SUPPORTING INFORMATION

Transition-Metal-Free Decarboxylative Iodination: New Routes for Decarboxylative Oxidative Cross-Couplings

Gregory J. P. Perry, Jacob M. Quibell and Adyasha Panigrahi and Igor Larrosa*

School of Chemistry, University of Manchester, Oxford Road, Manchester, M13 9PL (UK)

*Corresponding Author: igor.larrosa@manchester.ac.uk
Contents

General Information..........................................................................................................................................3
General Procedure A for the Decarboxylative Iodination of Aromatic Acids..............................................4
Preparation of Starting Materials .....................................................................................................................5
Optimisation of the Decarboxylative Iodination...............................................................................................9
Experimental details, Spectroscopic data and Analytical data ...................................................................10
Scheme S1. The scope of the decarboxylative iodination of benzoic acids using low equivalents (1.0 - 2.0 equiv) of I₂ ........................................................................................................................................27
Scheme S2. The scope of the decarboxylative iodination of heteroaromatic acids using low equivalents (1.0 - 2.0 equiv) of I₂ ......................................................................................................................................28
Robustness Screen for the Decarboxylative Iodination of Aromatic Acids .................................................29
Procedure for Multi-Gram Scale Synthesis of 2-Iodo-1,3-dimethoxybenzene (2f) ..........................32
Radical clock experiment with 2-(allyloxy)-4-methoxybenzoic acid (1A) ........................................33
Computational Methods....................................................................................................................................34
Hammett Plot Analysis ..................................................................................................................................46
General Procedures for the Decarboxylative Cross-Coupling of Benzoic acids with Arenes.60
General Procedures for the Decarboxylative Cross-Coupling of Two Benzoic acids.........................65
Scheme S5. Summary of the conditions for the decarboxylative oxidative cross-coupling between benzoic acids and arenes........................................................................................................69
Scheme S6. Summary of the conditions for the decarboxylative oxidative cross-coupling between two benzoic acids..................................................................................................................................70
NMR Spectra ....................................................................................................................................................71
References.........................................................................................................................................................156
General Information

Unless otherwise indicated, all reactions were carried out in 10 mL microwave vials using reagents obtained from commercial sources and used without further purification. K$_3$PO$_4$ was kept in a vacuum oven at 200 °C for 24 h prior to use and stored in a glove box. All other starting materials and solvents were purchased from Acros, Aldrich, Alfa Aesar, Fluorochem, Apollo Scientific and Manchester Organics, and used without further purification unless otherwise stated. Column chromatography was performed on silica gel (40–63 μm) or on a Biotage Isolera Four purification system using pre-packed silica cartridges. AgNO$_3$ impregnated silica gel was prepared by absorbing a solution of AgNO$_3$ in MeCN (10% wt of AgNO$_3$ to silica) onto silica. The MeCN was removed under reduced pressure on a rotary evaporator and the silica was further dried under vacuum overnight. Thin layer chromatography (TLC) was carried out on pre-coated silica gel F254 plates with visualization under UV light or using an aqueous basic KMnO$_4$ solution. Melting points were obtained using a Stuart SMP11 apparatus and are uncorrected. IR spectra were recorded using a Thermo Scientific Nicolet iS5 FTIR machine, relevant bands are quoted in cm$^{-1}$. High resolution mass spectra were performed by the School of Chemistry Mass Spectrometry Service (University of Manchester) employing a Thermo Finnigan MAT95XP or Thermo Exactive Plus EMR spectrometer. Elemental analyses were performed by the School of Chemistry Microanalysis Laboratory (University of Manchester) using a Flash 2000 elemental analyser machine. $^1$H NMR, $^{19}$F NMR and $^{13}$C NMR spectra were recorded at 400 or 500 MHz on Bruker machines. $^1$H NMR are referenced to the residual solvent peak at 7.26 ppm (CDCl$_3$), 2.50 ppm ((CD$_3$)$_2$SO) or 2.05 ppm ((CD$_3$)$_2$CO) and quoted in ppm to 2 decimal places with coupling constants ($J$) to the nearest 0.1 Hz. $^{13}$C NMR spectra, recorded at 101 MHz or 126 MHz, are referenced to the solvent peak at 77.16 ppm (CDCl$_3$), 39.52 ppm ((CD$_3$)$_2$SO) or 29.84 ppm ((CD$_3$)$_2$CO) and quoted in ppm to 1 decimal place with coupling constants ($J$) to the nearest 0.1 Hz. $^{19}$F NMR spectra were recorded at 376 or 471 MHz in CDCl$_3$ and quoted in ppm to 2 decimal places and with coupling constants ($J$) to the nearest 0.1 Hz.
General Procedure A for the Decarboxylative Iodination of Aromatic Acids

A flame-dried 10 mL microwave vial was charged with I₂ (507.6 mg, 2.00 mmol, 4.0 equiv), capped and flushed with N₂. The vial was transferred to a glove box, then (hetero)aromatic carboxylic acid (0.50 mmol, 1.0 equiv), anhydrous K₃PO₄ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous MeCN (2.5 mL, 0.2 M) were added. The vial was capped, transferred out of the glove box and stirred at the given temperature for the given time. On completion of the reaction, the mixture was cooled to room temperature, then 15% Na₂S₂O₈ (aq, 10.0 mL) and sat. Na₂CO₃ (aq, 10 mL) were added. The organic phase was collected by washing with CH₂Cl₂ (3 × 15 mL), dried over MgSO₄ and concentrated in vacuo. The mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of celite with further washings of pentane/EtOAc (4 × 10 mL, 98:2) Removal of the solvent in vacuo gave the desired product.

Note: The reaction can be set up without the use of a glovebox (Table S1, entry 21). The reagents can be weighed on the open bench and the reaction carried out under air. In this case, anhydrous K₃PO₄ was only removed from the vacuum oven immediately prior to weighing. K₃PO₄ is hygroscopic and we found that the yields decrease on prolonged exposure of this reagent to air.
Preparation of Starting Materials

**Preparation of potassium 2-methoxybenzoate (K-1a)**

Adapted from the reported procedure,1 a solution of tBuOK (224.4 mg, 2.00 mmol, 1.0 equiv) in EtOH (5.0 mL) was added dropwise to a solution of 2-methoxybenzoic acid (304.3 mg, 2.00 mmol, 1.0 equiv) in EtOH (5.0 mL) at room temperature. After 1 hour, part of the solvent was removed and Et₂O (20 mL) was added. The mixture was filtered and washed with cold EtOH and cold Et₂O. The resulting solid was dried in a vacuum oven at 70 °C for 12 h to afford the corresponding potassium salt as a white solid (319.6 mg, 84%). Spectroscopic data matched those previously reported.2

1H NMR (500 MHz, (CD₃)₂SO) δ 7.17 (d, J = 7.3 Hz, 1H), 7.08 (app t, J = 7.7 Hz, 1H), 6.83 (d, J = 8.2 Hz, 1H), 6.77 (app t, J = 7.3 Hz, 1H), 3.69 (s, 3H); 13C NMR (126 MHz, (CD₃)₂SO) δ 170.5, 155.4, 135.0, 127.7, 126.7, 119.6, 111.4, 55.2.

**Preparation of ((2-methoxybenzoyl)oxy)silver (Ag-1a)**

2-methoxybenzoic acid (60.9 mg, 0.40 mmol, 1.0 equiv) was partially dissolved in water (1.0 mL) before dropwise addition of a solution of NaOH (15.8 mg, 0.396 mmol, 0.99 equiv) in H₂O (0.8 mL). The mixture was stirred at 40 °C for 30 mins until all solids had dissolved in solution. Then a solution of AgNO₃ (68.0 mg, 0.40 mmol, 1.0 equiv) in H₂O (1.0 mL) was added dropwise, instantly forming the desired silver benzoate. The mixture was filtered and washed with H₂O and cold acetone. The resulting solid was dried in a vacuum oven at 70 °C for 12 h affording the corresponding silver salt as a white solid (77.7 mg, 75%).

1H NMR (500 MHz, (CD₃)₂SO) δ 7.38 (d, J = 7.4 Hz, 1H), 7.27 (app t, J = 7.8 Hz, 1H), 6.97 (d, J = 8.3 Hz, 1H), 6.88 (app t, J = 7.4 Hz, 1H), 3.74 (s, 3H); 13C NMR (126 MHz, (CD₃)₂SO) δ 171.3, 156.1, 129.7, 129.1, 128.7, 119.8, 111.7, 55.3; IR (ATR) 3004, 1507, 1377, 1102, 744; m.p. 170 - 175 °C with decomposition; Anal. Calcd. for C₈H₇AgO₃: C, 37.10; H, 2.72, Ag, 41.65. Found: C, 36.60; H, 2.48, Ag, 39.72; MS (ES⁻, DMSO) m/z 408.9 (40%) [(M + C₈H₇O₃)⁻].

**Preparation of methyl 2-(methoxymethoxy)benzoate (Me-1o)**

Methyl salicylate (1.30 mL, 10.0 mmol, 1.0 equiv) was dissolved in THF (35 mL) and cooled to 0 °C. NaH (60% dispersion in mineral oil, 800.0 mg, 20 mmol, 2.0 equiv) was added portion wise and the mixture stirred at 0 °C for 30 mins. After this time, chloromethyl methyl ether (1.52 mL, 20 mmol, 2.0 equiv) was added dropwise and the mixture allowed to warm to room temperature over 16 h. After this time the reaction was quenched with H₂O (10 mL) and sat. NaHCO₃ (aq, 10 mL). The mixture was extracted with EtOAc (3 × 30 mL), dried over MgSO₄, filtered and concentrated in vacuo to provide the desired product as a colourless oil (1.94 g, 99%). Spectroscopic data matched those previously reported.3

1H NMR (400 MHz, CDCl₃) δ 7.77 (dd, J = 7.8, 1.8 Hz, 1H), 7.43 (ddd, J = 8.4, 7.5, 1.8 Hz, 1H), 7.19 (d, J = 8.4 Hz, 1H), 7.04 (app t, J = 7.6 Hz, 1H), 5.25 (s, 2H), 3.89 (s, 3H), 3.52 (s,
Preparation of 2-(methoxymethoxy)benzoic acid (1o)
Methyl 2-(methoxymethoxy)benzoate (1.94 g, 9.9 mmol, 1.0 equiv) was dissolved in EtOH (15 mL) and aq LiOH (2 M, 6 mL) was added. The mixture was stirred at room temperature for 24 h then sat. Na₂CO₃ was added (10 mL) and the mixture washed with EtOAc (3 × 10 mL). The aqueous phase was acidified to pH 3 with 2 M aq HCl and the mixture was extracted with EtOAc, dried over MgSO₄, filtered and concentrated in vacuo to provide the desired product as a white solid (1.26 g, 70%).

Spectroscopic data matched those previously reported.

Preparation of 4-((triisopropylsilyl)oxy)benzoic acid (1p)
Silylation: Benzyl 4-hydroxybenzoate (1.14 g, 5.0 mmol, 1.0 equiv), triisopropylchlorosilane (1.2 mL, 5.5 mmol, 1.1 equiv) and DBU (1.1 mL, 7.5 mmol, 1.5 equiv) were mixed in dry DCM (50 mL) at room temperature to afford benzyl 4-((triisopropylsilyl)oxy)benzoate. The reaction mixture was quenched with water and extracted with DCM, which was washed with brine and dried over magnesium sulfate and the solvents were removed in vacuo to yield benzyl 4-((triisopropylsilyl)oxy)benzoate as an oily liquid. The crude product was used without further purification. Hydrogenolysis of benzyl 4-((triisopropylsilyl)oxy)benzoate: A 250 mL oven dried flask was charged with the crude benzyl 4-((triisopropylsilyl)oxy)benzoate (896 mg, 2.3 mmol, 1 equiv), to it Pd/C 10%wt (23 mg, 0.23 mmol, 10 mol%) and dry EtOAc (100 mL) was added. The reaction mixture was then flushed and stirred under hydrogen (1 ATM) for 16 h. After the allotted time the reaction mixture was then filtered through Celite with further washings of EtOAc. The filtrate was then basified by Na₂CO₃ sat. and the organic layers removed. The aqueous layer was then acidified to ~pH 2 with HCl (2 M) and the product was extracted with EtOAc (3 x 15 mL) which after removal of the solvents afforded pure 4-((triisopropylsilyl)oxy)benzoic acid as a white solid (1.32 g; 90%).

Spectroscopic data matched those previously reported.

Preparation of 4-(2-(dimethylamino)-2-oxoethoxy)benzoic acid (1q)
Adapted from the reported procedure. Alkylation: Benzyl 4-hydroxybenzoate (1.14 g, 5.0 mmol, 1.0 equiv), N,N-dimethyl-2-chloroacetamide (0.6 mL, 5.5 mmol, 1.1 equiv) and potassium carbonate (1.00 g, 7.5 mmol, 1.5 equiv) were mixed in dry DMF (5 mL) and stirred at room temperature.
temperature for 16 h to afford. The reaction mixture was quenched with water and extracted with EtOAc (3 × 15 mL), the organic extracts were combined, washed with brine and dried over magnesium sulphate, the solvents were then removed in vacuo to yield benzyl 4-(2-(dimethylamino)-2-oxoethoxy)benzoate as an oily liquid. The crude product was used without further purification. Hydrogenolysis of benzyl 4-(2-(dimethylamino)-2-oxoethoxy)benzoate: A 250 mL oven dried flask was charged with the 4-(2-(dimethylamino)-2-oxoethoxy)benzoate (720.7 mg, 2.3 mmol 1.0 equiv), to it Pd/C 10% w (23 mg, 0.23 mmol, 10 mol%) and dry EtOAc (100 mL) was added. The reaction mixture was flushed and stirred under of hydrogen (1 atm) for 16 h. After this time, the reaction mixture was filtered through Celite with further washings of EtOAc. The filtrate was then basified by Na2CO3 sat. and the organic layers removed. The aqueous layer was then acidified to ~pH 2 with HCl (2 M) and the product was extracted with EtOAc (3 × 15 mL) which after removal of the solvents afforded pure 4-(2-(dimethylamino)-2-oxoethoxy)benzoic acid (950 mg; 85%).

Preparation of (8R,9S,13S,14S)-3-methoxy-13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-6H-cyclopenta[a]phenanthrene-2-carboxylic acid (methylestrone-2-carboxylic acid, 1af)

Carboxylation: In the glove box, a vial was charged with NaH (60% dispersion in mineral oil, 240.0 mg, 6.0 mmol, 4.0 equiv) estrone (405.6 mg, 1.50 mmol, 1.0 equiv) and 2,4,6-trimethylphenol (204.3 mg, 1.50 mmol, 1.0 equiv). Then anhydrous THF (6 mL) was added and the mixture stirred for 5 min at room temperature. The THF was carefully removed under vacuum and the remaining solid mixture was ground to a fine powder using a spatula before sealing and removing the vial from the glove box. The mixture was purged with CO2 and reacted under a balloon filled with CO2 at 185 °C for 16 h. After this time, the reaction mixture was cooled to room temperature, and quenched with H2O (60 mL). To the mixture was added sat. Na2CO3 (aq, 20 mL) and the aqueous phase washed with EtOAc (3 × 30 mL). The aqueous phase was then acidified to pH 2 with 2 M aq HCl and extracted with EtOAc (3 × 30 mL), dried over MgSO4, filtered and concentrated under vacuum. Methylation: To the crude mixture was added DMF (20 mL), MeI (1.87 mL, 30.0 mmol, 20.0 equiv) and Na2CO3 (1.59 g, 15.0 mmol, 10.0 equiv). The mixture was heated at 100 °C for 48 h. After this time, the reaction was cooled to room temperature and H2O (60 mL) was added and the mixture extracted with EtOAc (3 × 30 mL). The organic phases were combined then washed with brine (20 mL), dried over MgSO4, filtered and concentrated under vacuum. Hydrolysis of ester: The crude mixture was dissolved in ethanol (6.0 mL), and aqueous NaOH (2 M, 2.0 mL) was added. The mixture was stirred at room temperature for 16 h. After this time, sat. Na2CO3 (aq, 20 mL) was added and the aqueous phase washed with EtOAc (3 × 30 mL). The aqueous phase was then acidified to pH 2 with 2 M aq HCl and extracted with EtOAc (3 × 30 mL), dried over MgSO4, filtered and concentrated under vacuum to provide the desired product as a white solid (226.6 mg, 46%).

1H NMR (500 MHz, (CD3)2CO) δ (1H missing due to overlap with residual solvent peak) 10.78 (broad s, 1H), 7.89 (s, 1H), 6.96 (s, 1H), 4.01 (s, 3H), 2.99 - 2.96 (m, 2H), 2.47 - 2.41 (m, 2H), 2.96 (s, 3H), 2.41 (m, 2H), 6.99 (d, J = 9.0 Hz, 2H), 7.88 (d, J = 8.8 Hz, 2H), 6.99 (d, J = 8.9 Hz, 2H).
2.28 (td, $J = 10.7$, 3.8 Hz, 1H), 2.12 - 2.06 (m, 2H), 1.90 - 1.87 (m, 1H), 1.72 - 1.42 (m, 6H), 0.91 (s, 3H); $^{13}$C NMR (126 MHz, (CD$_3$)$_2$CO) $\delta$ 219.3, 166.3, 157.4, 145.1, 133.9, 130.4, 117.0, 113.3, 56.9, 51.0, 48.4, 44.5, 38.9, 36.1, 32.5, 30.4, 26.9, 26.6, 22.1, 14.1; IR 3282, 2929, 1723, 1710, 1610, 1415, 1259; m.p. 235 - 238 °C; HRMS (EI) $m/z$ calcd. C$_{20}$H$_{24}$O$_4$ + H: 329.1747; found [M+H]$^+$ 329.1747.

---

**Preparation of 1-tosyl-1H-indole-3-carboxylic acid (1a)**

Following the reported procedure,$^6$ to a cooled solution (−78 °C) of 1H-indole-3-carboxylic acid (1.50 g, 9.30 mmol, 1.0 equiv) in THF (60.0 mL) was added dropwise n-BuLi (1.5 M in hexane, 14.0 mL, 22.0 mmol, 2.3 equiv.). The reaction mixture was stirred at −78 °C for 3 h then a solution of tosyl chloride (4.20 g, 22.00 mmol, 2.3 equiv) in THF (40.0 mL) was added dropwise. The reaction was allowed to warm to room temperature over 12 h. The reaction was quenched with 5% aqueous NaHSO$_4$ (100.0 mL) and extracted with EtOAc. Concentration of the combined organic phases gave a deep purple solid. The solid was filtered and washed with cold EtOAc to provide the desired product as a white solid (1.47 g, 50%).

