A Manganese(I)tricarbonyl-Catalyst for Near-Room-Temperature Alkene and Alkyne Hydroarylation

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1. General Experimental Details

All reagents and starting materials were purchased from commercial sources and were used without further purification. MnBr(CO)$_5$ was purchased from alfa aesar. Mn(I) complexes were prepared as described in literature.$^1$-$^4$ MnBr(CO)$_3$(MeCN)$_2$ was prepared in absence of light under inert conditions, and stored in an argon-filled glovebox. All hydroarylation reactions were set up inside an argon-filled glovebox. All liquid reagents and solvents were dried over 4 Å molecular sieves and degassed with 3 freeze-pump-thaw cycles. Purification of crude was carried out using silica gel based flash chromatography. $^1$H NMR, $^{19}$F NMR and $^{13}$C NMR spectra were recorded at 400 or 500 MHz on Bruker instruments. $^1$H NMR are referenced to the residual solvent peak at 7.26 ppm (CDCl$_3$) or 2.50 ppm DMSO-d$_6$ ppm values are quoted to 2 decimal places, with coupling constants (J) to the nearest 0.1 Hz. $^{13}$C NMR spectra were recorded at 126 or 101 MHz and quoted in ppm to 1 decimal place with coupling constants (J) to the nearest 0.1 Hz. The spectra were referenced to the residual solvent peak at 77.16 ppm (CDCl$_3$) or 39.52 ppm DMSO-d$_6$. $^{19}$F NMR spectra recorded at 376 MHz in CDCl$_3$ and quoted in ppm to 1 decimal place with coupling constants (J) to the nearest 0.1 Hz. Mass spectra were performed by the School of Chemistry Mass Spectrometry Service (University of Manchester) employing a Thermo Finnigan MAT95XP spectrometer. IR spectra were recorded using a Bruker alpha platinum ATR machine; relevant bands are quoted in cm$^{-1}$.

2. Preparation of MnBr(CO)$_3$(MeCN)$_2$

MnBr(CO)$_5$ (1.0 g, 3.6 mmol) was dissolved in hexane (50 mL). To this, dry acetonitrile (0.64 mL) was added and refluxed in the absence of light under nitrogen for 1.5 h. After completion, the reaction mixture was concentrated in vacuo. The precipitate was filtered under an inert atmosphere and the resulting yellow solid was washed with hexane to obtain MnBr(CO)$_3$(MeCN)$_2$ as a yellow solid (917 mg, 85%).$^1$ Anal. Calcd. for MnBr(CO)$_3$(MeCN)$_2$: C 27.93; H 2.01; N 9.31; Mn 18.25. Found C 27.08; H 1.73; N 8.20; Mn 18.36. $^1$H NMR (500 MHz, DMSO-d$_6$) δ 2.05 (s, 6H). $^{13}$C NMR (126 MHz, DMSO-d$_6$) δ 224.2, 220.4, 117.4, 0.6. IR$_{max}$ (neat/cm$^{-1}$): 2979, 2324, 2033, 1920, 1368, 1035, 674, 625; IR$_{max}$ (KBr/cm$^{-1}$): 2304, 2270, 2044, 1941, 1926, 676, 624; HRMS calculated for [C$_7$H$_6$O$_3$N$_2$BrMnNa]$^+$: 322.8835, found 322.8833. Note: the chemical shifts for the MeCN ligands appear at a similar value to those for free MeCN. This could be due to displacement by DMSO. The complex was insoluble in other common NMR solvents.

Yellow needle-shaped crystals were obtained by recrystallisation from MeCN/Hexane in a glovebox at ambient temperature. Data was obtained using XRD core facility, Rigaku FR-X Left, Rigaku FR-X Right, SuperNova, Oxford X'Calibur, Bruker D8 Advance, Phillips XPert, X ray Single Crystal Structure Determination Service, X-ray Power Diffraction data collection service, Diamond Collection Required, X-ray Air-Sensitive Single Crystal Structure Determination. X-ray data matches those reported.$^5$ Previously reported data can be obtained from X-ray data base using Identifier: BTMICM, CCDC 1115637 via www.ccdc.cam.ac.uk/conts/retrieving.html (or from the
| Property            | Value                  |
|---------------------|------------------------|
| Formula             | C₇H₆BrMnN₂O₃           |
| Mr                  | 300.99                 |
| Temperature         | 100 K                  |
| Cell                | a=6.1549(4)            |
|                     | b=8.7215(7)            |
|                     | c=10.7979(7)           |
|                     | α=81.729(6)            |
|                     | β=81.123(6)            |
|                     | γ=70.688(7)            |
| Volume              | 537.78(7)              |
| Z                   | 2                      |
| Dx,g cm⁻³           | 1.859                  |
| F000                | 292.0                  |
| Nref                | 2567                   |
| R(reflections)      | 0.0207(2376)           |
| wR2(reflections)    | 0.0496(2567)           |
| Wavelength/Å        | 0.71073                |
| Theta(max)          | 30.672                 |
| Tmin                | 0.719                  |
| Tmax                | 1.000                  |
3. General Procedures

A. Ester formation from acrylic acid and alcohol

In a round bottom flask, the corresponding alcohol (1.0 equiv), EDC (1.5 equiv) and DMAP (10 mol%) were dissolved in CH$_2$Cl$_2$ (0.5 M). To the reaction mixture, a solution of acrylic acid (1.1 equiv) in CH$_2$Cl$_2$ (2 M) was added slowly and stirred overnight at room temperature. After completion the reaction was diluted with water and extracted with CH$_2$Cl$_2$ (3 × 5.0 mL/mmol). The organic extracts were combined and washed with brine (5.0 mL/mmol), dried over Na$_2$SO$_4$ and concentrated in vacuo. This residue was purified using silica gel chromatography.

B. Hydroarylation of alkenes and terminal alkynes

In an argon-filled glove box, MnBr(CO)$_3$(MeCN)$_2$ (10 mol %, 9.0 mg) catalyst was added to an oven dried microwave vial containing a magnetic stirrer bar, followed by addition of $N$-directing group arene 1 (1.5 equiv), electrophile 2a-h, or 4a-j (0.3 mmol), and Cy$_2$NH (20 mol %) dissolved in Et$_2$O (1 M). The vial was sealed, taken out of the glove box and the reaction stirred at 35 °C for 24 h. After completion the reaction mixture was filtered through a cotton plug, washed with Et$_2$O and concentrated in vacuo. This material was purified using silica gel chromatography to obtain the desired product.

C. Hydroarylation of internal alkynes

In an argon-filled glove box, MnBr(CO)$_3$(MeCN)$_2$ (10 mol %, 9.0 mg) catalyst was added to an oven dried microwave vial containing a magnetic stirrer bar, followed by addition of 4-CF$_3$-benzoic acid (20 mol %), 1a (0.3 mmol), internal alkyne 4k-o (1.5 equiv), and Cy$_2$NH (30 mol %) dissolved in Et$_2$O (1 M). The vial was sealed, taken out of the glove box and stirred at 35 °C for 72 h. After completion the reaction was filtered through a cotton plug, washed with Et$_2$O and concentrated in vacuo. This material was purified using silica gel chromatography to obtain the desired product.
4. Substrate Scope

A. Scope of N-directing heteroarene

Compounds 1a, 1n, 1o, 1p are commercially available and were used without further purification. The following substrates were prepared according to procedures described in literature: 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1l, 1m.
B. Scope of alkene

Compounds 2a, 2b, 2c, 2d, 2e, 2f are commercially available and were used without further purification.

The following substrates were prepared according to general procedure A: 2g, 2h, 2i.
C. Scope of terminal alkynes

Compounds 4a, 4b, 4c, 4d, 4e, 4f, 4g, 4h, 4i are commercially available and used without further purification. 4j was prepared according to procedure described in literature.

D. Scope of internal alkynes

Compounds 4k, 4l, 4m, 4n, 4o, are commercially available and used without further purification.
5. Optimisation Results

A. Catalyst screening

![Reaction Scheme]

| Entry | Mn(I) Cat                          | Catalyst Loading (x mol%) | 1a(%) | 3aa(%) |
|-------|-----------------------------------|---------------------------|-------|--------|
| 1     | [MnBr(CO)₅]                       | 10                        | 99    | <1     |
| 2     | [Mn(CO)₃(MeCN)₃]PF₆              | 10                        | 86    | 51     |
| 3     | MnBr(CO)₃(MeCN)₂                  | 10                        | 40    | 98     |
| 4     | [Mn(CO)₃(naphthalene)]BF₄        | 10                        | 95    | 48     |
| 5     | [Mn₂(μ-Br)₃(CO)₆]NEt₄            | 5                         | 96    | 14     |
| 6     | [Mn(CO)₅(OTf)]                   | 10                        | 85    | 11     |

*Table 1. Results of the preliminary catalyst screening. Yields determined by GC-FID using hexadecane as an internal standard.*
B. Additive screening

![Chemical structure and reaction conditions](image)

| Reaction | Additive (mol%) | 1a(%) | 3aa(%) |
|----------|-----------------|-------|--------|
| 1        | Et₃N (20%)      | 84    | 44     |
| 2ᵃ       | Et₃N (20%)      | 80    | 45     |
| 3        | Et₃N (30%)      | 58    | 74     |
| 4        | Cy₂NH (20%)     | 40    | 98     |
| 5        | Cy₂NMe (20%)    | 81    | 32     |
| 6        | KOAc (20%)      | 125   | 1      |

Table 2. Results of the additive screen. Yields determined by GC-FID using hexadecane as an internal standard. ᵃReaction performed in absence of light.
C. Temperature Screening and catalyst loading

Table 3. Results of the temperature testing reactions with the \([\text{MnBr(CO)}_3(\text{MeCN})_2]\) catalyst. Yields determined by GC-FID using hexadecane as an internal standard.
### Table 4.

