (dq, J = 9.5, 7.0 Hz, 2H), 3.57 (dq, J = 9.5, 7.0 Hz, 2H), 3.25 (d, J = 5.5 Hz, 2H), 1.23 (t, J = 7.1 Hz, 6H). **¹³C NMR** (100 MHz, CDCl₃) δ 147.95, 129.22, 117.63, 113.09, 100.89, 62.30, 46.38, 15.35.

***N*-hexylaniline (S2)**



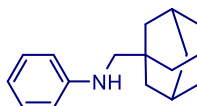
Colorless oil. **¹H NMR** (400 MHz, CDCl₃) δ 7.16 (t, J = 7.9 Hz, 2H), 6.67 (t, J = 7.3 Hz, 1H), 6.59 (d, J = 7.7 Hz, 2H), 3.56 (br s, 1H), 3.09 (t, J = 7.1 Hz, 2H), 1.65 – 1.55 (m, 2H), 1.48 – 1.26 (m, 6H), 0.90 (t, J = 7.0 Hz, 3H). **¹³C NMR** (100 MHz, CDCl₃) δ 148.54, 129.17, 117.03, 112.66, 44.00, 31.64, 29.56, 26.84, 22.61, 14.01. **HRMS–ESI** (m/z): [M+H]⁺ calcd. for C₁₂H₂₀N, 178.1591; found, 178.1582.

***N*-isobutylaniline (S3)**



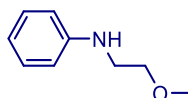
Colorless oil. **¹H NMR** (400 MHz, CDCl₃) δ 7.15 (t, J = 7.7 Hz, 2H), 6.66 (t, J = 7.3 Hz, 1H), 6.58 (d, J = 8.5 Hz, 2H), 3.61 (br s, 1H), 2.91 (d, J = 6.9 Hz, 2H), 1.86 (dp, J = 13.3, 6.6 Hz, 1H), 0.97 (d, J = 7.0 Hz, 6H). **¹³C NMR** (100 MHz, CDCl₃) δ 148.55, 129.15, 116.90, 112.61, 51.78, 28.01, 20.43. **HRMS–ESI** (m/z): [M+H]⁺ calcd. for C₁₀H₁₆N, 150.1278; found, 150.1270.

***N*-(adamantan-1-ylmethyl)aniline (S4)**



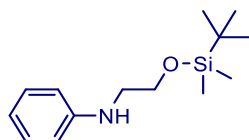
White solid. **¹H NMR** (400 MHz, CDCl₃) δ 7.18 – 7.09 (m, 2H), 6.68 – 6.58 (m, 3H), 3.64 (br s, 1H), 2.79 (s, 1H), 2.00 (p, J = 3.2 Hz, 3H), 1.79 – 1.63 (m, 6H), 1.58 (d, J = 2.9 Hz, 6H). **¹³C NMR** (100 MHz, CDCl₃) δ 149.25, 129.16, 116.70, 112.57, 56.29, 40.77, 37.13, 33.91, 28.41. **HRMS–ESI** (m/z): [M+H]⁺ calcd. for C₁₇H₂₄N, 242.1904; found, 242.1893.

***N*-(2-methoxyethyl)aniline (S5)**



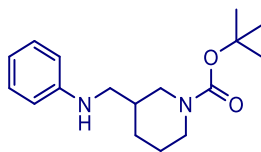
Colorless oil. **¹H NMR** (400 MHz, CDCl₃) δ 7.17 (t, J = 7.1 Hz, 2H), 6.71 (t, J = 7.3 Hz, 1H), 6.63 (d, J = 7.8 Hz, 2H), 4.00 (s, 1H), 3.60 (t, J = 5.3 Hz, 2H), 3.38 (s, 3H), 3.28 (t, J = 4.9 Hz, 2H). **¹³C NMR** (100 MHz, CDCl₃) δ 148.20, 129.16, 117.53, 113.04, 71.01, 58.67, 43.44. **HRMS–ESI** (m/z): [M+H]⁺ calcd. for C₉H₁₄NO, 152.1070; found, 152.1063.

***N*-(2-((*tert*-butyldimethylsilyl)oxy)ethyl)aniline (S6)**



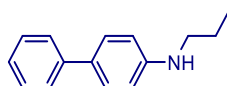
Colorless oil. **¹H NMR** (400 MHz, CDCl₃) δ 7.18 (t, J = 7.4 Hz, 2H), 6.71 (td, J = 7.3, 1.0 Hz, 1H), 6.63 (d, J = 7.8 Hz, 2H), 4.03 (br s, 1H), 3.82 (t, J = 5.5 Hz, 2H), 3.25 – 3.17 (m, 2H), 0.92 (s, 9H), 0.07 (s, 6H). **¹³C NMR** (100 MHz, CDCl₃) δ 148.40, 129.20, 117.53, 113.22, 61.64, 46.03, 25.91, 18.31, -5.33. **HRMS–ESI** (m/z): [M+H]⁺ calcd. for C₁₄H₂₆NOSi, 252.1779; found, 252.1784.

tert-butyl 3-((phenylamino)methyl)piperidine-1-carboxylate (S7)



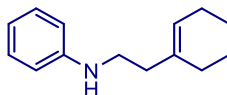
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.21 – 7.10 (m, 2H), 6.69 (t, J = 7.3 Hz, 1H), 6.59 (d, J = 7.6 Hz, 2H), 4.12 (d, J = 7.1 Hz, 2H), 3.03 (d, J = 6.2 Hz, 2H), 2.69 (t, J = 12.8 Hz, 2H), 1.84 – 1.65 (m, 3H), 1.46 (s, 9H), 1.18 (ddd, J = 12.3, 4.7, 1.7 Hz, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 154.83, 148.19, 129.28, 117.29, 112.68, 79.37, 49.73, 36.07, 30.20, 28.47. **HRMS-ESI** (m/z): $[\text{M}+\text{Na}]^+$ calcd. for $\text{C}_{17}\text{H}_{22}\text{N}_2\text{O}_2\text{Na}$, 313.1886; found, 313.1884.

N-propyl-[1,1'-biphenyl]-4-amine (S8)



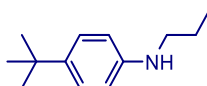
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.53 (d, J = 7.1 Hz, 2H), 7.37 (t, J = 7.7 Hz, 2H), 7.28 – 7.18 (m, 1H), 7.04 (dd, J = 309.8, 8.6 Hz, 4H), 3.69 (br s, 1H), 3.10 (t, J = 7.1 Hz, 2H), 1.64 (h, J = 7.3 Hz, 2H), 1.00 (t, J = 7.4 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 147.91, 141.31, 129.93, 128.58, 127.87, 126.21, 125.92, 112.89, 45.79, 22.72, 11.60. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{15}\text{H}_{18}\text{N}$, 212.1434; found, 212.1434.

N-(2-(cyclohex-1-en-1-yl)ethyl)aniline (S9)



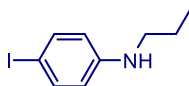
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.17 (ddt, J = 8.5, 4.5, 1.6 Hz, 2H), 6.73 – 6.65 (m, 1H), 6.64 – 6.57 (m, 2H), 5.53 (s, 1H), 3.61 (br s, 1H), 3.16 (td, J = 6.9, 2.9 Hz, 2H), 2.26 (t, J = 7.1 Hz, 2H), 1.99 (d, J = 30.3 Hz, 4H), 1.71 – 1.54 (m, 4H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 148.45, 134.91, 129.17, 123.52, 117.13, 112.82, 41.45, 37.66, 27.88, 25.26, 22.87, 22.41. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{14}\text{H}_{20}\text{N}$, 202.1591; found, 202.1593.

4-(tert-butyl)-N-propylaniline (S10)



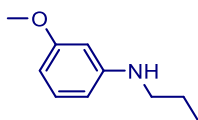
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 6.87 (dd, J = 254.5, 8.7 Hz, 4H), 3.06 (t, J = 7.1 Hz, 2H), 1.62 (h, J = 7.3 Hz, 2H), 1.27 (s, 9H), 0.98 (t, J = 7.4 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 146.19, 139.84, 125.95, 112.42, 77.32, 77.00, 76.68, 46.07, 33.80, 31.55, 22.83, 11.64. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{13}\text{H}_{22}\text{N}$, 192.1747; found, 192.1749.

4-iodo-N-propylaniline (S11)



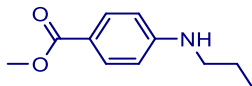
Brown oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 6.85 (dd, J = 414.8, 8.4 Hz, 4H), 3.62 (br s, 1H), 2.99 (t, J = 7.2 Hz, 2H), 1.58 (h, J = 7.3 Hz, 2H), 0.96 (t, J = 6.9 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 147.85, 137.50, 114.74, 77.18, 45.41, 22.41, 11.50.

3-methoxy-N-propylaniline (S12)



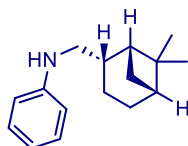
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.07 (t, J = 8.1 Hz, 1H), 6.28 – 6.20 (m, 2H), 6.17 (q, J = 2.3 Hz, 1H), 3.78 (s, 3H), 3.63 (br s, 1H), 3.08 (t, J = 7.1 Hz, 2H), 1.64 (h, J = 7.3 Hz, 2H), 1.00 (t, J = 7.4 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 160.87, 149.91, 129.89, 105.92, 102.19, 98.63, 55.05, 45.79, 22.70, 11.60. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{10}\text{H}_{16}\text{NO}$, 166.1227; found, 166.1226.

methyl 4-(propylamino)benzoate (S13)



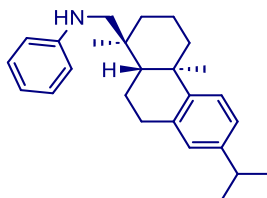
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.19 (dd, J = 526.1, 8.8 Hz, 4H), 4.12 (br s, 1H), 3.84 (s, 3H), 3.13 (t, J = 7.1 Hz, 2H), 1.65 (q, J = 7.3 Hz, 2H), 1.00 (t, J = 7.4 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 167.32, 152.12, 131.52, 118.04, 111.30, 51.44, 45.14, 22.52, 11.50. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{11}\text{H}_{16}\text{NO}_2$, 194.1176; found, 194.1179.

***N*-(((1R,2S,5R)-6,6-dimethylbicyclo[3.1.1]heptan-2-yl)methyl)aniline (S14)**



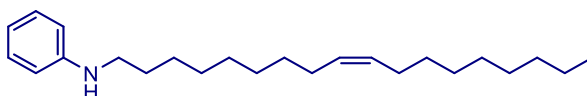
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.20 – 7.13 (m, 2H), 6.67 (t, J = 7.3 Hz, 1H), 6.58 (d, J = 7.7 Hz, 2H), 3.65 (br s, 1H), 3.17 – 3.04 (m, 2H), 2.44 – 2.26 (m, 2H), 2.07 – 1.82 (m, 5H), 1.61 – 1.48 (m, 1H), 1.21 (s, 3H), 1.04 (s, 3H), 0.92 (d, J = 9.6 Hz, 1H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 148.58, 129.21, 116.96, 112.66, 49.99, 44.22, 41.52, 41.21, 38.74, 33.44, 28.07, 26.17, 23.34, 20.42. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{16}\text{H}_{24}\text{N}$, 230.1904; found, 230.1913.

***N*-(((1S,4aR,10aS)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methyl)aniline (S15)**



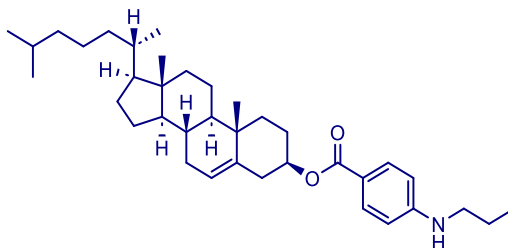
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.22 – 7.13 (m, 1H), 7.17 – 7.10 (m, 2H), 7.00 (dd, J = 8.2, 2.1 Hz, 1H), 6.91 – 6.86 (m, 1H), 6.69 – 6.60 (m, 1H), 6.63 – 6.56 (m, 2H), 3.58 (br s, 1H), 3.09 – 2.97 (m, 1H), 2.89 (ddt, J = 12.4, 5.8, 3.2 Hz, 2H), 2.86 – 2.74 (m, 2H), 2.30 (dt, J = 13.4, 3.7 Hz, 1H), 1.80 (d, J = 17.1 Hz, 3H), 1.73 – 1.58 (m, 3H), 1.50 – 1.39 (m, 2H), 1.23 (d, J = 1.9 Hz, 6H), 1.21 (s, 3H), 1.01 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 148.98, 147.31, 145.66, 134.70, 129.20, 126.85, 124.21, 123.89, 116.87, 112.63, 54.92, 45.35, 38.46, 37.50, 36.35, 33.45, 30.10, 25.28, 23.97, 19.29, 18.91, 18.76. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{26}\text{H}_{36}\text{N}$, 362.2843; found, 362.2833.

(*Z*)-*N*-(octadec-9-en-1-yl)aniline (S16)



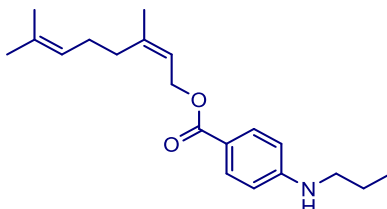
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.20 – 7.12 (m, 2H), 6.67 (t, J = 7.3 Hz, 1H), 6.59 (d, J = 7.9 Hz, 2H), 5.40 – 5.32 (m, 2H), 3.57 (br s, 1H), 3.09 (t, J = 7.1 Hz, 2H), 2.01 (q, J = 6.4 Hz, 3H), 1.61 (p, J = 7.2 Hz, 2H), 1.40 – 1.21 (m, 23H), 0.88 (t, J = 6.8 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 148.54, 129.97, 129.79, 129.19, 117.06, 112.68, 44.01, 31.91, 29.77, 29.75, 29.61, 29.52, 29.48, 29.43, 29.33, 29.32, 29.24, 27.23, 27.19, 27.18, 22.68, 14.09.

(3R,8R,9R,10S,13S,14R,17S)-10,13-dimethyl-17-((S)-6-methylheptan-2-yl)-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-3-yl-4-(propylamino)benzoate (S17)



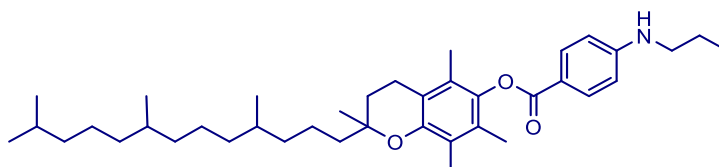
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.21 (dd, $J = 528.2, 8.7$ Hz, 4H), 5.40 (d, $J = 4.8$ Hz, 1H), 4.88 – 4.71 (m, 1H), 4.07 (br s, 1H), 3.13 (q, $J = 6.3, 5.7$ Hz, 2H), 2.43 (d, $J = 7.2$ Hz, 2H), 2.07 – 1.93 (m, 3H), 1.94 – 1.74 (m, 2H), 1.74 – 1.61 (m, 3H), 1.62 – 1.42 (m, 7H), 1.34 (d, $J = 8.0$ Hz, 3H), 1.28 – 1.08 (m, 7H), 1.06 (s, 3H), 1.00 (t, $J = 7.4$ Hz, 6H), 0.92 (d, $J = 6.5$ Hz, 3H), 0.88 (d, $J = 1.8$ Hz, 3H), 0.86 (d, $J = 1.8$ Hz, 3H), 0.69 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 166.24, 151.99, 140.01, 131.49, 122.45, 118.84, 111.27, 73.64, 56.73, 56.18, 50.10, 45.20, 42.35, 39.79, 39.54, 38.40, 37.12, 36.69, 36.21, 35.81, 31.96, 31.93, 28.24, 28.02, 24.31, 23.85, 22.81, 22.56, 21.07, 19.40, 18.73, 11.87, 11.53. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{37}\text{H}_{58}\text{NO}_2$, 548.4463; found, 548.4460.