Spectroscopic data matched those previously reported.$^6$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.40 (s, 1H), 8.18 - 8.15 (m, 1H), 7.99 - 7.97 (m, 1H), 7.86 (d, $J = 8.4$ Hz, 2H), 7.42 - 7.34 (m, 2H), 7.29 (d, $J = 8.6$ Hz, 2H), 2.37 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 168.9, 146.1, 135.1, 134.7, 133.6, 130.4, 127.8, 127.4, 125.7, 124.8, 122.3, 113.5, 112.8, 21.8.
Optimisation of the Decarboxylative Iodination

The general procedure A was applied with I\textsubscript{2} (152.3 mg, 0.60 mmol, 3.0 equiv), 2-methoxybenzoic acid (30.4 mg, 0.20 mmol, 1.0 equiv) and the appropriate base (equivalents given in Table S1) at 100 °C for 4 h. On completion of the reaction, the mixture was cooled to room temperature then 15% Na\textsubscript{2}S\textsubscript{2}O\textsubscript{8} (aq, 2.0 mL), 2 M aq HCl (0.5 mL), CDCl\textsubscript{3} (1.0 mL) and CH\textsubscript{2}Br\textsubscript{2} (2.8 µL, 0.04 mmol, 0.2 equiv) were added. An aliquot of the organic layer was filtered through a short plug of MgSO\textsubscript{4} directly into an NMR tube for analysis.

![Chemical structure diagram]

Table S1. Optimisation of the Transition Metal-Free Decarboxylative Iodination\textsuperscript{[a]}

| Entry | Base (equiv) | 1a | 2a | 1a’ | 2a’ |
|-------|-------------|----|----|-----|-----|
| 1\textsuperscript{[b]} | – | 14 | 0 | 74 | 10 |
| 2\textsuperscript{[c]} | – | 9 | 90 | 2 | trace |
| 3 | K\textsubscript{2}PO\textsubscript{4} (1.0) | 4 | 93 | 1 | trace |
| 4 | K\textsubscript{2}HPO\textsubscript{4} (2.0) | 2 | 90 | trace | trace |
| 5 | K\textsubscript{2}HPO\textsubscript{4} (1.0) | 17 | 73 | 4 | 4 |
| 6 | KH\textsubscript{2}PO\textsubscript{4} (2.0) | 95 | 0 | trace | 0 |
| 7 | Li\textsubscript{2}CO\textsubscript{3} (1.0) | 89 | 11 | trace | 0 |
| 8 | K\textsubscript{2}CO\textsubscript{3} (1.0) | 64 | 31 | trace | 0 |
| 9 | Na\textsubscript{2}CO\textsubscript{3} (1.0) | 76 | 23 | trace | 0 |
| 10 | Cs\textsubscript{2}CO\textsubscript{3} (1.0) | 57 | 38 | trace | trace |
| 11 | LiOAc (2.0) | 88 | 12 | trace | 0 |
| 12 | KOAc (2.0) | 45 | 38 | trace | trace |
| 13 | NaOAc (2.0) | 30 | 51 | trace | trace |
| 14 | CsOAc (2.0) | 51 | 38 | trace | trace |
| 15 | KTFA (2.0) | 57 | 18 | 11 | 2 |
| 16 | PhCO\textsubscript{2}K (2.0) | 20 | 59 | trace | trace |
| 17 | KO\textsubscript{Bu} (2.0) | 71 | 5 | 0 | 0 |
| 18\textsuperscript{[d]} | K\textsubscript{3}PO\textsubscript{4} (1.0) | 62 | 34 | 0 | 0 |
| 19\textsuperscript{[e]} | K\textsubscript{3}PO\textsubscript{4} (1.0) | 3 | 94 | 1 | trace |
| 20\textsuperscript{[f]} | – | 94 | 0 | 2 | 0 |
| 21\textsuperscript{[g]} | K\textsubscript{3}PO\textsubscript{4} (1.0) | 2 | 94 | 4 | trace |

\[a\] Yields determined by \textsuperscript{1}H NMR using CH\textsubscript{2}Br\textsubscript{2} as an internal standard. \[b\] (2-Methoxybenzoyl)oxy)silver Ag-1\textsubscript{a} was used in place of 2-methoxybenzoic acid 1\textsubscript{a}. \[c\] Potassium 2-methoxybenzoate K-1\textsubscript{a} was used in place of 2-methoxybenzoic acid 1\textsubscript{a}. \[d\] 1.0 equiv H\textsubscript{2}O added. \[e\] Reaction run in the dark. \[f\] No base added. \[g\] Reagents weighed on the open bench and the reaction carried out under air for 16 h.
Experimental details, Spectroscopic data and Analytical data

2-iodoanisole (2a)
The general procedure A was applied with I$_2$ (380.7 mg, 1.50 mmol, 3.0 equiv) and 2-methoxybenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 4 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (105.9 mg, 90%) as a mixture with 2,4-diiodoanisole 2a' (ratio GC-FID 2a:2a' >100:1).

Spectroscopic data matched those previously reported

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.77 (dd, $J = 7.8, 1.6$ Hz, 1H), 7.31 (ddd, $J = 8.2, 7.4, 1.6$ Hz, 1H), 6.83 (dd, $J = 8.2, 1.4$ Hz, 1H), 6.72 (app td, $J = 7.6, 1.4$ Hz, 1H), 3.88 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 158.2, 139.6, 129.7, 122.6, 111.1, 86.1, 56.4.

4-iodoanisole (2b)
The general procedure A was applied with 4-methoxybenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 2 h. The general work-up procedure was applied then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a white solid (108.8 mg, 93%).

Spectroscopic data matched those previously reported.

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.56 (d, $J = 8.3$ Hz, 2H), 6.68 (d, $J = 8.3$ Hz, 2H), 3.78 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 159.6, 138.3, 116.5, 82.8, 55.5.

4-iodo-1-methoxy-2-methylbenzene (2c)
The general procedure A was applied with 4-methoxy-3-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 4 h. The general work-up procedure gave the desired product as a white solid (122.8 mg, 99%)

Spectroscopic data matched those previously reported.

$^1$H NMR (500 MHz, CDCl$_3$) δ 7.45 - 7.43 (m, 2H), 6.58 (d, $J = 8.3$ Hz, 1H), 3.80 (s, 3H), 2.17 (s, 3H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 157.8, 139.1, 135.6, 129.6, 112.3, 82.6, 55.5, 16.0.

2-iodo-1,5-dimethoxybenzene (2e)
The general procedure A was applied with I$_2$ (126.9 mg, 1.00 mmol, 2.0 equiv) and 2,4-dimethoxybenzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv) at 23 °C for 3 h. The general work-up procedure gave the desired product as an off-white solid (126.7 mg, 96%).

Spectroscopic data matched those previously reported.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.62 (d, $J = 8.6$ Hz, 1H), 6.43 (d, $J = 2.6$ Hz, 1H), 6.32 (dd, $J = 8.6, 2.6$ Hz, 1H), 3.85 (s, 3H), 3.80 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 161.5, 159.0, 139.3, 107.1, 99.4, 74.9, 56.4, 55.7.

2-iodo-1,3-dimethoxybenzene (2f)
The general procedure A was applied with 2,6-dimethoxybenzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv) at 23°C for 2 h. The general work-up procedure gave the desired product as a white solid (125.4 mg, 95%).

Spectroscopic data matched those previously reported.$^7$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.26 (t, $J = 8.3$ Hz, 1H), 6.51 (d, $J = 8.3$ Hz, 2H), 3.89 (s, 6H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 159.6, 129.9, 104.1, 77.6, 56.7.

1-iodo-2-methoxy-4-methylbenzene (2g)
The general procedure A was applied with 2-methoxy-4-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv) at 50°C for 4 h. The general work-up procedure gave the desired product as a white solid (112.5 mg, 91%).

Spectroscopic data matched those previously reported.$^{10}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.61 (d, $J = 7.9$ Hz, 1H), 6.65 (s, 1H), 6.55 (d, $J = 7.9$ Hz, 1H), 3.86 (s, 3H), 2.33 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.0, 140.0, 139.1, 123.5, 112.2, 81.9, 56.3, 21.6.

1-iodo-4-methoxy-2-methylbenzene (2h)
The general procedure A was applied with 4-methoxy-2-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv) at 50°C for 4 h. The general work-up procedure gave the desired product as a white solid (114.0 mg, 92%).

Spectroscopic data matched those previously reported.$^9$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 (d, $J = 8.7$ Hz, 1H), 6.82 (d, $J = 3.0$ Hz, 1H), 6.49 (dd, $J = 8.7, 3.0$ Hz, 1H), 3.77 (s, 3H), 2.40 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 159.9, 142.4, 139.3, 115.9, 113.4, 89.7, 55.3, 28.3.

2-iodo-1,3,5-trimethylbenzene (2i)
The general procedure A was applied with 2,4,6-trimethylbenzoic acid (82.1 mg, 0.50 mmol, 1.0 equiv) at 100°C for 6 h. The general work-up procedure gave the desired product as a white solid (114.8 mg, 93%).

Spectroscopic data matched those previously reported.$^{11}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.90 (s, 2H), 2.44 (s, 6H), 2.25 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 141.9, 137.4, 128.1, 104.4, 29.6, 20.8.
The general procedure A was applied with 2,4-dimethylbenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 9 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (74.3 mg, 64%).

Spectroscopic data matched those previously reported. 12

1H NMR (500 MHz, CDCl3) δ 7.67 (d, J = 8.0 Hz, 1H), 7.07 (s, 1H), 6.70 (d, J = 8.0 Hz, 1H), 2.40 (s, 3H), 2.28 (s, 3H); 13C NMR (126 MHz, CDCl3) δ 141.2, 138.8, 138.2, 130.9, 128.5, 97.2, 28.1, 21.0.

---

The general procedure A was applied with 2,6-dimethylbenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 9 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (63.8 mg, 55%).

Spectroscopic data matched those previously reported. 13

1H NMR (400 MHz, CDCl3) δ 7.15 - 7.11 (m, 1H), 7.06 (d, J = 7.4 Hz, 2H), 2.48 (s, 6H); 13C NMR (101 MHz, CDCl3) δ 142.2, 127.7, 127.1, 108.6, 29.9.

---

The general procedure A was applied with I2 (761.4 mg, 3.00 mmol, 6.0 equiv.) and 2-methylbenzoic acid (68.1 mg, 0.50 mmol, 1.0 equiv) at 140 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (43.6 mg, 40%).

Spectroscopic data matched those previously reported. 13

1H NMR (500 MHz, CDCl3) δ 7.81 (d, J = 7.8 Hz, 1H), 7.24 - 7.24 (m, 2H), 6.89 - 6.84 (m, 1H), 2.43 (s, 3H); 13C NMR (126 MHz, CDCl3) δ 141.5, 139.1, 129.9, 128.3, 127.5, 101.3, 28.3.
1-iodonaphthalene and 1,4-diiodonaphthalene (2m + 2m′)
The general procedure A was applied with I₂ (761.4 mg, 3.00 mmol, 6.0 equiv) and 1-napthoic acid (86.1 mg, 0.50 mmol, 1.0 equiv) at 140 °C for 16 h. The general work-up procedure was followed then column chromatography (pentane, 100%) afforded, after removal of the solvent, 1-iodonaphthalene as a colourless oil (72.4 mg, 57%) and 1,8-diiodonaphthalene as a white solid (13.3 mg, 7%).

Spectroscopic data matched those previously reported.¹⁴

1-iodonaphthalene (2m)
¹H NMR (400 MHz, CDCl₃) δ 8.10 (d, J = 7.4 Hz, 2H), 7.85 (d, J = 8.2 Hz, 1H), 7.78 (d, J = 8.0 Hz, 1H), 7.59 (app t, J = 7.6 Hz, 1H), 7.53 (app t, J = 7.4 Hz, 1H), 7.19 (app t, J = 7.7 Hz, 1H); ¹³C NMR (101 MHz, CDCl₃) δ 137.6, 134.5, 134.3, 132.3, 129.1, 128.7, 127.9, 127.0, 126.9, 99.7.

1,4-diiodonaphthalene (2m′)
¹H NMR (500 MHz, CDCl₃) δ 8.42 (d, J = 7.4 Hz, 2H), 7.85 (d, J = 8.1 Hz, 2H), 7.08 (app t, J = 7.7 Hz, 2H); ¹³C NMR (126 MHz, CDCl₃) δ 144.2, 135.9, 132.3, 131.2, 127.1, 96.1.

1-iodo-2-methylnaphthalene (2n)
The general procedure A was applied with 2-methyl-1-napthoic acid (93.1 mg, 0.50 mmol, 1.0 equiv) at 120 °C for 5 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10.0 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (109.9 mg, 82%) as a mixture with an indeterminable diiodination product 2n’ (ratio GC-FID 2n:2n’ >150:1).

Spectroscopic data matched those previously reported.¹⁵

¹H NMR (400 MHz, CDCl₃) δ 8.23 (d, J = 8.5 Hz, 1H), 7.75 (d, J = 7.5 Hz, 1H), 7.72 (d, J = 8.3 Hz, 1H), 7.56 (ddd, J = 8.4, 6.9, 1.3 Hz, 1H), 7.48 - 7.44 (m, 1H), 7.37 (d, J = 8.3 Hz, 1H), 2.71 (s, 3H); ¹³C NMR (101 MHz, CDCl₃) δ 140.9, 135.2, 132.5, 132.3, 128.5, 128.3, 128.1, 127.8, 125.8, 105.8, 30.5.

1-iodo-2-(methoxymethoxy)benzene (2o)
The general procedure A was applied with 2-(methoxymethoxy)benzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous MeCN (5.0 mL, 0.1 M) at 100 °C for 16 h in a flame-dried 25 mL microwave vial. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of basic alumina with further washings of pentane/EtOAc (4 x 10.0 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (59.4 mg, 45%).

Spectroscopic data matched those previously reported.¹⁶
\( ^1 \text{H NMR} (500 \text{ MHz, CDCl}_3) \delta 7.78 \text{ (dd, } J = 7.8, 1.6 \text{ Hz, 1H)}, 7.28 \text{ (ddd, } J = 8.3, 7.4, 1.6 \text{ Hz, 1H}), 7.07 \text{ (dd, } J = 8.3, 1.4 \text{ Hz, 1H}), 6.76 \text{ (app td, } J = 7.7, 1.4 \text{ Hz, 1H}), 5.24 \text{ (s, 2H)}, 3.52 \text{ (s, 3H)); } ^{13} \text{C NMR} (126 \text{ MHz, CDCl}_3) \delta 156.3, 139.7, 129.6, 123.8, 115.2, 95.2, 87.4, 56.6. \)

\( \text{(4-iodophenoxy)triisopropylsilane (2p)} \)

The general procedure A was applied with 4-((triisopropylsilyl)oxy)benzoic acid (147.2 mg, 0.50 mmol, 1.0 equiv) and I\(_2\) (380.7 mg, 1.50 mmol, 3.0 equiv) in dioxane (1.0 M) at 170 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Purification by flash chromatography (hexane) afforded, after removal of the solvent, the desired product as a pale-yellow oil (184.3 mg, 98%).

Spectroscopic data matched those previously reported.\(^{17} \)

\( ^1 \text{H NMR} (400 \text{ MHz, CDCl}_3) \delta 7.41 \text{ (d, } J = 8.7 \text{ Hz, 2H}), 6.58 \text{ (d, } J = 8.7 \text{ Hz, 2H}), 1.24 - 1.10 \text{ (m, 3H)}, 1.01 \text{ (d, } J = 7.2 \text{ Hz, 18H); } ^{13} \text{C NMR} (101 \text{ MHz, CDCl}_3) \delta 156.1, 138.3, 122.3, 83.2, 17.9, 12.6. \)

\( 2-(4\text{-iodophenoxy})-N,N\text{-dimethylacetamide (2q)} \)

The general procedure A was applied with 4-(2-(dimethylamino)-2-oxoethoxy)benzoic acid (111.6 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure was followed then the mixture was submitted directly for purification by flash chromatography (DCM/MeOH 98:2) which afforded, after removal of the solvent, the desired product as a white solid (122.0 mg, 80%).

\( ^1 \text{H NMR} (400 \text{ MHz, CDCl}_3) \delta 7.56 \text{ (d, } J = 8.5 \text{ Hz, 2H}), 6.73 \text{ (d, } J = 8.5 \text{ Hz, 2H}), 4.66 \text{ (s, 2H)}, 3.07 \text{ (s, 3H)}, 2.97 \text{ (s, 3H); } ^{13} \text{C NMR} (126 \text{ MHz, CDCl}_3) \delta 167.5, 158.0, 138.4, 117.2, 84.0, 67.5, 36.6, 35.8.; \text{m.p.} 62-64 ^\circ \text{C; IR (ATR) } 2907, 1653, 1484, 1443, 1282, 1244, 1282, 802; \text{HRMS (EI) } m/z \text{ calcld. } \text{C}_{10}\text{H}_{12}\text{O}_2\text{NINa: 327.9805; found [M + Na]^+ 327.9795.} \)

\( N\text{-}(4\text{-iodophenyl})acetamide (2r) \)

The general procedure A was applied with 4-acetamidobenzoic acid (89.6 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure was followed then column chromatography (hexane:EtOAc:AcOH, 100:0:0 to 80:19:1) afforded, after removal of the solvent, the desired product as a pale-yellow solid (105.7 mg, 81%).

Spectroscopic data matched those previously reported.\(^{18} \)

\( ^1 \text{H NMR} (400 \text{ MHz, CDCl}_3) \delta 7.61 \text{ (d, } J = 8.7 \text{ Hz, 2H}), 7.29 \text{ (d, } J = 8.7 \text{ Hz, 2H}), 2.17 \text{ (s, 3H); } ^{13} \text{C NMR} (101 \text{ MHz, CDCl}_3) \delta 168.4, 138.1, 137.8, 121.8, 87.6, 24.8. \)
4-(2-iodophenyl)morpholine (2s)
The general procedure A was applied with I$_2$ (126.9 mg, 1.00 mmol, 2.0 equiv), 2-morpholinobenzoic acid (103.6 mg, 0.50 mmol, 1.0 equiv) and anhydrous MeCN (5.0 mL, 0.1 M) at 23 °C for 3 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 x 10.0 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (76.6 mg, 53%) as a mixture with 4-((2,4-diiodophenyl)morpholine 2s' (ratio GC-FID 2s:2s' >40:1). Purification by flash chromatography on 10% AgNO$_3$-impregnated silica (hexane/EtOAc, 95:5) afforded, after removal of the solvent, the desired product as a colourless oil (72.3 mg, 50%).