Results of varying reaction concentration experiment and reaction solvent. \(^1\)H NMR yields obtained using 1,3,5-trimethoxybenzene as an internal standard.

| Reaction | Solvent | Concentration/ (M) | 1a (%) | 3aa (%) |
|----------|---------|-------------------|--------|---------|
| 1        | Et\(_2\)O | (0.5)             | 60     | 65      |
| 2        | Et\(_2\)O | (1.0)             | 40     | 98      |
| 3        | iPr\(_2\)O | (1.0)             | 62     | 62      |
| 4        | PhMe     | (1.0)             | 49     | 79      |
| 5        | THF      | (1.0)             | 66     | 57      |
| 6        | 1,4 Dioxane | (1.0)         | 59     | 72      |
E. Reaction optimisation for internal alkyne substrates

![Chemical structure diagram]

| Entry | 1a (x mmol) | 4n (x mmol) | Solvent | Co-catalyst (x mol%) | 1a (%) | 5an (%) |
|-------|-------------|-------------|---------|----------------------|--------|--------|
| 1     | 0.15        | 0.1         | Et₂O (0.5 M) | K-m-NO₂benzoate 20%  | 127    | 28     |
| 2     | 0.1         | 0.15        | Et₂O (0.5 M) | K-m-NO₂benzoate 20%  | 81     | 22     |
| 3     | 0.1         | 0.15        | Et₂O (1 M)   | 3-(NO₂)benzoic acid 20% + Cy₂NH 20% | 80     | 23     |
| 5     | 0.1         | 0.15        | Et₂O (0.5 M) | 3-CF₃benzoic acid 20% + Cy₂NH 30% | 68     | 41     |
| 6     | 0.1         | 0.15        | Et₂O (0.5 M) | Benzoic acid 20% + Cy₂NH 20%  | 69     | 31     |
| 7     | 0.1         | 0.15        | Et₂O (0.5 M) | 2,6-difluorobenzoic acid 20% + Cy₂NH 20% | 73     | 36     |
| 8     | 0.1         | 0.15        | Et₂O (0.5 M) | 3,5-(NO₂)benzoic acid 20% + Cy₂NH 20% | 83     | 19     |
| 9     | 0.1         | 0.15        | Et₂O (0.5 M) | 4-(NMe₂)benzoic acid 20% + Cy₂NH 20% | 76     | 30     |
| 10    | 0.1         | 0.15        | Et₂O (0.5 M) | 4-(CF₃)benzoic acid 20% + Cy₂NH 30% | 92     | 8      |
| 11    | 0.1         | 0.15        | Et₂O (1 M)   | 4-(CF₃)benzoic acid 20% + Cy₂NH 30% | 52     | 48     |
| 12    | 0.1         | 0.15        | Et₂O (0.5 M) | PhP(O)(OH)₂ 10% + Cy₂NH 20%  | 97     | 0      |

Table 5. Results of the solvent, additive screening reactions. Yields determined by GC-FID using hexadecane as an internal standard.
F. Failed arenes

G. Failed alkene coupling partners
6. Characterisation Data

4-acetyl-2-methoxyphenyl acrylate (2g)

![Chemical Structure](attachment:structure2g.png)

Compound 2g was prepared according to general procedure A, with the use of acrylic acid (75.5 µL, 1.1 mmol) and apocynin (166.2 mg, 1 mmol). The crude mixture was purified using flash chromatography (95:5 Hexane/EtOAc) to yield the title compound 2g (176 mg, 80%) as a colourless oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) δ 7.61 (d, \(J = 1.8\) Hz, 1H), 7.57 (dd, \(J = 8.2, 2.0\) Hz, 1H), 7.17 (d, \(J = 8.1\) Hz, 1H), 6.63 (d, \(J = 17.2\) Hz, 1H), 6.35 (dd, \(J = 17.4, 10.5\) Hz, 1H), 6.05 (d, \(J = 10.5\) Hz, 1H), 3.89 (s, 3H), 2.60 (s, 3H). \(^13\)C NMR (101 MHz, CDCl\(_3\)) δ 196.0, 162.6, 150.5, 142.7, 135.1, 132.3, 126.3, 121.9, 121.0, 110.6, 55.1, 25.6. Mass calcd for C\(_{12}\)H\(_{13}\)O\(_4\) [M+H]: 221.0747. Mass Found: 221.0741

(3S,8S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-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 acrylate (2h)

![Chemical Structure](attachment:structure2h.png)

Compound 2h was prepared according to general procedure A, with the use of acrylic acid (75.5 µL, 1.1 mmol) and cholesterol (386.7 mg, 1 mmol). The crude mixture was purified using flash chromatography (95:5 Hexane/EtOAc) to yield the title compound 2h (361 mg, 82%) as a white solid. \(^1\)H NMR (400 MHz, CDCl\(_3\)) δ 6.36 (dd, \(J = 17.4, 1.6\) Hz, 1H), 6.07 (dd, \(J = 17.4, 10.4\) Hz, 1H), 5.77 (dd, \(J = 10.5, 1.7\) Hz, 1H), 5.36 (d, \(J = 6.2\) Hz, 1H), 4.71 – 4.61 (m, 1H), 2.33 (d, \(J = 8.2\) Hz, 2H), 2.00 – 1.76 (m, 5H), 1.65 – 1.27 (m, 11H), 1.17 – 0.92 (m, 13H), 0.90 – 0.81 (m, 9H), 0.65 (s, 3H). \(^13\)C NMR (101 MHz, CDCl\(_3\)) δ 165.8, 139.8, 130.4, 129.2, 122.9, 74.3, 56.8, 56.3, 50.2, 42.5, 39.9, 39.7, 38.2, 37.1, 36.8, 36.3, 35.9, 32.1, 32.0, 28.4, 28.2, 27.9, 24.4, 24.0, 23.0, 22.7, 21.2, 19.5, 18.9, 12.0. Spectral data matches those reported. \(^{12}\)
(S)-4-(2-((tert-butoxycarbonyl)amino)-3-methoxy-3-oxopropyl)phenyl acrylate (2i)

Compound 2i was prepared according to general procedure A, with the use of acrylic acid (75.5 µL, 1.1 mmol) and Boc-Tyr-OMe (295.3 mg, 1 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 2h (314 mg, 90%) as a white solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.14 (d, $J = 8.4$ Hz, 2H), 7.05 (d, $J = 8.6$ Hz, 2H), 6.58 (dd, $J = 17.3$, 1.3 Hz, 1H), 6.29 (dd, $J = 17.2$, 10.4 Hz, 1H), 5.99 (dd, $J = 10.5$, 1.3 Hz, 1H), 5.01 (d, $J = 8.3$ Hz, 1H), 4.59 – 4.54 (m, 1H), 3.69 (s, 3H), 3.13 – 3.01 (m, 2H), 1.41 (s, 9H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 172.3, 164.5, 155.2, 149.7, 133.8, 132.6, 130.4, 128.0, 121.6, 80.1, 54.5, 52.3, 37.8, 28.4. Spectral data matches those reported.$^{13}$

$n$-Butyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3aa)

Compound 3aa was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and $n$-butylacrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3aa (76 mg, 89%) as a yellow oil. $^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 8.61 (d, $J = 4.4$ Hz, 1H), 7.72 – 7.66 (m, 1H), 7.34 (d, $J = 7.8$ Hz, 1H), 7.30 – 7.17 (m, 5H), 3.94 (t, $J = 6.7$ Hz, 2H), 3.01 – 2.95 (m, 2H), 2.49 – 2.43 (m, 2H), 1.51 – 1.45 (m, 2H), 1.29 – 1.19 (m, 2H), 0.84 (t, $J = 7.4$ Hz, 3H). $^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ 173.3, 160.0, 149.3, 140.5, 138.7, 136.5, 130.0, 129.8, 128.6, 126.5, 124.1, 121.9, 64.3, 35.9, 30.7, 28.6, 19.2, 13.8. Spectral data matches those reported.$^{14}$
**n-Butyl 3-(5-methoxy-2-(pyridin-2-yl)phenyl)propanoate (3ba)**

![Chemical structure of 3ba]

Compound 3ba was prepared according to general procedure B, with the use of 2-(4-methoxyphenyl)pyridine 1b (83.4 mg, 0.45 mmol) and n-butylacrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ba (59 mg, 63%) as a yellow oil. 

\[ ^1H \text{ NMR} \ (400 \text{ MHz, } \text{CDCl}_3) \delta 8.58 \ (d, \ J = 5.6 \text{ Hz}, 1H), 7.66 \ (\text{app. t}, \ J = 7.7 \text{ Hz}, 1H), 7.34 – 7.20 \ (m, 2H), 7.20 – 7.13 \ (m, 1H), 6.83 – 6.73 \ (m, 2H), 3.94 \ (t, \ J = 6.7 \text{ Hz}, 2H), 3.76 \ (s, 3H), 3.04 – 2.93 \ (m, 2H), 2.53 – 2.43 \ (m, 2H), 1.55 – 1.43 \ (m, 2H), 1.19 – 1.29 \ (m, 2H), 0.82 \ (t, \ J = 7.4 \text{ Hz}, 3H). \]

\[ ^{13}C \text{ NMR} \ (126 \text{ MHz, } \text{CDCl}_3) \delta 173.3, 159.5, 149.2, 140.3, 136.4, 133.2, 131.4, 124.0, 121.5, 115.3, 111.8, 64.3, 55.4, 35.8, 30.7, 28.9, 19.2, 13.8. \]

Mass calcd for C\textsubscript{19}H\textsubscript{24}O\textsubscript{3}N \ [M+H]: 314.1876. Mass Found: 314.1741. 

**n-Butyl 3-(4-(pyridin-2-yl)-[1,1'-biphenyl]-3-yl)propanoate (3ca)**

![Chemical structure of 3ca]

Compound 3ca was prepared according to general procedure B, with the use of 2-([1,1'-biphenyl]-4-yl)pyridine 1c (104.1 mg, 0.45 mmol) and n-butylacrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ca (56 mg, 52%) as a colorless oil. 

\[ ^1H \text{ NMR} \ (400 \text{ MHz, } \text{CDCl}_3) \delta 8.71 \ (d, \ J = 4.9 \text{ Hz}, 1H), 7.80 \ (\text{app. t}, \ J = 7.7 \text{ Hz}, 1H), 7.63 \ (d, \ J = 7.1 \text{ Hz}, 2H), 7.57 – 7.52 \ (m, 2H), 7.49 – 7.43 \ (m, 4H), 7.37 \ (t, \ J = 7.3 \text{ Hz}, 1H), 7.29 \ (t, \ J = 7.6 \text{ Hz}, 1H), 4.02 \ (t, \ J = 6.7 \text{ Hz}, 2H), 3.17 – 3.11 \ (m, 2H), 2.63 – 2.57 \ (m, 2H), 1.58 – 1.50 \ (m, 2H), 1.35 – 1.26 \ (m, 2H), 0.88 \ (t, \ J = 7.4 \text{ Hz}, 3H). \]

\[ ^{13}C \text{ NMR} \ (101 \text{ MHz, } \text{CDCl}_3) \delta 173.3, 159.5, 149.1, 141.6, 140.8, 139.3, 139.1, 136.8, 130.6, 128.9, 128.8, 127.6, 127.3, 125.3, 124.2, 122.0, 64.4, 35.9, 30.7, 28.8, 19.2, 13.8. \]

Mass calcd for C\textsubscript{24}H\textsubscript{25}O\textsubscript{2}Na \ [M+Na]: 382.1778. Mass Found: 382.1775.
**n-Butyl 3-(5-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3da)**

![Chemical structure of 3da](image)

Compound 3da was prepared according to general procedure B, with the use of 2-(4-fluorophenyl)pyridine 1d (77.9 mg, 0.45 mmol) and n-butylacrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3da (81 mg, 90%) as a dark yellow oil. 