(Z)-3,7-dimethylocta-2,6-dien-1-yl 4-(propylamino)benzoate (S18)



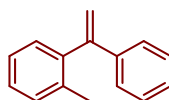
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.19 (dd, $J = 533.2, 8.7$ Hz, 4H), 5.47 (td, $J = 7.1, 1.5$ Hz, 1H), 5.12 (tdd, $J = 6.8, 2.9, 1.5$ Hz, 1H), 4.75 (dd, $J = 7.2, 1.1$ Hz, 2H), 4.15 – 4.00 (m, 1H), 3.13 (td, $J = 7.1, 5.5$ Hz, 2H), 2.21 – 2.03 (m, 4H), 1.78 (s, 3H), 1.67 (s, 3H), 1.66 – 1.62 (m, 2H), 1.60 (s, 3H), 1.00 (t, $J = 7.4$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 166.88, 152.04, 141.89, 132.06, 131.56, 123.71, 119.90, 118.45, 111.27, 60.88, 45.17, 32.25, 26.72, 25.66, 23.51, 22.55, 17.66, 11.52. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{20}\text{H}_{30}\text{NO}_2$, 316.2272; found, 316.2286.

2,5,7,8-tetramethyl-2-(4,8,12-trimethyltridecyl)chroman-6-yl 4-(propylamino)benzoate (S19)



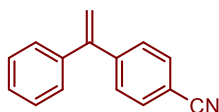
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.32 (dd, $J = 569.8, 8.3$ Hz, 4H), 4.18 (t, $J = 5.6$ Hz, 1H), 3.18 (td, $J = 7.1, 5.5$ Hz, 2H), 2.60 (t, $J = 6.9$ Hz, 2H), 2.11 (s, 3H), 2.05 (s, 3H), 2.01 (s, 3H), 1.79 (dt, $J = 11.4, 6.5$ Hz, 2H), 1.68 (q, $J = 7.2$ Hz, 2H), 1.52 (d, $J = 1.6$ Hz, 4H), 1.39 (tt, $J = 10.7, 5.4$ Hz, 4H), 1.34 – 1.19 (m, 10H), 1.19 – 1.03 (m, 6H), 1.02 (t, $J = 7.4$ Hz, 3H), 0.86 (t, $J = 7.1$ Hz, 12H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 165.31, 152.49, 149.20, 132.24, 127.22, 125.38, 122.90, 117.38, 111.43, 74.97, 45.17, 39.39, 37.48, 37.41, 37.31, 32.81, 32.80, 32.75, 32.67, 27.99, 24.81, 24.46, 22.72, 22.62, 22.55, 21.07, 20.64, 19.76, 19.69, 19.65, 19.61, 13.05, 12.19, 11.82, 11.53. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{39}\text{H}_{62}\text{NO}_3$, 592.4725; found, 592.4721.

1-methyl-2-(1-phenylvinyl)benzene (S20)



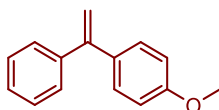
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.29 – 7.23 (m, 6H), 7.23 – 7.20 (m, 2H), 7.20 – 7.16 (m, 1H), 5.77 (d, J = 1.4 Hz, 1H), 5.19 (d, J = 1.4 Hz, 1H), 2.05 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 149.47, 141.63, 140.60, 136.12, 130.06, 130.00, 128.31, 127.54, 127.50, 126.47, 125.65, 114.81, 20.08.

4-(1-phenylvinyl)benzonitrile (S21)



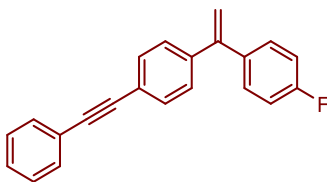
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.53 (dd, J = 73.9, 8.4 Hz, 4H), 7.38 – 7.32 (m, 3H), 7.31 – 7.22 (m, 2H), 5.56 (dd, J = 17.5, 0.8 Hz, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 148.73, 146.08, 140.21, 132.06, 128.84, 128.45, 128.25, 128.15, 118.83, 116.67, 111.39.

1-methoxy-4-(1-phenylvinyl)benzene (S22)



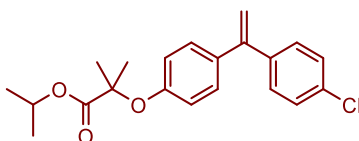
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.35 – 7.29 (m, 5H), 7.10 (dd, J = 163.4, 7.2 Hz, 4H), 5.37 (dd, J = 17.2, 1.3 Hz, 2H), 3.82 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 159.35, 149.53, 141.83, 134.00, 129.37, 128.30, 128.10, 127.62, 113.53, 112.90, 55.28. HRMS-ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{15}\text{H}_{15}\text{O}$, 211.1118; found, 211.1108.

1-fluoro-4-(1-(4-(phenylethynyl)phenyl)vinyl)benzene (S23)



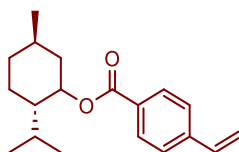
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.58 – 7.52 (m, 2H), 7.51 – 7.47 (m, 2H), 7.34 (dd, J = 5.1, 2.0 Hz, 3H), 7.31 – 7.26 (m, 4H), 7.02 (t, J = 8.7 Hz, 2H), 5.45 (dd, J = 20.2, 1.0 Hz, 2H). ^{13}C NMR (100 MHz, CDCl_3) δ 163.82, 161.37, 148.51, 141.12, 137.21, 137.18, 131.56 (d, J = 12.1 Hz), 129.92 (d, J = 8.0 Hz), 128.30, 128.23 (d, J = 24.6 Hz), 123.03 (d, J = 44.0 Hz), 115.14 (d, J = 21.6 Hz), 114.74, 89.67 (d, J = 91.5 Hz). ^{19}F NMR (376 MHz, CDCl_3) δ -114.39.

isopropyl 2-(4-(1-(4-chlorophenyl)vinyl)phenoxy)-2-methylpropanoate (S24)



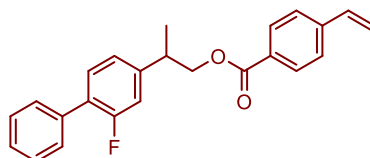
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.32 – 7.22 (m, 5H), 6.98 (dd, J = 152.6, 8.7 Hz, 4H), 5.36 (dd, J = 26.0, 1.2 Hz, 2H), 5.13 – 5.03 (m, 1H), 1.60 (s, 6H), 1.22 (d, J = 6.3 Hz, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 173.60, 155.51, 148.38, 140.19, 134.48, 133.52, 129.59, 128.8j6, 128.29, 118.45, 113.54, 79.15, 68.97, 25.41, 21.56. HRMS-ESI (m/z): $[\text{M}+\text{Na}]^+$ calcd. for $\text{C}_{21}\text{H}_{20}\text{O}_3\text{ClNa}$, 381.1227; found, 381.1227.

(2S,5R)-2-isopropyl-5-methylcyclohexyl 4-vinylbenzoate (S25)



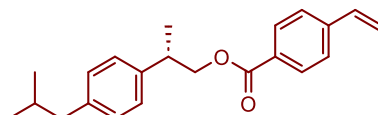
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.72 (dd, $J = 216.9, 8.4$ Hz, 4H), 6.75 (dd, $J = 17.6, 10.9$ Hz, 1H), 5.85 (d, $J = 17.4$ Hz, 1H), 5.37 (d, $J = 10.9$ Hz, 1H), 4.93 (td, $J = 10.9, 4.4$ Hz, 1H), 2.13 (dtd, $J = 12.0, 3.9, 1.8$ Hz, 1H), 2.01 – 1.86 (m, 1H), 1.79 – 1.68 (m, 2H), 1.56 (tt, $J = 8.7, 1.9$ Hz, 2H), 1.38 – 1.21 (m, 1H), 1.12 (dtd, $J = 15.2, 12.4, 9.7$ Hz, 1H), 0.92 (dd, $J = 6.8, 5.2$ Hz, 6H), 0.80 (d, $J = 7.0$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 165.83, 141.74, 136.09, 129.85, 126.03, 116.27, 74.81, 55.74, 47.31, 41.00, 34.35, 31.45, 26.56, 25.47, 24.68, 23.73, 22.03, 20.74, 16.58. **HRMS-ESI** (m/z): $[\text{M}+\text{Na}]^+$ calcd. for $\text{C}_{19}\text{H}_{20}\text{O}_2\text{Na}$, 309.1825; found, 309.1822.

2-(2-fluoro-[1,1'-biphenyl]-4-yl)propyl 4-vinylbenzoate (S26)



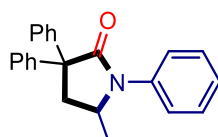
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.95 (d, $J = 8.4$ Hz, 2H), 7.54 (dt, $J = 8.2, 1.5$ Hz, 2H), 7.50 – 7.42 (m, 4H), 7.42 – 7.31 (m, 2H), 7.22 – 6.98 (m, 2H), 6.74 (dd, $J = 17.6, 10.9$ Hz, 1H), 5.85 (d, $J = 16.9$ Hz, 1H), 5.38 (d, $J = 10.2$ Hz, 1H), 4.58 – 4.27 (m, 2H), 3.29 (q, $J = 7.0$ Hz, 1H), 1.42 (d, $J = 7.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 166.17, 161.00, 144.93, 144.86, 142.04, 136.01, 135.65, 130.70 (d, $J = 4.0$ Hz), 129.87, 129.28, 128.94 (d, $J = 2.8$ Hz), 128.41, 127.32 (d, $J = 13.6$ Hz), 126.14, 123.35 (d, $J = 3.2$ Hz), 116.52, 114.96 (d, $J = 23.2$ Hz), 77.32, 77.00, 76.68, 69.45, 38.70 (d, $J = 1.1$ Hz), 17.91. $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -117.99. **HRMS-ESI** (m/z): $[\text{M}+\text{Na}]^+$ calcd. for $\text{C}_{24}\text{H}_{20}\text{O}_2\text{FNa}$, 383.1417; found, 383.1405.

(S)-2-(4-isobutylphenyl)propyl 4-vinylbenzoate (S27)



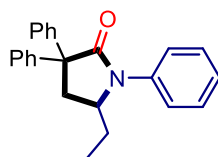
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.68 (dd, $J = 201.5, 8.2$ Hz, 4H), 7.14 (dd, $J = 36.9, 7.7$ Hz, 4H), 6.74 (dd, $J = 17.6, 10.9$ Hz, 1H), 5.84 (d, $J = 17.6$ Hz, 1H), 5.37 (d, $J = 10.8$ Hz, 1H), 4.38 (qdd, $J = 10.8, 7.1, 1.6$ Hz, 2H), 3.22 (h, $J = 7.0$ Hz, 1H), 2.45 (d, $J = 6.8$ Hz, 2H), 1.86 (dq, $J = 13.5, 6.8, 1.4$ Hz, 1H), 1.38 (d, $J = 7.0$ Hz, 3H), 0.89 (d, $J = 6.7$ Hz, 6H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 166.22, 141.86, 140.34, 140.02, 136.04, 129.83, 129.53, 129.20, 127.01, 126.05, 116.36, 69.99, 45.03, 38.69, 30.18, 22.38, 22.35, 18.03. **HRMS-ESI** (m/z): $[\text{M}+\text{Na}]^+$ calcd. for $\text{C}_{22}\text{H}_{26}\text{O}_2\text{Na}$, 345.1825; found, 345.1834.

5-methyl-1,3,3-triphenylpyrrolidin-2-one (3a)



Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.47 – 7.42 (m, 2H), 7.41 – 7.35 (m, 4H), 7.34 – 7.26 (m, 6H), 7.26 – 7.18 (m, 3H), 4.16 – 4.10 (m, 1H), 2.78 (ddd, $J = 21.8, 12.8, 7.3$ Hz, 2H), 1.20 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.49, 143.86, 142.17, 137.42, 128.81, 128.50, 128.15, 128.04, 127.66, 126.98, 126.70, 126.00, 124.64, 58.05, 51.45, 43.21, 19.88. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{22}\text{NO}$, 328.1696; found, 328.1694.

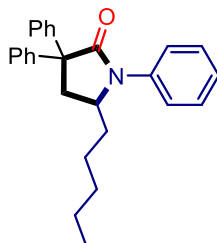
5-ethyl-1,3,3-triphenylpyrrolidin-2-one (3b)



Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.46 – 7.42 (m, 2H), 7.41 – 7.35 (m, 4H), 7.35 – 7.27 (m, 6H), 7.27 – 7.19 (m, 3H), 4.00 (tdd, $J = 9.0, 5.8, 3.2$ Hz, 1H), 2.78 (ddd, $J = 21.9, 12.8, 7.4$ Hz, 2H),

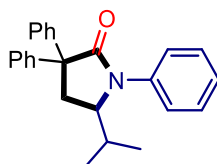
1.57 (dddd, $J = 21.1, 16.3, 8.3, 5.3$ Hz, 2H), 0.85 (t, $J = 7.5$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 174.71, 144.06, 142.26, 137.55, 128.81, 128.50, 128.16, 128.03, 127.69, 126.98, 126.69, 126.10, 124.83, 57.83, 56.65, 40.17, 25.91, 8.52. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}$, 342.1852; found, 342.1842.

5-pentyl-1,3,3-triphenylpyrrolidin-2-one (3c)



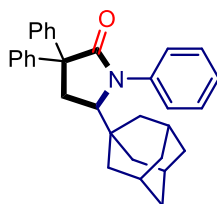
White solid. ^1H NMR (400 MHz, CDCl_3) δ 7.46 – 7.42 (m, 2H), 7.38 (dd, $J = 8.5, 7.2$ Hz, 4H), 7.34 – 7.27 (m, 6H), 7.23 (ddd, $J = 7.0, 3.7, 1.0$ Hz, 3H), 4.07 – 4.00 (m, 1H), 2.78 (ddd, $J = 21.8, 12.8, 7.4$ Hz, 2H), 1.82 – 1.64 (m, 1H), 1.40 – 1.09 (m, 7H), 0.82 (t, $J = 6.9$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 174.63, 144.09, 142.25, 137.57, 128.82, 128.50, 128.17, 128.04, 127.68, 126.98, 126.68, 126.10, 124.85, 57.84, 55.77, 40.98, 33.34, 31.64, 24.19, 22.43, 13.84. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{27}\text{H}_{30}\text{NO}$, 384.2322; found, 384.2318.