Spectroscopic data matched those previously reported.$^{19}$

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.86 (d, $J$ = 7.9, 1.5 Hz, 1H), 7.33 (ddd, $J$ = 7.9, 7.3, 1.5 Hz, 1H), 7.04 (dd, $J$ = 8.0, 1.5 Hz, 1H), 6.82 (ddd, $J$ = 7.8, 7.4, 1.5 Hz, 1H), 3.91 - 3.89 (m, 4H), 3.01 - 2.99 (m, 4H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 152.2, 140.3, 129.4, 125.8, 121.2, 98.3, 67.4, 52.9.

4-(4-iodophenyl)morpholine (2t)
The general procedure A was applied with I$_2$ (126.9 mg, 1.00 mmol, 2.0 equiv), 4-morpholinobenzoic acid (103.6 mg, 0.50 mmol, 1.0 equiv) and anhydrous MeCN (5.0 mL, 0.1 M) at 23 °C for 4 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 x 10.0 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a white solid (83.8 mg, 58%).

Spectroscopic data matched those previously reported.$^{20}$

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.53 (d, $J$ = 9.1 Hz, 2H), 6.67 (d, $J$ = 9.0 Hz, 2H), 3.86 - 3.83 (m, 4H), 3.13 - 3.11 (m, 4H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 151.2, 140.3, 129.4, 125.8, 121.2, 98.3, 67.4, 52.9.

4-fluoro-1-iodo-2-methoxybenzene (2u)
The general procedure A was applied with 4-fluoro-2-methoxybenzoic acid (85.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as a pale yellow oil (119.7 mg, 95%).

$^1$H NMR (500 MHz, CDCl$_3$) δ 7.69 (dd, $J$ = 8.6, 6.5 Hz, 1H), 6.58 (dd, $J$ = 10.7, 2.7 Hz, 1H), 6.50 (app td, $J$ = 8.3, 2.7 Hz, 1H), 3.87 (s, 3H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 164.2 (d, $J$ = 246.9 Hz), 159.4 (d, $J$ = 9.9 Hz), 139.7 (d, $J$ = 9.4 Hz), 109.4 (d, $J$ = 21.9 Hz), 99.8 (d, $J$ = 26.5 Hz), 78.9 (d, $J$ = 3.5 Hz), 56.6; $^{19}$F NMR (376 MHz, CDCl$_3$) δ −110.92 - −110.98 (m, 1F); IR (ATR) 2940, 1599, 1276, 1280, 1037, 1020, 830; HRMS (EI) $m/z$ calcd. C$_7$H$_6$OFI: 251.9442; found [M]$^+$ 251.9446.
4-chloro-1-iodo-2-methoxybenzene (2v)
The general procedure A was applied with 4-chloro-2-methoxybenzoic acid (93.3 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a pale yellow oil (128.9 mg, 96%).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 (d, $J = 8.3$ Hz, 1H), 6.80 (d, $J = 2.2$ Hz, 1H), 6.73 (dd, $J = 8.3, 2.2$ Hz, 1H), 3.87 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.9, 139.9, 135.4, 122.7, 111.8, 83.4, 56.7; IR (ATR) 2928, 1573, 1469, 1388, 12650, 1036, 1013, 867, 835, 796; HRMS (EI) $m/z$ calcd. C$_7$H$_6$OClI: 267.9146; found [M]$^+$ 267.9133.

4-bromo-1-iodo-2-methoxybenzene (2w)
The general procedure A was applied with 4-bromo-2-methoxybenzoic acid (115.5 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (148.6 mg, 95%).

Spectroscopic data matched those previously reported.$^{21}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.60 (d, $J = 8.3$ Hz, 1H), 6.94 (d, $J = 2.1$ Hz, 1H), 6.86 (dd, $J = 8.3, 2.1$ Hz, 1H), 3.87 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.9, 140.3, 125.7, 123.1, 114.7, 84.3, 56.7.

1,4-diiodo-2-methoxybenzene (2x)
The general procedure A was applied with 4-iodo-2-methoxybenzoic acid (139.0 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as an orange solid (169.2 mg, 94%).

Spectroscopic data matched those previously reported.$^{22}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.39 (d, $J = 8.1$ Hz, 1H), 7.03 (d, $J = 1.4$ Hz, 1H), 6.97 (dd, $J = 8.1, 1.4$ Hz, 1H), 3.80 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.8, 140.7, 131.8, 120.4, 94.1, 85.8, 56.7.
4-fluoro-2-iodo-1-methoxybenzene (2y)
The general procedure A was applied with 5-fluoro-2-methoxybenzoic acid (85.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a pale-yellow oil (98.3 mg, 78%).

\[ 1^1H \text{ NMR (400 MHz, CDCl}_3 \] δ 7.50 (dd, \( J = 7.7, 3.0 \) Hz, 1H), 7.03 (ddd, \( J = 9.0, 7.7, 3.0 \) Hz, 1H), 6.75 (dd, \( J = 9.0, 4.5 \) Hz, 1H), 3.85 (s, 3H); \[ 1^3C \text{ NMR (101 MHz, CDCl}_3 \] δ 156.9 (d, \( J = 243.3 \) Hz), 154.9 (d, \( J = 2.4 \) Hz), 126.3 (d, \( J = 25.1 \) Hz), 115.7 (d, \( J = 22.6 \) Hz), 111.1 (d, \( J = 8.1 \) Hz), 85.4 (d, \( J = 8.6 \) Hz), 57.1; \[ 1^9F \text{ NMR (376 MHz, CDCl}_3 \] δ –122.5 –122.5 (m, 1F); IR (ATR) 2927 1485, 1259, 904, 726; HRMS (PI) m/z calcd. C\(_7\)H\(_6\)OFI: 251.9442; found [M]+ 251.9434.

4-chloro-2-iodo-1-methoxybenzene (2z)
The general procedure A was applied with 5-chloro-2-methoxybenzoic acid (93.3 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (73.8 mg, 55%).

Spectroscopic data matched those previously reported.\(^{12}\)

\[ 1^1H \text{ NMR (400 MHz, CDCl}_3 \] δ 7.74 (d, \( J = 2.5 \) Hz, 1H), 7.27 (dd, \( J = 8.8, 2.5 \) Hz, 1H), 6.73 (d, \( J = 8.8 \) Hz, 1H), 3.86 (s, 3H); \[ 1^3C \text{ NMR (101 MHz, CDCl}_3 \] δ 157.1, 138.7, 129.4, 126.4, 111.5, 86.2, 56.8.

4-bromo-2-iodo-1-methoxybenzene (2aa)
The general procedure A was applied with 5-bromo-2-methoxybenzoic acid (115.5 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a pale-yellow oil (43.8 mg, 28%).

\[ 1^1H \text{ NMR (400 MHz, CDCl}_3 \] δ 7.87 (d, \( J = 2.4 \) Hz, 1H), 7.41 (dd, \( J = 8.7, 2.4 \) Hz, 1H), 6.69 (d, \( J = 8.7 \) Hz, 1H), 3.86 (s, 3H); \[ 1^3C \text{ NMR (101 MHz, CDCl}_3 \] δ 157.6, 141.3, 132.3, 113.5, 112.1, 86.8, 56.7; IR (ATR) 2929, 1471, 1283, 1248, 1041, 802, 619; HRMS (PI) m/z calcd. C\(_7\)H\(_6\)BrOI: (100%) 311.8641 (95%) 313.8621; found [M]+ (100%) 311.8642 (95%) 313.8621.

2-iodo-1-methoxy-4-(trifluoromethyl)benzene (2ab)
The general procedure A was applied with 2-methoxy-5-(trifluoromethyl)benzoic acid (110.1 mg, 0.50 mmol, 1.0 equiv) at 120 °C for 16 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of...
pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a pale-yellow oil (60.4 mg, 40%).

Spectroscopic data matched those previously reported.\textsuperscript{23}

\textsuperscript{1}H NMR (500 MHz, CDCl\textsubscript{3}) \(\delta\) 8.01 (d, \(J = 1.7\) Hz, 1H), 7.58 (dd, \(J = 8.6, 1.7\) Hz, 1H), 6.85 (d, \(J = 8.6\) Hz, 1H), 3.93 (s, 3H); \textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) \(\delta\) 159.6, 135.5 (q, \(J = 3.7\) Hz), 125.9 (q, \(J = 3.8\) Hz), 123.5 (q, \(J = 33.2\) Hz), 122.2 (q, \(J = 271.7\) Hz), 109.2, 84.6, 55.5; \textsuperscript{19}F NMR (471 MHz, CDCl\textsubscript{3}) \(\delta\) –61.60.

**Pentafluoriodobenzene (2ac)**

The general procedure A was applied with pentafluorobenzoic acid (106.0 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. Then 15% aq. Na\textsubscript{2}S\textsubscript{2}O\textsubscript{8} (2.0 mL), CDCl\textsubscript{3} (1.0 mL) and fluorobenzene (46.9 µL, 0.50 mmol, 1.0 equiv) were added. An aliquot (200 µL) of the organic layer was passed through a plug of MgSO\textsubscript{4} directly into an NMR tube and diluted with CDCl\textsubscript{3} (400 µL) for quantitative \textsuperscript{19}F NMR analysis to yield the crude product (>99%). Due to the volatility of pentafluoriodobenzene 2ac, this product could not be isolated with a yield comparable to the \textsuperscript{19}F NMR yield.

Spectroscopic data matched those previously reported.\textsuperscript{24}

Quantitative \textsuperscript{19}F NMR (CDCl\textsubscript{3})
1,2,4,5-tetrafluoro-3-iodobenzene (2ad)
The general procedure A was applied with I$_2$ (158.6 mg, 1.25 mmol, 2.5 equiv) and 2,3,5,6-tetrafluorobenzoic acid (97.0 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. Then 15% aq. Na$_2$S$_2$O$_8$ (2.0 mL), CDCl$_3$ (1.0 mL) and fluorobenzene (46.9 µL, 0.50 mmol, 1.0 equiv) were added. An aliquot (200 µL) of the organic layer was passed through a plug of MgSO$_4$ directly into an NMR tube and diluted with CDCl$_3$ (400 µL) for quantitative $^{19}$F NMR analysis to yield the crude product (92%) as a mixture with 1,2,4,5-tetrafluoro-3,6-diiodobenzene 2ad' (ratio GC-FID 2ad:2ad' >300:1). Due to the volatility of 1,2,4,5-tetrafluoro-3-iodobenzene 2ad, this product could not be isolated with a yield comparable to the $^{19}$F NMR yield.

Spectroscopic data matched those previously reported.$^{25}$

Quantitative $^{19}$F NMR (CDCl$_3$)
1,3-difluoro-2-iodobenzene (2ae)

The general procedure A was applied with 2,6-difluorobenzoic acid (79.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. On completion of the reaction, the mixture was cooled to room temperature then 15% aq. Na₂S₂O₈ (2.0 mL), CDCl₃ (1.0 mL) and fluorobenzene (46.9 µL, 0.50 mmol, 1.0 equiv) were added. An aliquot (200.0 µL) of the organic layer was passed through a plug of MgSO₄ directly into an NMR tube and diluted with CDCl₃ (400.0 µL) for quantitative ¹⁹F NMR analysis to yield the crude product (92%). Due to the volatility of 1,3-difluoro-2-iodobenzene 2ae, this product could not be isolated with a yield comparable to the ¹⁹F NMR yield.

Spectroscopic data matched those previously reported.²⁶

Quantitative ¹⁹F NMR (CDCl₃)
The general procedure A was applied with I₂ (253.8 mg, 1.0 mmol, 4.0 equiv), methyl estrone-2-carboxylic acid 1ae (82.1 mg, 0.25 mmol, 1.0 equiv), anhydrous K₃PO₄ (53.1 mg, 0.25 mmol, 1.0 equiv) and anhydrous MeCN (2.5 mL, 0.1 M) at 50 °C for 16 h. The general work-up procedure gave the desired product as a white solid (94.4 mg, 92%).

Spectroscopic data matched those previously reported.²⁷

\(^1\)H NMR (500 MHz, (CDCl₃) δ 7.65 (s, 1H), 6.55 (s, 1H), 3.84 (s, 3H), 2.88 (dd, J = 8.5, 3.7 Hz, 2H), 2.50 (dd, J = 19.1, 8.8 Hz, 1H), 2.38 - 2.34 (m, 1H), 2.25 - 2.21 (m, 1H), 2.18 - 2.11 (m, 1H), 2.08 - 2.01 (m, 2H), 1.97 - 1.95 (m, 1H), 1.66 - 1.38 (m, 6H), 0.91 (s, 3H); \(^1\)³C NMR (126 MHz, (CDCl₃) δ 220.8, 156.2, 138.3, 136.6, 134.5, 111.5, 82.9, 56.6, 50.4, 48.1, 43.8, 38.3, 36.0, 29.7, 26.5, 26.1, 21.7, 14.0. IR (ATR) 2930, 1736, 1486, 1252, 1049, 730; m.p. 154 - 157 °C; HRMS (EI) m/z calcd. C₁₉H₂₃O₂I + H: 411.0815; found [M+H]⁺ 411.0814.

3-ido-1-methyl-1H-indole (2ak)

The general procedure A was applied with I₂ (253.8 mg, 1.0 mmol, 2.0 equiv) and 1-methyl-1H-indole-3-carboxylic acid (87.6 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as pale-yellow oil (119.7 mg, 93%).

Spectroscopic data matched those previously reported.²⁸

\(^1\)H NMR (500 MHz, (CD₃)₂SO) δ 7.53 (s, 1H), 7.46 (d, J = 8.2 Hz, 1H), 7.28 (d, J = 7.9 Hz, 1H), 7.25 - 7.21 (m, 1H), 7.16 - 7.13 (m, 1H), 3.81 (s, 3H); \(^1\)³C NMR (126 MHz, (CD₃)₂SO) δ 136.6, 133.4, 129.7, 122.1, 120.0, 119.9, 110.1, 54.4, 32.7.

3-ido-1-tosyl-1H-indole (2al)

The general procedure A was applied with I₂ (253.8 mg, 1.0 mmol, 2.0 equiv) and 1-tosyl-1H-indole-3-carboxylic acid (157.7 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as an orange solid (172.8 mg, 87%).

Spectroscopic data matched those previously reported.²⁹

\(^1\)H NMR (500 MHz, CDCl₃) δ 7.96 (d, J = 8.6 Hz, 1H), 7.78 (d, J = 7.8 Hz, 2H), 7.70 (s, 1H), 7.38 - 7.35 (m, 2H), 7.32 - 7.29 (m, 1H), 7.24 (d, J = 8.0 Hz, 2H), 2.35 (s, 3H); \(^1\)³C NMR (126 MHz, CDCl₃) δ 145.5, 135.0, 134.4, 132.6, 130.2, 129.9, 127.1, 125.8, 124.1, 122.1, 113.5, 67.0, 21.8.

S²¹
2-iodo-3-methylbenzo[b]thiophene (2am)
The general procedure A was applied with I$_2$ (253.8 mg, 1.00 mmol, 2.0 equiv) and 3-methylbenzo[b]thiophene-2-carboxylic acid (96.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as an off-white solid (123.4 mg, 90%).

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.76 - 7.73 (m, 1H), 7.68 - 7.65 (m, 1H), 7.34 (app td, $J$ = 7.5, 1.4 Hz, 1H), 7.29 (app td, $J$ = 7.5, 1.5 Hz, 1H), 2.41 (s, 3H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 143.6, 138.7, 137.3, 124.5, 124.4, 121.8, 121.7, 80.1, 16.3; IR (ATR) 2912, 1422, 916.9, 748, 724, 706; m.p. 51 - 53 °C; HRMS (EI) $m/z$ calcd. C$_9$H$_7$I: 273.9308; found [M]$^+$ 273.9295.

3-iodobenzo[b]thiophene (2an)
The general procedure A was applied with benzo[b]thiophene-3-carboxylic acid (89.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 3 h. The general work-up procedure gave the desired product as a colourless oil (123.5 mg, 95%) as a mixture with 2,3-diiodobenzo[b]thiophene 2an' (ratio GC-FID 2an:2an’ >50:1). Purification by flash chromatography on 10% AgNO$_3$-impregnated silica (hexane/EtOAc, 95:5) afforded, after removal of the solvent, the desired product as a colourless oil (118.3 mg, 91%).

Spectroscopic data matched those previously reported. $^{30}$

$^1$H NMR (500 MHz, CDCl$_3$) δ 7.86 (d, $J$ = 8.0 Hz, 1H), 7.77 (d, $J$ = 8.0 Hz, 1H), 7.61 (s, 1H), 7.48 (app t, $J$ = 7.6 Hz, 1H), 7.40 (app t, $J$ = 7.8 Hz, 1H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ (1C missing) 140.5, 138.5, 129.3, 125.4, 125.4, 122.6, 78.4.

2-iodobenzob[b]thiophene and 2,3-diiiodobenzob[b]thiophene (2ao + 2ao’)
The general procedure A was applied with benzo[b]thiophene-2-carboxylic acid (88.4 mg, 0.50 mmol, 1.0 equiv) and anhydrous MeCN (5.0 mL, 0.1 M) at 120 °C for 16 h in a flame-dried 25 mL microwave vial. The general work-up procedure was followed then purification by flash chromatography on 10% AgNO$_3$-impregnated silica (hexane/EtOAc, 95:5) afforded, after removal of the solvent, the desired product as a white solid (88.4 mg, 68%) and 2,3-diiiodobenzob[b]thiophene 2ao’ as a colourless oil (13.5 mg, 7%).

Spectroscopic data matched those previously reported. $^{31}$

2-iodobenzob[b]thiophene (2ao)
$^1$H NMR (500 MHz, CDCl$_3$) δ 7.77 (d, $J$ = 7.4 Hz, 1H), 7.72 (d, $J$ = 7.4 Hz, 1H), 7.54 (s, 1H), 7.33 - 7.28 (m, 2H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 144.5, 140.9, 133.9, 124.6, 124.5, 122.4, 121.4, 78.5.