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 8.59 (d, $J = 4.5$ Hz, 1H), 7.69 – 7.66 (m, 1H), 7.29 (d, $J = 7.8$ Hz, 1H), 7.27 – 7.22 (m, 1H), 7.19 (s, 1H), 6.97 – 6.94 (m, 1H), 6.92 – 6.88 (m, 1H), 3.94 (t, $J = 6.7$ Hz, 2H), 2.99 – 2.93 (m, 2H), 2.48 – 2.42 (m, 2H), 1.50 – 1.44 (m, 2H), 1.28 – 1.20 (m, 2H), 0.82 (t, $J = 7.4$ Hz, 3H). $^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ 172.9, 162.7 (d, $J = 242.9$ Hz), 159.1, 149.3, 141.4 (d, $J = 7.5$ Hz), 136.6(3), 136.6(0), 131.7 (d, $J = 8.5$ Hz), 124.1, 122.0, 116.4 (d, $J = 21.3$ Hz), 113.3 (d, $J = 21.1$ Hz), 64.4, 35.4, 30.7, 28.6, 19.2, 13.8. $^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ -113.8. Mass calcd for C$_{18}$H$_{21}$O$_2$NF [M+H]: 302.1551. Mass Found: 302.1540

**n-Butyl 3-(5-chloro-2-(pyridin-2-yl)phenyl)propanoate (3ea)**

![Chemical structure of 3ea](image)

Compound 3ea was prepared according to general procedure B, with the use of 2-(4-chlorophenyl)pyridine 1e (85.4 mg, 0.45 mmol) and n-butylacrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ea (77 mg, 81%) as a dark yellow oil. 

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 8.63 (d, $J = 4.7$ Hz, 1H), 7.74 – 7.70 (m, 1H), 7.34 (d, $J = 7.8$ Hz, 1H), 7.28 (d, $J = 1.7$ Hz, 1H), 7.24 (s, 1H), 7.24 – 7.22 (m, 2H), 3.98 (t, $J = 6.7$ Hz, 2H), 3.02 – 2.96 (m, 2H), 2.52 – 2.46 (m, 2H), 1.54 – 1.48 (m, 2H), 1.32 – 1.24 (m, 2H), 0.87 (t, $J = 7.4$ Hz, 3H). $^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ 172.9, 158.9, 149.4, 140.8, 138.9, 136.7, 134.3, 131.4, 129.8, 126.6, 124.0, 122.2, 64.4, 35.5, 30.7, 28.5, 19.2, 13.8. Mass calcd for C$_{18}$H$_{21}$O$_2$NCl [M+H]: 318.1255. Mass Found: 318.1248
**n-Butyl 3-(2-(pyridin-2-yl)-5-(trifluoromethyl)phenyl)propanoate (3fa)**

![Chemical Structure of 3fa](image)

Compound 3fa was prepared according to general B, with the use of 2-(4-(trifluoromethyl)phenyl)pyridine 1f (67.0 mg, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3fa (68 mg, 64%) as a yellow oil. 

**1H NMR** (400 MHz, CDCl₃) δ 8.69 (d, J = 5.0 Hz, 1H), 7.83 – 7.77 (m, 1H), 7.59 – 7.53 (m, 2H), 7.46 (d, J = 7.9 Hz, 1H), 7.41 (d, J = 7.8 Hz, 1H), 7.33 – 7.29 (m, 1H), 4.01 (t, J = 6.7 Hz, 2H), 3.12 – 3.05 (m, 2H), 2.58 – 2.51 (m, 2H), 1.58 – 1.49 (m, 2H), 1.35 – 1.26 (m, 2H), 0.89 (t, J = 7.4 Hz, 3H).

**13C NMR** (101 MHz, CDCl₃) δ 172.8, 158.6, 149.4, 143.8, 139.9, 136.9, 130.8, 130.6 (q, J = 33.6 Hz), 126.74 (q, J = 264.0 Hz), 125.5, 123.3 (q, J = 3.7 Hz), 122.8 (q, J = 3.1 Hz), 122.6, 64.5, 35.5, 30.7, 28.6, 19.2, 13.8. 

**19F NMR** (376 MHz, CDCl₃) δ -62.4. 

**Mass** calcd for C₁₉H₂₀O₂NF₃Na [M+Na]: 374.1338. Mass Found: 374.1326

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**Methyl 3-(3-butoxy-3-oxopropyl)-4-(pyridin-2-yl)benzoate (3ga)**

![Chemical Structure of 3ga](image)

Compound 3ga was prepared according to general procedure B, with the use of methyl 4-(pyridin-2-yl)benzoate 1g (95.9 mg, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ga (52 mg, 51%) as a dark yellow oil. 

**1H NMR** (500 MHz, CDCl₃) δ 8.68 (d, J = 5.9 Hz, 1H), 8.03 – 7.90 (m, 2H), 7.79 – 7.76 (m, 1H), 7.42 (d, J = 7.8 Hz, 2H), 7.28 (s, 1H), 4.00 (t, J = 6.7 Hz, 2H), 3.92 (s, 3H), 3.09 – 3.06 (m, 2H), 2.56 – 2.53 (m, 2H), 1.60 – 1.47 (m, 2H), 1.32 – 1.28 (m, 2H), 0.88 (t, J = 7.5 Hz, 3H).

**13C NMR** (126 MHz, CDCl₃) δ 173.0, 166.9, 158.9, 149.4, 144.7, 139.2, 136.8, 131.0, 130.2, 127.7, 124.1, 122.5, 64.4, 52.3, 35.6, 30.7, 28.5, 19.2, 13.8. 

**Mass** calcd for C₂₀H₂₄O₄N [M+H]: 342.1700. Mass Found: 342.1690
**n-Butyl 3-(3-methoxy-2-(pyridin-2-yl)phenyl)propanoate (3ha)**

![Structural formula of 3ha](image)

Compound 3ha was prepared according to general procedure B, with the use of 2-(2-methoxyphenyl)pyridine 1h (77.9 µL, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ha (58 mg, 62%) as a yellow oil. 

**1H NMR** (400 MHz, CDCl$_3$) δ 8.73 (d, $J = 4.4$ Hz, 1H), 7.76 (app. t, $J = 7.6$ Hz, 1H), 7.36 – 7.26 (m, 3H), 6.95 (d, $J = 7.7$ Hz, 1H), 6.88 (d, $J = 8.3$ Hz, 1H), 4.01 (t, $J = 6.6$ Hz, 2H), 3.73 (s, 3H), 2.75 (t, $J = 7.9$ Hz, 2H), 2.47 (t, $J = 7.9$ Hz, 2H), 1.59 – 1.52 (m, 2H), 1.37 – 1.29 (m, 2H), 0.92 (t, $J = 7.4$ Hz, 3H).

**13C NMR** (126 MHz, CDCl$_3$) δ 173.2, 157.1, 156.5, 149.2, 140.6, 136.2, 129.5, 129.4, 126.0, 122.1, 121.6, 109.1, 64.3, 55.9, 35.5, 30.7, 28.6, 19.2, 13.8.

**Mass** calcd for C$_{19}$H$_{24}$O$_3$N [M+H]: 314.1751. Mass Found: 314.1743

**n-Butyl 3-(3-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3ia)**

![Structural formula of 3ia](image)

Compound 3ia was prepared according to general procedure B, with the use of 2-(2-fluorophenyl)pyridine 1i (68.5 µL, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 3ia (28 mg, 31%) as a colorless oil. 

**1H NMR** (400 MHz, CDCl$_3$) δ 8.72 (d, $J = 6.1$ Hz, 1H), 7.83 – 7.76 (m, 1H), 7.40 (d, $J = 7.8$ Hz, 1H), 7.34 – 7.27 (m, 2H), 7.11 (d, $J = 7.5$ Hz, 1H), 7.02 (t, $J = 8.9$ Hz, 1H), 3.99 (t, $J = 6.7$ Hz, 2H), 2.87 (t, $J = 7.9$ Hz, 2H), 2.47 (t, $J = 7.9$ Hz, 2H), 1.57 – 1.49 (m, 2H), 1.35 – 1.34 (m, 2H), 0.89 (t, $J = 7.4$ Hz, 3H).

**13C NMR** (101 MHz, CDCl$_3$) δ 172.9, 158.9 (d, $J = 247.9$ Hz), 153.7, 149.5, 141.7 (d, $J = 2.6$ Hz), 136.5, 129.8 (d, $J = 9.0$ Hz), 128.2, 125.9, 125.1 (d, $J = 3.4$ Hz), 122.6, 113.6 (d, $J = 22.9$ Hz), 64.3, 35.4, 30.7, 28.3, 19.2, 13.8.

**19F NMR** (376 MHz, CDCl$_3$) δ -116.2. **Mass** calcd for C$_{18}$H$_{21}$O$_2$NF [M+H]: 302.1551. Mass Found: 302.1548
Compound 3ja was prepared according to general procedure B, with the use of 2-(m-tolyl)pyridine 1j (73.9 µL, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ja (65 mg, 73%) as a yellow oil. 1H NMR (400 MHz, CDCl3) δ 8.68 – 8.66 (m, 1H), 7.76 – 7.72 (m, 1H), 7.39 (d, J = 7.7 Hz, 1H), 7.25 – 7.12 (m, 4H), 4.00 (t, J = 6.7 Hz, 2H), 3.00 (t, J = 8.1 Hz, 2H), 2.51 – 2.47 (m, 2H), 2.35 (s, 3H), 1.57 – 1.50 (m, 2H), 1.34 – 1.28 (m, 2H), 0.90 (t, J = 7.4 Hz, 3H). 13C NMR (101 MHz, CDCl3) δ 173.4, 160.1, 149.3, 140.4, 136.4, 135.6, 135.0, 129.7, 129.3, 124.1, 121.8, 64.3, 36.0, 30.7, 28.2, 21.1, 19.2, 13.8. Mass calcd for C19H24O2N [M+H]: 298.1802. Mass Found: 298.1801

Compound 3ka was prepared according to general procedure B, with the use of 2-(3-(trifluoromethyl)phenyl)pyridine 1k (81.6 µL, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ka (43 mg, 41%) as a yellow oil. 1H NMR (400 MHz, CDCl3) δ 8.70 (d, J = 4.0 Hz, 1H), 7.83 – 7.78 (m, 1H), 7.61 – 7.57 (m, 2H), 7.44 (t, J = 7.6 Hz, 2H), 7.33 – 7.30 (m, 1H), 4.01 (t, J = 6.7 Hz, 2H), 3.09 (t, J = 7.8 Hz, 2H), 2.54 (t, J = 7.9 Hz, 2H), 1.58 – 1.50 (m, 2H), 1.33 – 1.25 (m, 2H), 0.89 (t, J = 7.4 Hz, 3H). 13C NMR (126 MHz, CDCl3) δ 172.9, 158.6, 149.5, 142.0 (q, J = 243.3 Hz), 136.9, 130.4, 128.9 (q, J = 32.6 Hz), 127.5, 126.9 (q, J = 3.6 Hz), 125.2 (q, J = 3.3 Hz), 124.1, 123.1, 122.6, 64.3, 35.4, 30.7, 28.5, 19.2, 13.8. 19F NMR (376 MHz, CDCl3) δ -62.4. Mass calcd for C19H24O2NF3 [M+H]: 352.1519. Mass Found: 352.1512
Methyl 4-(3-butoxy-3-oxopropyl)-3-(pyridin-2-yl)benzoate (3la)

![Chemical structure of 3la](attachment://structure.png)

