Electronic Supplementary Information

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1. Experimental section

a) General information

All chemicals, unless otherwise noted, were purchased from commercial sources and were used without further purification. Unless stated otherwise, all reactions were carried out under nitrogen atmosphere. The substrates were synthesized according to the literature methods.\textsuperscript{1-4} Irradiation with visible light was performed using blue LEDs illumination instruments (The actual output power density of the LEDs at 0.5 cm distance is 33.70 mW/cm\textsuperscript{2} detected by CEL-NP2000-10 (Beijing CeauLight Co. Ltd., China) light power meter).

The nuclear magnetic resonance spectra were recorded on the Bruker Ascend\textsuperscript{TM} 400 MHz NMR spectrometer and the Bruker Ascend\textsuperscript{TM} 500 MHz NMR spectrometer with tetramethylsilane (TMS) as an internal standard. High resolution mass spectra were recorded using a Q Exactive mass spectrometer (Thermo Fisher Scientific, USA). X-Ray diffraction data of the single crystal were collected on XtaLAB PRO MM007HF DW.
b) Methods for the synthesis of substrates

\[
\text{R}^1 \text{N} = \text{TMS} \quad \xrightarrow{\text{NaBH}_4, \text{HOAc}} \quad \text{R}^1 \text{N} \quad \text{S1}
\]

\[
\text{S2} \quad \xrightarrow{\text{K}_2\text{CO}_3, \text{MeOH}} \quad \text{a}
\]

i) To a solution of 2-((trimethylsilyl)ethynyl)aniline (3 mmol, 1.0 equiv) in AcOH (7.0 mL) was added benzaldehyde (3.6 mmol, 1.2 equiv). The reaction was stirred at room temperature for 1 h and then cooled to 0 °C. The resulting mixture was then warmed to ambient temperature and stirred for 1 h before the addition of NaBH\(_4\) (6 mmol, 2.0 equiv). NaOH (3 N, 30 mL) and ethyl acetate (30 mL) were added and the layers were separated. The aqueous phase was extracted twice with ethyl acetate. The combined organic phase was dried over Na\(_2\)SO\(_4\), filtered and concentrated under reduced pressure to afford S1. The crude product S1 were isolated by silica-gel column chromatography in excellent yield (64-82%).

ii) S1 was treated with K\(_2\)CO\(_3\) (0.83 g, 6 mmol) in MeOH (20 mL) at room temperature for 1 h. MeOH was removed under reduced pressure. The residue was diluted with ethyl acetate (30 mL) and water (20 mL). The phases were separated and the aqueous phase was extracted twice with ethyl acetate. The combined organic solution was dried over MgSO\(_4\), filtered, and concentrated under reduced pressure to afford S2 as a light yellow oil. The crude product S2 was used in the following step without purification.

iii) To a solution of S2 in CH\(_2\)Cl\(_2\) (15 mL) was added Et\(_3\)N (0.84 mL, 6.0 mmol) and trifluoroacetic anhydride (0.51 mL, 3.6 mmol). The reaction mixture was stirred at room temperature for 2 h and then concentrated under reduced pressure. The residue was chromatographed through silica gel eluting with ethyl acetate/hexanes to give the product (47-85%).
Some of the substrates were synthesized using this method. To a solution of \( N-(2\text{-ethynylphenyl})-2,2,2\text{-trifluoroacetamide} \) (1.0 equiv) in \( \text{CH}_3\text{CN} \) (0.2 M) was added \( \text{K}_2\text{CO}_3 \) (1.2 equiv), followed by benzyl bromide (1.2 equiv). The reaction mixture was stirred at 80 °C for 2 h, cooled to RT, and concentrated under reduced pressure. The residue was chromatographed through silica gel eluting with ethyl acetate/hexanes to give the product (75-83%).

\[
\begin{align*}
\text{NH}_2 & \quad \text{NHAc} \\
\text{1.5 equiv} & \quad \text{Et}_3\text{N} \\
\text{1.5 equiv} & \quad \text{MeCOCl} \\
\text{THF, RT} & \quad 99\%
\end{align*}
\]

\( N\)-acetyl-\( o \)-ethynylaniline was synthesized using this method. To a solution of \( o \)-ethynylaniline (1 mmol, 117 mg), \( \text{Et}_3\text{N} \) (1.5 mmol, 0.206 mL) in THF (2 mL) was added acetyl chloride (1.5 mmol, 118 mg) dropwise at room temperature. After the addition was complete, the reaction mixture was stirred for a further 30 minutes. The reaction was quenched by water (10 mL) and the resulting mixture was extracted with \( \text{Et}_2\text{O} \) (3×10 mL). The combined extracts were washed with brine, dried over sodium sulfate and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel to afford \( N\)-acetyl-\( o \)-ethynylaniline \( \text{S4} \) as a white solid (158.4 mg, 99% yield).

\[
\begin{align*}
\text{Fe} & \quad (4 \text{ equiv}) \\
\text{EtOH/HCl} & \quad 78^\circ\text{C}, 2h
\end{align*}
\]