2,3-diiiodobenzob[b]thiophene (2ao’)
$^1$H NMR (500 MHz, CDCl$_3$) δ 7.72 (d, $J$ = 8.0 Hz, 1H), 7.69 (d, $J$ = 8.0 Hz, 1H), 7.38 (app t, $J$ = 7.5 Hz, 1H), 7.32 (app t, $J$ = 7.5 Hz, 1H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 143.9, 141.5, 126.8, 125.9, 125.6, 121.6, 95.2, 89.4.
2-iodo-3-methylbenzofuran (2ap)
The general procedure A was applied with I$_2$ (253.8 mg, 1.00 mmol, 2.0 equiv) and 3-methylbenzofuran-2-carboxylic acid (88.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure gave the desired product as a colourless oil (114.8 mg, 89%).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.48 - 7.41 (m, 2H), 7.24 - 7.21 (m, 2H), 2.22 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.1, 129.1, 124.2, 123.2, 122.8, 118.7, 111.0, 97.6, 10.6; IR (ATR) 2917, 1445, 1101, 1081, 741; HRMS (PI) $m/z$ calcd. C$_{9}$H$_7$OI: 257.9536; found [M]$^+$ 257.9527.

2-iodobenzofuran (2aq)
The general procedure A was applied with benzofuran-2-carboxylic acid (81.1 mg, 0.50 mmol, 1.00 equiv) and anhydrous MeCN (5.0 mL, 0.1 M) at 120 °C for 16 h in a flame-dried 25 mL microwave vial. The general work-up procedure gave the desired product as a pale-yellow oil (85.4 mg, 70%) as a mixture with 2,3-diiodobenzofuran 2aq' (ratio GC-FID 2aq:2aq' > 100:1). Purification by flash chromatography on 10% AgNO$_3$-impregnated silica (hexane/EtOAc, 95:5) afforded, after removal of the solvent, the desired product as a colourless oil (82.8 mg, 68%)

Spectroscopic data matched those previously reported.$^{25a}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.55 - 7.45 (m, 2H), 7.25 - 7.19 (m, 2H), 6.96 (d, $J = 0.9$ Hz, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 158.3, 129.3, 124.4, 123.3, 119.8, 117.4, 111.0, 96.0.

2-bromo-5-iodothiophene (2ar)
The general procedure A was applied with 5-bromothiophene-2-carboxylic acid (103.5 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure gave the desired product as a colourless oil (106.9 mg, 74%).

Spectroscopic data matched those previously reported.$^{32}$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.04 (d, $J = 3.8$ Hz, 1H), 6.76 (d, $J = 3.8$ Hz, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 137.6, 131.8, 115.3, 72.4.

2-iodo-5-(p-tolyl)furan (2as)
The general procedure A was applied with 5-(p-tolyl)furan-2-carboxylic acid (101.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure gave the desired product as an orange solid (110.8 mg, 78%).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.52 (d, $J = 8.1$ Hz, 2H), 7.19 (d, $J = 8.1$ Hz, 2H), 6.60 (d, $J = 3.4$ Hz, 1H), 6.50 (d, $J = 3.4$ Hz, 1H), 2.37 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 159.8, 137.9, 129.5, 127.4, 123.7, 122.3, 107.2, 86.5, 21.4; IR (ATR) 2912, 1508, 1011, 918, 816, 784; m.p. 46 - 48 °C; HRMS (PI) $m/z$ calcd. C$_{11}$H$_9$OI + H: 284.9771; found [M+H]$^+$ 284.9767.
The general procedure A was applied with I₂ (761.4 mg, 3.00 mmol, 6.0 equiv.) and 5-nitrofuran-2-carboxylic acid (78.5 mg, 0.50 mmol, 1.0 equiv) at 140 °C for 16 h. The general work-up procedure was followed then column chromatography (100% hexane) gave the desired product as a pale-yellow solid (27.5 mg, 23%).

Spectroscopic data matched those previously reported. 33

1H NMR (400 MHz, CDCl₃) δ 7.19 (d, J = 3.7 Hz, 1H), 6.84 (d, J = 3.7 Hz, 1H); 13C NMR (101 MHz, CDCl₃) δ 156.2, 124.2, 113.4, 95.2; IR 3144, 1498, 1419, 1343, 1017, 962, 809; m.p. 69 - 72 °C; HRMS (EI) m/z calcd. C₄H₂O₃Ni: 238.9074; found [M]+ 238.9067.

4-iodo-1-methyl-1H-pyrazole (2au)

The general procedure A was applied with 1-methyl-1H-pyrazole-4-carboxylic acid (1.0 equiv, 0.50 mmol, 63.1 mg) at 100 °C for 16 h. The general work-up procedure gave the desired product as a white solid (96.7 mg, 93%).

Spectroscopic data matched those previously reported. 34

1H NMR (500 MHz, CDCl₃) δ 7.48 (s, 1H), 7.39 (s, 1H), 3.91 (s, 3H); 13C NMR (126 MHz, CDCl₃) δ 144.5, 134.4, 56.0, 39.4.

5-iodo-4-methylthiazole (2av)

The general procedure A was applied with 4-methylthiazole-5-carboxylic acid (71.5 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 5 h. The general work-up procedure gave the title product as a colourless oil (86.3 mg, 77%,) as a mixture with 2,5-diodo-4-methylthiazole 2av' (ratio GC-FID 2av:2av' >53:1). Column chromatography (5% EtOAc in Hexane) gave the desired product as a colourless oil (76.2 mg, 68%).

1H NMR (500 MHz, CDCl₃) δ 8.83 (s, 1H), 2.51 (s, 3H); 13C NMR (126 MHz, CDCl₃) δ 157.9, 157.1, 68.8, 17.7; IR (ATR) 2920, 1504, 1406, 1371, 1289, 971, 924, 838, 789; m.p. 50 - 53 °C; HRMS (EI) m/z calcd. C₄H₄NiS: 225.9182; found [M+H]+ 225.9180.

4-(5-iodopyridin-2-yl)morpholine (2aw)

The general procedure A was applied with 6-morpholinonicotinic acid (104.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as a colourless oil (87.0 mg, 60%)

1H NMR (400 MHz, CDCl₃) δ 8.32 (d, J = 2.3 Hz, 1H), 7.68 (dd, J = 8.9, 2.3 Hz, 1H), 6.47 (d, J = 8.9 Hz, 1H), 3.81 - 3.78 (m, 4H), 3.47 - 3.45 (m, 4H); 13C NMR (101 MHz, CDCl₃) δ 158.4, 153.7, 145.1, 109.2, 78.1, 66.7, 45.4; IR (ATR) 2849, 1574, 1482, 1241, 1115, 945, 804; m.p. 123 - 127 °C; HRMS (PI) m/z calcd. C₉H₂₁ON₂I: 289.9911; found [M]+ 289.9914.
3-iodo-2-methoxypyridine (2ax)

The general procedure A was applied with 2-methoxynicotinic acid (76.5 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 9 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 x 10.0 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (72.8 mg, 62%).

Spectroscopic data matched those previously reported.35

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.11 (dd, $J = 4.9, 1.7$ Hz, 1H), 8.02 (dd, $J = 7.5, 1.7$ Hz, 1H), 6.64 (dd, $J = 7.5, 4.9$ Hz, 1H), 3.98 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 162.0, 148.2, 146.6, 118.4, 80.0, 54.8.

3-iodo-4H-chromen-4-one (2ay)

The general procedure A was applied with 4-oxo-4H-chromene-3-carboxylic acid (95.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 6 h. The general work-up procedure gave the desired product as an off-white solid (129.2 mg, 95%).

Spectroscopic data matched those previously reported.36

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.29 (s, 1H), 8.23 (ddd, $J = 8.0, 1.7, 0.4$ Hz, 1H), 7.70 (ddd, $J = 8.7, 7.1, 1.7$ Hz, 1H), 7.47 - 7.42 (m, 2H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 173.4, 157.8, 156.2, 134.2, 126.7, 126.1, 121.9, 118.1, 87.0.

(E)-(2-iodovinyl)benzene (2az)

The general procedure A was applied with cinnamic acid (74.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 16 h. The general work-up procedure gave the desired product as a yellow oil (65.6 mg, 57%) as a mixture with (Z)-(2-iodovinyl)benzene 2az* (ratio $^1$H NMR 2az:2az* > 10:1).

Spectroscopic data matched those previously reported.37

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.44 (d, $J = 14.9$ Hz, 1H), 7.36 - 7.27 (m, 5H), 6.84 (d, $J = 14.9$ Hz, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 145.1, 137.8, 128.9, 128.5, 126.1, 76.8.

(E)-1-(2-iodovinyl)-4-methoxybenzene (2az*)

The general A procedure was applied with (E)-3-(4-methoxyphenyl)acrylic acid (89.1 mg, 0.50 mmol, 1.0 equiv, ~50:1 E/Z isomers) at 100 °C for 16 h. The general work-up procedure gave the desired product as a yellow solid (110.5 mg, 85%) as a mixture with (Z)-1-(2-iodovinyl)-4-methoxybenzene 2az** (ratio $^1$H NMR 2az*:2az** > 23:1).

Spectroscopic data matched those previously reported.38
\[ ^1H \text{NMR (400 MHz, CDCl} _3) \delta 7.36 (d, J = 14.9 \text{ Hz, 1H}), 7.23 (d, J = 8.7 \text{ Hz, 2H}), 6.85 (d, J = 8.7 \text{ Hz, 2H}), 6.63 (d, J = 14.9 \text{ Hz, 1H}), 3.81 (s, 3H); \]

\[ ^{13}C \text{NMR (101 MHz, CDCl} _3) \delta 159.9, 144.5, 130.9, 127.4, 114.2, 73.7, 55.5. \]

2-iodo-1-methoxy-4-methylbenzene (2B)

The general procedure A was applied with I\(_2\) (253.8 mg, 1.00 mmol, 2.0 equiv) and 2-methoxy-5-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 7 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (94.3 mg, 76%).

Spectroscopic data matched those previously reported.\(^{39}\)

\[ ^1H \text{NMR (500 MHz, CDCl} _3) \delta 7.60 (s, 1H), 7.10 (d, J = 8.3 \text{ Hz, 1H}), 6.72 (d, J = 8.3 \text{ Hz, 1H}), 3.85 (s, 3H), 2.26 (s, 3H); \]

\[ ^{13}C \text{NMR (126 MHz, CDCl} _3) \delta 156.2, 139.9, 132.2, 130.1, 110.9, 85.9, 56.5, 20.1. \]

2-iodo-1,4-dimethoxybenzene (2C)

The general procedure A was applied with I\(_2\) (253.8 mg, 1.00 mmol, 2.0 equiv) and 2,5-dimethoxybenzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 7 h. The general work-up procedure was followed then the mixture was dissolved in pentane/EtOAc (5.0 mL, 98:2) and filtered through a short plug of silica with further washings of pentane/EtOAc (4 × 10 mL, 98:2). Removal of the solvent in vacuo gave the desired product as a colourless oil (91.1 mg, 69%) as a mixture with 2,6-diiodo-1,4-dimethoxybenzene 2C’ (ratio GC-FID 2C:2C’ \> 160:1).

Spectroscopic data matched those previously reported.\(^{40}\)

\[ ^1H \text{NMR (500 MHz, CDCl} _3) \delta 7.34 (s, 1H), 6.86 (d, J = 8.9 \text{ Hz, 1H}), 6.76 (d, J = 8.9 \text{ Hz, 1H}), 3.83 (s, 3H), 3.75 (s, 3H); \]

\[ ^{13}C \text{NMR (126 MHz, CDCl} _3) \delta 154.4, 152.8, 124.9, 114.9, 111.7, 86.2, 57.1, 56.1. \]
Scheme S1. The scope of the decarboxylative iodination of benzoic acids using low equivalents (1.0 - 2.0 equiv) of I₂.
Scheme S2. The scope of the decarboxylative iodination of heteroaromatic acids using low equivalents (1.0 - 2.0 equiv) of I\(_2\).
Robustness Screen for the Decarboxylative Iodination of Aromatic Acids

The general procedure A was applied with I$_2$ (152 mg, 0.60 mmol, 3.0 equiv), 2-methoxybenzoic acid (30 mg, 0.20 mmol, 1.0 equiv) and the appropriate additive (0.20 mmol, 1.0 equiv) at 100 °C for 4 h. On completion of the reaction, the mixture was cooled to room temperature then 20% Na$_2$S$_2$O$_8$ (aq, 1.0 mL), 10% tartaric acid (aq, 1.0 mL), EtOAc (4.0 mL) and mesitylene (28 µL, 0.20 mmol, 1.0 equiv) were added. An aliquot of the organic layer (0.4 mL) was diluted with EtOAc (2.0 mL) and transferred to a GC vial for analysis.

The yields of product and the recovery of starting material and additive were determined by GC-FID analysis. Calibration of the GC was undertaken using a single point calibration technique of each additive and both the starting material and the product. The calibration for each compound was determined as follows:

1) In a 5.0 mL volumetric flask was made a solution of the compound under investigation (starting material/product/additive, 1.0 mmol) in acetonitrile.
2) In a separate 5.0 mL volumetric flask was made a solution of mesitylene (1.0 mmol) in EtOAc.
3) A 1:1 mixture of both solutions were analysed by GC-FID. Calculating the ratio of the peak for the compound (starting material/product/additive) in question to the standard enables a single point calibration (1:1, 100%)

Entries 2, 25, 27 and 30

In these cases, the additive was not transferred quantitatively using the standard work-up procedure, therefore, this experiment was run in duplicate. The first experiment followed the standard work-up procedure in order to determine the yield of product and recovery of starting material. The second experiment used an alternative work-up procedure in order to determine the recovery of the additive: On completion of the reaction, the mixture was cooled to room temperature and H$_2$O (0.5 mL), EtOAc (4.0 mL) and mesitylene (28 µL, 0.20 mmol, 1.0 equiv) were added. An aliquot of the organic layer (0.4 mL) was diluted with EtOAc (2.0 mL) and transferred to a GCMS vial for analysis.
Table S2a. Robustness screen of the Decarboxylative Iodination.

| Entry | Additive          | Additive Recovery | Yield 2a | Recovery 1a |
|-------|-------------------|-------------------|----------|-------------|
| 1     | OH                | 0%                | 0%       | >99%        |
| 2<sup>a</sup> | NH<sub>2</sub> | 0%                | 0%       | >99%        |
| 3     | O                 | 95%               | 77%      | 11%         |
| 4     | CN                | >99%              | 86%      | 14%         |
| 5     |                  | 33%               | 0%       | 13%         |
| 6     |                  | 2%                | 2%       | >99%        |
| 7     |                  | 20%               | 39%      | 40%         |
| 8     | Cl                | >99%              | 88%      | 12%         |
| 9     | OH                | 0%                | 0%       | >99%        |
| 10    | OH                | 36%               | trace    | >99%        |
| 11    | NH<sub>2</sub>    | 3%                | 3%       | >99%        |
| 12    | COPh              | >99%              | 87%      | 11%         |
| 13    | CO<sub>2</sub>Me  | >99%              | 90%      | 0%          |
| 14<sup>b</sup> | CHO | 51%               | 84%      | 1%          |
| 15    | NO<sub>2</sub>    | >99%              | 89%      | 2%          |

Reactions carried out at a 0.2 mmol scale of 1a. Yields and recoveries determined by crude GC-FID analysis. <sup>a</sup>Alternative work-up procedure followed. <sup>b</sup> 1,3-dinitrobenzene used as standard.
Table S2b. Robustness screen of the Decarboxylative Iodination

| Entry | Additive | Additive Recovery | Yield 2a | Recovery 1a |
|-------|----------|------------------|----------|-------------|
| 16    | NO₂      | 94%              | 87%      | 0%          |
| 17    | CN       | >99%             | 92%      | 0%          |
| 18    |            | 0%               | trace    | 19%         |
| 19    | OTf      | 97%              | 80%      | 0%          |
| 20    | OTs      | >99%             | 86%      | 0%          |
| 21    | OMs      | >99%             | 87%      | 0%          |
| 22    | I        | 98%              | 90%      | 0%          |
| 23    | Br       | 96%              | 91%      | 0%          |
| 24    | Cl       | >99%             | 90%      | 0%          |
| 25    | Me-CN     | 48%              | 72%      | 20%         |
| 26    | NCl       | 94%              | 91%      | 9%          |
| 27    | Me-CN     | 25%              | 49%      | 43%         |
| 28    | NCl       | 94%              | 63%      | 34%         |
| 29    | Boc      | 0%               | 0%       | >99%        |
| 30    | Me       | 0%               | 1%       | 83%         |

Reactions carried out at a 0.2 mmol scale of 1a. Yields and recoveries determined by crude GC-FID analysis. *Alternative work-up procedure followed. **1,3-dinitrobenzene used as standard. ***No H₂O added in work-up.
Procedure for Multi-Gram Scale Synthesis of 2-Iodo-1,3-dimethoxybenzene (2f)

In a glove box, a flame-dried 1 L pear-shaped flask was charged with 2,6-dimethoxybenzoic acid (10.0 g, 55.0 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (11.7 g, 55.0 mmol, 1.0 equiv) and anhydrous MeCN (275 mL, 0.2 M). Outside the glove box, a 100 mL flame-dried round-bottomed flask was charged with I$_2$ (55.8 g, 220.0 mmol, 4.0 equiv) and transferred to the glove box. The I$_2$ was then added to the mixture in the pear-shaped flask (Figure S1). The mixture was stoppered, transferred out of the glove box and stirred at 23 °C for 2 h under a nitrogen balloon (Figure S2). After this time H$_2$O (800 mL) was added and the reaction triturated with Na$_2$S$_2$O$_8$ (60.0 g). The mixture was transferred to a 2 L separating funnel and sat. Na$_2$CO$_3$ (aq, 200 mL) and pentane (500 mL) were added. The organic layer was collected and the aqueous layer was further washed with pentane (3 x 200 mL). The organic fractions were dried with MgSO$_4$ (60.0 g) and concentrated in vacuo to yield the desired product as a white solid (14.1 g, 97%, Figure S3).
Radical clock experiment with 2-(allyloxy)-4-methoxybenzoic acid (1A)

Preparation of 2-(allyloxy)-4-methoxybenzoic acid (1A)

2-Hydroxy-4-methoxybenzoic acid (1.46 g, 8.7 mmol, 1.0 equiv) and allyl bromide (3.0 mL, 34.8 mmol, 4.0 equiv) were dissolved in acetone (25.0 mL). K₂CO₃ (3.91 g, 27.0 mmol, 3.1 equiv) was added, and the reaction mixture was refluxed for 8 h. The salts were filtered off, and the acetone was removed under reduced pressure. Excess allyl bromide was removed by applying high vacuum to the rotary evaporator. The yellowish crude oil was dissolved in ethanol (12.5 ml), and aqueous NaOH (2 M, 5.2 ml) was added. The mixture was stirred overnight at room temperature and then acidified using 2 M aq HCl. The crude product was precipitated by adding ice water and then filtered. Column chromatography (hexane:EtOAc, 8:2) afforded the product as a white solid (1.54 g, 85%).