5-isopropyl-1,3,3-triphenylpyrrolidin-2-one (3d)



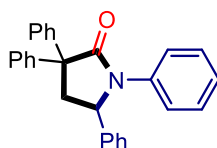
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.43 – 7.35 (m, 6H), 7.34 – 7.27 (m, 6H), 7.26 – 7.20 (m, 3H), 4.10 (ddd, $J = 9.9, 5.9, 4.1$ Hz, 1H), 2.66 (ddd, $J = 22.8, 12.9, 7.9$ Hz, 2H), 2.25 – 2.08 (m, 1H), 0.91 (d, $J = 7.0$ Hz, 3H), 0.72 (d, $J = 6.7$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 175.05, 144.37, 142.14, 137.50, 128.74, 128.52, 128.17, 128.08, 127.73, 127.03, 126.65, 126.06, 124.86, 59.59, 57.63, 33.98, 26.67, 18.22, 14.04. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{25}\text{H}_{26}\text{NO}$, 356.2009; found, 356.2017.

5-((3r,5r,7r)-adamantan-1-yl)-1,3,3-triphenylpyrrolidin-2-one (3e)



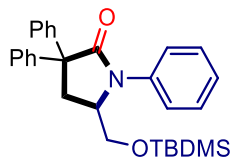
White solid. ^1H NMR (400 MHz, CDCl_3) δ 7.42 – 7.37 (m, 4H), 7.36 – 7.28 (m, 6H), 7.28 – 7.22 (m, 3H), 7.22 – 7.17 (m, 2H), 3.80 (dd, $J = 9.7, 6.3$ Hz, 1H), 2.75 (ddd, $J = 22.9, 13.2, 8.0$ Hz, 2H), 1.85 (s, 3H), 1.60 (d, $J = 12.1$ Hz, 3H), 1.46 (d, $J = 12.6$ Hz, 6H), 1.37 (d, $J = 12.0$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 176.62, 144.60, 142.24, 140.97, 128.83, 128.50, 128.20, 128.09, 127.87, 127.24, 127.08, 127.03, 126.57, 65.61, 57.07, 38.64, 36.81, 36.78, 35.66, 28.19. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{32}\text{H}_{34}\text{NO}$, 448.2635; found, 448.2634.

1,3,5-tetraphenylpyrrolidin-2-one (3f)



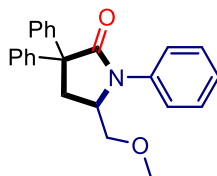
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.44 (d, $J = 7.4$ Hz, 2H), 7.39 (d, $J = 7.0$ Hz, 2H), 7.37 – 7.30 (m, 6H), 7.29 – 7.24 (m, 2H), 7.24 – 7.15 (m, 7H), 7.07 – 7.02 (m, 1H), 5.10 (dd, $J = 9.5, 5.9$ Hz, 1H), 3.03 (ddd, $J = 22.5, 13.0, 7.7$ Hz, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.09, 143.23, 142.04, 140.09, 137.81, 128.79, 128.74, 128.49, 128.21, 128.08, 127.83, 127.71, 127.22, 126.91, 126.81, 125.26, 123.35, 60.27, 58.47, 45.54. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{28}\text{H}_{24}\text{NO}$, 390.1852; found, 390.1855.

5-(((tert-butyldimethylsilyl)oxy)methyl)-1,3,3-triphenylpyrrolidin-2-one (3g)



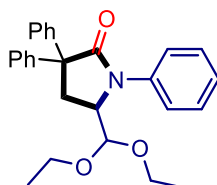
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.44 – 7.40 (m, 3H), 7.40 – 7.35 (m, 5H), 7.35 – 7.29 (m, 4H), 7.29 – 7.19 (m, 4H), 4.22 – 4.11 (m, 1H), 3.63 (ddd, $J = 13.4, 10.7, 3.6$ Hz, 2H), 3.01 – 2.84 (m, 2H), 0.82 (s, 9H), -0.12 (s, 3H), -0.20 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.10, 144.39, 142.30, 137.40, 128.79, 128.51, 128.22, 128.17, 127.87, 127.04, 126.67, 126.20, 124.85, 61.38, 58.10, 57.29, 37.10, 25.75, 18.13, -5.77, -5.90. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{29}\text{H}_{36}\text{NO}_2\text{Si}$, 458.2510; found, 458.2496.

5-(methoxymethyl)-1,3,3-triphenylpyrrolidin-2-one (3h)



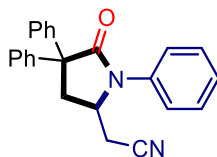
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.46 (dd, $J = 8.4, 1.2$ Hz, 2H), 7.41 – 7.33 (m, 6H), 7.33 – 7.27 (m, 4H), 7.26 – 7.20 (m, 3H), 4.18 (tdd, $J = 9.4, 6.1, 3.2$ Hz, 1H), 3.36 (ddd, $J = 15.8, 9.8, 4.6$ Hz, 2H), 3.18 (s, 3H), 2.95 (ddd, $J = 21.3, 13.0, 7.3$ Hz, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.86, 143.76, 142.45, 137.42, 128.90, 128.48, 128.16, 128.06, 127.68, 126.97, 126.72, 126.35, 124.84, 71.98, 59.08, 57.73, 55.75, 37.90. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}_2$, 358.1802; found, 358.1805.

5-(diethoxymethyl)-1,3,3-triphenylpyrrolidin-2-one (3i)



Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.48 (dd, $J = 5.3, 3.3$ Hz, 2H), 7.37 (dd, $J = 6.9, 3.1$ Hz, 6H), 7.34 – 7.26 (m, 4H), 7.25 – 7.19 (m, 3H), 4.40 (d, $J = 4.0$ Hz, 1H), 4.26 (ddd, $J = 7.7, 6.8, 4.0$ Hz, 1H), 3.57 – 3.51 (m, 2H), 3.22 (ddq, $J = 48.9, 9.3, 7.1$ Hz, 2H), 3.00 (ddd, $J = 20.1, 13.3, 7.2$ Hz, 2H), 1.07 (t, $J = 7.0$ Hz, 3H), 0.97 (t, $J = 7.0$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.08, 143.88, 142.95, 138.02, 128.76, 128.42, 128.17, 128.11, 127.72, 126.87, 126.67, 126.13, 124.72, 101.70, 64.82, 64.14, 58.49, 57.54, 34.48, 15.22, 15.00. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{27}\text{H}_{30}\text{NO}_3$, 416.2220; found, 416.2230.

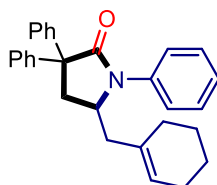
2-(5-oxo-1,4,4-triphenylpyrrolidin-2-yl)acetonitrile (3j)



White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.47 – 7.40 (m, 4H), 7.39 – 7.35 (m, 4H), 7.33 (dd, $J = 6.0, 2.0$ Hz, 3H), 7.31 – 7.26 (m, 4H), 4.31 (tdd, $J = 8.1, 6.1, 3.4$ Hz, 1H), 3.05 (ddd, $J = 21.3, 13.1, 7.1$ Hz,

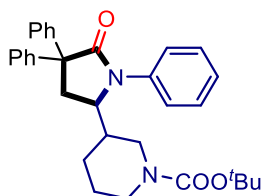
2H), 2.58 (ddd, $J = 24.4, 16.9, 5.4$ Hz, 2H). **NMR** (100 MHz, CDCl_3) δ 174.42, 142.73, 141.14, 136.10, 129.55, 128.79, 128.54, 127.92, 127.61, 127.49, 127.30, 127.25, 124.93, 115.82, 57.82, 52.35, 40.08, 22.37. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}$, 353.1648; found, 353.1642.

5-(cyclohex-1-en-1-ylmethyl)-1,3,3-triphenylpyrrolidin-2-one (3k)



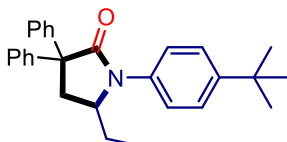
White solid. **^1H NMR** (400 MHz, CDCl_3) δ 7.46 – 7.42 (m, 2H), 7.39 – 7.34 (m, 5H), 7.33 – 7.26 (m, 4H), 7.25 – 7.15 (m, 3H), 5.37 (dt, $J = 4.4, 2.0$ Hz, 1H), 4.21 (dtd, $J = 8.0, 4.0, 2.0$ Hz, 1H), 3.08 – 2.48 (m, 2H), 2.45 – 2.37 (m, 1H), 1.95 (dp, $J = 5.9, 2.8$ Hz, 2H), 1.89 – 1.74 (m, 3H), 1.63 – 1.45 (m, 4H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.55, 144.10, 142.34, 137.53, 132.80, 128.76, 128.40, 128.12, 128.01, 127.62, 126.87, 126.63, 125.97, 124.75, 124.64, 57.79, 54.37, 42.37, 40.77, 28.70, 25.18, 22.72, 22.15. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{29}\text{H}_{30}\text{NO}$, 408.2322; found, 408.2327.

tert-butyl 3-5-oxo-1,4,4-triphenylpyrrolidin-2-yl)piperidine-1-carboxylate (3l)



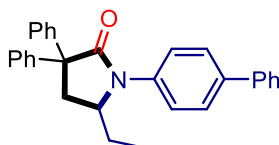
White solid. **^1H NMR** (400 MHz, CDCl_3) δ 7.42 – 7.36 (m, 4H), 7.36 – 7.28 (m, 8H), 7.28 – 7.20 (m, 3H), 4.15 (dq, $J = 8.5, 4.2, 3.2$ Hz, 1H), 3.98 (d, $J = 11.5$ Hz, 2H), 2.81 (dd, $J = 12.8, 6.0$ Hz, 1H), 2.64 (t, $J = 11.2$ Hz, 1H), 2.52 (s, 1H), 2.50 – 2.39 (m, 1H), 1.91 (s, 1H), 1.65 – 1.51 (m, 2H), 1.42 (s, 9H), 1.15 (td, $J = 12.1, 10.7, 8.3$ Hz, 2H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.92, 154.74, 144.03, 137.31, 128.90, 128.58, 128.25, 127.95, 127.62, 127.20, 126.78, 126.33, 124.78, 79.65, 57.59, 57.03, 35.40, 32.68, 28.40, 26.40, 26.30, 24.70, 22.86. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{32}\text{H}_{37}\text{N}_2\text{O}_3$, 497.2799; found, 497.2818.

1-(4-(tert-butyl)phenyl)-5-ethyl-3,3-diphenylpyrrolidin-2-one (3m)



Colorless oil. **^1H NMR** (400 MHz, CDCl_3) δ 7.44 (dt, $J = 3.2, 1.9$ Hz, 2H), 7.41 – 7.35 (m, 4H), 7.35 – 7.27 (m, 4H), 7.26 – 7.20 (m, 4H), 3.98 (tdd, $J = 9.0, 5.8, 3.2$ Hz, 1H), 2.76 (ddd, $J = 21.9, 12.8, 7.4$ Hz, 2H), 1.84 – 1.76 (m, 1H), 1.41 – 1.22 (m, 10H), 0.86 (t, $J = 7.5$ Hz, 3H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.74, 148.98, 144.17, 142.39, 134.82, 128.48, 128.16, 128.07, 127.73, 126.95, 126.66, 125.73, 124.30, 57.82, 56.71, 40.27, 34.49, 31.34, 26.06, 8.60. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{28}\text{H}_{32}\text{NO}$, 398.2478; found, 398.2498.

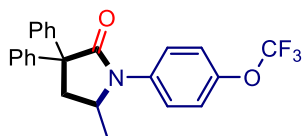
1-([1,1'-biphenyl]-4-yl)-5-ethyl-3,3-diphenylpyrrolidin-2-one (3n)



White solid. **^1H NMR** (400 MHz, CDCl_3) δ 7.60 (d, $J = 8.6$ Hz, 2H), 7.58 – 7.55 (m, 2H), 7.44 (ddd, $J = 10.0, 5.3, 3.5$ Hz, 3H), 7.41 – 7.36 (m, 5H), 7.35 – 7.28 (m, 5H), 7.27 – 7.21 (m, 2H), 4.04 (tdd, $J = 9.0, 5.8, 3.1$ Hz, 1H), 2.80 (ddd, $J = 21.9, 12.8, 7.4$ Hz, 2H), 1.90 – 1.80 (m, 1H), 1.46 – 1.32 (m, 1H), 0.88

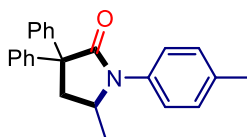
(t, $J = 7.5$ Hz, 3H). **NMR** (100 MHz, CDCl_3) δ 174.82, 144.05, 142.21, 140.53, 138.97, 136.75, 128.75, 128.53, 128.20, 128.05, 127.70, 127.52, 127.27, 127.03, 126.73, 124.89, 57.89, 56.59, 40.13, 25.90, 8.54. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{30}\text{H}_{28}\text{NO}$, 418.2165; found, 418.2168.

5-methyl-3,3-diphenyl-1-(4-(trifluoromethoxy)phenyl)pyrrolidin-2-one (3o)



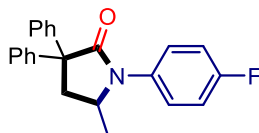
Colorless oil. **^1H NMR** (400 MHz, CDCl_3) δ 7.45 – 7.40 (m, 2H), 7.39 – 7.32 (m, 6H), 7.30 (t, $J = 5.0$ Hz, 2H), 7.27 – 7.21 (m, 4H), 4.13 (dp, $J = 9.0, 6.0$ Hz, 1H), 2.80 (ddd, $J = 21.8, 12.8, 7.3$ Hz, 2H), 1.23 (d, $J = 6.1$ Hz, 3H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.73, 146.72 (d, $J = 1.8$ Hz), 143.60, 141.85, 136.01, 128.62, 128.25, 128.00, 127.59, 127.16, 126.87, 125.68, 121.49, 58.07, 51.47, 43.12, 19.81. **^{19}F NMR** (376 MHz, CDCl_3) δ -57.96. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}$, 412.1519; found, 412.1521.

5-methyl-3,3-diphenyl-1-(p-tolyl)pyrrolidin-2-one (3p)



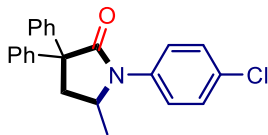
Colorless oil. **^1H NMR** (400 MHz, CDCl_3) δ 7.45 – 7.42 (m, 2H), 7.38 – 7.34 (m, 2H), 7.33 – 7.25 (m, 4H), 7.25 – 7.19 (m, 2H), 7.18 (s, 4H), 4.13 – 3.99 (m, 1H), 2.76 (ddd, $J = 21.8, 12.7, 7.3$ Hz, 2H), 2.33 (s, 3H), 1.18 (d, $J = 6.1$ Hz, 3H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.46, 143.90, 142.22, 135.79, 134.76, 129.42, 128.45, 128.10, 128.02, 127.66, 126.91, 126.63, 124.60, 58.00, 51.48, 43.26, 20.96, 19.86. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}$, 342.1852; found, 342.1846.