Compound 3la was prepared according to general procedure B, with the use of methyl 3-(pyridin-2-yl)benzoate 1l (95.9 mg, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3la (30 mg, 29%) as a yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.70 (d, $J = 4.8$ Hz, 1H), 8.04 – 7.99 (m, 2H), 7.83 (t, $J = 7.7$ Hz, 1H), 7.47 (d, $J = 7.8$ Hz, 1H), 7.40 (d, $J = 7.9$ Hz, 1H), 7.36 – 7.29 (m, 1H), 4.00 (t, $J = 6.7$ Hz, 2H), 3.90 (s, 3H), 3.10 (t, $J = 7.8$ Hz, 2H), 2.55 (t, $J = 7.8$ Hz, 2H), 1.57 – 1.49 (m, 2H), 1.33 – 1.26 (m, 2H), 0.89 (t, $J = 7.3$ Hz, 3H). $^{13}$C NMR (126 MHz, CDCl$_3$) δ 173.0, 166.9, 159.0, 149.2, 144.3, 140.5, 136.9, 131.3, 130.1, 129.7, 128.5, 124.2, 122.4, 64.4, 52.2, 35.4, 30.7, 28.7, 19.2, 13.8. Mass calcd for C$_{20}$H$_{24}$O$_4$N [M+H]: 342.1700. Mass Found: 342.1693

$n$-Butyl 3-(2-(5-methylpyridin-2-yl)phenyl)propanoate (3ma)

![Chemical structure of 3ma](attachment://structure.png)

Compound 3ma was prepared according to general procedure B, with the use of 5-methyl-2-phenylpyridine 1m (76.2 mg, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ma (82 mg, 92%) as a yellow oil. $^1$H NMR (500 MHz, CDCl$_3$) δ 8.46 (s, 1H), 7.51 (d, $J = 7.4$ Hz, 1H), 7.32 – 7.20 (m, 5H), 3.97 (t, $J = 6.5$ Hz, 2H), 3.01 – 2.98 (m, 2H), 2.49 – 2.46 (m, 2H), 2.34 (s, 3H), 1.53 – 1.47 (m, 2H), 1.31 – 1.24 (m, 2H), 0.86 (t, $J = 7.3$ Hz, 3H). $^{13}$C NMR (126 MHz, CDCl$_3$) δ 173.4, 157.1, 149.7, 140.5, 138.8, 137.1, 131.3, 130.0, 129.8, 128.4, 126.5, 123.5, 64.3, 35.9, 30.7, 28.7, 19.2, 18.3, 13.8. Mass calcd for C$_{19}$H$_{24}$O$_2$N [M+H]: 298.1802. Mass Found: 298.1797
Compound 3na was prepared according to general procedure B, with the use of 1-phenyl-1H-pyrazole 1n (60.0 µL, 0.45 mmol) and n-butyl acrylate 2a (43.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3na (64 mg, 78%) as a dark yellow oil. ¹H NMR (500 MHz, CDCl₃) δ 7.72 (s, 1H), 7.62 (s, 1H), 7.36 – 7.35 (m, 2H), 7.31 – 7.30 (m, 2H), 6.45 (s, 1H), 4.01 (t, J = 6.7 Hz, 2H), 2.90 (t, J = 7.7 Hz, 2H), 2.45 (t, J = 7.6 Hz, 2H), 1.57 – 1.51 (m, 2H), 1.35 – 1.27 (m, 2H), 0.90 (t, J = 7.4 Hz, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 173.0, 140.6, 139.8, 136.8, 130.8, 130.5, 128.9, 127.3, 126.7, 106.6, 64.4, 34.9, 30.7, 27.0, 19.2, 13.8. Mass calcd for C₁₆H₂₁N₂O₂ [M+H]: 273.1598. Mass Found: 273.1590

Compound 3oa was prepared according to general procedure B, with the use of MnBr(CO)₃(MeCN)₂ (20 mol%, 12.0 mg), 5-phenyl-1,3-dihydro-2H-benzo[e][1,4]diazepin-2-one 1o (47.2 mg, 0.2 mmol) and n-butyl acrylate 2a (57.3 µL, 0.4 mmol) in Et₂O (0.2 ml). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (75:25 Hexane/EtOAc) to yield the title compound 3oa (39 mg, 53%) as a white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.92 (d, J = 4.8 Hz, 1H), 7.30 (t, J = 7.8 Hz, 2H), 7.20 (t, J = 7.1 Hz, 2H), 7.08 (d, J = 4.4 Hz, 1H), 6.98 – 6.87 (m, 3H), 4.10 – 3.97 (m, 2H), 3.74 (t, J = 8.1 Hz, 1H), 3.63 (d, J = 15.2 Hz, 1H), 3.48 – 3.31 (m, 2H), 3.10 – 3.04 (m, 1H), 1.65 – 1.62 (m, 2H), 1.52 – 1.44 (m, 2H), 1.23 – 1.16 (m, 2H), 0.82 (t, J = 7.4 Hz, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 172.4, 171.5, 140.9, 136.9, 131.2, 130.1, 128.7, 128.6, 127.1, 126.3, 125.4, 125.2, 124.8, 124.1, 121.9, 74.5, 64.9, 64.8, 33.1, 30.6, 19.1, 13.8; mp 186-188 °C. Mass calcd for C₂₂H₂₅O₃N₂ [M+H]: 365.1860. Mass Found: 365.1859.
**n-Butyl 3-(2-(7-chloro-1-methyl-2-oxo-2,3-dihydro-1H-benzo[e][1,4]diazepin-5-yl)phenyl)propanoate (3pa)**

![Chemical Structure]

Compound 3pa was prepared according to general procedure B, with the use of \( \text{MnBr(CO)}_3(\text{MeCN})_2 \) \((20 \text{ mol\%}, 12.0 \text{ mg})\), 7-chloro-1-methyl-5-phenyl-1,3-dihydro-2H-benzo[e][1,4]diazepin-2-one 1p \((56.9 \text{ mg}, 0.2 \text{ mmol})\) and \( n\)-butyl acrylate 2a \((57.3 \mu\text{L}, 0.4 \text{ mmol})\) in \( \text{Et}_2\text{O} \) \((0.2 \text{ ml})\). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography \((75:25 \text{ Hexane/EtOAc})\) to yield the title compound 3pa \((64 \text{ mg}, 77\%)\) as a colourless oil.

**1H NMR** \((400 \text{ MHz, CDCl}_3)\) \( \delta \)

- 7.43 – 7.36 (m, 1H)
- 7.34 – 7.22 (m, 3H)
- 7.22 – 7.17 (m, 1H)
- 7.14 – 7.11 (m, 1H)
- 6.41 (d, \( J = 2.0 \text{ Hz} \), 1H)
- 4.12 – 3.95 (m, 2H)
- 3.46 (d, \( J = 13.8 \text{ Hz} \), 1H)
- 3.39 – 3.36 (m, 3H)
- 3.34 (d, \( J = 4.3 \text{ Hz} \), 1H)
- 3.29 (d, \( J = 7.9 \text{ Hz} \), 2H)
- 2.82 – 2.73 (m, 1H)
- 1.64 – 1.53 (m, 2H)
- 0.89 – 0.83 (m, 3H).

**13C NMR** \((126 \text{ MHz, CDCl}_3)\) \( \delta \)

- 173.7
- 145.0
- 141.8
- 141.2
- 137.4
- 131.5
- 130.1
- 129.3
- 129.2
- 129.1
- 127.5
- 126.5
- 126.4
- 125.0
- 124.4
- 74.4
- 64.9
- 49.1
- 35.4
- 34.6
- 30.6
- 19.2
- 13.8.

**Mass** calcd for \( C_{23}H_{26}O_3N_2\)[M+H]: 413.1313. Mass Found: 413.1307

**n-Butyl 3-(2-fluoro-6-(pyridin-2-yl)phenyl)propanoate (3qa) and n-Butyl 3-(4-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3qa')**

![Chemical Structures]

Compound 3qa and 3qa' were prepared according to general procedure B, with the use of 2-(3-(trifluoromethyl)phenyl)pyridine 1q \((68.5 \mu\text{L}, 0.45 \text{ mmol})\) and \( n\)-butyl acrylate 2a \((43.0 \mu\text{L}, 0.3 \text{ mmol})\). The reaction was stirred at 35 °C for 24 h. The crude mixture was purified using flash chromatography \((85:15 \text{ Hexane/EtOAc})\) to yield a mixture of two regioisomers 3qa/3qa' in ratio 5.7/1 \((81.4 \text{ mg}, 90\%)\) as a yellow oil. The major isomer was determined to be 3qa, based on \(^{19}\text{F}-^{13}\text{C}\) coupling at the -CH\(_2\)CH\(_2\)CO- motif (no such coupling is observed for 3qa'). Peaks corresponding to the major compound 3qa, are as follows: **1H NMR** \((400 \text{ MHz, CDCl}_3)\) \( \delta \)

- 8.73 – 8.62 (m, 1H)
- 7.76 (app. t, \( J = 7.7 \text{ Hz} \), 1H)
- 7.39 (d, \( J = 7.8 \text{ Hz} \), 1H)
- 7.30 – 7.26 (m, 1H)
- 7.23 (d, \( J = 7.7 \text{ Hz} \), 1H)
- 7.15 (d, \( J = 7.6 \text{ Hz} \), 1H)
- 7.08 (t, \( J = 9.0 \text{ Hz} \), 1H)
- 4.01 (t, \( J = 6.7 \text{ Hz} \), 2H)
- 3.07 – 2.97 (m, 2H)
- 2.65 – 2.55 (m, 2H)
- 1.58 – 1.51 (m, 2H)
- 1.37 – 1.27 (m, 2H)
- 0.90 (t, \( J = 7.4 \text{ Hz} \), 3H).

**13C NMR** \((101 \text{ MHz, CDCl}_3)\) \( \delta \)

- 173.0
- 145.0
- 141.8
- 141.2
- 137.4
- 131.5
- 130.1
- 129.3
- 129.2
- 129.1
- 127.5
- 126.5
- 126.4
- 125.0
- 124.4
- 74.4
- 64.9
- 49.1
- 35.4
- 34.6
- 30.6
- 19.2
- 13.8.
127.6 (d, $J = 9.2$ Hz), 126.4 (d, $J = 16.1$ Hz), 125.6 (d, $J = 3.0$ Hz), 124.0, 122.3, 115.3 (d, $J = 23.0$ Hz), 64.3, 34.6 (d, $J = 1.7$ Hz), 30.7, 21.8 (d, $J = 3.8$ Hz), 19.2, 13.8.  

$^1$F NMR (376 MHz, CDCl$_3$)  

δ -117.05. Mass calcd for C$_{18}$H$_{20}$O$_2$NFNa [M+Na]: 412.1313. Mass Found: 413.1307.

**Methyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3ab)**

![Methyl 3-(2-(pyridin-2-yl)phenyl)propanoate](image)

Compound 3ab was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and methylacrylate 2b (27.2 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 3ab (67 mg, 92%) as a yellow oil.  