³H NMR (400 MHz, (CD₃)₂SO) δ 12.20 (s, 1H), 7.71 (d, J = 8.6 Hz, 1H), 6.61 (d, J = 2.3 Hz, 1H), 6.57 (dd, J = 8.6, 2.3 Hz, 1H), 6.03 (ddt, J = 17.2, 10.6, 4.6 Hz, 1H), 5.52 (dq, J = 17.2, 1.8 Hz, 1H), 5.25 (dq, J = 10.6, 1.6 Hz, 1H), 4.63 (dt, J = 4.6, 1.6 Hz, 2H), 3.80 (s, 3H); ¹³C NMR (101 MHz, (CD₃)₂SO) δ 166.5, 163.5, 159.4, 133.3, 117.0, 113.0, 105.4, 100.0, 68.6, 55.5; IR (ATR) 3284, 2928, 1726, 1681, 1604, 1573, 1255, 1021, 996; m.p. 79-83 °C; HRMS (El) m/z calcd. C₁₁H₁₂O₄ + H: 209.0808; found [M+H]⁺ 209.0806.

Preparation of 2-(allyloxy)-1-iodo-4-methoxybenzene (2A)

The general procedure A was applied with I₂ (126.9 mg, 1.00 mmol, 2.0 equiv) and 2-(allyloxy)-4-methoxybenzoic acid (104.1 mg, 0.50 mmol, 1.0 equiv) at 100 °C for 2 h. The general work-up procedure gave the desired product as a colourless oil (137.8 mg, 95%).

³H NMR (400 MHz, CDCl₃) δ 7.63 (d, J = 8.6 Hz, 1H), 6.42 (d, J = 2.7 Hz, 1H), 6.33 (dd, J = 8.6, 2.7 Hz, 1H), 6.05 (ddt, J = 17.3, 10.6, 4.8 Hz, 1H), 5.53 (dq, J = 17.3, 1.7 Hz, 1H), 5.32 (dq, J = 10.6, 1.5 Hz, 1H), 4.57 (dt, J = 4.8, 1.6 Hz, 2H), 3.78 (s, 3H); ¹³C NMR (101 MHz, CDCl₃) δ 161.3, 158.0, 139.3, 132.6, 117.8, 107.4, 100.7, 75.6, 69.8, 55.6; IR (ATR) 2934, 1576, 1301, 1021, 1166, 1013; HRMS (El) m/z calcd. C₁₀H₁₁O₂I + H: 290.9876; found [M+H]⁺ 290.9876.
Computational Methods

All the calculations were performed at the DFT level with Gaussian 09, revision B.01. All optimisations and single point calculations were performed using the B97D3 functional with the LanL2DZ basis set and ECPs for I atom and 6-31G(d) for all other atoms (C, H, and O). Stationary points were characterized as minima or saddle points by frequencies analysis using an acetonitrile solvent correction. Representative transition states were confirmed to correspond to the desired step by optimization through the intrinsic reaction coordinate (IRC) to starting materials and products. Dispersion corrections where calculated from single point calculations at the optimized geometries using an acetonitrile solvent correction. Gibbs free energies were evaluated at 298 K and 1 atm.

The decarboxylative iodination was modelled starting from the benzoyl hypoiodite I. An initial rotation provides intermediate VI via transition state TS-V (ΔG₁ = 10.3 kcal mol⁻¹). The decarboxylation step proceeds from intermediate VI via transition state TS-IV (ΔG₂ = 27.6 kcal mol⁻¹). The resulting overall energy diagram is shown below:

![Reaction Scheme](image)

**Scheme S3.** Energies measured in kcal mol⁻¹ for DFT modelling using an acetonitrile solvent correction.
Coordinates and energies of computed structures

![Structure Diagram]

I (minimum)
No imaginary frequencies
E = – 545.792344 a.u.
G = – 545.699140 a.u.

|   |   |   |   |
|---|---|---|---|
| C | -1.39005800 | -0.42662800 | 0.14158800 |
| C | -2.54540500 | 0.38932900  | -0.02894100 |
| C | -1.52425100 | -1.82845800 | 0.17132700  |
| C | -3.80643300 | -0.22773800 | -0.13491100 |
| C | -2.78099400 | -2.43103300 | 0.07399500  |
| C | -3.91612800 | -1.62286100 | -0.07946800 |
| H | -2.87327000 | -3.51541700 | 0.11826400  |
| H | -4.90402700 | -2.07726200 | -0.16109400 |
| O | 0.86594900  | -0.52770100 | -0.37068800 |
| H | -4.70265000 | 0.37383300  | -0.26443500 |
| O | -2.34457700 | 1.72933400  | -0.10276300 |
| C | -3.48936800 | 2.58044300  | -0.27163700 |
| H | -4.18861200 | 2.47294000  | 0.57046700  |
| H | -3.09064000 | 3.59881400  | -0.29452100 |
| H | -4.00749300 | 2.36181600  | -1.21697700 |
| C | -0.04659300 | 0.20129100  | 0.33509000  |
| O | 0.20892200  | 1.18895800  | 1.00289100  |
| I | 2.85942500  | 0.00549100  | -0.08539500 |
| H | -0.63038600 | -2.43656800 | 0.29645600  |
V – rotation transition state (maximum)
One imaginary frequency: \( i61.54 \text{ cm}^{-1} \)

\[ E = -545.777343 \text{ a.u.} \]
\[ G = -545.682755 \text{ a.u.} \]

|   |   |   |   |
|---|---|---|---|
| C | -1.10587100 | 0.21278500 | 0.45681600 |
| C | -2.39133400 | -0.19905300 | -0.02506900 |
| C | -0.83610300 | 1.59640300 | 0.57542000 |
| C | -3.34076100 | 0.78303900 | -0.37455000 |
| C | -1.78480300 | 2.55754000 | 0.23538800 |
| C | -3.03787400 | 2.14099000 | -0.24165900 |
| H | -1.55483300 | 3.61706700 | 0.33916200 |
| H | -3.79290000 | 2.87915400 | -0.51437700 |
| O | 1.17074800 | -0.17994400 | 1.18881500 |
| H | -4.31919000 | 0.49118300 | -0.74631000 |
| O | -2.62540600 | -1.52662500 | -0.13503600 |
| C | -3.88939800 | -1.96069200 | -0.66677300 |
| H | -4.03840400 | -1.58205600 | -1.68818600 |
| H | -3.83333900 | -3.05314800 | -0.67894400 |
| H | -4.71919900 | -1.63703800 | -0.02204700 |
| C | -0.06965100 | -0.76995000 | 0.82510400 |
| O | -0.19302400 | -1.97713000 | 0.92122100 |
| I | 2.52897900 | 0.01304900 | -0.34244500 |
| H | 0.13818600 | 1.89645500 | 0.95223800 |
VI (minimum)

No imaginary frequencies

\[ E = -545.785669 \text{ a.u.} \]
\[ G = -545.692045 \text{ a.u.} \]

| Atom | X        | Y        | Z        |
|------|----------|----------|----------|
| C    | -1.23035600 | -0.77280400 | 0.26960200 |
| C    | -1.44179700 | 0.62273100  | 0.40899600 |
| C    | -2.09969900 | -1.53365800 | -0.53155300|
| C    | -2.47833500 | 1.24006300  | -0.31211200|
| C    | -3.12726300 | -0.91700400 | -1.25238800|
| C    | -3.30517200 | 0.46928000  | -1.14110100|
| H    | -3.78109700 | -1.51021000 | -1.89038900|
| H    | -4.10384400 | 0.96335800  | -1.69519500|
| O    | 1.15593800  | -1.10671600 | 0.93207200 |
| H    | -2.65197900 | 2.30974400  | -0.22460300|
| O    | -0.61320200 | 1.26391100  | 1.27919900 |
| C    | -0.67228300 | 2.69771800  | 1.34004700 |
| H    | -1.64613700 | 3.03582100  | 1.72288500 |
| H    | 0.12061100  | 2.99105600  | 2.03433200 |
| H    | -0.48474500 | 3.13794000  | 0.34982000 |
| C    | -0.15530000 | -1.48785400 | 1.00771700 |
| O    | -0.34186500 | -2.46670200 | 1.71992400 |
| I    | 1.88567500  | 0.15559900  | -0.56375600|
| H    | -1.93931900 | -2.60920900 | -0.60258300|
IV – decarboxylative iodination transition state (maximum)

One imaginary frequency: \( \nu 215.16 \text{ cm}^{-1} \)

\[ E = -545.747400 \text{ a.u.} \]

\[ G = -545.655108 \text{ a.u.} \]
**2 (minimum)**

No imaginary frequencies

\[ E = -357.359304 \text{ a.u.} \]
\[ G = -357.274131 \text{ a.u.} \]

| Atom | x       | y       | z       |
|------|---------|---------|---------|
| C    | -0.31350400 | -0.54534900 | -0.00001300 |
| C    | -0.67712300 | -1.89502700 | -0.00003800 |
| C    | -1.28713000 | 0.48078500  | 0.00000000  |
| C    | -2.03481100 | -2.25137300 | -0.00005100 |
| C    | -2.64605700 | 0.10487100  | -0.00001400 |
| C    | -3.01053200 | -1.24799500 | -0.00003900 |
| H    | -3.42028500 | 0.86915100  | -0.00000600 |
| H    | -4.06863700 | -1.51085500 | -0.00004900 |
| O    | -0.84643400 | 1.76775800  | 0.00002300  |
| C    | -1.82556500 | 2.81767700  | 0.00005800  |
| H    | -2.45658500 | 2.77007000  | 0.89998100  |
| H    | -1.25050600 | 3.74865500  | 0.00008800  |
| H    | -2.45658500 | 2.77012900  | -0.89986900 |
| H    | -2.31586700 | -3.30416300 | -0.00007000 |
| I    | 1.76255300  | -0.03022900 | 0.00000700  |
| H    | 0.09296600  | -2.66443400 | -0.00004700 |

**CO₂ (minimum)**

No imaginary frequencies

\[ E = -188.475219 \text{ a.u.} \]
\[ G = -188.482766 \text{ a.u.} \]

| Atom | x       | y       | z       |
|------|---------|---------|---------|
| O    | 1.17614000 | 0.05416800 | 0.00000000 |
| C    | 0.00000000 | 0.00058600 | 0.00000000 |
| O    | -1.17614000 | -0.05460700 | 0.00000000 |
The investigation of a possible ortho effect was conducted by comparing the energies of each benzoyl hypoiodite (I(A) and I(B)) and their respective transition states for decarboxylation (IV(A) and IV(B)). The results showed that 2-methoxybenzoic acid has a lower barrier to decarboxylation, consistent with a higher reactivity of this substrate under our standard conditions. The ortho-substituted hypoiodite I(A) is higher in energy than the non-ortho-substituted analogue I(B) by 4.5 kcal mol⁻¹ and the ortho-substituted transition state is higher in energy than the non-ortho-substituted one by 3.6 kcal mol⁻¹. It is likely that the difference in energy between the ortho- and non-ortho-substituted species is due to steric destabilization. This shows that if an ortho-effect, similar to that observed in transition metal-catalysed decarboxylations, is present in our system, it is of much less significance.

**Scheme S4.** Energies measured in kcal mol⁻¹ for DFT modelling using an acetonitrile solvent correction.
I(A) (minimum)
No imaginary frequencies
E = $-545.792344$ a.u.
G = $-545.699140$ a.u.

\[
\begin{align*}
\text{C} &\quad -1.39005800 & -0.42662800 & 0.14158800 \\
\text{C} &\quad -2.54540500 & 0.38932900 & -0.02894100 \\
\text{C} &\quad -1.52425100 & -1.82845800 & 0.17132700 \\
\text{C} &\quad -3.80643300 & -0.22773800 & -0.13491100 \\
\text{C} &\quad -2.78099400 & -2.43103300 & 0.07399500 \\
\text{C} &\quad -3.91612800 & -1.62286100 & -0.07946800 \\
\text{H} &\quad -2.87327000 & -3.51541700 & 0.11826400 \\
\text{H} &\quad -4.90402700 & -2.07726200 & -0.16109400 \\
\text{O} &\quad 0.86594900 & -0.52770100 & -0.37068800 \\
\text{H} &\quad -4.70265000 & 0.37383300 & -0.26443500 \\
\text{O} &\quad -2.34457700 & 1.72933400 & -0.10276300 \\
\text{C} &\quad -3.48936800 & 2.58044300 & -0.27163700 \\
\text{H} &\quad -4.18861200 & 2.47294000 & 0.57046700 \\
\text{H} &\quad -3.09006400 & 3.59881400 & -0.29452100 \\
\text{H} &\quad -4.00749300 & 2.36181600 & -1.21697700 \\
\text{C} &\quad -0.04659300 & 0.20129100 & 0.33509000 \\
\text{O} &\quad 0.20892200 & 1.18895800 & 1.00289100 \\
\text{I} &\quad 2.85942500 & 0.00549100 & -0.08539500 \\
\text{H} &\quad -0.63038600 & -2.43656800 & 0.29645600 \\
\end{align*}
\]
**TS-IV(A)** – decarboxylative iodination transition state (maximum)

One imaginary frequency: $i215.16 \text{ cm}^{-1}$

$E = -545.747400 \text{ a.u.}$

$G = -545.655108 \text{ a.u.}$

| Atom | X        | Y        | Z        | C       | H        | O        | I        |
|------|----------|----------|----------|---------|----------|----------|----------|
| C    | 0.49104800 | -0.07838600 | 0.78434500 |
| C    | 1.57159500 | -0.05322800 | -0.19656900 |
| C    | 0.31257700 | 1.08719900  | 1.61662100 |
| C    | 2.27528500 | 1.13383600  | -0.44441100 |
| C    | 1.04494900 | 2.23383600  | 1.38710500 |
| C    | 2.00251200 | 2.25887200  | 0.33905400 |
| H    | 0.89108900 | 3.12034400  | 1.99962500 |
| H    | 2.55721700 | 3.17686600  | 0.14649800 |
| O    | -1.30042100| -1.52245300 | 1.44918200 |
| H    | 3.03949700 | 1.18388300  | -1.21524500 |
| O    | 1.77173600 | -1.21764500 | -0.81009200 |
| C    | 2.81804000 | -1.32155100 | -1.80789800 |
| H    | 3.78732800 | -1.05898000 | -1.36622900 |
| H    | 2.80779400 | -2.36834300 | -2.11876000 |
| H    | 2.58872400 | -0.66539300 | -2.65705500 |
| C    | -0.02630500| -1.43381100 | 1.33765700 |
| O    | 0.80271000 | -2.28613300 | 1.70689200 |
| I    | -1.66708300| 0.24200500  | -0.64261600 |
| H    | -0.43463900| 1.03443500  | 2.40651200 |
**I(B) (minimum)**

No imaginary frequencies

\[ E = -545.799034 \text{ a.u.} \]
\[ G = -545.706276 \text{ a.u.} \]

| Atom | X       | Y       | Z       | Coordinate (Angstroms) |
|------|---------|---------|---------|------------------------|
| C    | 1.01047300 | 0.21705700 | 0.00000300 |
| C    | 1.45770700 | -1.12476500 | 0.00000700 |
| C    | 1.96311600 | 1.25530500 | -0.00000300 |
| C    | 2.81740300 | -1.41150400 | 0.00000300 |
| C    | 3.33049100 | 0.97711700 | -0.00000700 |
| C    | 3.76743300 | -0.36451500 | -0.00000500 |
| H    | 4.04104700 | 1.79989400 | -0.00001400 |
| O    | -1.22355900 | -0.51007100 | -0.00000200 |
| H    | 3.17366800 | -2.44087500 | 0.00000700 |
| C    | -0.42587000 | 0.59952400 | 0.00000500 |
| O    | -0.84668900 | 1.74977800 | 0.00001000 |
| I    | -3.25699600 | -0.14371700 | -0.00000100 |
| H    | 1.61967500 | 2.28831700 | -0.00000500 |
| O    | 5.06862900 | -0.75308200 | -0.00000400 |
| C    | 6.08142300 | 0.26745400 | 0.00000200 |
| H    | 7.03500300 | -0.26898500 | 0.00001100 |
| H    | 6.00719600 | 0.89550800 | -0.89981900 |
| H    | 6.00718200 | 0.89551300 | 0.89981900 |
| H    | 0.73689700 | -1.93941900 | 0.00001200 |
**TS-IV(B)** – decarboxylative iodination transition state (maximum)

One imaginary frequency: \(i176.92\) cm\(^{-1}\)

\[E = -545.752574 \text{ a.u.}\]

\[G = -545.660801 \text{ a.u.}\]

\[
\begin{align*}
C & \quad -0.13366200 \quad 1.12942800 \quad -0.07003300 \\
C & \quad 0.59525000 \quad 1.37038000 \quad 1.14187800 \\
C & \quad 0.57191500 \quad 0.52788000 \quad -1.18336300 \\
C & \quad 1.86795100 \quad 0.88206800 \quad 1.29427600 \\
C & \quad 1.87560300 \quad 0.08422300 \quad -1.05789300 \\
C & \quad 2.52583500 \quad 0.22690100 \quad 0.19358800 \\
H & \quad 2.38059200 \quad -0.36789700 \quad -1.90665700 \\
O & \quad -2.29936600 \quad 1.25883000 \quad -1.09510500 \\
H & \quad 2.42614000 \quad 1.00444400 \quad 2.22082700 \\
C & \quad -1.46898800 \quad 1.85493000 \quad -0.32791500 \\
O & \quad -1.59806500 \quad 2.98848700 \quad 0.18858800 \\
I & \quad -1.51757900 \quad -1.20969600 \quad 0.17769300 \\
H & \quad 0.04742800 \quad 0.44526800 \quad -2.13343900 \\
O & \quad 3.76366000 \quad -0.17858400 \quad 0.45825700 \\
C & \quad 4.54872800 \quad -0.82561800 \quad -0.57830600 \\
H & \quad 4.69765200 \quad -0.13737100 \quad -1.41913900 \\
H & \quad 5.50246500 \quad -1.06040800 \quad -0.10134000 \\
H & \quad 4.04656500 \quad -1.74291400 \quad -0.90907400 \\
H & \quad 0.10523600 \quad 1.92175800 \quad 1.94158800 
\end{align*}
\]
Natural Bond Order (NBO) charges