1-(4-fluorophenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3q)



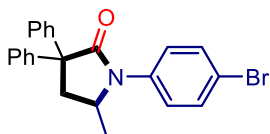
Colorless oil. **^1H NMR** (400 MHz, CDCl_3) δ 7.42 (d, $J = 7.3$ Hz, 2H), 7.37 – 7.33 (m, 2H), 7.32 – 7.29 (m, 3H), 7.29 – 7.21 (m, 5H), 7.11 – 6.99 (m, 2H), 4.07 (dt, $J = 9.0, 5.9$ Hz, 1H), 3.08 (dd, $J = 12.8, 5.6$ Hz, 1H), 2.48 (dd, $J = 12.8, 9.0$ Hz, 1H), 1.19 (d, $J = 6.1$ Hz, 3H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.68, 160.67 (d, $J = 245.7$ Hz), 142.84 (d, $J = 177.5$ Hz), 133.36 (d, $J = 3.0$ Hz), 128.55, 128.18, 127.98, 127.61, 127.06, 126.76, 126.54, 126.45, 115.72 (d, $J = 22.6$ Hz), 57.98, 51.72, 43.25, 19.82. **^{19}F NMR** (376 MHz, CDCl_3) δ -115.74. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{21}\text{NOF}$, 346.1602; found, 346.1588.

1-(4-chlorophenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3r)



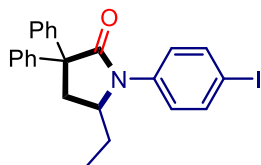
Colorless oil. **^1H NMR** (400 MHz, CDCl_3) δ 7.43 – 7.40 (m, 2H), 7.38 – 7.34 (m, 3H), 7.34 – 7.28 (m, 6H), 7.28 – 7.22 (m, 3H), 4.15 – 4.04 (m, 1H), 2.79 (ddd, $J = 21.8, 12.8, 7.3$ Hz, 2H), 1.21 (d, $J = 6.1$ Hz, 3H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.63, 143.62, 141.92, 135.98, 131.44, 129.01, 128.61, 128.24, 128.01, 127.62, 127.14, 126.85, 125.73, 58.09, 51.41, 43.14, 19.80. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{21}\text{NOCl}$, 362.1306; found, 362.1311.

1-(4-bromophenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3s)



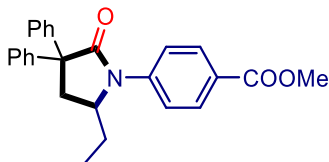
Yellow oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.53 – 7.48 (m, 2H), 7.41 (dd, J = 8.2, 1.1 Hz, 2H), 7.37 – 7.27 (m, 6H), 7.27 – 7.19 (m, 4H), 4.10 (dt, J = 9.0, 5.9 Hz, 1H), 2.79 (ddd, J = 21.8, 12.8, 7.3 Hz, 2H), 1.21 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.56, 143.58, 141.88, 136.48, 131.94, 128.59, 128.22, 127.99, 127.59, 127.12, 126.83, 125.99, 119.22, 58.08, 51.31, 43.08, 19.76. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{21}\text{NOBr}$, 406.0801; found, 406.0784.

1-(4-iodophenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3t)



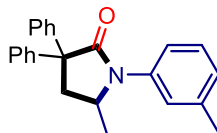
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.71 – 7.68 (m, 2H), 7.44 – 7.38 (m, 2H), 7.36 – 7.27 (m, 6H), 7.25 (dd, J = 6.5, 2.2 Hz, 2H), 7.13 – 7.06 (m, 2H), 3.98 (tdd, J = 9.0, 5.8, 3.2 Hz, 1H), 2.77 (ddd, J = 21.9, 12.8, 7.4 Hz, 2H), 1.88 – 1.72 (m, 1H), 1.45 – 1.26 (m, 1H), 0.85 (t, J = 7.5 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.74, 143.78, 141.97, 137.91, 137.33, 128.59, 128.24, 128.00, 127.62, 127.13, 126.83, 126.39, 90.38, 57.89, 56.33, 39.96, 39.96, 25.69, 8.45. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{23}\text{NOI}$, 468.0819; found, 468.0835.

methyl-4-(5-methyl-2-oxo-3,3-diphenylpyrrolidin-1-yl)benzoate (3u)



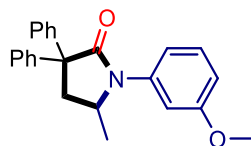
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.06 (d, J = 8.7 Hz, 2H), 7.47 – 7.44 (m, 2H), 7.43 – 7.40 (m, 2H), 7.37 – 7.28 (m, 6H), 7.28 – 7.23 (m, 3H), 4.09 (tdd, J = 8.9, 5.9, 3.0 Hz, 1H), 3.91 (s, 3H), 2.81 (ddd, J = 21.8, 12.9, 7.5 Hz, 2H), 1.88 – 1.77 (m, 1H), 1.44 – 1.31 (m, 1H), 0.86 (t, J = 7.5 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.88, 166.54, 143.75, 141.96, 141.81, 130.31, 128.63, 128.29, 128.01, 127.61, 127.23, 127.19, 126.90, 123.62, 58.00, 56.28, 52.10, 39.77, 25.62, 8.45. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{26}\text{H}_{26}\text{NO}_3$, 400.1907; found, 400.1924.

5-methyl-3,3-diphenyl-1-(m-tolyl)pyrrolidin-2-one (3v)



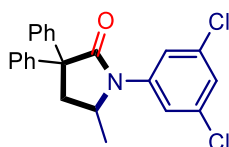
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.46 – 7.41 (m, 2H), 7.37 (dd, J = 5.4, 3.4 Hz, 2H), 7.34 – 7.28 (m, 4H), 7.24 (dt, J = 7.4, 5.0 Hz, 3H), 7.19 (s, 1H), 7.05 (t, J = 8.0 Hz, 2H), 4.15 – 4.07 (m, 1H), 2.78 (ddd, J = 21.8, 12.7, 7.3 Hz, 2H), 2.36 (s, 3H), 1.21 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.53, 143.92, 142.26, 138.78, 137.32, 128.63, 128.53, 128.17, 128.08, 127.72, 126.99, 126.93, 126.72, 125.65, 121.47, 58.10, 51.52, 43.28, 21.42, 19.96. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}$, 342.1852; found, 342.1860.

1-(3-methoxyphenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3w)



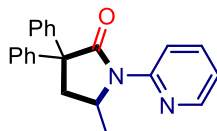
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.43 (dt, $J = 3.2, 1.9$ Hz, 2H), 7.37 – 7.31 (m, 4H), 7.31 – 7.24 (m, 4H), 7.24 – 7.20 (m, 1H), 6.95 (t, $J = 2.2$ Hz, 1H), 6.85 (ddd, $J = 7.9, 1.8, 0.8$ Hz, 1H), 6.77 (ddd, $J = 8.3, 2.5, 0.7$ Hz, 1H), 3.97 (tdd, $J = 9.0, 5.8, 3.1$ Hz, 1H), 3.78 (s, 3H), 2.77 (ddd, $J = 21.9, 12.8, 7.4$ Hz, 2H), 1.86 – 1.75 (m, 1H), 1.42 – 1.29 (m, 1H), 0.85 (t, $J = 7.5$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.67, 159.99, 143.91, 142.29, 138.73, 129.39, 128.49, 128.15, 128.03, 127.65, 126.96, 126.69, 116.64, 111.83, 110.86, 57.89, 56.68, 55.34, 40.00, 25.83, 8.53. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{25}\text{H}_{26}\text{NO}_2$, 372.1958; found, 372.1946.

1-(3,5-dichlorophenyl)-5-methyl-3,3-diphenylpyrrolidin-2-one (3x)



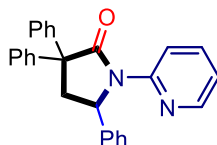
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.41 – 7.37 (m, 2H), 7.36 – 7.28 (m, 8H), 7.28 – 7.23 (m, 2H), 7.21 (t, $J = 1.8$ Hz, 1H), 4.15 – 4.08 (m, 1H), 2.80 (ddd, $J = 21.7, 12.9, 7.3$ Hz, 2H), 1.25 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.74, 143.28, 141.54, 139.37, 135.12, 128.70, 128.31, 127.94, 127.51, 127.29, 126.99, 125.85, 122.41, 58.12, 51.32, 42.83, 19.74. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{20}\text{NOCl}_2$, 396.0916; found, 396.0914.

5-methyl-3,3-diphenyl-1-(pyridin-2-yl)pyrrolidin-2-one (3y)



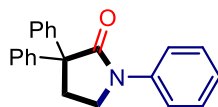
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.39 (ddd, $J = 4.9, 1.9, 0.8$ Hz, 1H), 8.14 (dt, $J = 8.4, 0.9$ Hz, 1H), 7.71 (ddd, $J = 8.4, 7.4, 2.0$ Hz, 1H), 7.51 – 7.42 (m, 2H), 7.34 (ddd, $J = 6.2, 2.5, 0.7$ Hz, 3H), 7.31 – 7.28 (m, 2H), 7.28 – 7.23 (m, 3H), 7.23 – 7.18 (m, 1H), 7.06 (ddd, $J = 7.3, 4.9, 1.0$ Hz, 1H), 4.67 (dd, $J = 13.5, 6.6$ Hz, 1H), 2.83 (ddd, $J = 232.3, 13.0, 7.1$ Hz, 2H), 1.31 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.27, 151.17, 147.69, 143.94, 142.48, 137.40, 128.44, 128.30, 128.07, 127.69, 126.96, 126.83, 120.10, 118.16, 58.73, 50.87, 42.12, 20.31. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{22}\text{H}_{21}\text{N}_2\text{O}$, 329.1648; found, 329.1656.

3,3,5-triphenyl-1-(pyridin-2-yl)pyrrolidin-2-one (3z)



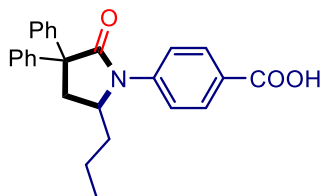
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.15 – 8.06 (m, 2H), 7.67 (ddd, $J = 8.6, 7.4, 1.9$ Hz, 1H), 7.44 – 7.40 (m, 2H), 7.39 – 7.33 (m, 3H), 7.33 – 7.26 (m, 4H), 7.23 (t, $J = 4.7$ Hz, 1H), 7.19 (d, $J = 4.4$ Hz, 4H), 7.18 – 7.10 (m, 1H), 6.93 (ddd, $J = 7.4, 5.0, 0.9$ Hz, 1H), 5.60 (dd, $J = 8.9, 6.6$ Hz, 1H), 3.05 (ddd, $J = 22.2, 13.2, 7.7$ Hz, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.74, 150.90, 147.69, 143.08, 142.20, 141.85, 137.26, 128.69, 128.42, 128.22, 128.09, 127.64, 127.19, 127.09, 126.92, 126.24, 120.14, 118.19, 59.03, 58.92, 44.54. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{27}\text{H}_{23}\text{N}_2\text{O}$, 391.1805; found, 391.1806.

1,3,3-triphenylpyrrolidin-2-one (3aa)



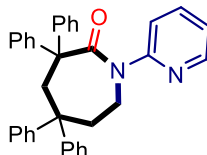
Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.68 (dd, $J = 8.7, 1.0$ Hz, 2H), 7.39 (dd, $J = 5.3, 3.3$ Hz, 6H), 7.36 – 7.29 (m, 4H), 7.28 – 7.25 (m, 3H), 7.17 (dt, $J = 14.8, 4.7$ Hz, 1H), 3.80 (t, $J = 6.4$ Hz, 2H), 2.89 (t, $J = 6.4$ Hz, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.36, 142.48, 139.63, 128.85, 128.74, 128.40, 127.93, 127.73, 127.02, 126.70, 124.68, 119.96, 58.94, 45.22, 34.12. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{22}\text{H}_{20}\text{NO}$, 314.1539; found, 314.1531.

4-(2-oxo-3,3-diphenyl-5-propylpyrrolidin-1-yl)benzoic acid (3ab)



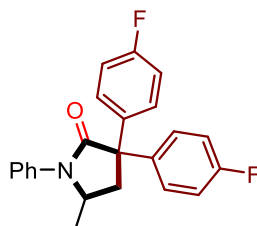
Yellow solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.80 (dd, $J = 256.1, 8.7$ Hz, 4H), 7.41 (d, $J = 7.3$ Hz, 2H), 7.37 – 7.28 (m, 6H), 7.28 – 7.23 (m, 2H), 4.14 (dtd, $J = 8.7, 5.8, 3.0$ Hz, 1H), 3.10 (dd, $J = 12.9, 5.9$ Hz, 1H), 2.56 (dd, $J = 12.9, 8.8$ Hz, 1H), 1.85 – 1.70 (m, 1H), 1.48 – 1.17 (m, 3H), 0.86 (t, $J = 7.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.90, 171.42, 143.60, 142.52, 141.78, 130.94, 128.60, 128.26, 127.96, 127.55, 127.18, 126.88, 126.34, 123.65, 77.32, 77.00, 76.68, 58.05, 55.28, 40.53, 35.21, 17.77, 13.96. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{26}\text{H}_{25}\text{NO}_3$, 400.1907; found, 400.1924.

3,3,5-tetraphenyl-1-(pyridin-2-yl)azepan-2-one (3ac)



White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.41 (ddd, $J = 4.9, 1.9, 0.8$ Hz, 1H), 8.25 – 8.17 (m, 1H), 7.69 (ddd, $J = 8.4, 7.4, 2.0$ Hz, 1H), 7.43 – 7.37 (m, 3H), 7.37 – 7.31 (m, 5H), 7.28 (dt, $J = 4.6, 1.9$ Hz, 1H), 7.24 – 7.14 (m, 7H), 7.12 (dd, $J = 5.0, 3.6$ Hz, 1H), 7.06 (ddd, $J = 7.3, 4.9, 0.9$ Hz, 1H), 7.00 (dd, $J = 5.2, 3.3$ Hz, 2H), 4.69 – 4.55 (m, 1H), 4.08 (dd, $J = 10.5, 5.6$ Hz, 1H), 2.96 (dd, $J = 13.3, 7.2$ Hz, 1H), 2.88 (ddd, $J = 13.4, 10.5, 3.0$ Hz, 1H), 2.59 (dd, $J = 13.3, 5.9$ Hz, 1H), 1.77 (ddd, $J = 13.4, 10.2, 5.6$ Hz, 1H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.18, 151.16, 147.67, 145.08, 144.27, 142.57, 142.31, 137.50, 128.56, 128.51, 128.40, 128.32, 128.29, 128.03, 127.74, 127.61, 126.94, 126.91, 126.59, 126.22, 120.05, 117.51, 58.81, 54.13, 48.23, 39.16, 38.87. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{35}\text{H}_{31}\text{N}_2\text{O}$, 495.2431; found, 495.2411.