To a solid of \( \text{a23} \) (696 mg, 2 mmol, 1 equiv) in ethanol (8 mL) were added iron powder (448 mg, 8 mmol, 4 equiv) and concd HCl (2 mL, 2.4 mmol, 1.2 equiv). After 2 h of reflux, the mixture was cooled to room temperature and \( \text{Na}_2\text{CO}_3 \) was added by
portions until gas evolution ceased. After filtration over Celite, the filtrate was extracted with Et₂O and the combined organic fractions were washed with H₂O and a saturated solution of NaCl. The organic layer was then dried over Na₂SO₄, filtered, and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel to afford a (217 mg, 35 % yield).
c) **Table S1. Optimization of the reaction time**

![Reaction Scheme]

<table>
<thead>
<tr>
<th>Entry</th>
<th>Reaction time (h)</th>
<th>Yield (%)$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>73</td>
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<tr>
<td>4</td>
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<td>85</td>
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<td>5</td>
<td>7</td>
<td>86</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>86</td>
</tr>
</tbody>
</table>

$^a$Reaction conditions: 0.1 mmol a1, 3% Ru(bpy)$_2$Cl$_2$·6H$_2$O, 0.25 mmol b and c1 were dissolved in CH$_2$Cl$_2$, degassed for 15 min under N$_2$, 450 nm LEDs irradiation at room temperature; $^b$ isolated yields.
d) **Scheme S1.** Optimization of pyridine-\(N\)-oxide derivatives.

![Chemical structures and yields](image-url)
e) Crystal structure determination of d1

A suitable crystal of d1 was mounted with glue at the end of a glass fiber. Data collection was performed with a XtaLAB PRO MM007-DW diffractometer system equipped with a RA-Micro7HF-MR-DW(Cu/Mo) X-ray generator and Pilatus3R-200K-A detector (Rigaku, Japan, Cu Ka, \( \lambda = 1.54178 \text{ Å} \)). The structure was solved by direct methods (SHELXTL-97) and refined by full-matrix least-squares (SHELXTL-97)\(^6\) refinements based on \( F^2 \). Anisotropic thermal parameters were applied to all non-hydrogen atoms. The hydrogen atoms were generated geometrically. Crystal data and structure refinement parameters are summarized in Table S2. CCDC No. 1936747.

Single crystals suitable for X-ray diffraction were obtained by slow evaporation of a saturated solution of d1 (methanol) in a loosely capped vial.

Table S2 Crystal data and structure refinement for d1

<table>
<thead>
<tr>
<th>Identification code</th>
<th>d1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical formula</td>
<td>( \text{C}<em>{18}\text{H}</em>{11}\text{F}_{6}\text{NO} )</td>
</tr>
<tr>
<td>Formula weight</td>
<td>371.28</td>
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<tr>
<td>Temperature/K</td>
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</tr>
<tr>
<td>Crystal system</td>
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<tr>
<td>Space group</td>
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<tr>
<td>( a/\text{Å} )</td>
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</tr>
<tr>
<td>( b/\text{Å} )</td>
<td>15.2537(5)</td>
</tr>
<tr>
<td>( c/\text{Å} )</td>
<td>26.0789(7)</td>
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<td>( \alpha/\text{°} )</td>
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<tr>
<td>( \beta/\text{°} )</td>
<td>92.227(3)</td>
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<tr>
<td>( \gamma/\text{°} )</td>
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<tr>
<td>Volume/( \text{Å}^3 )</td>
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<td>( Z )</td>
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<tr>
<td>( \rho_{\text{calc}}/\text{g/cm}^3 )</td>
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<tr>
<td><strong>μ/mm⁻¹</strong></td>
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</tr>
<tr>
<td>------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>F(000)</strong></td>
<td>1504.0</td>
</tr>
<tr>
<td><strong>Crystal size/mm³</strong></td>
<td>0.3 × 0.1 × 0.05</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
<td>CuKα (λ = 1.54184)</td>
</tr>
<tr>
<td><strong>2Θ range for data collection/°</strong></td>
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<td><strong>Index ranges</strong></td>
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<tr>
<td><strong>Reflections collected</strong></td>
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</tr>
<tr>
<td><strong>Independent reflections</strong></td>
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</tr>
<tr>
<td><strong>Data/restraints/parameters</strong></td>
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</tr>
<tr>
<td><strong>Goodness-of-fit on F²</strong></td>
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</tr>
<tr>
<td><strong>Final R indexes [I&gt;=2σ (I)]</strong></td>
<td>R₁ = 0.0521, wR₂ = 0.1340</td>
</tr>
<tr>
<td><strong>Final R indexes [all data]</strong></td>
<td>R₁ = 0.0587, wR₂ = 0.1378</td>
</tr>
<tr>
<td><strong>Largest diff. peak/hole / e Å⁻³</strong></td>
<td>0.40/-0.22</td>
</tr>
</tbody>
</table>
f) General procedure for the photoreactions

The substrate (0.1 mmol, 1 equiv.), trifluoroacetic anhydride (0.25 mmol, 2.5 equiv.), pyridine N-oxide (0.25 mmol, 2.5 equiv.) and 3 mol% Ru(bpy)$_3$Cl$_2$·6H$_2$O were dissolved in 6.0 mL CH$_2$Cl$_2$ in a 15 mL reaction tube equipped with magnetic stirring bar, the reaction tube was sealed and the resulting mixture was deaerated with nitrogen for 15 min, then the reaction tube was irradiated by blue LEDs for 9 h. After reaction, the solvent was removed by rotary evaporation and purified by column chromatography on silica gel using petroleum ether/ethyl acetate as the eluent.