$^1$H NMR (500 MHz, CDCl$_3$) δ 8.68 (d, $J = 4.6$ Hz, 1H), 7.78 – 7.74 (m, 1H), 7.41 (d, $J = 7.7$ Hz, 1H), 7.36 – 7.28 (m, 5H), 3.60 (s, 3H), 3.04 (t, $J = 7.9$ Hz, 2H), 2.55 (t, $J = 7.9$ Hz, 2H).  

$^{13}$C NMR (126 MHz, CDCl$_3$) δ 173.9, 160.1, 149.4, 140.7, 138.9, 136.9, 130.3, 130.1, 128.9, 126.8, 124.4, 122.3, 51.9, 35.9, 28.8. Spectral data matches those reported.

**t-Butyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3ac)**

![t-Butyl 3-(2-(pyridin-2-yl)phenyl)propanoate](image)

Compound 3ac was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and t-butyl acrylate 2c (43.9 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ac (71 mg, 83%) as a yellow oil.  

$^1$H NMR (500 MHz, CDCl$_3$) δ 8.59 (d, $J = 5.5$ Hz, 1H), 7.65 (app. t, $J = 7.7$ Hz, 1H), 7.31 (d, $J = 7.8$ Hz, 1H), 7.24 (d, $J = 10.4$ Hz, 3H), 7.21 – 7.13 (m, 2H), 2.91 (t, $J = 7.9$ Hz, 2H), 2.33 (t, $J = 7.9$ Hz, 2H), 1.28 (s, 9H).  

$^{13}$C NMR (126 MHz, CDCl$_3$) δ 172.6, 160.0, 149.3, 140.5, 138.9, 136.5, 130.0, 129.8, 128.5, 126.4, 124.1, 121.9, 80.2, 36.9, 28.7, 28.2. Spectral data matches those reported.
4-(2-(pyridin-2-yl)phenyl)butan-2-one (3ad)

Compound 3ad was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and but-3-en-2-one 2d (25.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ad (38 mg, 57%) as a yellow oil.\[^1\]H NMR (400 MHz, CDCl\(_3\)) δ 8.57 (d, \(J = 4.0\) Hz, 1H), 7.67 (app. t, \(J = 7.7\) Hz, 1H), 7.31 (d, \(J = 7.8\) Hz, 1H), 7.26 – 7.15 (m, 5H), 2.89 – 2.83 (m, 2H), 2.59 (t, \(J = 7.8\) Hz, 2H), 1.95 (s, 3H). \[^{13}\]C NMR (101 MHz, CDCl\(_3\)) δ 208.5, 160.1, 149.2, 140.5, 139.2, 136.6, 130.0, 130.0, 128.7, 126.4, 124.2, 122.0, 45.6, 30.0, 27.6. Spectral data matches those reported.\[^6\]

3-(2-(Pyridin-2-yl)phenyl)cyclohexanone (3ae)

Compound 3ae was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and cyclohex-en-1-one 2e (29.2 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 3ae (35 mg, 46%) as a dark yellow oil. \[^1\]H NMR (400 MHz, CDCl\(_3\)) δ 8.59 (d, \(J = 6.1\) Hz, 1H), 7.69 (app. t, \(J = 8.6\) Hz, 1H), 7.37 – 7.32 (m, 2H), 7.29 – 7.17 (m, 4H), 3.27 – 3.17 (m, 1H), 2.45 (d, \(J = 8.9\) Hz, 2H), 2.29 – 2.25 (m, 2H), 2.01 – 1.94 (m, 2H), 1.80 – 1.70 (m, 1H), 1.55 – 1.45 (m, 1H). \[^{13}\]C NMR (101 MHz, CDCl\(_3\)) δ 211.3, 159.7, 149.2, 142.3, 139.9, 136.7, 130.3, 129.0, 126.5, 126.2, 124.3, 122.1, 49.0, 41.3, 40.2, 32.9, 25.6. Spectral data matches those reported.\[^4\]
1,3-diphenyl-3-(2-(pyridin-2-yl)phenyl)propan-1-one (3af)

![Chemical structure of 3af](image)

Compound 3af was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and chalcone 2f (62.5 mg, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 3af (100 mg, 92%) as a colorless oil. 

\[ ^1H \text{ NMR} (400 \text{ MHz, CDCl}_3) \delta 8.61 (d, J = 5.3 \text{ Hz}, 1H), 7.85 – 7.83 (m, 2H), 7.66 (\text{app. t}, J = 7.7 \text{ Hz}, 1H), 7.48 (t, J = 7.4 \text{ Hz}, 1H), 7.36 (t, J = 7.7 \text{ Hz}, 2H), 7.33 – 7.27 (m, 4H), 7.25 – 7.20 (m, 2H), 7.12 (t, J = 7.2 \text{ Hz}, 2H), 7.07 – 7.01 (m, 3H), 5.15 (t, J = 7.4 \text{ Hz}, 1H), 3.72 (d, J = 7.3 \text{ Hz}, 2H). \]

\[ ^{13}C \text{ NMR} (101 \text{ MHz, CDCl}_3) \delta 198.0, 159.8, 148.8, 143.8, 142.4, 140.2, 137.0, 136.7, 133.0, 130.2, 128.8, 128.6, 128.4, 128.2, 128.0, 127.9, 126.5, 126.2, 124.7, 122.1, 45.1, 41.6. \]

Spectral data matches those reported.

4-acetyl-2-methoxyphenyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3ag)

![Chemical structure of 3ag](image)

Compound 3ag was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and 4-acetyl-2-methoxyphenyl acrylate 2g (66.1 mg, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ag (37 mg, 33%) as a colorless oil.

\[ ^1H \text{ NMR} (400 \text{ MHz, CDCl}_3) \delta 8.75 – 8.74 (m, 1H), 7.87 (\text{app. t}, J = 6.7 \text{ Hz}, 1H), 7.55 (s, 1H), 7.54 – 7.48 (m, 2H), 7.43 – 7.34 (m, 5H), 7.02 (d, J = 8.1 \text{ Hz}, 1H), 3.81 (s, 3H), 3.18 (t, J = 7.6 \text{ Hz}, 2H), 2.88 (t, J = 7.6 \text{ Hz}, 2H), 2.58 (s, 3H). \]

\[ ^{13}C \text{ NMR} (126 \text{ MHz, CDCl}_3) \delta 197.1, 170.7, 158.7, 151.4, 147.7, 144.0, 139.8, 138.4, 136.0, 130.3, 130.0, 129.4, 126.9, 126.7, 125.0, 122.8, 122.6, 122.1, 111.5, 56.1, 35.2, 28.4, 26.7. \]

Mass calcd for C_{23}H_{22}O_4N [M+H]: 376.1543. Mass Found: 376.1542.
(3S,8S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-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 3-(2-(pyridin-2-yl)phenyl)propanoate (3ah)

Compound 3ah was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and (3S,8S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-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 acrylate 2h (132.2 mg, 0.3 mmol). The reaction was stirred at 35 °C for 72h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 3ah (156 mg, 87%) as a white solid. 

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.63 (d, $J$ = 4.9 Hz, 1H), 7.71 (app. t, $J$ = 7.7 Hz, 1H), 7.36 (d, $J$ = 7.8 Hz, 1H), 7.32 – 7.27 (m, 3H), 7.24 – 7.18 (m, 2H), 5.30 (d, $J$ = 5.5 Hz, 1H), 4.55 – 4.45 (m, 1H), 3.01 – 2.97 (m, 2H), 2.45 (t, $J$ = 7.9 Hz, 2H), 2.19 (d, $J$ = 7.5 Hz, 2H), 1.99 – 1.87 (m, 2H), 1.81 – 1.70 (m, 3H), 1.56 – 1.36 (m, 9H), 1.32 – 1.25 (m, 3H), 1.12 – 1.00 (m, 7H), 0.98 – 0.93 (m, 4H), 0.87 – 0.86 (m, 4H), 0.83 – 0.81 (m, 5H), 0.62 (s, 3H). 

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 172.6, 160.1, 149.3, 140.5, 139.8, 138.8, 136.5, 130.0, 129.9, 128.6, 126.5, 124.1, 122.7, 121.9, 74.0, 56.8, 56.3, 50.1, 42.4, 39.9, 39.7, 38.2, 37.1, 36.7, 36.3, 36.1, 35.9, 32.0, 32.0, 28.6, 28.4, 28.2, 27.9, 24.4, 24.0, 23.0, 22.7, 21.2, 19.4, 18.8, 12.0; mp 82-84 ºC. Mass calcd for C$_{41}$H$_{58}$O$_2$N [M+H]: 596.4462. Mass Found: 596.4465

Methyl(S)-2-((tert-butoxycarbonyl)amino)-3-(4-((3-(2-(pyridin-2-yl)phenyl)propanoyl)oxy)phenyl)propanoate (3ai)

Compound 3ai was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and 2i (104.8 mg, 0.3 mmol). The reaction was stirred at 35 °C for 72h. The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 3ai (134 mg, 88%) as a colorless oil. 

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.81 – 8.58 (m, 1H), 7.78 app. (t, $J$ = 7.5 Hz, 1H), 7.44 (d, $J$ = 7.6 Hz, 1H), 7.40 – 7.27 (m, 5H), 7.09 (d, $J$ = 8.2 Hz, 2H), 6.91 (d, $J$ = 8.2 Hz, 2H), 5.00 (d, $J$ = 8.4 Hz, 1H), 4.58 – 4.53 (m, 1H), 3.69 (s, 3H),
3.16 (t, J = 7.6 Hz, 2H), 3.07 – 3.00 (m, 2H), 2.79 (t, J = 7.3 Hz, 2H), 1.41 (s, 9H). 13C NMR (101 MHz, CDCl3) δ 172.3, 171.6, 159.7, 155.1, 149.8, 148.9, 140.2, 138.4, 136.9, 133.6, 130.2, 130.1, 130.0, 128.8, 126.7, 124.2, 122.1, 121.6, 80.0, 54.4, 52.3, 37.7, 35.8, 29.7, 28.6, 28.3. Mass calcd for C29H32O6N2Na [M+Na]: 527.215 Mass Found: 527.2154.

(E)-2-(2-(hex-1-en-1-yl)phenyl)pyridine (5aa)

\[
\text{N} \\
\text{C}_6\text{H}_3
\]

Compound 5aa was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and hexyne 4a (33.0 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (90:10 Hexane/EtOAc) to yield the title compound 5aa (36 mg, 50%) as a light yellow oil. 1H NMR (400 MHz, CDCl3) δ 8.63 (d, J = 7.9 Hz, 1H), 7.64 (app. t, J = 7.6 Hz, 1H), 7.48 (d, J = 8.1 Hz, 1H), 7.40 – 7.33 (m, 2H), 7.28 – 7.14 (m, 3H), 6.35 (d, J = 15.2 Hz, 1H), 6.08 – 6.03 (m, 1H), 2.05 (d, J = 7.2 Hz, 2H), 1.36 – 1.19 (m, 4H), 0.80 (t, J = 7.3 Hz, 3H). 13C NMR (101 MHz, CDCl3) δ 159.1, 149.3, 138.6, 136.4, 136.1, 132.9, 130.1, 128.6, 128.4, 127.0, 126.4, 125.2, 121.8, 32.9, 31.5, 22.3, 14.0. Spectral data matches those reported.