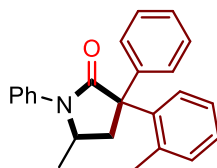
3,3-bis(4-fluorophenyl)-5-methyl-1-phenylpyrrolidin-2-one (4a)



Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.45 – 7.36 (m, 4H), 7.34 – 7.28 (m, 4H), 7.26 – 7.21 (m, 1H), 7.05 – 6.92 (m, 4H), 4.12 (dt, $J = 9.0, 5.9$ Hz, 1H), 3.03 (dd, $J = 12.8, 5.6$ Hz, 1H), 2.44 (dd, $J = 12.8, 9.0$ Hz, 1H), 1.21 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.22, 162.98 (d, $J = 13.3$ Hz), 160.53 (d, $J = 12.8$ Hz), 139.47 (d, $J = 3.2$ Hz), 137.69 (d, $J = 3.3$ Hz), 137.14, 129.58 (d, $J = 8.0$

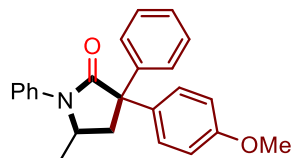
Hz), 129.23 (d, $J = 8.0$ Hz), 128.92, 126.28, 124.65, 115.44 (d, $J = 21.3$ Hz), 115.03 (d, $J = 21.3$ Hz), 56.93, 51.47, 43.33, 19.85. **^{19}F NMR** (376 MHz, CDCl_3) δ -115.38, -115.97. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{20}\text{NOF}_2$, 364.1508; found, 364.1508.

5-methyl-1,3-diphenyl-3-(*o*-tolyl)pyrrolidin-2-one (4b)



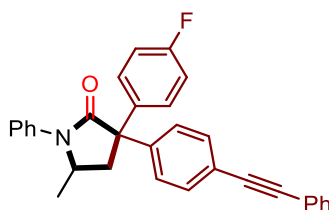
Colorless oil. **mixture of diastereomers and rotamers.** **^1H NMR** (400 MHz, CDCl_3) δ 7.52 – 7.48 (m, 1H), 7.43 – 7.39 (m, 3H), 7.39 – 7.35 (m, 4H), 7.35 – 7.28 (m, 9H), 7.25 (d, $J = 5.1$ Hz, 6H), 7.22 – 7.16 (m, 5H), 7.14 (d, $J = 7.0$ Hz, 4H), 4.48 – 4.34 (m, 1H), 4.07 (dt, $J = 8.8, 6.1$ Hz, 1.3H), 3.43 (dd, $J = 13.6, 6.8$ Hz, 1H), 3.05 – 2.70 (m, 2.6H), 2.30 (dd, $J = 13.5, 8.1$ Hz, 1H), 2.06 (s, 3.9H), 1.91 (s, 3H), 1.26 (d, $J = 6.1$ Hz, 3.6 H), 1.23 (d, $J = 6.1$ Hz, 3.0 H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.77, 174.42, 143.46, 141.72, 141.56, 140.91, 137.66, 137.36, 136.92, 136.67, 132.94, 132.53, 128.86, 128.82, 128.46, 128.11, 127.98, 127.89, 127.59, 127.32, 127.01, 126.98, 126.74, 126.02, 126.00, 125.75, 125.70, 124.62, 124.57, 59.45, 58.57, 52.21, 51.19, 41.24, 40.28, 21.60, 21.33, 20.64, 19.88.

5-3-(4-methoxyphenyl)-5-methyl-1,3-diphenylpyrrolidin-2-one (4c)



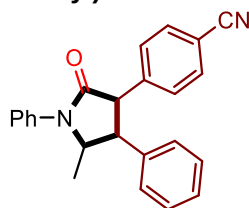
White solid. **mixture of diastereomers and rotamers.** **^1H NMR** (400 MHz, CDCl_3) δ 7.46 – 7.39 (m, 2H), 7.39 – 7.34 (m, 6H), 7.34 – 7.26 (m, 11H), 7.26 – 7.18 (m, 5H), 6.91 – 6.75 (m, 4H), 4.12 (tt, $J = 8.7, 5.9$ Hz, 2H), 3.78 (s, 3H), 3.77 (s, 3H), 3.04 (td, $J = 12.7, 5.7$ Hz, 2H), 2.46 (ddd, $J = 18.3, 12.7, 9.0$ Hz, 2H), 1.21 (dd, $J = 6.1, 1.2$ Hz, 6H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.77, 174.75, 158.51, 158.31, 144.28, 142.65, 137.48, 137.43, 135.87, 133.86, 129.11, 128.80, 128.78, 128.61, 128.52, 128.47, 128.13, 127.96, 127.56, 126.88, 126.61, 125.97, 124.65, 124.61, 113.86, 113.54, 76.68, 57.47, 57.42, 55.21, 55.20, 51.50, 51.38, 43.41, 43.27, 19.90, 19.85. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{24}\text{NO}_2$, 358.1802; found, 358.1813.

5-3-(4-fluorophenyl)-5-methyl-1-phenyl-3-(4-(phenylethynyl)phenyl)pyrrolidin-2-one (4d)



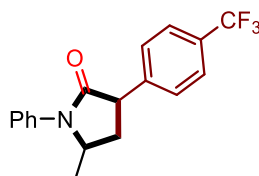
White solid. **mixture of diastereomers and rotamers.** **^1H NMR** (400 MHz, CDCl_3) δ 7.50 (dddd, $J = 10.7, 8.6, 5.6, 2.4$ Hz, 8H), 7.40 (ddd, $J = 8.9, 4.6, 2.8$ Hz, 8H), 7.33 (qd, $J = 7.0, 4.6$ Hz, 14H), 7.28 – 7.21 (m, 2H), 7.01 (q, $J = 8.5$ Hz, 4H), 4.14 (s, 2H), 3.06 (ddd, $J = 12.8, 5.7, 3.8$ Hz, 2H), 2.47 (dd, $J = 12.8, 8.9$ Hz, 2H), 1.22 (d, $J = 6.1$ Hz, 6H). **^{13}C NMR** (100 MHz, CDCl_3) δ 174.03, 174.02, 163.11, 162.99, 160.66, 160.55, 143.99, 142.19, 139.10, 139.06, 137.49, 137.45, 137.20, 137.18, 131.85, 131.61, 131.52, 129.69 (d, $J = 8.0$ Hz), 129.35 (d, $J = 8.0$ Hz), 128.95, 128.33, 128.31, 128.23, 127.97, 127.61, 126.31, 126.28, 124.72, 124.66, 123.21 (d, $J = 12.9$ Hz), 122.10 (d, $J = 37.0$ Hz), 115.47 (d, $J = 21.3$ Hz), 115.07 (d, $J = 21.3$ Hz), 89.73 (d, $J = 31.1$ Hz), 57.50, 57.43, 51.60, 51.50, 43.14, 43.10, 19.91, 19.89. **^{19}F NMR** (376 MHz, CDCl_3) δ -115.35, -115.92. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{31}\text{H}_{25}\text{NOF}$, 446.1915; found, 446.1902.

4-(5-methyl-2-oxo-1,4-diphenylpyrrolidin-3-yl)benzonitrile (4e)



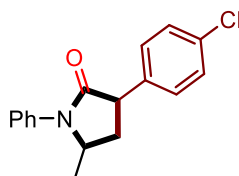
White solid. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.60 (dd, $J = 9.7, 8.0$ Hz, 4H), 7.47 – 7.39 (m, 4H), 7.37 (td, $J = 7.6, 7.0, 1.1$ Hz, 2H), 7.32 – 7.26 (m, 3H), 7.25 – 7.18 (m, 1H), 4.68 – 4.58 (m, 1H), 4.40 (d, $J = 12.2$ Hz, 1H), 4.05 (dd, $J = 12.2, 7.7$ Hz, 1H), 0.96 (d, $J = 6.6$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 171.48, 142.60, 137.73, 135.92, 132.32, 129.60, 129.22, 128.94, 128.16, 125.79, 122.65, 118.67, 111.27, 58.13, 50.84, 50.34, 14.94. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.58 (d, $J = 8.3$ Hz, 2H), 7.44 (dd, $J = 8.4, 7.2$ Hz, 2H), 7.40 – 7.33 (m, 4H), 7.33 – 7.22 (m, 6H), 4.32 (dq, $J = 8.9, 6.0$ Hz, 1H), 4.09 (d, $J = 11.6$ Hz, 1H), 3.08 (dd, $J = 11.6, 8.9$ Hz, 1H), 1.22 (d, $J = 6.0$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 171.49, 143.20, 137.81, 136.89, 132.35, 129.35, 129.15, 129.05, 128.01, 127.95, 126.54, 124.87, 118.71, 111.19, 60.15, 57.21, 56.26, 18.44. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}$, 353.1649; found, 353.1657.

5-methyl-1-phenyl-3-(4-(trifluoromethyl)phenyl)pyrrolidin-2-one (4f)



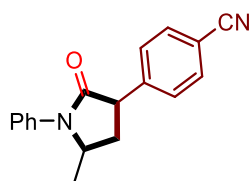
Colorless oil. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.62 – 7.58 (m, 2H), 7.51 (d, $J = 7.8$ Hz, 2H), 7.46 – 7.42 (m, 2H), 7.42 – 7.38 (m, 2H), 7.22 (t, $J = 7.4$ Hz, 1H), 4.44 (dq, $J = 7.7, 6.3, 3.6$ Hz, 1H), 4.04 (t, $J = 8.8$ Hz, 1H), 2.49 (ddd, $J = 12.9, 8.7, 7.7$ Hz, 1H), 2.31 (ddd, $J = 12.8, 9.0, 3.7$ Hz, 1H), 1.32 (d, $J = 6.3$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.85, 143.32 (d, $J = 1.4$ Hz), 137.58, 129.41 (d, $J = 32.5$ Hz), 129.08, 128.43, 125.75, 125.64 (q, $J = 3.8$ Hz), 123.18, 53.69, 47.75, 35.71, 19.55. $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -62.55. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.63 (d, $J = 8.0$ Hz, 2H), 7.50 (d, $J = 8.0$ Hz, 2H), 7.45 – 7.38 (m, 2H), 7.36 – 7.31 (m, 2H), 7.29 – 7.19 (m, 1H), 4.32 (dp, $J = 8.8, 6.2$ Hz, 1H), 3.90 (dd, $J = 11.2, 8.9$ Hz, 1H), 2.86 (ddd, $J = 12.8, 9.0, 6.4$ Hz, 1H), 1.88 (ddd, $J = 12.7, 11.2, 8.7$ Hz, 1H), 1.27 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.20, 143.25 (d, $J = 1.2$ Hz), 137.18, 129.39 (d, $J = 32.4$ Hz), 128.95, 128.59, 126.22, 125.58 (q, $J = 3.8$ Hz), 124.67, 53.02, 48.26, 36.75, 20.63. $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -62.53. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{18}\text{H}_{16}\text{NOF}_3$, 320.1257; found, 320.1244.

3-(4-chlorophenyl)-5-methyl-1-phenylpyrrolidin-2-one (4g)



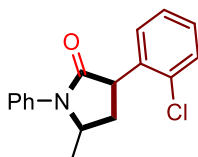
Colorless oil. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.51 (d, $J = 7.8$ Hz, 2H), 7.40 (dd, $J = 8.4, 7.5$ Hz, 2H), 7.34 – 7.28 (m, 2H), 7.27 – 7.16 (m, 3H), 4.48 – 4.37 (m, 1H), 3.95 (t, $J = 8.7$ Hz, 1H), 2.45 (ddd, $J = 12.8, 8.6, 7.7$ Hz, 1H), 2.28 (ddd, $J = 12.8, 8.9, 3.8$ Hz, 1H), 1.31 (d, $J = 6.3$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.24, 137.76, 137.68, 132.94, 129.37, 129.04, 128.83, 125.64, 123.15, 53.58, 47.32, 35.85, 19.56. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.43 – 7.38 (m, 2H), 7.37 – 7.29 (m, 6H), 7.23 (ddt, $J = 7.9, 6.8, 1.3$ Hz, 1H), 4.29 (dp, $J = 8.7, 6.2$ Hz, 1H), 3.82 (dd, $J = 11.2, 8.9$ Hz, 1H), 2.83 (ddd, $J = 12.7, 8.9, 6.4$ Hz, 1H), 1.84 (ddd, $J = 12.8, 11.2, 8.7$ Hz, 1H), 1.26 (d, $J = 6.1$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.56, 137.74, 137.31, 132.96, 129.54, 128.92, 128.79, 126.11, 124.64, 52.94, 47.86, 36.88, 20.66. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{17}\text{H}_{17}\text{NOCl}$, 286.0994; found, 286.0998.

4-(5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)benzonitrile (4h)



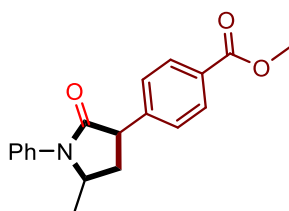
Colorless oil. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.64 (d, J = 8.3 Hz, 2H), 7.50 (d, J = 7.7 Hz, 2H), 7.44 (d, J = 9.5 Hz, 2H), 7.43 – 7.38 (m, 2H), 7.25 – 7.18 (m, 1H), 4.44 (dq, J = 7.7, 6.3, 3.5 Hz, 1H), 4.04 (t, J = 8.9 Hz, 1H), 2.48 (ddd, J = 12.9, 8.8, 7.7 Hz, 1H), 2.32 (ddd, J = 12.7, 9.0, 3.5 Hz, 1H), 1.33 (d, J = 6.3 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.33, 144.64, 137.41, 132.46, 129.12, 128.91, 125.89, 123.19, 118.70, 111.07, 53.72, 47.87, 35.43, 19.53. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.58 (dd, J = 64.9, 8.3 Hz, 4H), 7.46 – 7.38 (m, 2H), 7.35 – 7.30 (m, 2H), 7.29 – 7.21 (m, 1H), 4.32 (dt, J = 8.8, 6.2 Hz, 1H), 3.91 (dd, J = 11.4, 8.8 Hz, 1H), 2.86 (ddd, J = 12.8, 8.9, 6.3 Hz, 1H), 1.86 (ddd, J = 12.8, 11.3, 8.8 Hz, 1H), 1.27 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.75, 144.56, 137.01, 132.40, 129.06, 128.99, 126.36, 124.70, 118.76, 111.04, 53.06, 48.39, 36.57, 20.60. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{18}\text{H}_{17}\text{N}_2\text{O}$, 277.1336; found, 277.1326.