Figure S1. Reaction setup for general photoreactions.

The substrate (0.1 mmol, 1 equiv.), ethyldifluoroiodoacetate (0.2 mmol, 2 equiv.), Potassium carbonate (0.15 mmol, 1.5 equiv.) and the Pt-I complex (0.003 mmol, 3 mol%) were dissolved in 5.0 mL (CH$_2$Cl$_2$:CH$_3$OH=1:1) in a 15 mL reaction tube equipped with magnetic stirring bar, the reaction tube was sealed and the resulting mixture was deaerated with nitrogen for 15 min, then the reaction tube was irradiated
by blue LEDs for 12 h. After reaction, the solvent was removed by rotary evaporation and purified by column chromatography on silica gel using petroleum ether/ethyl acetate as the eluent.

The substrate (0.1 mmol, 1 equiv.), diethyl bromodifluoromethane phosphonate (0.2 mmol, 2 equiv.), sodium dicarbonate (0.15 mmol, 1.5 equiv.) and the Pt-I complex (0.003 mmol, 3 mol%) were dissolved in 5.0 mL CH₂Cl₂ in a 15 mL reaction tube equipped with magnetic stirring bar, the reaction tube was sealed and the resulting mixture was deaerated with nitrogen for 15 min, then the reaction tube was irradiated by blue LEDs for 12 h. After reaction, the solvent was removed by rotary evaporation and purified by column chromatography on silica gel using petroleum ether/ethyl acetate as the eluent.
g) **Procedure for the gram-scale reaction**

The substrate (3.4 mmol, 1 equiv.), trifluoroacetic anhydride (8.5 mmol, 2.5 equiv.), pyridine N-oxide (8.5 mmol, 2.5 equiv.) and 3 mol% Ru(bpy)$_3$Cl$_2$·6H$_2$O were dissolved in 80 mL CH$_2$Cl$_2$ in a 250 mL reaction flask equipped with magnetic stirring bar, the flask was sealed and the resulting mixture was deaerated with nitrogen for 30 min, then the flask was irradiated by blue LEDs for 48 h. After reaction, the solvent was removed by rotary evaporation and purified by column chromatography on silica gel using petroleum ether/ethyl acetate as the eluent.

Figure S2. Gram scale reaction setup and product d1.
h) Scheme S2. Trifluoroacetic anhydride induced oxidation of triple bond.
i) Procedures for further transformation of d1

A white solid of d1 (1.1 g, 2.8 mmol) in MeOH (150 mL) was cooled to 0 °C, and then 5 N NaOH solution (25 mL) was added slowly. This mixture was stirred for 1 h at room temperature. The residue mixture was concentrated under reduced pressure. This solution was then extracted with CH$_2$Cl$_2$ (2 × 20 mL). The combined organic phases were washed with brine and dried over sodium sulphate. The solvent was removed by rotary evaporation and purified by column chromatography on silica gel by using petroleum ether/ethyl acetate as eluent.

The substrate f (0.1 mmol, 1 equiv) and Pt 1 (0.00025 mmol, 0.0025 equiv) were dissolved in DMF (2 mL) in a 10 mL reaction tube equipped with magnetic stirring bar, and the resulting mixture was irradiated using blue LEDs at the ambient condition. After the substrate was completely converted (monitored by TLC), the reaction mixture was evaporated under reduced pressure until DMF was gone. Then diethyl ether (25 mL) and water (25 mL) were added to the residue. The organic layer was extracted with diethyl ether (3 × 25 mL). The combined organic phases were washed with brine and dried over sodium sulphate. The solvent was removed by rotary evaporation and purified by column chromatography on silica gel by using petroleum ether/ethyl acetate as eluent.
To a solution of f (0.21 mmol, 1.0 equiv) in CHCl₃ (5 mL) was added MnO₂ (1.0 mmol, 5.0 equiv). The reaction mixture was heated for 1 h at 60 °C and cooled to room temperature. The solvent was removed by rotary evaporation and purified by column chromatography on silica gel by using petroleum ether/ethyl acetate as eluent.
j) Reaction Quantum Yield (Φ) Measurement^{9-11}

1) Determination of the light intensity at 450 nm

The photon flux of the LED ($\lambda_{\text{max}} = 450$ nm) was determined by standard ferrioxalate actinometry. By dissolving potassium ferrioxalate hydrate (0.737 g) in H$_2$SO$_4$ (10 mL of a 0.05 M solution), a 0.15 M solution of ferrioxalate was prepared. By dissolving 1,10-phenanthroline (25 mg) and sodium acetate (5.63 g) in H$_2$SO$_4$ (25 mL of a 0.5 M solution), a buffered solution of 1,10-phenanthroline was prepared. Both solutions were stored in the dark. To determine the photon flux of the LED, a cuvette containing 1.0 mL ferrioxalate solution was irradiated for 90 s at $\lambda_{\text{max}} = 450$ nm. After irradiation, 0.175 mL phenanthroline solution was added to the cuvette and the mixture was allowed to stir in the dark for 1.5 h to allow the ferrous ions to completely coordinate to the phenanthroline. The absorbance of the solution was measured at 510 nm. A non-irradiated sample was also prepared and measured the absorbance at 510 nm. The results were shown as below:

![Figure S3. UV-vis spectrum of irradiation and non-irradiation sample.](image)

Conversion was calculated using equation 1.

$$\text{mol Fe}^{2+} = \frac{V \cdot \Delta A(510 \text{ nm})}{1 \cdot \varepsilon}$$

(1)
Where $V$ is the total volume ($0.001175$ L) of the solution after addition of phenanthroline, $\Delta A$ is the difference in absorbance at $510$ nm between the irradiated and non-irradiated solutions, $l$ is the path length ($1.0$ cm), and $\varepsilon$ is the molar absorptivity of the ferrioxalate actinometer at $510$ nm ($11100$ L mol$^{-1}$ cm$^{-1}$). The photon flux can be calculated using equation 2.

$$\text{Photon flux} = \frac{mol \ Fe^2+}{\Phi\cdot t\cdot f}$$

(2)

Where $\Phi$ is the quantum yield for the ferrioxalate actinometer at $\lambda_{\text{max}} = 450$ nm, $t$ is the irradiation time, and $f$ is the fraction of light absorbed at $\lambda_{\text{max}} = 450$ nm by the ferrioxalate actinometer. This value is calculated using equation 3 where $A$ is the absorbance of the ferrioxalate solution at 450 nm. An absorption spectrum gave an $A$ value of $>3$, indicating that the fraction of absorbed light ($f$) is $>0.999$.

$$f = 1 - 10^{-A(450\ \text{nm})}$$

The photon flux was thus calculated to be $1.05 \times 10^{-9}$ einstein s$^{-1}$.

2) Determination of the reaction quantum yield

The degassed solution containing $a_1$ (0.1 mmol, 1 equiv.), trifluoroacetic anhydride (0.25 mmol, 2.5 equiv.), pyridine $N$-oxide (0.25 mmol, 2.5 equiv.) and 3 mol% Ru(bpy)$_3$Cl$_2$·6H$_2$O with magnetic stirring bar was constantly irradiated for 30 min. After irradiation, the yield of product $d_1$ was determined to be 9 mol% by $^1$H NMR. The reaction quantum yield was determined using equation 4, where photon flux was determined as above described, $t$ is the reaction time, $f$ is the fraction of incident light absorbed by the reaction mixture. This value is calculated using equation 3 where $A$ is the absorbance of the reaction mixture at 450 nm. An absorption spectrum of the reaction mixture shown as Figure S4 gave an $A$ value of $>3$, indicating that the fraction of absorbed light ($f$) is $>0.999$.

$$\Phi = \frac{\text{mol of product formed}}{\text{photon flux} \cdot t \cdot f}$$

(4)
The reaction quantum yield ($\Phi$) was determined to be 5.5, which is above unity, indicating that a radical chain propagation might be operative in this reaction.
k) References

2. Characterization data of the products

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta \text{ ppm } = 7.49 \sim 7.41 (m, 4H), 7.39 \sim 7.34 (m, 2H), 7.30 (t, J = 7.1 Hz, 1H), 7.16 (d, J = 7.5 Hz, 1H), 6.12 (q, J = 8.0 Hz, 1H), 5.98 (d, J = 17.1 Hz, 1H), 4.34 (d, J = 17.1 Hz, 1H).

\[ \text{C NMR (126 MHz, CDCl}_3\text{)} \delta \text{ ppm } = 156.83 (q, J = 36.7 Hz), 148.56 (q, J = 5.0 Hz), 136.28 (s), 135.85 (s), 134.75 (s), 133.69 (s), 130.07 (s), 129.86 (s), 129.39 (s), 129.31 (s), 128.82 (q, J = 2.9 Hz), 128.05 (s), 127.93 (s), 126.69 (d, J = 2.5 Hz), 122.14 (q, J = 270.9 Hz), 120.18 (q, J = 34.4 Hz), 116.11 (q, J = 288.5 Hz), 50.62 (s).

\[ \text{F NMR (376 MHz, CDCl}_3\text{)} \delta \text{ ppm } = -57.18 (s, 3F), -67.90 (s, 3F).

HRMS (ESI) (m/z): [M+Na]+ called. for C_{18}H_{11}F_{6}NONa: 394.0643, found: 394.0631.

\[ \text{H NMR (400 MHz, CDCl}_3\text{)} \delta \text{ ppm } = 7.40 (dd, J = 7.6, 1.3 Hz, 1H), 7.35 (td, J = 7.4, 1.5 Hz, 1H), 7.31 \sim 7.28 (m, 1H), 7.24 (s, 2H), 7.20 (s, 1H), 7.14 (d, J = 7.5 Hz, 1H), 6.09 (q, J = 8.1 Hz, 1H), 5.96 (d, J = 17.1 Hz, 1H), 4.31 (d, J = 17.1 Hz, 1H), 2.39 (s, 3H).

\[ \text{C NMR (126 MHz, CDCl}_3\text{)} \delta \text{ ppm } = 156.97 (q, J = 36.5 Hz), 148.78 (q, J = 5.6 Hz), 139.67 (s), 136.09 (s), 134.95 (s), 133.76 (s), 133.19 (s), 130.60 (s), 129.78 (s), 129.26 (s), 129.20 (d, J = 2.5 Hz), 128.06 (s), 127.86 (s), 126.43 (d, J = 1.7 Hz), 122.20 (q, J = 272.2 Hz), 119.91 (q, J = 34.0 Hz), 116.16 (q, J = 288.5 Hz), 50.69 (s), 21.17 (s).

\[ \text{F NMR (376 MHz, CDCl}_3\text{)} \delta \text{ ppm } = -57.21 (s, 3F), -67.90 (s, 3F).