(E)-2-(2-(dec-1-en-1-yl)phenyl)pyridine (5ab)

\[
\text{N} \\
\text{C}_8\text{H}_{17}
\]

Compound 5ab was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and hexyne 4b (56.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (88:12 Hexane/EtOAc) to yield the title compound 5ab (48 mg, 54%) as a yellow oil. 1H NMR (400 MHz, CDCl3) δ 8.65 – 8.64 (m, 1H), 7.67 – 7.63 (m, 1H), 7.52 – 7.49 (m, 1H), 7.42 – 7.39 (m, 1H), 7.36 (d, J = 7.8 Hz, 1H), 7.30 – 7.26 (m, 1H), 7.25 – 7.21 (m, 1H), 7.19 – 7.16 (m, 1H), 6.37 (d, J = 15.8 Hz, 1H), 6.12 – 6.05(m, 1H), 2.10 – 2.02 (m, 2H), 1.38 – 1.30 (m, 2H), 1.24 – 1.14 (m, 10H), 0.83 – 0.77 (m, 3H). 13C NMR (101 MHz, CDCl3) δ 159.1, 149.4, 138.7, 136.4, 136.0, 133.0, 130.1, 128.6, 128.4, 127.0, 126.4, 125.1, 121.8, 33.3, 32.0, 29.6, 29.4, 29.4, 29.3, 22.8, 14.2. Mass calcd for C21H28N [M+H]: 294.2216. Mass Found: 294.2210
(E)-2-(2-(4-methoxystyryl)phenyl)pyridine (5ac)

Compound 5ac was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and 1-ethynyl-4-methoxybenzene 4c (39.3 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ac (74 mg, 86%) as a yellow oil. 1H NMR (400 MHz, CDCl3) δ 8.66 (d, J = 5.1 Hz, 1H), 7.65 (d, J = 7.9 Hz, 2H), 7.46 (d, J = 7.8 Hz, 1H), 7.40 – 7.21 (m, 5H), 7.20 – 7.16 (m, 1H), 7.02 (d, J = 16.1 Hz, 1H), 6.92 (d, J = 16.3 Hz, 1H), 6.76 (d, J = 8.7 Hz, 2H), 3.71 (s, 3H). 13C NMR (101 MHz, CDCl3) δ 159.3, 159.0, 149.5, 139.4, 136.0, 130.5, 130.3, 129.6, 128.7, 127.8, 127.4, 126.1, 125.4, 125.1, 121.9, 114.1, 55.3. Spectral data matches those reported.19

(E)-2-(2-styrylphenyl)pyridine (5ad)

Compound 5ad was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and phenylacetylene 4d (32.9 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ad (65 mg, 84%) as a light yellow oil. 1H NMR (500 MHz, CDCl3) δ 8.65 (d, J = 4.5 Hz, 1H), 7.66 – 7.63 (m, 2H), 7.45 (d, J = 7.4 Hz, 1H), 7.37 – 7.33 (m, 1H), 7.32 (d, J = 7.5 Hz, 1H), 7.28 (d, J = 8.0 Hz, 3H), 7.21 – 7.17 (m, 3H), 7.14 – 7.09 (m, 2H), 6.95 (d, J = 16.2 Hz, 1H). 13C NMR (126 MHz, CDCl3) δ 158.8, 149.5, 139.4, 137.7, 136.4, 135.9, 130.4, 130.3, 128.9, 128.8, 127.9, 127.7, 127.6, 126.7, 126.4, 125.3, 122.1. Spectral data matches those reported.19
(E)-2-(2-(4-bromostyryl)phenyl)pyridine (5ae)

Compound 5ae was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and 1-bromo-4-ethynylbenzene 4e (54.3 µL, 0.3 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ae (93 mg, 92%) as a yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.64 (d, $J = 4.9$ Hz, 1H), 7.66 – 7.62 (m, 2H), 7.44 (d, $J = 8.4$ Hz, 1H), 7.36 – 7.27 (m, 5H), 7.19 – 7.16 (m, 1H), 7.15 – 7.08 (m, 3H), 6.87 (d, $J = 16.3$ Hz, 1H). $^{13}$C NMR (101 MHz, CDCl$_3$) δ 158.9, 149.5, 139.6, 136.6, 136.3, 135.5, 131.8, 130.4, 128.9, 128.4, 128.2, 128.0, 126.4, 125.1, 122.1, 121.4. Spectral data matches those reported.\(^{19}\)

(E)-methyl 4-(2-(pyridin-2-yl)styryl)benzoate (5af)

Compound 5af was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and methyl 4-ethynylbenzoate 4f (48.0 mg, 0.3 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 5ae (37 mg, 39%) as a yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.79 (d, $J = 4.5$ Hz, 1H), 7.97 (d, $J = 8.1$ Hz, 2H), 7.86 – 7.75 (m, 2H), 7.60 (d, $J = 7.5$ Hz, 1H), 7.53 – 7.41 (m, 5H), 7.38 – 7.31 (m, 2H), 7.08 (d, $J = 16.1$ Hz, 1H), 3.90 (s, 3H). $^{13}$C NMR, (101 MHz, CDCl$_3$) δ 167.0, 158.9, 149.7, 142.2, 140.0, 136.3, 135.3, 130.4, 130.3, 130.1, 129.0, 128.9, 128.8, 128.4, 126.5, 125.1, 122.1, 52.2. Spectral data matches those reported.\(^{19}\)
(E)-2-(2-(naphthalen-2-yl)vinyl)phenyl)pyridine (5ag)

[Chemical structure image]

Compound 5ag was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and 2-ethynlnaphthalene 4g (45.6 mg, 0.3 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 5ag (85 mg, 92%) as a white solid. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.68 (d, $J$ = 5.4 Hz, 1H), 7.74 – 7.62 (m, 6H), 7.48 (app.t, $J$ = 8.6 Hz, 2H), 7.40 – 7.29 (m, 6H), 7.20 – 7.17 (m, 1H), 7.13 (d, $J$ = 16.3 Hz, 1H). $^{13}$C NMR (101 MHz, CDCl$_3$) δ 158.9, 149.6, 139.7, 136.2, 135.8, 135.2, 133.7, 133.0, 130.4, 130.3, 128.8, 128.1, 128.0, 127.8, 126.8, 126.4, 126.3, 126.0, 125.2, 123.7, 122.0. Spectral data matches those reported.$^{19}$

(E)-2-(2-(3-phenylprop-1-en-1-yl)phenyl)pyridine (5ah)

[Chemical structure image]

Compound 5ah was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and prop-2-yn-1-ylbenzene 4h (38.0 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ah (52 mg, 64%) as a light yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.61 (d, $J$ = 4.9 Hz, 1H), 7.61 (app.t, $J$ = 8.6 Hz, 1H), 7.48 (d, $J$ = 7.3 Hz, 1H), 7.39 – 7.37 (m, 1H), 7.31 (d, $J$ = 7.8 Hz, 1H), 7.25 – 7.12 (m, 5H), 7.09 (d, $J$ = 7.2 Hz, 3H), 6.43 (d, $J$ = 15.6 Hz, 1H), 6.23 – 6.15 (m, 1H), 3.38 (d, $J$ = 6.8 Hz, 2H). $^{13}$C NMR (101 MHz, CDCl$_3$) δ 159.0, 149.4, 140.3, 138.9, 136.1, 136.0, 130.8, 130.1, 129.9, 128.8, 128.7, 128.6, 127.3, 126.5, 126.2, 125.1, 121.9, 39.6. Spectral data matches those reported.$^{20}$
(E)-2-(2-(4-Phenylbut-1-en-1-yl)phenyl)pyridine (5ai)

![Chemical structure](image)

Compound 5ai was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and but-3-yn-1-ylbenzene 4i (41.7 µL, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ai (53 mg, 62%) as a yellow oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.64 (d, \(J = 4.7\) Hz, 1H), 7.62 – 7.56 (m, 1H), 7.51 (d, \(J = 7.5\) Hz, 1H), 7.42 (d, \(J = 7.2\) Hz, 1H), 7.33 – 7.25 (m, 2H), 7.22 – 7.11 (m, 7H), 6.39 (d, \(J = 15.7\) Hz, 1H), 6.18 – 6.10 (m, 1H), 2.70 (t, \(J = 7.5\) Hz, 2H), 2.43 (q, \(J = 7.1\) Hz, 2H). \(^1\)C NMR (126 MHz, CDCl\(_3\)) \(\delta\) 158.4, 148.8, 141.8, 137.9, 136.7, 136.2, 131.9, 130.2, 129.1, 129.0, 128.7, 128.4, 127.3, 126.6, 125.9, 125.5, 122.0, 35.7, 35.1. Spectral data matches those reported.\(^{21}\)

Methyl (E)-(4-(2-(pyridin-2-yl)styryl)benzoyl)-l-alaninate (5aj)

![Chemical structure](image)

Compound 5aj was prepared according to general procedure B, with the use of 2-phenylpyridine 1a (64.3 µL, 0.45 mmol) and methyl (4-ethynylbenzoyl)-l-alaninate 4j (69.4 mg, 0.3 mmol). The reaction was stirred at 35 °C for 72 h. The crude mixture was purified using flash chromatography (70:30 Hexane/EtOAc) to yield the title compound 5aj (102 mg, 88%) as a yellow oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.68 (d, \(J = 4.2\) Hz, 1H), 7.74 – 7.62 (m, 4H), 7.49 – 7.47 (m, 1H), 7.40 – 7.32 (m, 5H), 7.25 – 7.16 (m, 2H), 6.97 (d, \(J = 16.3\) Hz, 1H), 6.74 (d, \(J = 7.3\) Hz, 1H), 4.73 – 4.66 (m, 1H), 3.69 (s, 3H), 1.42 (d, \(J = 7.2\) Hz, 3H). \(^1\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 173.8, 166.4, 158.4, 149.1, 141.0, 139.2, 136.9, 135.4, 132.6, 130.5, 129.6, 129.1, 129.1, 128.3, 127.6, 126.7, 126.5, 125.3, 122.3, 52.7, 48.6, 18.7. Spectral data matches those reported.\(^{22}\)
(E)-2-(2-(1-phenylprop-1-en-1-yl)phenyl)pyridine (5ak)

![Chemical structure of 5ak]

Compound 5ak was prepared according to general procedure C, with the use of 2-phenylpyridine \(1a\) (43.0 µL, 0.3 mmol) and prop-1-yn-1-ylbenzene \(4k\) (55.6 µL, 0.45 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5ak (46 mg, 57%) as a colorless oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.71 (d, \(J = 5.6\) Hz, 1H), 7.69 – 7.61 (m, 2H), 7.54 (d, \(J = 7.8\) Hz, 1H), 7.43 – 7.42 (m, 3H), 7.33 (d, \(J = 6.8\) Hz, 2H), 7.24 – 7.19 (m, 4H), 6.47 (s, 1H), 1.93 (s, 3H). \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 159.7, 149.6, 144.8, 139.1, 138.8, 138.2, 135.9, 130.8, 130.3, 129.1, 128.9, 128.5, 128.3, 127.5, 126.5, 124.3, 121.7, 20.2.