3-(2-chlorophenyl)-5-methyl-1-phenylpyrrolidin-2-one (4i)



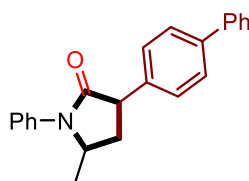
Colorless oil. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.56 – 7.52 (m, 2H), 7.45 – 7.37 (m, 3H), 7.27 – 7.17 (m, 4H), 4.53 – 4.25 (m, 2H), 2.35 (dd, J = 8.9, 5.7 Hz, 2H), 1.32 (d, J = 6.3 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.10, 137.75, 137.55, 134.28, 129.76, 129.33, 129.07, 128.36, 127.23, 125.68, 123.29, 53.57, 46.09, 35.26, 19.63. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.46 – 7.36 (m, 6H), 7.33 – 7.19 (m, 3H), 4.34 (dt, J = 8.5, 6.3 Hz, 1H), 4.26 (dd, J = 10.9, 9.3 Hz, 1H), 2.92 (ddd, J = 12.7, 9.3, 6.7 Hz, 1H), 1.76 (ddd, J = 12.8, 10.9, 8.5 Hz, 1H), 1.24 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.34, 137.76, 137.42, 134.30, 129.80, 129.75, 128.93, 128.37, 127.29, 126.08, 124.69, 53.21, 46.95, 36.25, 20.62. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{17}\text{H}_{17}\text{NOCl}$, 286.0994; found, 286.0998.

methoxy 4-(5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (4j)



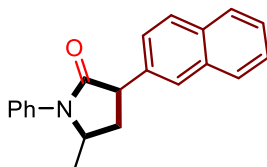
Colorless oil. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.02 (d, J = 8.4 Hz, 2H), 7.51 (d, J = 8.1 Hz, 2H), 7.40 (t, J = 8.5 Hz, 4H), 7.21 (ddt, J = 7.8, 7.0, 1.2 Hz, 1H), 4.47 – 4.38 (m, 1H), 4.04 (t, J = 8.7 Hz, 1H), 3.90 (s, 3H), 2.49 (ddd, J = 12.8, 8.4, 7.6 Hz, 1H), 2.31 (ddd, J = 12.9, 9.0, 3.8 Hz, 1H), 1.32 (d, J = 6.4 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.98, 166.84, 144.55, 137.62, 130.01, 129.06, 129.00, 128.07, 125.72, 123.26, 53.70, 52.04, 47.95, 35.78, 19.62. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.05 (d, J = 8.3 Hz, 2H), 7.47 – 7.44 (m, 2H), 7.41 (dd, J = 8.4, 7.2 Hz, 2H), 7.36 – 7.32 (m, 2H), 7.27 – 7.22 (m, 1H), 4.31 (dt, J = 8.6, 6.2 Hz, 1H), 3.96 – 3.86 (m, 4H), 2.86 (ddd, J = 12.8, 9.0, 6.4 Hz, 1H), 1.88 (ddd, J = 12.8, 11.1, 8.6 Hz, 1H), 1.26 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.31, 166.90, 144.53, 137.25, 129.95, 128.97, 128.93, 128.25, 126.16, 124.67, 53.06, 52.05, 48.47, 36.80, 20.65. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{19}\text{H}_{20}\text{N}_2\text{O}_3$, 310.1438; found, 310.1441.

3-([1,1'-biphenyl]-4-yl)-5-methyl-1-phenylpyrrolidin-2-one (4k)



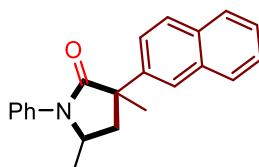
White solid. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.63 – 7.52 (m, 6H), 7.45 – 7.36 (m, 6H), 7.35 – 7.29 (m, 1H), 7.21 (t, J = 7.4 Hz, 1H), 4.46 (dddd, J = 8.6, 6.3, 3.9, 1.9 Hz, 1H), 4.02 (t, J = 8.6 Hz, 1H), 2.53 (ddd, J = 12.8, 8.3, 7.7 Hz, 1H), 2.31 (ddd, J = 12.9, 9.0, 3.9 Hz, 1H), 1.33 (d, J = 6.3 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.76, 140.89, 140.08, 138.42, 137.85, 129.01, 128.71, 128.39, 127.50, 127.19, 127.08, 125.52, 123.17, 53.65, 47.74, 36.04, 19.66. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.63 – 7.56 (m, 4H), 7.48 – 7.42 (m, 4H), 7.43 – 7.38 (m, 2H), 7.38 – 7.31 (m, 3H), 7.25 – 7.17 (m, 1H), 4.32 (dt, J = 8.6, 6.2 Hz, 1H), 3.89 (dd, J = 11.1, 9.0 Hz, 1H), 2.87 (ddd, J = 12.7, 9.0, 6.5 Hz, 1H), 1.93 (ddd, J = 12.7, 11.1, 8.6 Hz, 1H), 1.28 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.02, 140.98, 140.08, 138.39, 137.45, 128.87, 128.72, 128.58, 127.46, 127.18, 127.11, 125.98, 124.62, 52.95, 48.24, 36.96, 20.71. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{23}\text{H}_{23}\text{NO}$, 328.1696; found, 328.1709.

5-methyl-3-(naphthalen-2-yl)-1-phenylpyrrolidin-2-one (4l)



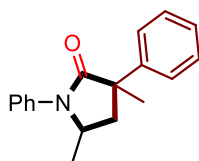
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.89 – 7.81 (m, 4H), 7.54 – 7.44 (m, 3H), 7.43 – 7.36 (m, 3H), 7.26 – 7.22 (m, 2H), 4.35 (dp, J = 8.6, 6.2 Hz, 1H), 4.02 (dd, J = 10.9, 9.0 Hz, 1H), 2.91 (ddd, J = 12.8, 9.0, 6.5 Hz, 1H), 1.99 (ddd, J = 12.8, 11.0, 8.6 Hz, 1H), 1.29 (d, J = 6.2 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.04, 137.49, 136.80, 133.51, 132.61, 128.91, 128.47, 127.80, 127.62, 126.98, 126.21, 126.07, 126.02, 125.74, 124.68, 53.09, 48.70, 37.03, 20.75. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{21}\text{H}_{20}\text{NO}$, 302.1540; found, 302.1540.

3,5-dimethyl-3-(naphthalen-2-yl)-1-phenylpyrrolidin-2-one (4m)



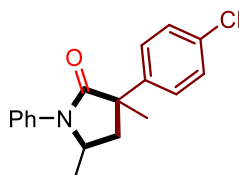
White solid. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.85 – 7.74 (m, 4H), 7.56 (dd, J = 8.6, 2.0 Hz, 1H), 7.47 – 7.42 (m, 2H), 7.42 – 7.36 (m, 2H), 7.34 – 7.28 (m, 2H), 7.22 (dt, J = 7.9, 1.3 Hz, 1H), 4.04 (dt, J = 9.3, 6.0 Hz, 1H), 2.91 (dd, J = 12.8, 5.8 Hz, 1H), 1.93 (dd, J = 12.8, 9.3 Hz, 1H), 1.73 (s, 3H), 1.19 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 176.50, 140.44, 137.44, 133.25, 132.26, 128.87, 128.51, 128.08, 127.38, 126.11, 125.99, 125.84, 124.74, 124.54, 124.42, 51.66, 49.96, 44.32, 26.53, 20.13. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.00 (d, J = 1.9 Hz, 1H), 7.92 – 7.78 (m, 3H), 7.66 (dd, J = 8.7, 2.0 Hz, 1H), 7.54 – 7.37 (m, 6H), 7.24 – 7.18 (m, 1H), 4.38 – 4.25 (m, 1H), 2.59 (dd, J = 12.8, 7.2 Hz, 1H), 2.33 (dd, J = 12.8, 6.5 Hz, 1H), 1.69 (s, 3H), 1.14 (d, J = 6.2 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 176.80, 142.34, 137.73, 133.27, 132.20, 128.92, 128.26, 128.10, 127.41, 126.01, 125.83, 125.75, 124.93, 124.70, 124.20, 51.99, 49.19, 43.40, 25.60, 20.14. **HRMS–ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{22}\text{H}_{22}\text{NO}$, 316.1696; found, 316.1702.

3,5-dimethyl-1,3-diphenylpyrrolidin-2-one (4n)



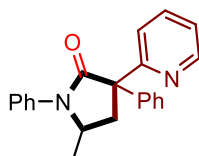
Colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 7.58 – 7.53 (m, 2H), 7.45 – 7.38 (m, 4H), 7.35 (d, J = 8.0 Hz, 2H), 7.25 – 7.18 (m, 2H), 4.38 – 4.21 (m, 1H), 2.53 (dd, J = 12.8, 7.1 Hz, 1H), 2.23 (dd, J = 12.8, 6.6 Hz, 1H), 1.61 (s, 3H), 1.13 (d, J = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 176.88, 145.09, 137.74, 128.90, 128.46, 126.60, 126.31, 125.80, 124.19, 51.88, 49.02, 43.54, 25.63, 20.10. HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{18}\text{H}_{20}\text{NO}$, 266.1540; found, 266.1551.

3-(4-chlorophenyl)-3,5-dimethyl-1-phenylpyrrolidin-2-one (4o)



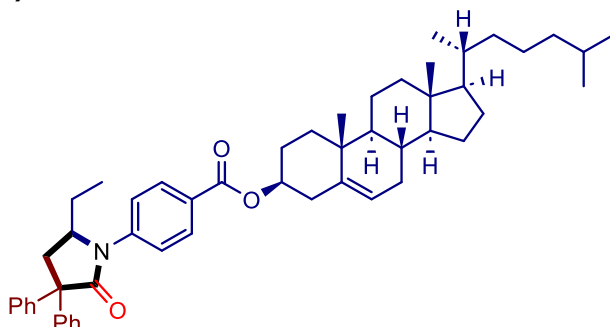
Colorless oil. **Isomer 1.** ^1H NMR (400 MHz, CDCl_3) δ 7.42 – 7.36 (m, 2H), 7.36 – 7.31 (m, 2H), 7.31 – 7.26 (m, 4H), 7.23 (ddt, J = 8.6, 7.1, 1.3 Hz, 1H), 4.01 (dt, J = 9.2, 6.0 Hz, 1H), 2.76 (dd, J = 12.9, 5.9 Hz, 1H), 1.87 (dd, J = 12.9, 9.2 Hz, 1H), 1.62 (s, 3H), 1.18 (d, J = 6.1 Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 176.14, 141.80, 137.27, 132.71, 128.91, 128.75, 127.54, 126.11, 124.66, 51.61, 49.36, 44.16, 26.63, 20.17. **Isomer 2.** ^1H NMR (400 MHz, CDCl_3) δ 7.50 (d, J = 8.6 Hz, 2H), 7.44 – 7.37 (m, 4H), 7.33 (d, J = 8.6 Hz, 2H), 7.25 – 7.19 (m, 1H), 4.30 (ddt, J = 13.2, 7.0, 6.2 Hz, 1H), 2.52 (dd, J = 12.8, 7.0 Hz, 1H), 2.17 (dd, J = 12.8, 6.9 Hz, 1H), 1.58 (s, 3H), 1.14 (d, J = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 176.43, 143.51, 137.54, 132.52, 128.95, 128.55, 127.83, 125.99, 124.27, 51.86, 48.56, 43.32, 25.71, 20.16. HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{18}\text{H}_{19}\text{NOCl}$, 300.1150; found, 300.1160.

5-methyl-1,3-diphenyl-3-(pyridin-2-yl)pyrrolidin-2-one (4p)



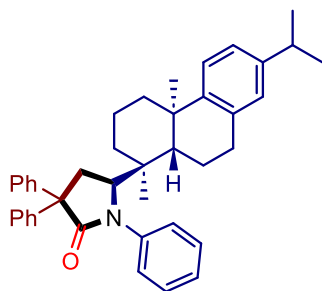
White solid. **mixture of diastereomers and rotamers.** ^1H NMR (400 MHz, CDCl_3) δ 8.58 (dddd, J = 13.1, 4.8, 1.9, 1.0 Hz, 2H), 7.52 (dtd, J = 11.0, 7.7, 1.9 Hz, 2H), 7.36 (d, J = 7.1 Hz, 2H), 7.32 – 7.27 (m, 4H), 7.27 – 7.24 (m, 2H), 7.20 (ddt, J = 7.6, 5.1, 1.9 Hz, 2H), 7.13 – 7.03 (m, 8H), 6.62 (tdt, J = 7.3, 3.9, 1.1 Hz, 2H), 6.41 (d, J = 7.7 Hz, 2H), 6.36 (d, J = 7.9 Hz, 2H), 4.39 – 4.21 (m, 2H), 3.42 – 3.26 (m, 2H), 2.56 – 2.36 (m, 2H), 2.34 – 2.10 (m, 2H), 1.19 (dd, J = 9.0, 6.2 Hz, 6H). ^{13}C NMR (100 MHz, CDCl_3) δ 163.68, 163.35, 149.23, 149.09, 147.64, 147.55, 143.66, 143.53, 136.36, 136.32, 129.14, 128.56, 128.52, 128.21, 128.08, 126.55, 126.49, 123.26, 123.08, 121.31, 121.30, 116.88, 116.78, 113.24, 113.19, 50.50, 50.47, 46.93, 46.87, 42.77, 42.70, 21.31, 21.02. HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{22}\text{H}_{21}\text{N}_2\text{O}$, 329.1649; found, 329.1643.

(3*S*,8*S*,9*S*,10*R*,13*R*,14*S*,17*R*)-10,13-dimethyl-17-((*R*)-6-methylheptan-2-yl)-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1*H*-cyclopenta[*a*]phenanthren-3-yl-4-(5-ethyl-2-oxo-3,3-diphenylpyrrolidin-1-yl)benzoate (5a)



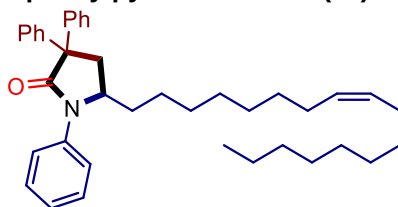
White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.25 (dd, $J = 459.7, 8.7$ Hz, 4H), 7.40 – 7.30 (m, 7H), 7.30 – 7.25 (m, 3H), 5.40 (d, $J = 5.0$ Hz, 1H), 5.03 – 4.66 (m, 1H), 4.23 (s, 1H), 3.40 – 3.05 (m, 2H), 2.56 – 2.37 (m, 3H), 1.91 (td, $J = 31.4, 19.0, 12.1, 6.6$ Hz, 6H), 1.75 – 1.57 (m, 2H), 1.54 – 1.45 (m, 4H), 1.35 (s, 4H), 1.31 – 1.07 (m, 8H), 1.06 (s, 3H), 1.06 – 0.94 (m, 3H), 0.97 – 0.88 (m, 6H), 0.87 (dd, $J = 6.6, 1.8$ Hz, 6H), 0.69 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 176.10, 165.81, 146.39, 142.04, 141.82, 139.84, 130.98, 129.07, 128.66, 127.57, 127.49, 127.41, 127.30, 122.60, 116.25, 95.17, 74.06, 58.17, 56.73, 56.18, 50.09, 47.71, 42.35, 39.78, 39.54, 38.31, 37.08, 36.68, 36.21, 35.81, 31.95, 31.92, 30.10, 28.24, 28.02, 27.96, 24.31, 23.85, 22.81, 22.56, 21.07, 19.39, 18.73, 11.87, 8.08. This compound is hard to protonate, so we can't find the signal in HRMS.