HRMS (ESI) (m/z): [M+Na]+ called. for C_{19}H_{13}F_{6}NONa: 408.0799, found: 408.0786.
$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.41 (dd, $J = 7.6$, 1.2 Hz, 1H), 7.35 (td, $J = 7.4$, 1.5 Hz, 1H), 7.30 (d, $J = 7.7$ Hz, 2H), 7.23 (d, $J = 7.9$ Hz, 1H), 7.18 (s, 1H), 7.15 (d, $J = 7.5$ Hz, 1H), 6.11 (q, $J = 8.1$ Hz, 1H), 5.96 (d, $J = 17.1$ Hz, 1H), 4.33 (d, $J = 17.0$ Hz, 1H), 2.41 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.82 (q, $J = 36.6$ Hz), 148.66 (q, $J = 5.6$ Hz), 140.55 (s), 135.73 (s), 134.98 (s), 133.73 (s), 133.22 (s), 130.06 (s), 129.74 (s), 129.26 (s), 128.55 (q, $J = 2.8$ Hz), 128.05 (s), 127.86 (s), 127.08 (d, $J = 1.7$ Hz), 122.24 (q, $J = 272.2$ Hz), 120.00 (q, $J = 34.0$ Hz), 116.15 (d, $J = 288.5$ Hz), 50.67 (s), 21.16 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.10 (s, 3F), -67.86 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{19}$H$_{13}$F$_{6}$NONa: 408.0799, found: 408.0789.

$^1$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.38 (dd, $J = 13.2$, 7.3 Hz, 3H), 7.31 (t, $J = 7.4$ Hz, 1H), 7.17 – 7.12 (m, 3H), 6.13 (q, $J = 8.0$ Hz, 1H), 5.97 (d, $J = 17.1$ Hz, 1H), 4.32 (d, $J = 17.1$ Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 163.25 (s), 161.26 (s), 156.85 (q, $J = 36.7$ Hz), 147.37 (q, $J = 5.0$ Hz), 138.42 (d, $J = 9.0$ Hz), 134.14 (s), 133.57 (s), 131.84 (d, $J = 2.6$ Hz), 130.12 (s), 129.44 (s), 128.72 (d, $J = 9.3$ Hz), 128.08 (d, $J = 3.4$ Hz), 121.93 (q, $J = 271.5$ Hz), 120.70 (q, $J = 34.6$ Hz), 116.90 (q, $J = 23.0$ Hz), 116.06 (ddd, $J = 24.5$, 6.0, 3.0Hz), 116.04 (q, $J = 289.2$ Hz), 50.63 (s)

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.30 (s, 3F), -67.92 (s, 3F), -110.42 (s, 1F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{10}$F$_{7}$NONa: 412.0548, found: 412.0533.

$^1$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.44 – 7.39 (m, 3H), 7.37 (dd, $J = 7.5$, 1.2 Hz, 1H), 7.31 (t, $J = 8.0$ Hz, 1H), 7.28 (s, 1H), 7.19 (d, $J = 7.7$ Hz, 2H), 7.15 (d, $J = 7.8$ Hz, 1H), 7.08 (d, $J = 7.9$ Hz, 1H), 6.13 (q, $J = 8.1$ Hz, 1H), 5.99 (d, $J = 17.1$ Hz, 1H), 4.34 (d, $J = 17.0$ Hz, 1H), 2.40 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.79 (q, $J = 36.6$ Hz), 148.54 (q, $J = 5.6$ Hz), 140.45 (s), 135.92 (s), 134.88 (s), 133.71 (s), 133.21 (s), 130.05 (s), 129.71 (s), 129.22 (s), 128.51 (q, $J = 2.8$ Hz), 128.02 (s), 127.80 (s), 127.05 (d, $J = 1.7$ Hz), 122.20 (q, $J = 272.2$ Hz), 119.97 (q, $J = 34.0$ Hz), 116.11 (d, $J = 288.5$ Hz), 50.68 (s), 21.15 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.16 (s, 3F), -68.00 (s, 3F), -110.38 (s, 1F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{10}$F$_{7}$NONa: 412.0548, found: 412.0533.

$^1$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.44 – 7.39 (m, 3H), 7.37 (dd, $J = 7.5$, 1.2 Hz, 1H), 7.31 (t, $J = 8.0$ Hz, 1H), 7.28 (s, 1H), 7.19 (d, $J = 7.7$ Hz, 2H), 7.15 (d, $J = 7.8$ Hz, 1H), 7.08 (d, $J = 7.9$ Hz, 1H), 6.13 (q, $J = 8.1$ Hz, 1H), 5.99 (d, $J = 17.1$ Hz, 1H), 4.34 (d, $J = 17.0$ Hz, 1H), 2.40 (s, 3H).
Hz, 2H), 7.16 (d, J = 7.6 Hz, 1H), 6.14 (q, J = 8.0 Hz, 1H), 5.97 (d, J = 17.1 Hz, 1H), 4.32 (d, J = 17.1 Hz, 1H).