### VI(A)
- C(1): -0.236
- C(2): +0.345
- C(3): -0.188
- C(4): -0.313
- C(5): -0.263
- C(6): -0.202
- H(7): +0.253
- H(8): +0.253
- O(9): -0.616

### TS-IV(A)
- C(1): -0.196
- C(2): +0.416
- C(3): -0.179
- C(4): -0.321
- C(5): -0.239
- C(6): -0.121
- H(7): +0.268
- H(8): +0.267
- O(9): -0.607

---

### H(10)
- +0.258

### O(11)
- -0.511

### C(12)
- -0.326

### H(13)
- +0.217

### H(14)
- +0.236

### H(15)
- +0.217

### C(16)
- +0.816

### O(17)
- -0.525

### I(18)
- +0.325

### H(19)
- +0.257

---

### H(10)
- +0.273

### O(11)
- -0.432

### C(12)
- -0.330

### H(13)
- +0.233

### H(14)
- +0.250

### H(15)
- +0.234

### C(16)
- +0.765

### O(17)
- -0.682

### I(18)
- +0.048

### H(19)
- +0.274
Hammett Plot Analysis

For the construction of the Hammett plot, the initial rates of various substituted 2-methoxybenzoic acids were measured (4-fluoro-2-methoxy benzoic acid 1u, 2-methoxy-5-methylbenzoic acid 1B, 2,5-dimethoxybenzoic acid 1C, 4-chloro-2-methoxybenzoic acid 1v, 4-bromo-2-methoxybenzoic acid 1w and 5-fluoro-2-methoxybenzoic acid 1y). 4-fluoro-2-methoxybenzoic acid 1u was used as $k_0$. As each substrate contains a 2-methoxy substituent, the sigma values for the corresponding substituted benzoic acids were used as reported in the literature.46

General procedure B for the measurement of initial rates for the construction of a Hammett Plot

A flame dried microwave vial was charged with I$_2$ (609.1 mg, 2.40 mmol, 4.0 equiv), capped and flushed with N$_2$. The vial was transferred to a glove box, then benzoic acid (0.60 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (127.4 mg, 0.60 mmol, 1.0 equiv), 4-nitrobenzotrifluoride (28.7 mg, 0.15 mmol, 0.25 equiv) and anhydrous $d_3$-MeCN (0.6 mL) were added. The vial was capped, transferred out of the glove box and stirred at r.t. for 10 min. Then, anhydrous $d_3$-MeCN (2.4 mL) that had been preheated to 80 $^\circ$C was added and the vial instantly placed in a heating block set at 85 $^\circ$C. Aliquots (~0.1 mL) were taken at the given time periods via syringe and instantly quenched in a mixture of $d_3$-MeCN (0.6 mL), trifluoroacetic acid (~20 µL, ~15 equiv) and H$_2$O (~5 µL, ~1.5 equiv). The yield of product and starting material were determined by quantitative $^1$H NMR analysis.
4-fluoro-2-methoxybenzoic acid (1u)

The general procedure B was followed with 4-fluoro-2-methoxybenzoic acid (102.1 mg, 0.60 mmol, 1.0 equiv).

![Chemical Structure]

Table S3. Initial rate measurements for the decarboxylative iodination of 1u

| Run A       | Time (s) | Yield (%) | Conc (M) | Yield (%) | Conc (M) | Yield (%) |
|-------------|----------|-----------|----------|-----------|----------|-----------|
| 1u          | 120      | 97        | 0.194    | 0         | 0.000    | 97        |
|             | 180      | 96        | 0.192    | 2         | 0.004    | 98        |
|             | 240      | 94        | 0.188    | 2         | 0.004    | 96        |
|             | 300      | 93        | 0.186    | 5         | 0.010    | 98        |
|             | 420      | 93        | 0.186    | 9         | 0.018    | 102       |
|             | 540      | 84        | 0.168    | 12        | 0.024    | 96        |
|             | 660      | 83        | 0.166    | 16        | 0.032    | 99        |
|             | 780      | 82        | 0.164    | 19        | 0.038    | 101       |

| Run B       | Time (s) | Yield (%) | Conc (M) | Yield (%) | Conc (M) | Yield (%) |
|-------------|----------|-----------|----------|-----------|----------|-----------|
| 1u          | 60       | 98        | 0.196    | 0         | 0.000    | 98        |
|             | 120      | 94        | 0.188    | 1         | 0.002    | 95        |
|             | 180      | 92        | 0.184    | 2         | 0.004    | 94        |
|             | 240      | 93        | 0.186    | 4         | 0.008    | 97        |
|             | 300      | 94        | 0.188    | 6         | 0.012    | 100       |
|             | 420      | 91        | 0.182    | 9         | 0.018    | 100       |
|             | 540      | 85        | 0.170    | 13        | 0.026    | 98        |
|             | 660      | 84        | 0.168    | 16        | 0.032    | 100       |
|             | 780      | 81        | 0.162    | 19        | 0.038    | 100       |
**Figure S4.** Initial rate plot for the decarboxylative iodination of 1u

\[
y = 0.0000591324x - 0.0076986301 \\
R^2 = 0.9934246575
\]

\[
y = 0.0000550133x - 0.0046160000 \\
R^2 = 0.9967140515
\]

Average Initial Rate = 5.71 x10\(^{-5}\) mol dm\(^{-3}\) s\(^{-1}\)
2-methoxy-5-methylbenzoic acid (1B)

The general procedure B was followed with 2-methoxy-5-methylbenzoic acid (99.7 mg, 0.60 mmol, 1.0 equiv).

![Chemical structure of 1B and 2B]

Table S4. Initial rate measurements for the decarboxylative iodination of 1B

| Run A | Time (s) | 1B Yield (%) | 1B Conc (M) | 2B Yield (%) | 2B Conc (M) | Recovery Yield (%) |
|-------|----------|--------------|-------------|--------------|-------------|--------------------|
| 90    | 103      | 0.206        | 0           | 0.000        | 103         |
| 120   | 98       | 0.196        | 1           | 0.002        | 99          |
| 150   | 97       | 0.194        | 4           | 0.008        | 101         |
| 180   | 97       | 0.194        | 5           | 0.010        | 102         |
| 210   | 95       | 0.190        | 7           | 0.014        | 102         |
| 240   | 91       | 0.182        | 9           | 0.018        | 100         |
| 330   | 86       | 0.172        | 14          | 0.028        | 100         |
| 390   | 83       | 0.166        | 18          | 0.036        | 101         |

| Run B | Time (s) | 1B Yield (%) | 1B Conc (M) | 2B Yield (%) | 2B Conc (M) | Recovery Yield (%) |
|-------|----------|--------------|-------------|--------------|-------------|--------------------|
| 90    | 99       | 0.198        | 0           | 0            | 99          |
| 120   | 96       | 0.192        | 1           | 0.002        | 97          |
| 150   | 95       | 0.19         | 3           | 0.006        | 98          |
| 180   | 93       | 0.186        | 4           | 0.008        | 97          |
| 210   | 91       | 0.182        | 6           | 0.012        | 97          |
| 240   | 90       | 0.18         | 8           | 0.016        | 98          |
| 270   | 90       | 0.18         | 9           | 0.018        | 99          |
| 330   | 86       | 0.172        | 12          | 0.024        | 98          |
| 390   | 84       | 0.168        | 15          | 0.03         | 99          |
**Figure S5.** Initial rate plot for the decarboxylative iodination of **1B**

Average Initial Rate = $1.11 \times 10^{-4}$ mol dm$^{-3}$s$^{-1}$
2,5-dimethoxybenzoic acid (1C)

The general procedure B was followed with 2,5-dimethoxybenzoic acid (109.3 mg, 0.60 mmol, 1.0 equiv).

![Chemical structure of 1C and 2C]

**Table S5.** Initial rate measurements for the decarboxylative iodination of 1C

| Time (s) | 1C  | 2C  | Recovery |
|----------|-----|-----|----------|
|          | Yield (%) | Conc (M) | Yield (%) | Conc (M) | Yield (%) |
| 120      | 60  | 0.120 | 0         | 0.000    | 60        |
| 240      | 100 | 0.200 | 2         | 0.004    | 102       |
| 360      | 98  | 0.196 | 5         | 0.010    | 103       |
| 480      | 94  | 0.188 | 7         | 0.014    | 101       |
| 600      | 94  | 0.188 | 8         | 0.016    | 102       |
| 840      | 90  | 0.180 | 12        | 0.024    | 102       |
| 1080     | 87  | 0.174 | 16        | 0.032    | 103       |
| 1320     | 83  | 0.166 | 19        | 0.038    | 102       |

| Time (s) | 1C  | 2C  | Recovery |
|----------|-----|-----|----------|
|          | Yield (%) | Conc (M) | Yield (%) | Conc (M) | Yield (%) |
| 120      | 93  | 0.186 | 0         | 0.000    | 93        |
| 240      | 93  | 0.186 | 2         | 0.004    | 95        |
| 360      | 92  | 0.184 | 4         | 0.008    | 96        |
| 480      | 89  | 0.178 | 6         | 0.012    | 95        |
| 600      | 89  | 0.178 | 8         | 0.016    | 97        |
| 840      | 85  | 0.170 | 12        | 0.024    | 97        |
| 1080     | 81  | 0.162 | 16        | 0.032    | 97        |
| 1320     | 80  | 0.160 | 19        | 0.038    | 99        |
Figure S6. Initial rate plot for the decarboxylative iodination of 1C

Average Initial Rate = \(3.19 \times 10^{-5} \text{ mol dm}^{-3} \text{ s}^{-1}\)
4-chloro-2-methoxybenzoic acid (1v)

The general procedure B was followed with 4-chloro-2-methoxybenzoic acid (112.0 mg, 0.60 mmol, 1.0 equiv).

Table S6. Initial rate measurements for the decarboxylative iodination of 1v

| Time (s) | 1v Yield (%) | Conc (M) | 2v Yield (%) | Conc (M) | Recovery (%) |
|----------|---------------|----------|--------------|----------|--------------|
| Run A    |               |          |              |          |              |
| 600      | 95            | 0.190    | 1            | 0.002    | 96           |
| 1200     | 88            | 0.176    | 2            | 0.004    | 90           |
| 1870     | 91            | 0.182    | 4            | 0.008    | 95           |
| 2400     | 88            | 0.176    | 5            | 0.010    | 93           |
| 3060     | 87            | 0.174    | 6            | 0.012    | 93           |
| 3600     | 92            | 0.184    | 7            | 0.014    | 99           |
| 4800     | 88            | 0.176    | 10           | 0.020    | 98           |
| 6000     | 85            | 0.170    | 12           | 0.024    | 97           |
| 7200     | 85            | 0.170    | 14           | 0.028    | 99           |
| 8400     | 84            | 0.168    | 16           | 0.032    | 100          |

| Time (s) | 1v Yield (%) | Conc (M) | 2v Yield (%) | Conc (M) | Recovery (%) |
|----------|---------------|----------|--------------|----------|--------------|
| Run B    |               |          |              |          |              |
| 600      | 94            | 0.188    | 0            | 0.000    | 94           |
| 1200     | 91            | 0.182    | 2            | 0.004    | 93           |
| 1860     | 93            | 0.186    | 4            | 0.008    | 97           |
| 2400     | 91            | 0.182    | 5            | 0.010    | 96           |
| 3000     | 94            | 0.188    | 6            | 0.012    | 100          |
| 3600     | 89            | 0.178    | 7            | 0.014    | 96           |
| 4800     | 88            | 0.176    | 10           | 0.020    | 98           |
| 6000     | 85            | 0.170    | 12           | 0.024    | 97           |
| 7200     | 86            | 0.172    | 14           | 0.028    | 100          |
| 9890     | 78            | 0.156    | 19           | 0.038    | 97           |
Figure S7. Initial rate plot for the decarboxylative iodination of 1v

Average Initial Rate = 3.93 x10^{-6} \text{ mol dm}^{-3} \text{ s}^{-1}
4-bromo-2-methoxybenzoic acid (1w)

The general procedure B was followed with 4-bromo-2-methoxybenzoic acid (138.6 mg, 0.60 mmol, 1.0 equiv).

Table S7. Initial rate measurements for the decarboxylative iodination of 1w

| Time (s) | 1w Yield (%) | Conc (M) | 2w Yield (%) | Conc (M) | Recovery Yield (%) |
|---------|--------------|----------|--------------|----------|-------------------|
| 600     | 113          | 0.226    | 1            | 0.002    | 114               |
| 1200    | 116          | 0.232    | 3            | 0.006    | 119               |
| 1800    | 104          | 0.208    | 4            | 0.008    | 108               |
| 2400    | 90           | 0.180    | 5            | 0.010    | 95                |
| 3000    | 87           | 0.174    | 6            | 0.012    | 93                |
| 3600    | 87           | 0.174    | 7            | 0.014    | 94                |
| 4800    | 90           | 0.180    | 10           | 0.020    | 100               |
| 6090    | 88           | 0.176    | 12           | 0.024    | 100               |
| 7200    | 85           | 0.170    | 14           | 0.028    | 99                |
| 9600    | 82           | 0.164    | 18           | 0.036    | 100               |

Run B

| Time (s) | 1w Yield (%) | Conc (M) | 2w Yield (%) | Conc (M) | Recovery Yield (%) |
|---------|--------------|----------|--------------|----------|-------------------|
| 600     | 107          | 0.214    | 0            | 0        | 107               |
| 1200    | 98           | 0.196    | 3            | 0.006    | 101               |
| 2400    | 94           | 0.188    | 5            | 0.01     | 99                |
| 3000    | 92           | 0.184    | 6            | 0.012    | 98                |
| 3600    | 91           | 0.182    | 7            | 0.014    | 98                |
| 4800    | 84           | 0.168    | 9            | 0.018    | 93                |
| 6000    | 85           | 0.17     | 12           | 0.024    | 97                |
| 7200    | 83           | 0.166    | 14           | 0.028    | 97                |
| 9600    | 78           | 0.156    | 17           | 0.034    | 95                |
**Figure S8.** Initial rate plot for the decarboxylative iodination of 1w

Average Initial Rate = $3.71 \times 10^{-6}$ mol dm$^{-3}$ s$^{-1}$
5-fluoro-2-methoxybenzoic acid (1y)

The general procedure B was followed with 5-fluoro-2-methoxybenzoic acid (102.1 mg, 0.60 mmol, 1.0 equiv).

![Chemical structure of 5-fluoro-2-methoxybenzoic acid (1y) and 2y]

Table S8. Initial rate measurements for the decarboxylative iodination of 1y

| Run A | Time (s) | 1y Yield (%) | 1y Conc (M) | 2y Yield (%) | 2y Conc (M) | Recovery Yield (%) |
|-------|----------|---------------|-------------|---------------|-------------|-------------------|
| 900   | 103      | 0.206         | 1           | 0.002         | 104         |
| 1800  | 101      | 0.202         | 2           | 0.004         | 103         |
| 2700  | 100      | 0.2           | 3           | 0.006         | 103         |
| 3600  | 98       | 0.196         | 5           | 0.01          | 103         |
| 4500  | 97       | 0.194         | 7           | 0.014         | 104         |
| 5400  | 95       | 0.19           | 8           | 0.016         | 103         |
| 7200  | 91       | 0.182         | 10          | 0.02          | 101         |
| 9000  | 89       | 0.178         | 13          | 0.026         | 102         |
| 10800 | 88       | 0.176         | 15          | 0.03          | 103         |
| 14400 | 83       | 0.166         | 20          | 0.04          | 103         |

| Run B | Time (s) | 1y Yield (%) | 1y Conc (M) | 2y Yield (%) | 2y Conc (M) | Recovery Yield (%) |
|-------|----------|---------------|-------------|---------------|-------------|-------------------|
| 900   | 103      | 0.206         | 0           | 0             | 103         |
| 1800  | 102      | 0.204         | 1           | 0.002         | 103         |
| 2700  | 98       | 0.196         | 3           | 0.006         | 101         |
| 3600  | 98       | 0.196         | 5           | 0.01          | 103         |
| 4500  | 95       | 0.19           | 7           | 0.014         | 102         |
| 5400  | 95       | 0.19           | 8           | 0.016         | 103         |
| 7200  | 91       | 0.182         | 11          | 0.022         | 102         |
| 9000  | 90       | 0.18           | 13          | 0.026         | 103         |
| 10800 | 86       | 0.172         | 16          | 0.032         | 102         |
| 14400 | 81       | 0.162         | 20          | 0.04          | 101         |
Figure S9. Initial rate plot for the decarboxylative iodination of 1y

Average Initial Rate = 2.94 x 10^{-6} mol dm^{-3} s^{-1}
Table S9. Hammett plot analysis for the decarboxylative iodination of aromatic acids

| Acid      | $\sigma$ | Initial rate (mol dm$^{-3}$ s$^{-1}$) | log(k/k$_0$) |
|-----------|----------|--------------------------------------|--------------|
| 1B (m-Me) | -0.069   | 1.11 x10$^4$                         | 0.289        |
| 1u (p-F)  | 0.062    | 5.71 x10$^5$                         | 0.000        |
| 1C (m-MeO)| 0.115    | 3.19 x10$^5$                         | -0.253       |
| 1v (p-Cl) | 0.227    | 3.93 x10$^6$                         | -1.162       |
| 1w (p-Br) | 0.232    | 3.71 x10$^6$                         | -1.187       |
| 1y (m-F)  | 0.337    | 2.94 x10$^6$                         | -1.288       |

Figure S10. Hammett plot for the decarboxylative iodination of aromatic acids

\[
y = -4.59x + 0.09
\]

\[
R^2 = 0.92
\]

$\rho = -4.6$

A $\rho$ value of $-4.6$ suggests a substantial build-up of positive charge on the aromatic ring during the reaction and is of the same order of magnitude as other electrophilic reactions on aromatic compounds.$^{47}$
General Procedures for the Decarboxylative Cross-Coupling of Benzoic acids with Arenes

2,3,5,6-tetrafluoro-4'-methoxy-3'-methyl-4-(trifluoromethyl)-1,1'-biphenyl (5a)
In a glove box, a flame-dried 10 mL microwave vial was charged with 4-methoxy-3-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous dioxane (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I$_2$ (209.4 mg, 0.825 mmol, 1.75 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 170 °C for 16 h. After this time, the vial was cooled to room temperature and Et$_3$N (87.7 µL, 0.625 mmol, 1.25 equiv) was added. The mixture was then stirred at 170 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K$_3$PO$_4$ (583.6 mg, 2.75 mmol, 5.5 equiv), 1,2,4,5-tetrafluoro-3-(trifluoromethyl)benzene (204.1 µL, 1.5 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of Et$_2$O. The mixture was concentrate in vacuo and purified by column chromatography (Hexane/EtOAc 100:1) to yield the desired product as a white solid (126.0 mg, 74%).