(*R*)-5-((1*S*,4*aR*,10*aS*)-7-isopropyl-1,4*a*-dimethyl-1,2,3,4,4*a*,9,10,10*a*-octahydrophenanthren-1-yl)-1,3,3-triphenylpyrrolidin-2-one (5b)



Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.44 – 7.36 (m, 4H), 7.35 – 7.24 (m, 5H), 7.24 – 7.17 (m, 1H), 7.11 (h, $J = 8.0, 7.6$ Hz, 4H), 6.92 (dd, $J = 12.5, 7.7$ Hz, 2H), 6.82 (dd, $J = 8.2, 2.0$ Hz, 1H), 6.60 (d, $J = 1.9$ Hz, 1H), 4.37 (dd, $J = 9.0, 6.7$ Hz, 1H), 2.97 (dd, $J = 13.5, 6.7$ Hz, 1H), 2.80 – 2.69 (m, 1H), 2.60 (ddd, $J = 29.2, 15.4, 8.2$ Hz, 2H), 2.18 – 2.04 (m, 2H), 1.78 – 1.58 (m, 6H), 1.56 – 1.44 (m, 2H), 1.17 (d, $J = 6.9$ Hz, 6H), 1.08 (s, 3H), 0.91 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 177.31, 147.00, 145.09, 144.65, 142.37, 141.21, 133.90, 128.94, 128.48, 128.17, 128.02, 127.86, 127.03, 126.97, 126.49, 126.18, 123.15, 123.09, 62.22, 57.07, 42.35, 40.70, 37.76, 37.47, 36.48, 33.33, 30.46, 28.09, 25.22, 24.04, 23.86, 18.33, 18.29, 18.06. HRMS–ESI (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{41}\text{H}_{46}\text{NO}$, 568.3574; found, 568.3585.

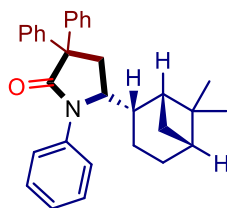
(*Z*)-5-(heptadec-8-en-1-yl)-1,3,3-triphenylpyrrolidin-2-one (5c)



White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.44 (dd, $J = 8.3, 1.1$ Hz, 2H), 7.38 (dd, $J = 10.5, 4.9$ Hz, 4H), 7.34 – 7.26 (m, 6H), 7.26 – 7.18 (m, 3H), 5.41 – 5.22 (m, 2H), 4.07 – 3.98 (m, 1H), 2.78 (ddd, $J = 21.8, 12.8, 7.4$ Hz, 2H), 1.99 (dt, $J = 13.1, 6.6$ Hz, 3H), 1.80 – 1.67 (m, 1H), 1.37 – 1.12 (m, 24H), 0.87 (t, $J = 6.8$ Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 174.61, 144.07, 142.22, 137.55, 129.96, 129.66, 128.80, 128.48, 128.15, 128.02, 127.66, 126.96, 126.66, 126.08, 124.82, 57.82, 55.74, 40.94, 33.31, 31.85,

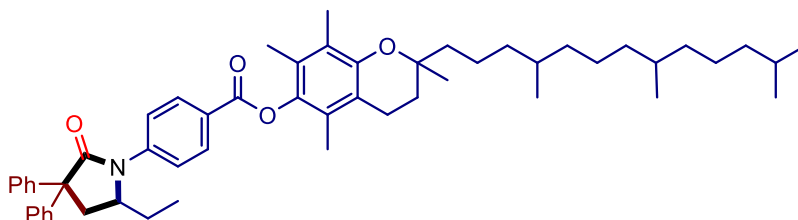
29.71, 29.62, 29.47, 29.44, 29.41, 29.39, 29.26, 29.02, 27.17, 27.10, 24.48, 22.63, 14.06. **HRMS-ESI** (m/z): $[M+H]^+$ calcd. for $C_{39}H_{52}NO$, 550.4043; found, 550.4022.

(S)-5-((1R,2S,5R)-6,6-dimethylbicyclo[3.1.1]heptan-2-yl)-1,3,3-triphenylpyrrolidin-2-one (5d)



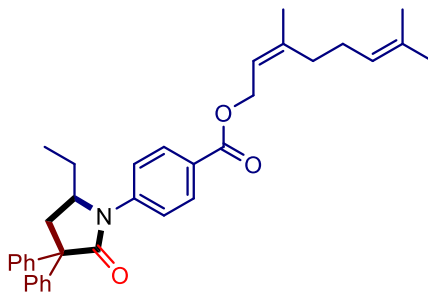
White solid. **1H NMR** (400 MHz, $CDCl_3$) δ 7.51 – 7.48 (m, 2H), 7.41 – 7.35 (m, 2H), 7.35 – 7.32 (m, 3H), 7.31 – 7.24 (m, 6H), 7.21 (ddt, J = 8.4, 6.1, 1.4 Hz, 2H), 4.27 (ddd, J = 9.9, 6.8, 5.6 Hz, 1H), 2.89 (ddd, J = 18.6, 13.1, 6.2 Hz, 2H), 2.10 – 1.99 (m, 2H), 1.89 (tt, J = 10.7, 4.3 Hz, 1H), 1.80 – 1.68 (m, 3H), 1.58 – 1.51 (m, 1H), 1.47 (dt, J = 6.5, 3.3 Hz, 1H), 0.97 (s, 3H), 0.74 (s, 3H), 0.50 (d, J = 9.7 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.39, 144.04, 143.46, 139.90, 128.82, 128.36, 128.29, 127.79, 126.78, 126.74, 126.42, 126.02, 61.06, 57.31, 46.91, 42.79, 40.81, 39.48, 37.89, 33.61, 27.27, 26.08, 23.33, 18.63. **HRMS-ESI** (m/z): $[M+H]^+$ calcd. for $C_{31}H_{34}NO$, 436.2635; found, 436.2634.

2,5,7,8-tetramethyl-2-(4,8,12-trimethyltridecyl)chroman-6-yl-4-(5-ethyl-2-oxo-3,3-diphenylpyrrolidin-1-yl)benzoate (5e)



Colorless oil. **1H NMR** (400 MHz, Chloroform- d) δ 7.37 (dd, J = 513.6, 8.8 Hz, 4H), 7.40 – 7.32 (m, 8H), 7.28 (dddd, J = 8.0, 4.9, 3.5, 1.5 Hz, 2H), 4.34 (s, 1H), 3.38 – 3.05 (m, 2H), 2.60 (t, J = 6.8 Hz, 2H), 2.52 (dq, J = 14.9, 7.4 Hz, 1H), 2.11 (s, 3H), 2.04 (s, 3H), 2.00 (s, 3H), 1.95 (dd, J = 14.4, 7.4 Hz, 1H), 1.80 (dd, J = 15.1, 8.1 Hz, 2H), 1.55 – 1.48 (m, 2H), 1.39 (pt, J = 9.5, 6.2 Hz, 4H), 1.34 – 1.18 (m, 12H), 1.17 – 1.04 (m, 6H), 0.96 (t, J = 7.4 Hz, 3H), 0.86 (t, J = 7.0 Hz, 12H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 176.08, 164.93, 149.31, 147.04, 141.98, 141.81, 140.70, 131.68, 129.11, 128.66, 127.62, 127.50, 127.41, 127.30, 127.06, 125.25, 122.98, 120.87, 117.37, 116.18, 94.99, 77.32, 77.00, 76.68, 75.01, 58.12, 47.86, 39.38, 37.58, 37.47, 37.40, 37.30, 32.80, 32.78, 30.10, 27.97, 24.81, 24.80, 24.45, 22.71, 22.62, 21.05, 20.63, 19.75, 19.69, 19.66, 19.60, 13.04, 12.19, 11.82, 8.12. This compound is hard to protonate, so we can't find the signal in HRMS.

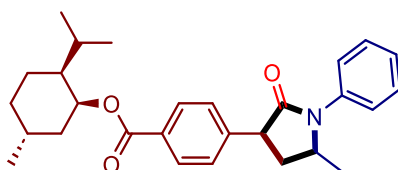
(Z)-3,7-dimethylocta-2,6-dien-1-yl 4-(5-ethyl-2-oxo-3,3-diphenylpyrrolidin-1-yl)benzoate (5f)



Colorless oil. **1H NMR** (400 MHz, $CDCl_3$) δ 8.07 (d, J = 8.7 Hz, 2H), 7.43 (t, J = 7.8 Hz, 4H), 7.36 – 7.29 (m, 5H), 7.29 – 7.22 (m, 4H), 5.48 (t, J = 7.2 Hz, 1H), 5.14 – 5.09 (m, 1H), 4.80 (d, J = 6.8 Hz, 2H), 4.08 (tdd, J = 8.9, 6.0, 2.9 Hz, 1H), 2.80 (ddd, J = 21.8, 12.9, 7.4 Hz, 2H), 2.22 – 2.05 (m, 4H), 1.88 – 1.74 (m, 4H), 1.67 (s, 3H), 1.60 (s, 3H), 1.43 – 1.32 (m, 1H), 0.86 (t, J = 7.5 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.84, 166.08, 143.73, 142.74, 142.00, 141.69, 132.20, 130.32, 128.62, 128.60, 128.29, 128.02, 127.62, 127.17, 126.89, 123.61, 123.57, 119.28, 61.63, 58.01, 56.27, 39.76, 32.26, 26.70,

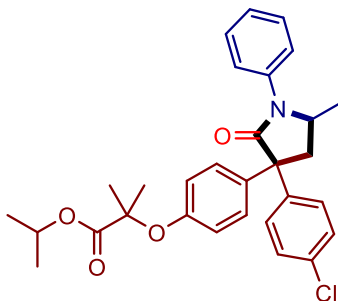
25.68, 25.59, 23.53, 17.67, 8.43. **HRMS-ESI** (m/z): [M+H]⁺ calcd. for C₃₅H₄₀NO₂, 522.3003; found, 522.2986.

(1S,2S,5R)-2-isopropyl-5-methylcyclohexyl 4-(5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5g)



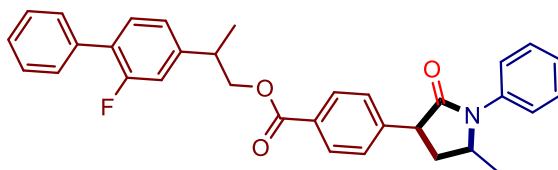
White solid. **¹H NMR** (400 MHz, CDCl₃) δ 8.02 (d, J = 8.3 Hz, 2H), 7.51 (ddd, J = 8.5, 2.0, 1.2 Hz, 2H), 7.44 – 7.35 (m, 4H), 7.21 (t, J = 7.4 Hz, 1H), 4.92 (td, J = 10.8, 4.4 Hz, 1H), 4.43 (dtd, J = 12.6, 6.2, 3.8 Hz, 1H), 4.03 (t, J = 8.7 Hz, 1H), 2.57 – 2.42 (m, 1H), 2.30 (ddd, J = 12.8, 9.0, 3.8 Hz, 1H), 2.16 – 2.05 (m, 1H), 1.94 (ddtd, J = 9.9, 7.1, 4.1, 2.9, 1.6 Hz, 1H), 1.78 – 1.67 (m, 2H), 1.62 – 1.47 (m, 2H), 1.32 (d, J = 6.3 Hz, 3H), 1.21 – 1.02 (m, 2H), 0.96 – 0.87 (m, 7H), 0.78 (d, J = 6.9 Hz, 3H). **¹³C NMR** (100 MHz, CDCl₃) δ 173.05, 173.03, 165.81, 144.35, 144.28, 137.66, 130.02, 130.00, 129.72, 129.05, 128.00, 127.98, 125.68, 123.23, 123.20, 74.80, 53.69, 48.01, 47.97, 47.30, 40.97, 35.87, 35.75, 34.34, 31.44, 26.54, 23.71, 22.02, 20.72, 19.62, 16.56. **¹H NMR** (400 MHz, CDCl₃) δ 8.14 – 8.00 (m, 2H), 7.47 – 7.42 (m, 2H), 7.42 – 7.37 (m, 2H), 7.36 – 7.31 (m, 2H), 7.28 – 7.20 (m, 1H), 4.93 (td, J = 10.9, 4.4 Hz, 1H), 4.56 – 4.15 (m, 1H), 3.90 (dd, J = 11.1, 9.0 Hz, 1H), 2.85 (ddd, J = 12.8, 9.0, 6.4 Hz, 1H), 2.18 – 2.05 (m, 1H), 2.02 – 1.83 (m, 2H), 1.73 (dt, J = 11.7, 2.9 Hz, 2H), 1.62 – 1.51 (m, 2H), 1.26 (d, J = 6.1 Hz, 3H), 1.11 (dt, J = 12.2, 1.6 Hz, 2H), 0.92 (t, J = 6.9 Hz, 7H), 0.79 (d, J = 7.0 Hz, 3H). **¹³C NMR** (100 MHz, CDCl₃) δ 173.35, 173.32, 165.85, 144.33, 144.25, 137.26, 129.95, 129.93, 129.69, 128.90, 128.17, 128.15, 126.10, 124.63, 74.78, 53.02, 53.01, 48.52, 48.45, 47.31, 40.97, 36.81, 36.65, 35.41, 34.34, 31.44, 26.56, 26.55, 23.72, 22.02, 20.71, 20.65, 16.57. **HRMS-ESI** (m/z): [M+H]⁺ calcd. for C₂₈H₃₆NO₃, 434.2690; found, 434.2686.

Isopropyl-2-(4-(3-(4-chlorophenyl)-5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)phenoxy)-2-methylpropanoate (5h)



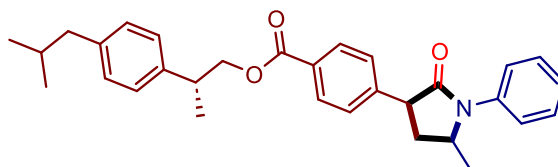
White solid. **mixture of diastereomers and rotamers.** **¹H NMR** (400 MHz, Chloroform-d) δ 7.39 (td, J = 7.9, 7.4, 1.0 Hz, 4H), 7.35 – 7.30 (m, 4H), 7.29 – 7.22 (m, 12H), 7.22 – 7.16 (m, 2H), 6.84 – 6.73 (m, 4H), 5.06 (h, J = 6.3 Hz, 2H), 4.11 (ddp, J = 9.2, 5.9, 3.1 Hz, 2H), 3.08 – 2.85 (m, 2H), 2.41 (ddd, J = 28.9, 12.8, 8.9 Hz, 2H), 1.57 (d, J = 1.2 Hz, 12H), 1.35 – 1.09 (m, 18H). **¹³C NMR** (100 MHz, CDCl₃) δ 174.32, 174.29, 173.60, 173.47, 154.76, 154.45, 142.59, 140.98, 137.26, 136.82, 134.59, 132.92, 132.65, 129.43, 129.05, 128.89, 128.87, 128.62, 128.58, 128.29, 128.22, 126.18, 126.15, 124.70, 124.58, 118.76, 118.64, 79.11, 79.08, 68.88, 68.87, 57.02, 51.49, 43.27, 43.15, 25.49, 25.44, 25.37, 25.36, 21.55, 21.52, 19.89, 19.84. **HRMS-ESI** (m/z): [M+H]⁺ calcd. for C₃₀H₃₃NO₄Cl, 506.2093; found, 506.2097.