**13C NMR** (126 MHz, CDCl$_3$) δ ppm = 156.70 (q, J = 36.8 Hz), 147.22 (q, J = 5.6 Hz), 137.87 (s), 135.34 (s), 134.34 (s), 134.13 (s), 133.46 (s), 130.14 (s), 129.39 (s), 128.82 (q, J = 2.9 Hz), 128.15 (d, J = 2.5 Hz), 128.10 (d, J = 3.8 Hz), 121.95 (q, J = 270.9 Hz), 120.72 (q, J = 34.5 Hz), 116.04 (q, J = 289.8 Hz), 50.52 (s).

**19F NMR** (376 MHz, CDCl$_3$) δ ppm = -57.29 (s, 3F), -67.89 (s, 3F).

**HRMS** (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{10}$ClF$_6$NONa: 428.0253, found: 428.0229.

![Diagram](image1)

**1H NMR** (400 MHz, CDCl$_3$) δ ppm = 7.61 – 7.56 (m, 2H), 7.38 (ddd, J = 8.9, 5.6, 1.8 Hz, 2H), 7.33 – 7.29 (m, 1H), 7.24 (s, 1H), 7.16 (d, J = 7.4 Hz, 1H), 6.13 (q, J = 8.0 Hz, 1H), 5.97 (d, J = 17.2 Hz, 1H), 4.31 (d, J = 17.1 Hz, 1H).

**13C NMR** (126 MHz, CDCl$_3$) δ ppm = 156.64 (q, J = 36.8 Hz), 147.07 (q, J = 5.6 Hz), 138.10 (s), 134.85 (s), 134.13 (s), 133.43 (s), 133.16 (s), 131.71 (q, J = 2.9 Hz), 130.14 (s), 129.37 (s), 128.36 (d, J = 1.8 Hz), 128.10 (d, J = 4.7 Hz), 123.23 (s), 121.93 (q, J = 272.2 Hz), 120.74 (q, J = 35.3 Hz), 116.00 (q, J = 288.5 Hz), 50.47 (s).

**19F NMR** (376 MHz, CDCl$_3$) δ ppm = -57.31 (s, 3F), -67.90 (s, 3F).

**HRMS** (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{10}$BrF$_6$NONa: 471.9748, found: 471.9740.

![Diagram](image2)

**1H NMR** (400 MHz, CDCl$_3$) δ ppm = 7.75 (d, J = 8.2 Hz, 1H), 7.70 (s, 1H), 7.53 (d, J = 8.2 Hz, 1H), 7.45 – 7.38 (m, 2H), 7.36 – 7.32 (m, 1H), 7.18 (d, J = 7.5 Hz, 1H), 6.19 (q, J = 7.9 Hz, 1H), 6.01 (d, J = 16.9 Hz, 1H), 4.34 (d, J = 16.6 Hz, 1H).

**13C NMR** (126 MHz, CDCl$_3$) δ ppm = 156.50 (q, J = 37.3 Hz), 147.11 (q, J = 5.5 Hz), 139.00 (s), 137.14 (s), 133.83 (s), 133.29 (s), 131.76 (q, J = 32.8 Hz), 130.28 (s), 129.39 (s), 128.26 (s), 128.10 (s), 127.53
(s), 127.16 (dd, J = 7.0, 3.5 Hz), 126.20 (t, J = 3.8 Hz), 123.20 (q, J = 273.4 Hz), 121.87 (q, J = 272.2 Hz), 121.16 (q, J = 35.3 Hz), 115.95 (q, J = 288.5 Hz), 50.40 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.36 (s, 3F), -62.90 (s, 3F), -67.94 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^{+}$ called for C$_{19}$H$_{10}$F$_{9}$NONa: 462.0516, found: 462.0508.

$^{1}$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.42 – 7.35 (m, 3H), 7.31 (t, J = 7.2 Hz, 1H), 7.18 – 7.12 (m, 3H), 6.15 (q, J = 8.0 Hz, 1H), 5.96 (d, J = 17.0 Hz, 1H), 4.34 (d, J = 17.0 Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 163.80 (s), 161.80 (s), 156.57 (q, J = 37.0 Hz), 147.62 (q, J = 5.7 Hz), 137.06 (d, J = 9.8 Hz), 134.44 (s), 133.39 (s), 132.38 (d, J = 3.7 Hz), 132.30 (d, J = 5.0 Hz), 130.02 (s), 129.30 (s), 128.08 (d, J = 1.3 Hz), 122.07 (q, J = 272.2 Hz), 120.71 (q, J = 34.0 Hz), 116.72 (d, J = 21.4 Hz), 115.96 (q, J = 288.5 Hz), 114.46 (d, J = 21.7 Hz), 50.51 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.21 (s, 3F), -68.01 (s, 3F), -109.54 (s, 1F).

HRMS (ESI) (m/z): [M+Na]$^{+}$ called for C$_{18}$H$_{10}$F$_{7}$NONa: 412.0548, found: 412.0526.