1H NMR (500 MHz, (CD$_3$)$_2$CO) δ 7.42 (d, J = 8.5 Hz, 1H), 7.37 (s, 1H), 7.13 (d, J = 8.5 Hz, 1H), 3.93 (s, 3H), 2.25 (s, 3H); 13C NMR (126 MHz, (CD$_3$)$_2$CO) δ 160.1, 145.3 (dm, J = 252.9 Hz, 2C), 132.7, 130.1, 127.7, 126.3 (t, J = 17.0 Hz), 122.2 (q, J = 273.2 Hz), 118.3, 111.2, 107.7 (qt, J = 34.3, 13.0 Hz), 55.9, 16.3; 19F NMR (376 MHz, CDCl$_3$) δ -56.13 (t, J = 21.5 Hz, 3F), -141.12 - -141.41 (m, 2F), -141.93 - -142.04 (m, 2F); m.p. 85-88 °C; IR (ATR) 2961, 1489, 1337, 1256, 1144, 984, 736, 713; HRMS (HESI) m/z calcd. C$_{15}$H$_9$F$_7$O: 338.0536; found [M]$^+$ 338.0532.

2,3,4,5,6-pentafluoro-4'-methoxy-1,1'-biphenyl (5b)
In a glove box, a flame-dried 10 mL microwave vial was charged with 4-methoxybenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous dioxane (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I$_2$ (253.8 mg, 1.0 mmol, 2.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 170 °C for 16 h. After this time, the vial was cooled to room temperature and Et$_3$N (105.3 µL, 0.75 mmol, 1.5 equiv) was added. The mixture was then stirred at 170 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K$_3$PO$_4$ (583.6 mg, 2.75 mmol, 5.5 equiv), pentafluorobenzene (163.2 µL, 1.5 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %), pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) and anhydrous dioxane (0.5 mL, 0.5 M) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of EtOAc. The mixture was concentrate in vacuo and purified by column chromatography (Hexane/EtOAc 100:1) to yield the desired product as a white solid (108.3 mg, 79%).
3-(2,6-dinitrophenyl)-1-methyl-1H-indole (5c)

In a glove box, a flame-dried 10 mL microwave vial was charged with 1-methyl-1H-indole-3-carboxylic acid (87.6 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.5 mmol, 1.0 equiv) and anhydrous 1,4-dioxane (1.0 mL, 0.5 M). The vial was transferred out of the glove box and I$_2$ (253.8 mg, 0.50 mmol, 1.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 150 °C for 16 h. Note: Ensure reaction is stirring efficiently to avoid decomposition. After this time, the vial was cooled to room temperature, transferred to a glove box and anhydrous K$_3$PO$_4$ (583.7 mg, 2.75 mmol, 5.5 equiv), 1,3-dinitrobenzene (318.2 mg, 1.5 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.2 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of DCM. The mixture was concentrated in vacuo and purified by column chromatography (hexane/DCM, 80:20) to yield the desired product as an orange solid (107.0 mg, 72%) as a mixture with 3-(2,4-dinitrophenyl)-1-methyl-1H-indole (>100:1 by GC-FID).

4-(benzo[|b|]thiophen-3-yl)-2,3,5,6-tetrafluorobenzonitrile (5d)

In a glove box, a flame-dried 10 mL microwave vial was charged with benzothiophene-3-carboxylic acid (89.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.5 mmol, 1.0 equiv) and anhydrous 1,4-dioxane (1.0 mL, 0.5 M). The vial was transferred out of the glove box and I$_2$ (222.1 mg, 0.875 mmol, 1.75 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 170 °C for 16 h. After this time, the vial was cooled to room temperature and Et$_3$N (87.2 µL, 0.625 mmol, 1.25 equiv) was added. The mixture was then stirred at 170 °C for 6 h. After this time, the vial was cooled to room temperature, transferred to a glove box and anhydrous K$_3$PO$_4$ (583.7 mg, 2.75 mmol, 5.5 equiv), 2,3,5,6-tetrafluorobenzonitrile (262.6 mg, 1.5 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.2 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of DCM. The mixture was concentrated in vacuo and purified by column chromatography (hexane/Et$_2$O, 80:20) to yield the desired product as an anhydrous solid (110.6 mg, 72%).

S61
In a glove box, a flame-dried 10 mL microwave vial was charged with 2-methoxybenzoic acid (76.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K3PO4 (106.1 mg, 0.5 mmol, 1.0 equiv) and anhydrous o-DCB (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I2 (190.4 mg, 0.75 mmol, 1.50 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 150 °C for 20 h. After this time, the vial was cooled to room temperature and Et3N (70.0 µL, 0.50 mmol, 1.0 equiv) and anhydrous K3PO4 (265.3 mg, 1.25 mmol, 2.5 equiv) was added in the glove box. The mixture was then stirred at 150 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K3PO4 (106.1 mg, 0.5 mmol, 1.0 equiv), 3,5-difluorotribenzenesulfonamide (265.3 mg, 1.25 mmol, 2.5 equiv) and pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of Et2O. The mixture was concentrated in vacuo and purified by column chromatography (hexane:DCM, 95:5) to yield the desired product as a yellow oil (86.2 mg, 65%) as a mixture with 2,4-difluoro-2'-methoxy-6-nitro-1,1'-biphenyl 5e’ (6.6 mg, 5%).

1H NMR (500 MHz, CD3CO) δ 7.99 (major, d, J = 6.7 Hz, 2H), 7.73 (minor, app dt, J = 8.2, 2.0 Hz, 1H), 7.57 - 7.53 (minor, m, 1H), 7.54 - 7.50 (major, m, 1H), 7.46 - 7.43 (minor, d, J = 17.4 Hz, 1H), 7.35 (major, d, J = 7.4 Hz, 1H), 7.30 (minor, d, J = 7.5 Hz, 1H), 7.21 (major, d, J = 8.4 Hz, 1H), 7.11 (major, app t, J = 7.5 Hz, 1H), 7.11 (minor, d, J = 8.1 Hz, 1H), 7.07 (minor, app t, J = 7.5 Hz, 1H), 3.83 (major, s, 3H) 3.73 (minor, s, 3H); 13C NMR (126 MHz, CD3CO) δ 162.6 (minor, dd, J = 134.3, 13.0 Hz), 160.9 (major, dd, J = 250.6, 8.1 Hz), 160.6 (minor, dd, J = 133.6, 13.1 Hz), 158.0 (major), 157.4 (minor), 149.0 (major, t, J = 11.3 Hz), 132.3 (major), 132.1 (major), 131.5 (minor), 131.5 (minor, d, J = 1.8 Hz), 123.3 (major, t, J = 21.3 Hz), 121.5 (minor), 121.4 (major), 119.3 (minor), 118.8 (minor, dd, J = 21.2, 4.6 Hz), 117.0 (major), 115.0 (minor), 112.4 (major), 112.1 (minor), 109.4 (minor, dd, J = 28.2, 25.5 Hz), 108.8 (minor, dd, J = 26.9, 3.9 Hz), 108.4 - 108.2 (major, m), 56.1 (major), 55.8 (minor); 19F{1H} NMR (376 MHz, CDCl3) δ −106.09 (minor, d, J = 7.8 Hz, 1F), −106.59 (major, s, 2F), −107.98 (minor, d, J = 7.8 Hz, 1F); 19F NMR (376 MHz, CDCl3) δ −106.07 - -106.12 (minor, m, 1F), −106.59 (minor, d, J = 6.3 Hz, 2F), −107.98 (minor, ddd, J = 7.9, 7.9, 7.9 Hz, 1F); IR (ATR) 3102, 2840, 1530, 1428, 1348, 1262, 1034, 782, 754; HRMS (EI) m/z calcd. C13H9O2FNO3: 265.0545; found [M]+ 265.0543.

5-(2,6-dimethoxyphenyl)thiophene-2-carbonitrile (5f)

In a glove box, a flame-dried 10 mL microwave vial was charged with 2,6-dimethoxybenzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K3PO4 (371.5 mg, 1.75 mmol, 3.5 equiv) and anhydrous o-DCB (0.5 mL,
The vial was transferred out of the glove box and I\(_2\) (160.5 mg, 0.625 mmol, 1.25 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 150 °C for 9 h. After this time, the vial was cooled to room temperature and \(\text{tPrNH}_2\) (64.0 µL, 0.75 mmol, 1.5 equiv) was added. The mixture was then stirred at 150 °C for 16 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K\(_3\)PO\(_4\) (106.1 mg, 0.5 mmol, 1.0 equiv), 2-thiophenecarbonitrile (70.0 µL, 0.75 mmol, 1.5 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of Et\(_2\)O. The mixture was concentrate in vacuo and purified by column chromatography (hexane/EtOAc 90:10) to yield the desired product as a white solid (101.8 mg, 83%).

\[\text{H NMR (400 MHz, CDCl}_3\) \delta 7.63 (d, J = 4.1 Hz, 1H), 7.58 (d, J = 4.1 Hz, 1H), 7.31 (t, J = 8.4 Hz, 1H), 6.67 (d, J = 8.4 Hz, 2H), 3.89 (s, 6H); \text{C NMR (101 MHz, CDCl}_3\) \delta 157.8, 142.2, 136.3, 130.2, 129.0, 115.4, 110.6, 108.3, 104.5, 56.1; m.p. 84 - 87 °C; IR (ATR) 2917, 2848, 2203, 1584, 1471, 1424, 1255, 1099, 723; HRMS (EI) m/z calcd. C\(_{13}\)H\(_{11}\)O\(_2\)NS + H: 246.0583; found [M+H]^+ 246.0573.

In a glove box, a flame-dried 10 mL microwave vial was charged with 4-chloro-2-methoxybenzoic acid (93.3 mg, 0.50 mmol, 1.0 equiv), anhydrous K\(_3\)PO\(_4\) (106.1 mg, 0.5 mmol, 1.0 equiv) and anhydrous o-DCB (0.60 mL, 0.83 M). The vial was transferred out of the glove box and I\(_2\) (380.7 mg, 1.50 mmol, 3.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 150 °C for 16 h. After this time, the vial was cooled to room temperature and Et\(_3\)N (209.0 µL, 1.50 mmol, 3.0 equiv) and anhydrous K\(_3\)PO\(_4\) (318.4 mg, 1.5 mmol, 3.0 equiv) was added. The mixture was then stirred at 150 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K\(_3\)PO\(_4\) (318.4 mg, 1.5 mmol, 3.0 equiv), 2,3,5,6-tetrafluoropyridine (76.0 µL, 0.75 mmol, 1.5 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of Et\(_2\)O. The mixture was concentrate in vacuo and purified by column chromatography (hexane 100%) to yield the desired product as a pale yellow oil (84.6 mg, 58%).

\[\text{H NMR (400 MHz, CDCl}_3\) \delta 7.21 (d, J = 8.2 Hz, 1H), 7.10 (dd, J = 8.2, 1.8 Hz, 1H), 7.06 (d, J = 1.8 Hz, 1H), 3.85 (s, 3H); \text{C NMR (126 MHz, CDCl}_3\) \delta 156.5, 142.6 (dm, J = 244.8 Hz), 138.8 (dm, J = 258.8 Hz), 137.1, 130.8, 129.2 (tt, J = 16.8, 3.2 Hz), 120.2, 112.5, 111.6, 55.2; \text{F NMR (376 MHz, CDCl}_3\) \delta –91.27 - –91.44, (m, 2F), –141.36 - –141.54 (m, 2F); IR (ATR) 2942, 1457, 1255, 964, 893; HRMS (EI) m/z calcd. C\(_{12}\)H\(_6\)ONClF\(_4\): 291.0069; found [M]^+ 291.0059.

\[\text{4-(4-chloro-2-methoxyphenyl)-2,3,5,6-tetrafluoropyridine (5g)}\]
4-(4-chloro-2-methoxyphenyl)-2,3,5,6-tetrafluoropyridine (5h)

In a glove box, a flame-dried 10 mL microwave vial was charged with 2-methoxy-4-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.5 mmol, 1.0 equiv) and anhydrous o-DCB (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I$_2$ (127.0 mg, 0.5 mmol, 1.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 150 °C for 16 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous K$_3$PO$_4$ (318.4 mg, 1.5 mmol, 3.0 equiv), anhydrous LiO'Bu (160.0 mg, 2.0 mmol, 4.0 equiv), 3,5-dichloropyridine (222 mg µL, 1.5 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %), 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) and pyridine (20.0 µL, 0.25 mmol, 0.5 equiv) were added. The vial was capped, transferred out of the glove box and stirred at 150 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of Et$_2$O. The mixture was concentrate in vacuo and purified by column chromatography (hexane/Et$_2$O 90:10) to yield the desired product as white solid (99 mg, 74%).

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.55 (s, 2H), 7.00 (d, $J = 7.6$ Hz, 1H), 6.90 (d, $J = 7.7$ Hz, 1H), 6.85 (s, 1H), 3.77 (s, 3H), 2.44 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 156.2, 147.4, 144.8, 141.4, 133.1, 129.8, 121.5, 120.3, 112.3, 55.8, 22.1; IR (ATR) 2918, 1387, 1279, 1207, 1171, 1101, 1038, 800; m.p. 62 - 64 °C; HRMS (EI) m/z calcd. C$_{13}$H$_{11}$NOCl$_2$+H: 268.0290; found [M+H]$^+$ 268.0285
General Procedures for the Decarboxylative Cross-Coupling of Two Benzoic acids

**2,3,6-trifluoro-4'-methoxy-3'-methyl-1,1'-biphenyl (8a)**
In a glovebox, a flame-dried 10 mL microwave vial was charged with 4-methoxy-3-methylbenzoic acid (83.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous 1,4-dioxane (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I$_2$ (253.8 mg, 1.00 mmol, 2.0 equiv) was added under a nitrogen funnel. The vial was capped and stirred at 170 °C for 16 h. After this time, the vial was cooled to room temperature, transferred to a glove box, washed with anhydrous K$_3$PO$_4$ (159.2 mg, 0.75 mmol, 1.5 equiv) and anhydrous K$_3$PO$_4$ (159.2 mg, 0.75 mmol, 1.5 equiv) were added. The mixture was then stirred at 170 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous DMA (0.5 mL, 1.0 M, total volume = 0.5 M), anhydrous K$_3$PO$_4$ (318.4 mg, 1.50 mmol, 3.0 equiv), potassium 2,3,6-trifluorobenzoate (321.3 mg, 1.50 mmol, 3.0 equiv), CuI (19.0 mg, 0.10 mmol, 20 mol %) and 1,10-phenanthroline (18.0 mg, 0.10 mmol, 20 mol %) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of DCM. The mixture was concentrated in vacuo and purified by silver doped column chromatography (hexane, 100%) to yield the desired product as a white solid (98.4 mg, 78%).

$^1$H NMR (500 MHz, CDCl$_3$) δ 7.30 (d, $J = 8.5$ Hz, 1H), 7.27 (d, $J = 2.0$ Hz, 1H), 7.09 (qd, $J = 9.1, 4.9$ Hz, 1H), 7.00 – 6.84 (m, 2H), 3.90 (s, 3H), 2.29 (s, 3H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 158.2, 155.5 (ddd, $J = 244.0, 4.8, 2.5$ Hz), 148.0 (ddd, $J = 248.9, 14.1, 7.5$ Hz), 147.7 (ddd, $J = 244.3, 13.9, 3.6$ Hz), 132.5 (t, $J = 1.8$ Hz), 128.9 (t, $J = 2.0$ Hz), 126.9, 120.4 (dd, $J = 20.7, 15.2$ Hz), 120.1 (d, $J = 2.0$ Hz), 115.1 (ddd, $J = 19.3, 9.9, 1.0$ Hz), 110.8 (ddd, $J = 25.7, 6.8, 4.2$ Hz), 109.9, 55.5, 16.4; $^{19}$F NMR (376 MHz, CDCl$_3$) δ –119.9 (dd, $J = 15.0, 3.1$ Hz, 1F), –138.1 (dd, $J = 21.7, 3.4$ Hz, 1F), –142.3 (dd, $J = 21.6, 15.0$ Hz, 1F); m.p. 56-58 °C; IR (ATR) 2955, 1489, 1250, 1232, 809; HRMS (PI) m/z calcld. C$_{14}$H$_{11}$F$_3$O: 252.0757; found [M]+ 252.0754.

**2'-fluoro-2,4-dimethoxy-6'-(trifluoromethyl)-1,1'-biphenyl (8b)**
A flame-dried 10 mL microwave vial was charged with I$_2$ (126.9 mg, 0.50 mmol, 1.0 equiv), capped and flushed with N$_2$. The vial was transferred to a glove box, then 2,4-dimethoxybenzoic acid (91.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) were added. The vial was capped, transferred out of the glove box and at 170 °C for 16 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous DMA (0.5 mL, 1.0 M, total volume = 0.5 M), anhydrous K$_3$PO$_4$ (477.6 mg, 2.25 mmol, 4.5 equiv), 2-fluoro-6-(trifluoromethyl)benzoic acid (312.2 mg, 1.50 mmol, 3.0 equiv), CuI (19.0 mg, 0.10 mmol, 20 mol %) and 1,10-phenanthroline (18.0 mg, 0.10 mmol, 20 mol %) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of DCM. The mixture was concentrated in vacuo and purified by column chromatography (hexane/Et$_2$O, 90:10) to yield the desired product as a white solid (65%, 97.6 mg).
3-(2,6-difluorophenyl)benzo[b]thiophene (8c)

In a glovebox, a flame-dried 10 mL microwave vial was charged with 1-benzo[b]thiophene-3-carboxylic acid (89.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous 1,4-dioxane (0.5 mL, 1.0 M). The vial was transferred out of the glove box and I$_2$ (190.4 mg, 0.75 mmol, 1.5 equiv) was added under a nitrogen funnel. The vial was capped and stirred at 170 °C for 16 h. After this time, the vial was cooled to room temperature, Et$_3$N (69.7 µL, 0.5 mmol, 1.0 equiv) was added. The mixture was then stirred at 170 °C for 6 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous DMA (0.5 mL, 1.0 M, total volume = 0.5 M), anhydrous K$_3$PO$_4$ (583.7 mg, 2.75 mmol, 5.5 equiv), potassium 2,6-difluorobenzoate (294.3 mg, 1.50 mmol, 3.0 equiv), CuI (19.0 mg, 0.10 mmol, 20 mol %) and 1,10-phenanthroline (18.0 mg, 0.10 mmol, 20 mol %) were added. The vial was capped, transferred out of the glove box and stirred at 190 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature and filtered through a plug of celite with washings of DCM. The mixture was concentrated in vacuo and purified by silver doped column chromatography (hexane, 100%) to yield the desired product as a white solid (47%, 57.9 mg).