Mass calcd for C\(_{20}\)H\(_{18}\)N [M+H]: 272.1434. Mass Found: 272.1425. Structure confirmed using HMBC and 2-D NOESY NMR.

(E)-2-(2-(1-phenylpent-1-en-2-yl)phenyl)pyridine (5al)

![Chemical structure of 5al]

Compound 5al was prepared according to general procedure C, with the use of 2-phenylpyridine \(1a\) (43.0 µL, 0.3 mmol) and pent-1-yn-1-ylbenzene \(4l\) (71.0 µL, 0.45 mmol). The crude mixture was purified using flash chromatography (85:15 Hexane/EtOAc) to yield the title compound 5al (61 mg, 68%) as a colorless oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.60 (d, \(J = 4.9\) Hz, 1H), 7.56 – 7.49 (m, 3H), 7.32 – 7.29 (m, 3H), 7.23 (d, \(J = 7.5\) Hz, 2H), 7.14 – 7.09 (m, 4H), 6.45 (s, 1H), 2.04 – 1.96 (m, 2H), 1.17 – 1.08 (m, 2H), 0.59 (t, \(J = 7.3\) Hz, 3H). \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 159.6, 149.6, 144.7, 143.0, 138.8, 138.2, 135.8, 130.8, 130.2, 130.0, 128.8, 128.4, 128.3, 127.5, 126.6, 124.4, 121.8, 34.1, 21.8, 14.1.

Mass calcd for C\(_{22}\)H\(_{22}\)N [M+H]: 300.1747. Mass Found: 300.1744. Structure confirmed using HMBC and 2-D NOESY NMR.
Methyl (Z)-3-phenyl-2-(2-(pyridin-2-yl)phenyl)acrylate (5am)

\[
\begin{align*}
&\text{N} \\
&\text{CO}_2\text{Me}
\end{align*}
\]

Compound 5am was prepared according to general procedure C, with the use of 2-phenylpyridine 1a (43.0 µL, 0.3 mmol) and methyl 3-phenylpropiolate 4m (64.4 µL, 0.45 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 5am (44 mg, 47%) as a colorless oil. \( ^1\text{H NMR} \) (400 MHz, CDCl\(_3\)) \( \delta \) 8.56 (d, \( J = 4.9 \) Hz, 1H), 7.72 (d, \( J = 6.0 \) Hz, 2H), 7.59 – 7.55 (m, 1H), 7.51 – 7.47 (m, 1H), 7.40 – 7.36 (m, 1H), 7.34 (d, \( J = 7.9 \) Hz, 1H), 7.24 – 7.22 (m, 1H), 7.20 – 7.10 (m, 4H), 7.03 – 7.00 (m, 2H), 3.57 (s, 3H). \( ^{13}\text{C NMR} \) (126 MHz, CDCl\(_3\)) \( \delta \) 168.4, 158.6, 158.4, 149.4, 140.5, 140.3, 136.1, 134.8, 134.8, 132.9, 131.1, 130.5, 130.0, 129.1, 129.0, 128.7, 128.4, 123.1, 121.8, 121.6, 52.3. Mass calcd for C\(_{21}\)H\(_{18}\)O\(_2\)N [M+H]: 316.1332. Mass Found: 316.1326. Structure confirmed using HMBC and 2-D NOESY NMR.

\((E)-2-(2-(1,2-diphenylvinyl)phenyl)pyridine (5an)\)

\[
\begin{align*}
&\text{N} \\
&\text{sp}^2
\end{align*}
\]

Compound 5an was prepared according to general procedure C, with the use of 2-phenylpyridine 1a (43.0 µL, 0.3 mmol) and 1,2-diphenylethyne 4n (80.2 µL, 0.45 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 5an (47 mg, 47%) as a colorless oil. \( ^1\text{H NMR} \) (500 MHz, CDCl\(_3\)) \( \delta \) 8.46 (d, \( J = 4.9 \) Hz, 1H), 7.52 – 7.51 (m, 1H), 7.46 – 7.40 (m, 4H), 7.32 (d, \( J = 7.8 \) Hz, 1H), 7.13 – 7.08 (m, 3H), 7.05 – 7.01 (m, 4H), 7.00 – 6.98 (m, 2H), 6.93 – 6.92 (m, 2H), 6.67 (s, 1H). \( ^{13}\text{C NMR} \) (126 MHz, CDCl\(_3\)) \( \delta \) 159.7, 149.1, 143.6, 142.5, 140.6, 140.3, 137.7, 135.5, 131.2, 131.0, 130.3, 129.3, 128.3, 128.0, 127.8, 127.8, 126.9, 126.8, 124.5, 121.3. Spectral data matches those reported. Structure confirmed using 2-D NOESY NMR.
(E)-2-(2-(1,2-bis(4-bromophenyl)vinyl)phenyl)pyridine (5ao)

Compound 5ao was prepared according to general procedure C, with the use of 2-phenylpyridine 1a (43.0 µL, 0.3 mmol) and 1,2-bis(4-bromophenyl)ethyne 4o (151.2 µL, 0.45 mmol). The crude mixture was purified using flash chromatography (80:20 Hexane/EtOAc) to yield the title compound 5ao (74 mg, 50%) as a colorless oil. 

\[ {^1H \text{ NMR}} \ (400 \text{ MHz, CDCl}_3) \ \delta \ 8.53 \ (d, \ J = 4.0 \text{ Hz, 1H}), \ 7.49 \ (\text{app. t, } J = 4.7 \text{ Hz, 4H}), \ 7.30 \ (d, \ J = 9.5 \text{ Hz, 4H}), \ 7.15 \ (d, \ J = 8.4 \text{ Hz, 3H}), \ 6.94 \ (d, \ J = 8.6 \text{ Hz, 2H}), \ 6.77 \ (d, \ J = 8.6 \text{ Hz, 2H}), \ 6.69 \ (s, 1H). \]

\[ {^{13}C \text{ NMR}} \ (126 \text{ MHz, CDCl}_3) \ \delta \ 159.4, \ 148.8, \ 142.9, \ 142.2, \ 140.2, \ 139.0, \ 136.2, \ 136.0, \ 131.9, \ 131.3, \ 131.1, \ 131.0, \ 130.9, \ 130.4, \ 130.2, \ 128.6, \ 128.3, \ 124.4, \ 121.6, \ 121.2, \ 121.0. \]

Mass calcd for C\textsubscript{25}H\textsubscript{18}NBr\textsubscript{2} [M+H]: 489.9801. Mass Found: 489.9799. Structure confirmed using \textbf{2-D NOESY NMR}. 
7. Mechanistic Studies

7.1 Competition experiments between electron-rich and poor aromatics

In an argon-filled glove box, [MnBr(CO)$_3$(MeCN)$_2$] (9.0 mg, 10 mol%) catalyst was weighed and transferred to an oven dried microwave vial containing magnetic stirrer bar, followed by addition of 1f (100.4 mg, 0.45 mmol), 1b (83.25 mg, 0.45 mmol), n-butyl acrylate (43.2 μL, 0.3 mmol), and Cy$_2$NH (11.9 μL, 20 mol%) dissolved in diethyl ether (0.3 mL, 1 M). The vial was sealed, taken out of the glove box and the reaction stirred at 35 °C for 16 h. After this time, 1 mL of a stock solution with internal standard (1,3,5-trimethoxybenzene (0.1 M in Et$_2$O)) was added to the reaction. The reaction was then filtered through a short pad of silica into an NMR tube. Analysis of the crude using $^1$H NMR, with reference to the spectra of pure compounds, showed the formation of 3fa (25%) and 3ba (75%).
7.2 Kinetic Concentration Sensitivity Experiments

General procedure employing 2-phenylpyridine 1a and butylacrylate 2a:

\[
\begin{align*}
\text{1a} & \quad 0.45 \text{ mmol} \\
\text{2a} & \quad 0.3 \text{ mmol}
\end{align*}
\]

\[
\text{[MnBr(CO)\textsubscript{3}(MeCN)\textsubscript{2}]} \text{ (10 mol\%)} \\
\text{Cy\textsubscript{2}NH} \text{ (20 mol\%)}
\]

\[
\text{Et\textsubscript{2}O (1 M), 35 \degree C, 4 h}
\]

In an argon-filled glove box, MnBr(CO)\textsubscript{3}(MeCN)\textsubscript{2} catalyst was weighed and transferred to an oven dried microwave vial containing a magnetic stirrer bar, followed by addition of 2-phenylpyridine 1a. Stock solutions of \textit{n}-butyl acrylate 2a and Cy\textsubscript{2}NH in Et\textsubscript{2}O were prepared, these were added to the vial via microsyringe. The vial was sealed, taken out of the glove box and the reaction stirred at 35 \degree C for 4 h. After the time duration, a stock solution of internal standard hexadecane was added and the reaction mixture was filtered through a short plug of silica into a GC vial ready for analysis.

| Entry | Variation | Recovered 1a (mmol) | 3aa (mmol) | kinetic sensitivity |
|-------|-----------|---------------------|------------|---------------------|
| 1     | -         | 0.34                | 0.10       | -                   |
| 2     | 1a (0.9 mmol) | 0.70                | 0.19       | Positive on 1a      |
| 3     | 2a (0.9 mmol) | 0.37                | 0.06       | Negative on 2a      |
| 4     | 3aa (0.1 mmol) | 0.36                | 0.18       | Negative on 3aa     |
| 5     | [Mn] (5 mol\%) | 0.38                | 0.07       | Positive on [Mn]    |
| 6     | Cy\textsubscript{2}NH (10 mol\%) | 0.37 | 0.08 | Positive on Cy\textsubscript{2}NH |

Table 6. Results of kinetic order. Yields determined by GC-FID using hexadecane as an internal standard.
7.3 Kinetic Experiments for determination of orders

7.3.1 General procedure for kinetic experiments employing 2-phenylpyridine 1a and butylacrylate 2a:

\[
\begin{align*}
\text{1a} & \quad \text{0.45 mmol} \\
\text{2a} & \quad \text{0.3 mmol} \\
\end{align*}
\]

In an argon-filled glove box, MnBr(CO)$_3$(MeCN)$_2$ catalyst was weighed and transferred to an oven dried microwave vial containing a magnetic stirrer bar. Stock solutions in Et$_2$O were prepared for \textit{n}-butyl acrylate 2a and Cy$_2$NH, and internal standard hexadecane, these were added to the vial. The vial was capped with a rubber stopper and the reaction was then heated at 35 °C inside the glove box, before a solution of 2-phenylpyridine 1a in Et$_2$O was added at 0 min to start the reaction. Aliquots of approximately 20 µL were then taken throughout the first 4 h of the reaction at specified time points. Each aliquot was added to approximately 0.5 mL of a solution of 1% pyridine in EtOAc (v/v), before being passed through a short plug of silica into a GC vial ready for analysis. The reaction was then monitored by GC-FID, using hexadecane as the internal standard.
7.3.2 Determination of Order in Catalyst

The order in catalyst has been determined using normalized time scale analysis. Reactions were carried out with different concentrations of catalyst and their temporal profiles were normalized according to the catalyst loading raised to the power of the order in the catalyst. All the resulting curves were plotted together and the correct order in catalyst is the one that causes the curves to overlay.