$^{1}$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.46 (ddd, J = 22.7, 7.9, 0.8 Hz, 2H), 7.37 (t, J = 7.9 Hz, 2H), 7.31 (dd, J = 18.5, 7.7 Hz, 2H), 7.14 (d, J = 7.6 Hz, 1H), 6.07 (q, J = 8.0 Hz, 1H), 5.99 (d, J = 17.2 Hz, 1H), 4.27 (d, J = 17.2 Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.58 (q, J = 36.8 Hz), 143.16 (q, J = 5.5 Hz), 137.01 (s), 135.72 (s), 134.32 (s), 133.11 (s), 132.85 (d, J = 2.5 Hz), 130.49 (s), 130.15 (s), 129.94 (s), 129.38 (s), 128.03 (s), 127.71 (s), 125.18 (s), 121.75 (q, J = 271.5 Hz), 121.12 (q, J = 34.7 Hz), 116.02 (q, J = 288.5 Hz), 50.29 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -62.76 (s, 3F), -67.96 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^{+}$ called for C$_{18}$H$_{10}$ClF$_5$NONa: 428.0253, found: 428.0233.
$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 8.10 (dd, $J = 8.0$, 1.6 Hz, 1H), 8.05 (s, 1H), 7.49 (d, $J = 8.0$ Hz, 1H), 7.41 (d, $J = 8.9$ Hz, 1H), 7.37 (dd, $J = 7.5$, 1.5 Hz, 1H), 7.31 (t, $J = 7.0$ Hz, 1H), 7.16 (d, $J = 7.6$ Hz, 1H), 6.15 (q, $J = 8.0$ Hz, 1H), 6.00 (d, $J = 17.2$ Hz, 1H), 4.33 (d, $J = 17.2$ Hz, 1H), 3.95 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 165.31 (s), 156.69 (q, $J = 36.9$ Hz), 147.71 (q, $J = 6.3$ Hz), 140.82 (s), 136.06 (s), 134.01 (s), 133.52 (s), 132.16 (s), 130.49 (s), 130.17 (s), 129.40 (s), 129.07 (d, $J = 3.0$ Hz), 128.11 (d, $J = 3.8$ Hz), 121.96 (q, $J = 272.2$ Hz), 120.68 (q, $J = 34.7$ Hz), 116.00 (q, $J = 288.5$ Hz), 52.64 (s), 50.48 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.30 (s, 3F), -67.85 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{13}$F$_6$NO$_3$Na: 452.0697, found: 452.0681.

$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.48 – 7.40 (m, 3H), 7.37 – 7.34 (m, 1H), 7.22 (s, 1H), 7.17 (d, $J = 7.9$ Hz, 1H), 7.03 (d, $J = 7.9$ Hz, 1H), 6.11 (q, $J = 8.1$ Hz, 1H), 5.94 (d, $J = 16.9$ Hz, 1H), 4.29 (d, $J = 17.0$ Hz, 1H), 2.36 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.79 (d, $J = 36.5$ Hz), 148.69 (dd, $J = 11.3$, 5.6 Hz), 137.72 (s), 136.37 (s), 135.83 (s), 134.55 (s), 130.65 (s), 129.97 (s), 129.72 (s), 129.32 (s), 128.75 (d, $J = 3.0$ Hz), 127.99 (s), 126.70 (d, $J = 1.8$ Hz), 122.19 (q, $J = 270.9$ Hz), 119.87 (q, $J = 34.7$ Hz), 116.11 (q, $J = 288.5$ Hz), 50.44 (s), 20.91 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.13 (s, 3F), -67.90 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{29}$H$_{13}$F$_6$NONa: 408.0799, found: 408.0783.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ ppm = 7.49 – 7.41 (m, 3H), 7.36 (d, $J = 6.2$ Hz, 1H), 7.08 – 7.04 (m, 1H), 6.91 (dq, $J = 5.3$, 2.7 Hz, 2H), 6.13 (q, $J = 8.0$ Hz, 1H), 5.90 (d, $J = 16.7$ Hz, 1H), 4.26 (d, $J = 16.7$ Hz, 1H), 3.84 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 158.89 (s), 156.74 (q, $J = 36.7$ Hz), 148.56 (q, $J = 5.5$ Hz), 136.03 (s), 135.84 (s), 135.66 (s), 130.05 (s), 129.31 (d, $J = 4.9$ Hz), 128.77 (d, $J = 2.9$ Hz), 126.71 (d, $J = 1.7$ Hz), 125.46 (s), 122.12 (q, $J = 270.9$ Hz), 120.20 (q, $J = 34.7$ Hz), 116.11 (q, $J = 288.5$ Hz), 115.62 (s), 114.28 (s), 55.55 (s), 50.15 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -57.18 (s, 3F), -67.89 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{19}$H$_{13}$F$_6$NO$_2$Na: 424.0748, found: 424.0736.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ ppm = 7.44 (ddd, $J = 13.8$, 6.9, 1.7 Hz, 2H), 7.37 (t, $J = 7.1$ Hz, 2H), 7.26 (t, $J = 8.1$ Hz, 1H), 6.99 (d, $J = 7.8$ Hz, 1H), 6.88 (d, $J = 8.2$ Hz, 1H), 6.13 (q, $J = 8.1$ Hz, 1H), 6.03 (d, $J = 18.0$ Hz, 1H), 4.11 (d, $J = 18.0$ Hz, 1H), 3.83 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.88 (q, $J = 36.4$ Hz), 156.84 (s), 148.42 (q, $J = 5.6$ Hz), 136.62 (s), 135.99 (s), 135.77 (s), 129.89 (s), 129.26 (s), 128.45 (d, $J = 3.8$ Hz), 128.31 (s), 126.66 (d, $J = 1.8$ Hz), 122.35 (s), 122.17 (q, $J = 271.5$ Hz), 121.21 (s), 119.73 (q, $J = 34.3$ Hz), 116.15 (q, $J = 290.4$ Hz), 110.82 (s), 55.63 (s), 46.88 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -57.34 (s, 3F), -67.85 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{19}$H$_{13}$F$_6$NO$_2$Na: 424.0748, found: 424.0730.
$^{1}H$ NMR (400 MHz, CDCl$_3$) $\delta$ ppm = 7.46 – 7.41 (m, 2H), 7.41 – 7.33 (m, 3H), 7.05 (d, $J = 16.4$ Hz, 2H), 6.11 (q, $J = 8.1$ Hz, 1H), 5.91 (d, $J = 17.2$ Hz, 1H), 4.09 (d, $J = 17.2$ Hz, 1H), 2.33 (s, 3H), 2.23 (s, 3H).