2,2',3,4,5,6,6'-heptafluoro-1,1'-biphenyl (8d)

A flame-dried 10 mL microwave vial was charged with I$_2$ (190.4 mg, 0.75 mmol, 1.5 equiv), capped and flushed with N$_2$. The vial was transferred to a glove box, then 2,6-difluorobenzoic acid (78.1 mg, 0.50 mmol, 1.0 equiv), anhydrous K$_3$PO$_4$ (106.1 mg, 0.50 mmol, 1.0 equiv) and anhydrous 1,4-dioxane (0.5 mL, 1.0 M) were added. The vial was capped, transferred out of the glove box and stirred at 190 °C for 3 h. After this time, the vial was cooled to room temperature and Et$_3$N (70.0 µL, 0.50 mmol, 1.0 equiv) was added. The mixture was then stirred at 130 °C for 1 h. After this time the vial was cooled to room temperature, transferred to a glove box and anhydrous 1,4-dioxane (0.5 mL, 0.5 M total volume), anhydrous K$_3$PO$_4$ (477.6 mg, 2.25 mmol, 4.5 equiv), pentafluorobenzoic acid (318.1 mg, 1.50 mmol, 3.0 equiv), CuI (9.5 mg, 0.05 mmol, 10 mol %) and 1,10-phenanthroline (9.0 mg, 0.05 mmol, 10 mol %) were added. The vial was capped, transferred out of the glove box and stirred at 190 °C for 4 h. After completion of the reaction, the mixture was cooled to room temperature then CDCl$_3$ (1.0 mL)
and fluorobenzene (46.9 µL, 0.50 mmol, 1.0 equiv) were added. An aliquot (200 µL) of the mixture was passed through a plug of Celite® directly into an NMR tube and diluted with CDCl₃ (400 µL) for quantitative ¹⁹F NMR analysis to yield the crude product (94%). Due to the volatility of 2,2',3,4,5,6,6'-heptafluoro-1,1'-biphenyl this product could not be isolated in a yield comparable to the NMR yield, however, flash column chromatography (100% pentane) did yield the product as a clear oil for analysis (63%, 88.2 mg).

¹H NMR (500 MHz, CDCl₃) δ 7.51 - 7.45 (m, 1H), 7.06 (app t, J = 8.0 Hz, 2H); ¹³C NMR (126 MHz, CDCl₃) δ 160.5 (dd, J = 252.5, 6.1 Hz), 144.7 (dddd, J = 250.8, 11.1, 7.4, 3.9 Hz), 141.9 (ddtt, J = 255.7, 13.4, 5.1 Hz), 137.9 (dm, J = 251.4 Hz), 132.3 (t, J = 10.2 Hz), 111.9 (dd, J = 20.7, 4.5 Hz), 104.6 - 104.9 (m, 2C); ¹⁹F NMR (376 MHz, CDCl₃) δ -110.17 - -110.25 (m, 2F), -137.89 - -138.01 (m, 2F), -152.57 (t, J = 20.9 Hz, 1F), -161.72 - -161.86 (m, 2F); m.p. 52 - 54 °C; IR (ATR) 2918, 1495, 1463, 1010, 981, 775; HRMS (EI) m/z calcd. C₁₂H₁₃F₇: 280.0117; found [M]⁺ 280.0113.

Quantitative ¹⁹F{¹H} NMR (CDCl₃)

2,4-diethoxy-2’,4’-dimethoxy-1,1’-biphenyl (8e)

In a glove box, a flame-dried 10 mL microwave vial was charged with potassium 2,4-diethoxybenzoate (81.9 mg, 0.33 mmol, 1.0 equiv), anhydrous K₃PO₄ (70.0 mg, 0.33 mmol, 1.0 equiv) and anhydrous dioxane (0.33 mL, 1.0 M). The vial was transferred out of the glove box and I₂ (83.8 mg, 0.33 mmol, 1.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 170 °C for 16 h. After this time the vial was cooled to room temperature, transferred to a glove box and PdCl₂ (5.3 mg, 0.03 mmol, 9.0 mol %), (R)-BINAP (18.7 mg, 0.03 mmol, 9.0 mol %), Ag₂CO₃ (287.5 mg, 1.05 mmol, 3.18 equiv) and DMA (1.67 mL, 0.165 M) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature, quenched with HCl (2M, 10 mL) extracted with EtOAc (3 x 10 mL) dried
over MgSO₄ filtered through a plug of celite with washings of EtOAc and concentrated in vacuo. The resulting residue was purified by column chromatography (hexane:EtOAc, 9:1) to yield the desired product as a yellow oil (45.9 mg, 46%).

1H NMR (400 MHz, CDCl₃) δ 7.16-7.12 (m, 2 H), 6.53-6.51 (m, 4 H), 4.05 (q, J = 6.9 Hz, 2 H), 3.99 (q, J = 6.8 Hz, 2 H), 3.84 (s, 3 H) 3.75 (s, 3 H), 1.43 (t, J = 7.0 Hz, 3H), 1.27 (t, J = 6.9 Hz, 3H); 13C NMR (101 MHz, CDCl₃) δ 159.9, 159.3, 158.1, 157.4, 132.0, 131.9, 120.5, 120.5, 104.9, 103.9, 100.5, 98.6, 63.9, 63.5, 55.5, 55.3, 15.0, 14.8; IR (ATR) 2975, 2932, 2368, 1604, 1576, 1494, 1180, 1156, 1036, 819; HRMS (EI) m/z calcd. C₁₈H₂₂O₄+H: 303.1591; found [M+H]+ 303.1582.

2,4-diethoxy-2′,6′-dimethoxy-1,1′-biphenyl (8f)
In a glove box, a flame-dried 10 mL microwave vial was charged with potassium 2,4-diethoxybenzoate (81.9 mg, 0.33 mmol, 1.0 equiv), anhydrous K₃PO₄ (70.0 mg, 0.33 mmol, 1.0 equiv) and anhydrous dioxane (0.33 mL, 1.0 M). The vial was transferred out of the glove box and I₂ (83.8 mg, 0.33 mmol, 1.0 equiv) was added under a nitrogen funnel. The vial was capped and the mixture stirred at 170 °C for 18 h. After this time the vial was cooled to room temperature, transferred to a glove box and potassium 2,6-dimethoxybenzoate (218.1 mg, 0.99 mmol, 3.0 equiv), PdCl₂ (5.3 mg, 0.03 mmol, 9.0 mol %), (R)-BINAP (18.7 mg, 0.03 mmol, 9.0 mol %), Ag₂CO₃ (287.5 mg, 1.05 mmol, 3.18 equiv) and DMA (1.67 mL, 0.165 M) were added. The vial was capped, transferred out of the glove box and stirred at 170 °C for 24 h. After completion of the reaction, the mixture was cooled to room temperature, quenched with HCl (2 M, 10 mL) extracted with EtOAc (3 x 10 mL) dried over MgSO₄ filtered through a plug of celite with washings of EtOAc and concentrated in vacuo. The resulting residue was purified by column chromatography (hexane:EtOAc, 9:1) to yield the desired product as a yellow oil (55.5 mg, 56%).

1H NMR (500 MHz, CDCl₃) δ 7.26 (app t, J = 8.3, 1H), 7.08 (d, J = 7.9 Hz, 1H), 6.63 (d, J = 8.3 Hz, 2H), 6.55-6.53 (m, 2H), 4.06 (q, J = 7.0 Hz, 2H), 3.98 (q, J = 7.0 Hz, 2H), 3.73 (s, 6H), 1.43 (t, J = 7.0 Hz, 3H), 1.21 (t, J = 7.0 Hz, 3H); 13C NMR (126 MHz, CDCl₃) δ 159.5, 158.4, 157.8, 132.5, 128.4, 116.3, 116.3, 105.1, 104.1, 100.8, 64.1, 63.4, 56.0, 15.1, 14.9; IR (ATR) 2958, 2161, 1678, 1598, 1248, 840, 754; HRMS (EI) m/z calcd. C₁₈H₂₂O₄+H: 303.1591; found [M+H]+ 303.1578.

S68
Scheme S5. Summary of the conditions for the decarboxylative oxidative cross-coupling between benzoic acids and arenes.
Scheme S6. Summary of the conditions for the decarboxylative oxidative cross-coupling between two benzoic acids.

1) I₂ (1.0 - 2.0 equiv), K₃PO₄, 1,4-dioxane, 150 - 190 °C
2) Et₃N (0.0 - 1.5 equiv), K₃PO₄, 1,4-dioxane, 150 - 190 °C
3) CuI/Phen (10 mol%), ArCO₂H (3.0 equiv), K₃PO₄, DMA, 170 °C, 6 h

1) I₂ (2.0 equiv), K₃PO₄ (1.0 equiv), 1,4-dioxane (1.0 M), 170 °C, 16 h
2) Et₃N (1.5 equiv), K₃PO₄ (1.5 equiv), 170 °C, 6 h
3) CuI/Phen (20 mol%), ArCO₂K (3.0 equiv), K₃PO₄ (3.0 equiv), DMA (1.0 M, Total = 0.5 M), 170 °C, 24 h

1) I₂ (1.0 equiv), K₃PO₄ (1.0 equiv), 1,4-dioxane (1.0 M), 170 °C, 16 h

1) I₂ (1.5 equiv), K₃PO₄ (1.0 equiv), 1,4-dioxane (1.0 M), 190 °C, 3 h
2) Et₃N (1.0 equiv), 130 °C, 1 h
3) CuI/Phen (10 mol%), ArCO₂H (3.0 equiv), K₃PO₄ (4.5 equiv), 1,4-dioxane (1.0 M, Total = 0.5 M), 190 °C, 4 h

1) I₂ (1.0 equiv), K₃PO₄ (1.0 equiv), 1,4-dioxane (1.0 M), 170 °C, 16 h
2) n/a
3) PdCl₂/BINAP (9 mol%), ArCO₂K (3.0 equiv), Ag₂CO₃ (3.2 equiv), DMA (0.2 M, Total = 0.17 M), 170 °C, 24 h

1) I₂ (1.0 equiv), K₃PO₄ (1.0 equiv), 1,4-dioxane (1.0 M), 170 °C, 18 h
2) n/a
3) PdCl₂/BINAP (9 mol%), ArCO₂K (3.0 equiv), Ag₂CO₃ (3.2 equiv), DMA (0.2 M, Total = 0.17 M), 170 °C, 24 h
NMR Spectra

Potassium 2-methoxybenzoate (K-1a)

$^1$H NMR ((CD$_3$)$_2$SO)

$^{13}$C NMR ((CD$_3$)$_2$SO)
((2-methoxybenzoyl)oxy)silver (Ag-1a)

$^1$H NMR ((CD$_3$)$_2$SO)

$^{13}$C NMR ((CD$_3$)$_2$SO)
Methyl 2-(methoxymethoxy)benzoate (Me-1o)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-(methoxymethoxy)benzoic acid (10)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-((triisopropylsilyl)oxy)benzoic acid (1p)

$^1$H NMR ((CD$_3$)$_2$CO)

$^{13}$C NMR ((CD$_3$)$_2$CO)
4-(2-(dimethylamino)-2-oxoethoxy)benzoic acid (1q)

$^1$H NMR ((CD$_3$)$_2$SO)

$^{13}$C NMR ((CD$_3$)$_2$SO)
(8R,9S,13S,14S)-3-methoxy-13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-6H-cyclopenta[a]phenanthrene-2-carboxylic acid (methylestrone-2-carboxylic acid, 1af)

$^1$H NMR ((CD$_3$)$_2$CO)

$^{13}$C NMR ((CD$_3$)$_2$CO)
1-tosyl-1H-indole-3-carboxylic acid (1a1)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodoanisole (2a)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-iodoanisole (2b)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-iodo-1-methoxy-2-methylbenzene (2c)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-1,5-dimethoxybenzene (2e)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-ido-1,3-dimethoxybenzene (2f)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-2-methoxy-4-methylbenzene (2g)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-4-methoxy-2-methylbenzene (2h)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-1,3,5-trimethylbenzene (2i)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-2,4-dimethylbenzene (2j)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)

S87
2-iodo-1,3-dimethylbenzene (2k)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-2-methylbenzene (2l)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodonaphthalene (2m)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1,4-diiodonaphthalene (2m')

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-2-methylnaphthalene (2n)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1-iodo-2-(methoxymethoxy)benzene (2o)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
(4-iodophenoxy)triisopropylsilane (2p)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-(4-iodophenoxy)-N,N-dimethylacetamide 4-iodophenoxy)triisopropylsilane (2q)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$N$-(4-iodophenyl)acetamide (2r)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-(2-iodophenyl)morpholine (2s)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-(4-iodophenyl)morpholine (2t)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-fluoro-1-iodo-2-methoxybenzene (2u)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}\text{F NMR (CDCl}_3\text{)}$
4-chloro-1-iodo-2-methoxybenzene (2v)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-bromo-1-iodo-2-methoxybenzene (2w)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
1,4-diiodo-2-methoxybenzene (2x)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-fluoro-2-iodo-1-methoxybenzene (2y)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl$_3$)
4-chloro-2-iodo-1-methoxybenzene (2z)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-bromo-2-iodo-1-methoxybenzene (2aa)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-1-methoxy-4-(trifluoromethyl)benzene (2ab)

$^1$H NMR (CDCl$_3$)

![1H NMR spectrum](image)

$^{13}$C NMR (CDCl$_3$)

![$^{13}$C NMR spectrum](image)
$^{19}$F NMR (CDCl$_3$)
(8R,9S,13S,14S)-2-iodo-3-methoxy-13-methyl-6,7,8,9,11,12,13,14,15,16-decahydro-17H-cyclopenta[a]phenanthren-17-one (2-iodomethylestrone, 2af)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
3-iodo-1-methyl-1H-indole (2ak)

$^1$H NMR (($CD_3$)$_2$SO)

$^{13}$C NMR (($CD_3$)$_2$SO)
3-iodo-1-tosyl-1H-indole (2aI)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-3-methylbenzo[b]thiophene (2am)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
3-iodobenzo[b]thiophene (2an)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodobenzo[b]thiophene (2ao)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2,3-diiodobenzo[b]thiophene (2ao’)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-3-methylbenzofuran (2ap)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodobenzofuran (2aq)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-bromo-5-iodothiophene (2ar)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-ido-5-(p-tolyl)furan (2as)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-5-nitrofurane (2at)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-iodo-1-methyl-1H-pyrazole (2au)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
5-iodo-4-methylthiazole (2av)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-(5-iodopyridin-2-yl)morpholine (2aw)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
3-iodo-2-methoxypyridine (2ax)

\(^1\text{H NMR (CDCl}_3\text{)}\)

\(^{13}\text{C NMR (CDCl}_3\text{)}\)
3-iodo-4H-chromen-4-one (2ay)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
(E)-(2-iodovinyl)benzene (10:1, E/Z) (2az)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
(E)-1-(2-iodovinyl)-4-methoxybenzene (23:1, E/Z) (2az’)

$^{1}H$ NMR (CDCl$_3$)

$^{13}C$ NMR (CDCl$_3$)

S128
2-iodo-1,4-dimethoxybenzene (2B)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-iodo-1,4-dimethoxybenzene (2C)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2-(allyloxy)-4-methoxybenzoic acid (1A)

$^1$H NMR ((CD$_3$)$_2$SO)

$^{13}$C NMR ((CD$_3$)$_2$SO)
2-(allyloxy)-1-iodo-4-methoxybenzene (2A)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2,3,5,6-tetrafluoro-4'-methoxy-3'-methyl-4-(trifluoromethyl)-1,1'-biphenyl (5a)

$^1$H NMR ((CD$_3$)$_2$CO)

$^{13}$C NMR ((CD$_3$)$_2$CO)
$^{19}$F NMR (CDCl$_3$)
2,3,4,5,6-pentafluoro-4'-methoxy-1,1'-biphenyl (5b)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl₃)
3-(2,6-dinitrophenyl)-1-methyl-1H-indole (5c)

$^1$H NMR ((CD$_3$)$_2$CO)

$^{13}$C NMR ((CD$_3$)$_2$CO)
4-(benzo[b]thiophen-3-yl)-2,3,5,6-tetrafluorobenzonitrile (5d)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}\text{F NMR (CDCl}_3\text{)}$
2,6-difluoro-2'-methoxy-4-nitro-1,1'-biphenyl (5e)

$^1$H NMR ((CD$_3$)$_2$CO)

$^{13}$C NMR ((CD$_3$)$_2$CO)
$^{19}$F{$^1$H} NMR (CDCl$_3$)

$^{19}$F NMR (CDCl$_3$)
5-(2,6-dimethoxyphenyl)thiophene-2-carbonitrile (5f)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
4-(4-chloro-2-methoxyphenyl)-2,3,5,6-tetrafluoropyridine (5g)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}\text{F NMR (CDCl}_3\text{)}$
4-(4-chloro-2-methoxyphenyl)-2,3,5,6-tetrafluoropyridine (5h)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2,3,6-trifluoro-4'-methoxy-3'-methyl-1,1'-biphenyl (8a)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl$_3$)
2'-fluoro-2,4-dimethoxy-6'-(trifluoromethyl)-1,1'-biphenyl (8b)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl$_3$)
3-(2,6-difluorophenyl)benzo[b]thiophene (8c)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl$_3$)
2,2',3,4,5,6,6'-heptafluoro-1,1'-biphenyl (8d)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
$^{19}$F NMR (CDCl$_3$)
2,4-diethoxy-2',4'-dimethoxy-1,1'-biphenyl (8e)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
2,4-diethoxy-2',6'-dimethoxy-1,1'-biphenyl (8f)

$^1$H NMR (CDCl$_3$)

$^{13}$C NMR (CDCl$_3$)