Figure 1. Determination of order in catalyst. (a) Temporal reaction profiles of reactions carried out with 10/15 mol % of [MnBr(CO)₃(MeCN)₂]; (b) Normalized time scale profiles for order 0.5 in [MnBr(CO)₃(MeCN)₂]; (c) Normalized time scale profiles for order 1.0 in [MnBr(CO)₃(MeCN)₂]; (d) Normalized time scale profiles for order 2.0 in [MnBr(CO)₃(MeCN)₂].

The overlap between the temporal reaction profiles with catalyst loadings of 10 and 15 mol % suggests that the order in [MnBr(CO)₃(MeCN)₂] is 1.0 at these concentrations.
7.3.3 Determination of Orders in Additive

Figure 2. Determination of order in Cy$_2$NH. (a) Temporal reaction profiles of reactions carried out with 10/20 mol % of [Cy$_2$NH]; (b) Normalized time scale profiles for order -0.5 in [Cy$_2$NH]; (c) Normalized time scale profiles for order 0.3 in [Cy$_2$NH]; (d) Normalized time scale profiles for order 1 in [Cy$_2$NH].

The overlap between the temporal reaction profiles with 10 and 20 mol % of additive suggests that the order in Cy$_2$NH is 0.3 at these concentrations.
7.3.4 Determination of Orders in Reagents

Determination of order in 1a

Figure 3. Determination of order in 1a. (a) Temporal reaction profiles of reactions carried out with 2.25/4.5 mmol of [1a]; (b) Normalized time scale profiles for order 0.5 in [1a]; (c) Normalized time scale profiles for order 1 in [1a]; (d) Normalized time scale profiles for order 2 in [1a].

The overlap between normalised time scale reaction profiles for these two reactions with differing concentrations of 1a shows an order of 1. This strongly suggests the C-H activation step of 1a is kinetically relevant.
Determination of order in 2a

Figure 4. Determination of order in 2a. (a) Temporal reaction profiles of reactions carried out with 1.5/3/4.5 mmol of [2a]; (b) Normalized time scale profiles for order -1 in [2a]; (c) Normalized time scale profiles for order -0.6 in [2a]; (d) Normalized time scale profiles for order 1 in [2a].

The overlap between reaction profiles for these two reactions with differing concentrations of 2a shows an order of -0.6. This inverse dependence on the concentration of alkene suggests that multiple coordination of the alkene are possible to form an off-cycle species of the type [Mn(2a)₂].
8. Copies of $^1H$ and $^{13}C$ NMR for isolated Compounds

$[\text{MnBr(CO)}_3(\text{MeCN})_2]$ complex

$^1H$-NMR (500 MHz, DMSO-d$_6$)

$^{13}C$-NMR (126 MHz, DMSO-d$_6$)
4-acetyl-2-methoxyphenyl acrylate (2g)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (101 MHz, CDCl$_3$)
(3S,8S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-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 acrylate (2h)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (101 MHz, CDCl$_3$)
(S)-4-(2-((tert-butoxycarbonyl)amino)-3-methoxy-3-oxopropyl)phenyl acrylate (2i)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (101 MHz, CDCl$_3$)
**n-Butyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3aa)**

**H-NMR (500 MHz, CDCl₃)**

\[
\text{\begin{center}
\includegraphics[width=0.8\textwidth]{h-nmr.png}
\end{center}}
\]

**C-NMR (126 MHz, CDCl₃)**

\[
\text{\begin{center}
\includegraphics[width=0.8\textwidth]{c-nmr.png}
\end{center}}
\]
$n$-Butyl 3-(5-methoxy-2-(pyridin-2-yl)phenyl)propanoate (3ba)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
\textbf{\textit{n}-Butyl 3-(4-(pyridin-2-yl)-[1,1'-biphenyl]-3-yl)propanoate (3ca)}

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
$n$-Butyl 3-(5-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3da)

$^1$H-NMR (500 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
$^{19}$F-NMR (376 MHz, CDCl$_3$)

$n$-Butyl 3-(5-chloro-2-(pyridin-2-yl)phenyl)propanoate (3ea)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

$n$-Butyl 3-(2-(pyridin-2-yl)-5-(trifluoromethyl)phenyl)propanoate (3fa)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

$^{19}$F-NMR (376 MHz, CDCl$_3$)
Methyl 3-(3-butoxy-3-oxopropyl)-4-(pyridin-2-yl)benzoate (3ga)

$^1$H-NMR (500 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
$n$-Butyl 3-(3-methoxy-2-(pyridin-2-yl)phenyl)propanoate (3ha)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
n-Butyl 3-(3-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3ia)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (101 MHz, CDCl$_3$)
$^{19}$F-NMR (376 MHz, CDCl$_3$)

$n$-Butyl 3-(4-methyl-2-(pyridin-2-yl)phenyl)propanoate (3ja)

$^1$H-NMR (400 MHz, CDCl$_3$)
\[ ^1 \text{H-NMR (400 MHz, CDCl}_3) \]

\[ ^{13} \text{C-NMR (101 MHz, CDCl}_3) \]

*n-Butyl 3-(2-(pyridin-2-yl)-4-(trifluoromethyl)phenyl)propanoate (3ka)*

\[ ^1 \text{H-NMR (400 MHz, CDCl}_3) \]

\[ ^{13} \text{C-NMR (101 MHz, CDCl}_3) \]
$^{13}\text{C}-\text{NMR (126 MHz, CDCl}_3\text{)}$

$^{19}\text{F}-\text{NMR (376 MHz, CDCl}_3\text{)}$
Methyl 4-(3-butoxy-3-oxopropyl)-3-(pyridin-2-yl)benzoate (3la)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
*n*-Butyl 3-(2-(5-methylpyridin-2-yl)phenyl)propanoate (3ma)

\[^1^H\text{-NMR} \ (500 \text{ MHz, CDCl}_3)\]

\[^{13}C\text{-NMR} \ (126 \text{ MHz, CDCl}_3)\]
*n*-Butyl 3-(2-(1H-pyrazol-1-yl)phenyl)propanoate (3na)

$^1$H-NMR (500 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
n-Butyl 3-(2-(2-oxo-2,3-dihydro-1H-benzo[e][1,4]diazepin-5-yl)phenyl)propanoate (3oa)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
*n*-Butyl 3-(2-(7-chloro-1-methyl-2-oxo-2,3-dihydro-1H-benzo[e][1,4]diazepin-5-yl)phenyl)propanoate (3pa)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
$n$-Butyl 3-(2-fluoro-6-(pyridin-2-yl)phenyl)propanoate (3qa) and $n$-Butyl 3-(4-fluoro-2-(pyridin-2-yl)phenyl)propanoate (3qa’)

$^1$H NMR (400 MHz, CDCl$_3$)

$^13$C NMR (101 MHz, CDCl$_3$)
$^{19}\text{F NMR (376 MHz, CDCl}_3\text{)}$

2-D COSY-NMR (400 MHz, CDCl$_3$)
2-D NOESY-NMR (400 MHz, CDCl$_3$)

Methyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3ab)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

$t$-Butyl 3-(2-(pyridin-2-yl)phenyl)propanoate (3ac)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

4-(2-(pyridin-2-yl)phenyl)butan-2-one (3ad)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

3-(2-(Pyridin-2-yl)phenyl)cyclohexanone (3ae)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

1,3-diphenyl-3-(2-(pyridin-2-yl)phenyl)propan-1-one (3af)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

4-acetyl-2-methoxyphenyl 3-(2-(pyridin-2-yl)phenyl)proanoate (3ag)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

(3S,8S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-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 3-(2-(pyridin-2-yl)phenyl)propanoate (3ah)

$^1$H-NMR (400 MHz, CDCl$_3$)
\[^{13}\text{C}-\text{NMR (101 MHz, CDCl}_3\text{)}\]

Methyl(S)-2-((tert-butoxycarbonyl)amino)-3-(4-((3-(2-(pyridin-2-yl)phenyl)propanoyl)oxy)phenyl)propanoate (3ai)

\[^1\text{H NMR (400 MHz, CDCl}_3\text{)}\]
$^{13}\text{C}$ NMR (101 MHz, CDCl$_3$)

(E)-2-(2-(hex-1-en-1-yl)phenyl)pyridine (5aa)

$^1\text{H}$ NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

(E)-2-(2-(dec-1-en-1-yl)phenyl)pyridine (5ab)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

(E)-2-(2-(4-methoxystyryl)phenyl)pyridine (5ac)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

$(E)$-2-(2-styrylphenyl)pyridine (5ad)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

(E)-2-(2-(4-bromostyryl)phenyl)pyridine (5ae)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

(E)-methyl 4-(2-(pyridin-2-yl)styryl)benzoate (5af)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

(E)-2-(2-(naphthalen-2-yl)vinyl)phenyl)pyridine (5ag)

$^1$H-NMR (400 MHz, CDCl$_3$)
\(^{13}\)C-NMR (101 MHz, CDCl\(_3\))

\((E)\)-2-(2-(3-phenylprop-1-en-1-yl)phenyl)pyridine (5ah)

\(^1\)H-NMR (400 MHz, CDCl\(_3\))
$^{13}$C-NMR (101 MHz, CDCl$_3$)

(E)-2-(2-(4-Phenylbut-1-en-1-yl)phenyl)pyridine (5ai)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

Methyl (E)-(4-(2-(pyridin-2-yl)styryl)benzoyl)-L-alaninate (5aj)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

(E)-2-(2-(1-phenylprop-1-en-1-yl)phenyl)pyridine (5ak)

$^1$H-NMR (400 MHz, CDCl$_3$)
$^{13}$C-NMR (101 MHz, CDCl$_3$)

2-D NOESY-NMR (500 MHz, CDCl$_3$)
HMBC-NMR (400 MHz, CDCl$_3$)

$\text{(E)}$-2-(2-(1-phenylpent-1-en-2-yl)phenyl)pyridine (5al)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

2-D NOESY-NMR (400 MHz, CDCl$_3$)
HMBC-NMR (400 MHz, CDCl₃)

Methyl (Z)-3-phenyl-2-(2-(pyridin-2-yl)phenyl)acrylate (5am)

¹H-NMR (500 MHz, CDCl₃)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

2-D NOESY-NMR (400 MHz, CDCl$_3$)
HMBC-NMR (400 MHz, CDCl$_3$)

(E)-2-(2-(1,2-diphenylvinyl)phenyl)pyridine (5an)

$^1$H-NMR (500 MHz, CDCl$_3$)
$^{13}$C-NMR (126 MHz, CDCl$_3$)

2-D NOESY-NMR (400 MHz, CDCl$_3$)
(E)-2-(2-(1,2-bis(4-bromophenyl)vinyl)phenyl)pyridine (5ao)

$^1$H-NMR (400 MHz, CDCl$_3$)

$^{13}$C-NMR (126 MHz, CDCl$_3$)
2-D NOESY-NMR (400 MHz, CDCl₃)
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