2-(2-fluoro-[1,1'-biphenyl]-4-yl)propyl 4-(5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5i)



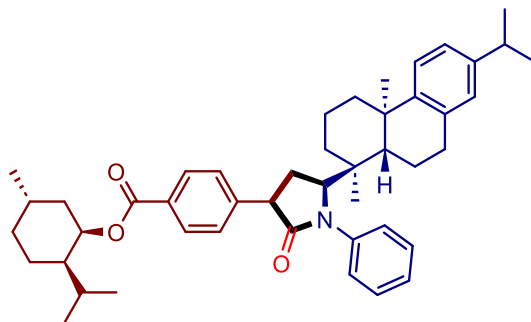
White solid. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.97 (d, J = 8.3 Hz, 2H), 7.57 – 7.49 (m, 4H), 7.47 – 7.30 (m, 8H), 7.23 – 7.18 (m, 1H), 7.16 – 6.99 (m, 2H), 4.47 – 4.37 (m, 3H), 4.02 (t, J = 8.7 Hz, 1H), 3.28 (q, J = 7.0 Hz, 1H), 2.48 (dt, J = 12.9, 8.0 Hz, 1H), 2.29 (ddd, J = 12.8, 9.0, 3.8 Hz, 1H), 1.41 (d, J = 7.0 Hz, 3H), 1.31 (d, J = 6.3 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.94, 166.14, 160.97, 158.50, 144.87 (d, J = 7.3 Hz), 144.67, 137.60, 135.63, 130.67 (d, J = 4.0 Hz), 129.99, 129.05, 128.93 (d, J = 2.9 Hz), 128.37, 128.11, 127.51, 127.27 (d, J = 13.5 Hz), 125.70, 123.34 (d, J = 3.2 Hz), 123.22, 114.90 (d, J = 23.2 Hz), 69.40, 53.68, 47.96, 38.66 (d, J = 1.4 Hz), 35.73, 19.60, 17.85. $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -118.18. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.00 (d, J = 8.3 Hz, 2H), 7.55 (dt, J = 8.1, 1.5 Hz, 2H), 7.47 – 7.37 (m, 7H), 7.38 – 7.30 (m, 3H), 7.28 – 7.20 (m, 1H), 7.17 – 7.07 (m, 2H), 4.49 – 4.39 (m, 2H), 4.30 (qd, J = 6.2, 2.5 Hz, 1H), 3.89 (dd, J = 11.1, 9.0 Hz, 1H), 3.29 (q, J = 7.0 Hz, 1H), 2.84 (ddd, J = 12.8, 9.0, 6.4 Hz, 1H), 1.87 (ddd, J = 12.7, 11.1, 8.7 Hz, 1H), 1.42 (d, J = 7.0 Hz, 3H), 1.25 (d, J = 6.1 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.27, 166.21, 160.98, 158.52, 144.90 (d, J = 7.3 Hz), 144.65, 137.24, 135.66, 130.69 (d, J = 4.0 Hz), 129.95, 128.96, 128.92, 128.39, 128.29, 127.52, 127.29 (d, J = 13.6 Hz), 126.15, 124.65, 123.36 (d, J = 3.1 Hz), 114.92 (d, J = 23.0 Hz), 69.41, 53.03, 48.49, 38.69 (d, J = 1.5 Hz), 36.77, 20.64, 17.87. $^{19}\text{F NMR}$ (376 MHz, CDCl_3) δ -118.16. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{33}\text{H}_{31}\text{NO}_3\text{F}$, 508.2283; found, 508.2261.

(R)-2-(4-isobutylphenyl)propyl 4-(5-methyl-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5j)



White solid. **Isomer 1.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.96 (d, J = 8.4 Hz, 2H), 7.59 – 7.46 (m, 2H), 7.46 – 7.32 (m, 4H), 7.28 – 7.15 (m, 3H), 7.15 – 6.98 (m, 2H), 4.49 – 4.30 (m, 3H), 4.02 (t, J = 8.7 Hz, 1H), 3.20 (q, J = 7.0 Hz, 1H), 2.52 – 2.39 (m, 3H), 2.29 (ddd, J = 12.9, 9.0, 3.8 Hz, 1H), 1.85 (dt, J = 13.5, 6.8 Hz, 1H), 1.37 (d, J = 7.0 Hz, 3H), 1.31 (d, J = 6.3 Hz, 3H), 0.89 (d, J = 6.7 Hz, 6H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 172.97, 166.21, 144.47, 140.30, 139.99, 137.61, 129.97, 129.20, 129.18, 129.04, 128.01, 126.98, 125.68, 123.21, 69.96, 53.66, 47.94, 45.01, 38.65, 35.75, 30.15, 22.37, 22.35, 19.59, 17.98. **Isomer 2.** $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.99 (d, J = 8.4 Hz, 2H), 7.47 – 7.37 (m, 4H), 7.37 – 7.31 (m, 2H), 7.28 – 7.21 (m, 1H), 7.19 (d, J = 8.1 Hz, 2H), 7.10 (d, J = 8.1 Hz, 2H), 4.45 – 4.35 (m, 2H), 4.34 – 4.24 (m, 1H), 3.89 (dd, J = 11.1, 9.0 Hz, 1H), 3.22 (h, J = 7.0 Hz, 1H), 2.84 (ddd, J = 12.8, 9.0, 6.5 Hz, 1H), 2.45 (d, J = 7.2 Hz, 2H), 1.97 – 1.76 (m, 2H), 1.38 (d, J = 7.0 Hz, 3H), 1.25 (d, J = 6.1 Hz, 3H), 0.90 (d, J = 6.6 Hz, 6H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 173.29, 166.28, 144.46, 140.34, 140.00, 137.25, 129.92, 129.20, 128.91, 128.19, 126.99, 126.12, 124.63, 69.97, 53.01, 48.45, 45.02, 38.67, 36.75, 30.16, 22.38, 22.36, 20.64, 17.99. **HRMS-ESI** (m/z): $[\text{M}+\text{H}]^+$ calcd. for $\text{C}_{31}\text{H}_{36}\text{NO}_3$, 470.2690; found, 470.2684.

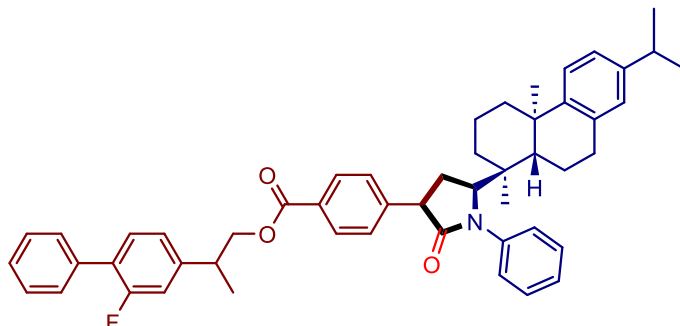
(1R,2R,5S)-2-isopropyl-5-methylcyclohexyl 4-((5R)-5-((1S,4aR,10aS)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5k)



White solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.98 (d, J = 8.4 Hz, 2H), 7.32 (d, J = 8.3 Hz, 2H), 7.30 – 7.25 (m, 4H), 7.18 (ddt, J = 8.5, 5.6, 3.2 Hz, 1H), 7.04 (d, J = 8.2 Hz, 1H), 6.90 (dd, J = 8.1, 2.0 Hz, 1H), 6.56 (d, J = 1.9 Hz, 1H), 4.90 (td, J = 10.9, 4.4 Hz, 1H), 4.45 (d, J = 9.3 Hz, 1H), 4.04 (dd, J = 11.7, 8.7 Hz, 1H), 2.81 – 2.71 (m, 1H), 2.68 (dd, J = 13.6, 8.8 Hz, 1H), 2.49 – 2.31 (m, 2H), 2.26 (dt, J = 12.8, 3.4 Hz, 1H), 2.11 (dtd, J = 12.0, 3.9, 1.6 Hz, 1H), 1.92 (td, J = 7.0, 2.7 Hz, 1H), 1.83 – 1.61 (m, 6H), 1.60 – 1.45 (m, 6H), 1.37 – 1.22 (m, 2H), 1.19 (d, J = 6.9 Hz, 6H), 1.15 (s, 3H), 1.11 – 1.02 (m, 2H), 1.00 (s, 3H), 0.90 (dd, J = 11.3, 6.8 Hz, 6H), 0.77 (d, J = 6.9 Hz, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 175.33, 165.86,

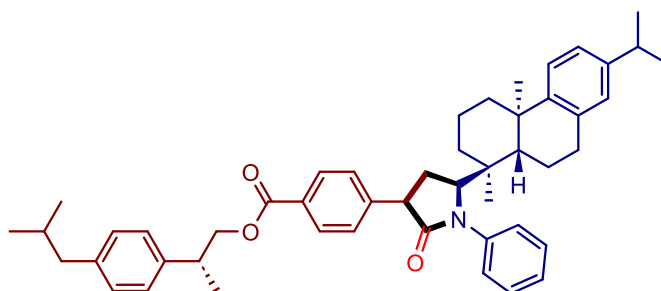
146.66, 145.31, 145.18, 140.11, 134.27, 129.86, 129.57, 128.87, 128.25, 126.49, 126.46, 126.40, 123.65, 123.36, 74.76, 64.75, 48.16, 47.30, 43.39, 42.93, 40.98, 38.11, 37.63, 34.35, 33.34, 32.10, 32.05, 31.44, 28.10, 26.54, 25.72, 23.99, 23.88, 23.73, 22.02, 20.70, 19.14, 18.64, 18.39, 16.57. **HRMS-ESI** (*m/z*): [M+Na]⁺ calcd. for C₄₆H₅₉NO₃Na, 696.4387; found, 696.4385.

2-(2-fluoro-[1,1'-biphenyl]-4-yl)propyl 4-((5*R*)-5-((1*S*,4*aR*,10*aS*)-7-isopropyl-1,4*a*-dimethyl-1,2,3,4,4*a*,9,10,10*a*-octahydrophenanthren-1-yl)-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5l)



White solid. **¹H NMR** (400 MHz, CDCl₃) δ 7.93 (d, *J* = 8.2 Hz, 2H), 7.54 (dt, *J* = 8.2, 1.5 Hz, 2H), 7.45 – 7.39 (m, 2H), 7.39 – 7.36 (m, 1H), 7.35 – 7.30 (m, 3H), 7.30 – 7.25 (m, 4H), 7.22 – 7.14 (m, 1H), 7.15 – 7.08 (m, 2H), 7.08 – 7.00 (m, 1H), 6.90 (dd, *J* = 8.2, 2.0 Hz, 1H), 6.56 (d, *J* = 2.0 Hz, 1H), 4.51 – 4.30 (m, 3H), 4.04 (dd, *J* = 11.7, 8.7 Hz, 1H), 3.26 (p, *J* = 6.9 Hz, 1H), 2.77 (h, *J* = 6.9 Hz, 1H), 2.65 (d, *J* = 8.8 Hz, 1H), 2.51 – 2.30 (m, 2H), 2.26 (d, *J* = 12.9 Hz, 1H), 1.77 (ddt, *J* = 11.9, 7.1, 3.6 Hz, 2H), 1.63 (dd, *J* = 10.2, 6.0 Hz, 2H), 1.53 (dd, *J* = 4.3, 2.6 Hz, 3H), 1.40 (d, *J* = 7.0 Hz, 3H), 1.28 (ddd, *J* = 18.2, 10.8, 6.9 Hz, 2H), 1.18 (d, *J* = 6.8 Hz, 6H), 1.14 (s, 3H), 1.00 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃) δ 175.22, 166.21, 160.98, 158.51, 146.65, 145.40 (d, *J* = 15.8 Hz), 144.89 (d, *J* = 7.6 Hz), 140.07, 135.66, 134.25, 130.68 (d, *J* = 3.9 Hz), 129.84, 128.95 (d, *J* = 2.9 Hz), 128.88, 128.83, 128.38, 127.51, 127.35, 127.21, 126.49, 126.48, 126.38, 123.64, 123.36, 114.91 (d, *J* = 23.0 Hz), 77.32, 77.00, 76.68, 69.40, 64.77, 48.11, 43.39, 42.94, 38.67, 38.11, 37.63, 33.35, 32.14, 31.99, 28.11, 25.72, 24.00, 23.88, 19.15, 18.65, 18.38, 17.86. **¹⁹F NMR** (376 MHz, CDCl₃) δ -117.99. **HRMS-ESI** (*m/z*): [M+Na]⁺ calcd. for C₅₁H₅₄NO₃FNa, 770.3979; found, 770.3980.

(*R*)-2-(4-isobutylphenyl)propyl 4-((5*R*)-5-((1*S*,4*aR*,10*aS*)-7-isopropyl-1,4*a*-dimethyl-1,2,3,4,4*a*,9,10,10*a*-octahydrophenanthren-1-yl)-2-oxo-1-phenylpyrrolidin-3-yl)benzoate (5m)



White solid. **¹H NMR** (400 MHz, CDCl₃) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.33 – 7.26 (m, 6H), 7.21 – 7.14 (m, 3H), 7.11 – 7.06 (m, 2H), 7.04 (d, *J* = 8.2 Hz, 1H), 6.90 (dd, *J* = 8.2, 2.0 Hz, 1H), 6.56 (d, *J* = 2.0 Hz, 1H), 4.44 (d, *J* = 9.3 Hz, 1H), 4.42 – 4.28 (m, 2H), 4.03 (dd, *J* = 11.7, 8.7 Hz, 1H), 3.19 (q, *J* = 7.0 Hz, 1H), 2.77 (dq, *J* = 13.8, 6.9 Hz, 1H), 2.67 (dd, *J* = 13.6, 8.8 Hz, 1H), 2.44 (d, *J* = 7.2 Hz, 2H), 2.43 – 2.31 (m, 2H), 2.26 (dt, *J* = 12.9, 3.4 Hz, 1H), 1.91 – 1.74 (m, 3H), 1.63 (dd, *J* = 9.5, 6.4 Hz, 2H), 1.57 – 1.48 (m, 3H), 1.36 (d, *J* = 7.0 Hz, 3H), 1.33 – 1.22 (m, 2H), 1.19 (d, *J* = 6.9 Hz, 6H), 1.15 (s, 3H), 1.00 (s, 3H), 0.89 (d, *J* = 6.6 Hz, 6H). **¹³C NMR** (100 MHz, CDCl₃) δ 175.24, 166.29, 146.66, 145.32, 145.28, 140.34, 140.09, 140.01, 134.26, 129.83, 129.19, 129.08, 128.88, 128.28, 127.00, 126.49, 126.47, 126.39, 123.65, 123.36, 69.97, 64.76, 48.10, 45.04, 43.39, 42.94, 38.67, 38.11, 37.63, 33.35, 32.14, 31.99, 30.17, 28.11, 25.72, 24.00, 23.88, 22.39, 22.38, 19.15, 18.66, 18.38, 17.99. **HRMS-ESI** (*m/z*): [M+Na]⁺ calcd. for C₄₉H₅₉NO₃Na, 732.4387; found, 732.4384.

5. ^1H NMR and ^{13}C NMR Spectra.