$^{13}C$ NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.94 (q, $J = 36.5$ Hz), 149.22 (q, $J = 5.6$ Hz), 137.20 (s), 136.96 (s), 136.26 (s), 135.53 (s), 135.00 (s), 132.75 (s), 129.80 (s), 129.36 (s), 128.61 (s), 128.31 (d, $J = 2.9$ Hz), 128.06 (s), 126.48 (s), 122.25 (q, $J = 271.5$ Hz), 119.23 (q, $J = 34.2$ Hz), 116.13 (q, $J = 288.5$ Hz), 49.03 (s), 20.74 (s), 19.39 (s).

$^{19}F$ NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -57.31 (s, 3F), -67.84 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{15}$F$_6$NONa: 422.0956, found: 422.0945.

$^{1}H$ NMR (500 MHz, CDCl$_3$) $\delta$ ppm = 7.46 – 7.41 (m, 2H), 7.38 (d, $J = 8.1$ Hz, 2H), 7.14 (dd, $J = 22.9$, 8.0 Hz, 2H), 6.09 (q, $J = 8.1$ Hz, 1H), 5.98 (d, $J = 17.1$ Hz, 1H), 4.15 (d, $J = 17.1$ Hz, 1H), 2.30 (s, 3H), 2.16 (s, 3H).

$^{13}C$ NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.97 (q, $J = 36.6$ Hz), 149.21 (dd, $J = 11.3$, 5.7 Hz), 138.82 (s), 137.09 (s), 135.51 (s), 134.74 (s), 133.09 (s), 131.48 (s), 129.80 (s), 129.34 (d, $J = 12.3$ Hz), 128.23 (d, $J = 2.8$ Hz), 127.03 (s), 126.33 (s), 122.29 (q, $J = 270.9$ Hz), 118.81 (q, $J = 34.2$ Hz), 116.13 (q, $J = 288.5$ Hz), 49.83 (s), 20.63 (s), 14.71 (s).

$^{19}F$ NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -57.20 (s, 3F), -67.86 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{15}$F$_6$NONa: 422.0956, found: 422.0940.
$^{1}H\text{ NMR (400 MHz, CDCl}_{3}\delta\text{ ppm }= 7.49 (t, J = 7.5, 5.9 Hz, 2H), 7.42 (t, J = 8.1 Hz, 3H), 7.35 (dd, J = 7.8, 1.1 Hz, 1H), 7.29 (d, J = 7.7 Hz, 1H), 6.19 – 6.11 (m, 2H), 4.24 (d, J = 17.8 Hz, 1H).}$

$^{13}C\text{ NMR (126 MHz, CDCl}_{3}\delta\text{ ppm }= 156.98 (q, J = 36.7 Hz), 147.69 (q, J = 5.6 Hz), 137.16 (s), 136.19 (s), 135.93 (s), 133.92 (s), 131.33 (s), 130.96 (s), 129.60 (s), 128.59 (s), 128.45 (d, J = 2.5 Hz), 128.14 (s), 126.72 (d, J = 1.8 Hz), 121.95 (q, J = 271.5 Hz), 120.50 (q, J = 34.6 Hz), 116.03 (q, J = 288.5 Hz), 49.45 (s).}$

$^{19}F\text{ NMR (376 MHz, CDCl}_{3}\delta\text{ ppm } = -57.59 (s, 3F), -67.92 (s, 3F).}$

$\text{HRMS (ESI) (m/z): }[\text{M+Na}]^{+} \text{ called for C}_{18}\text{H}_{10}\text{ClF}_{6}\text{NONa: 428.0253, found: 428.0243.}$

$^{1}H\text{ NMR (500 MHz, CDCl}_{3}\delta\text{ ppm }= 7.51 – 7.45 (m, 2H), 7.42 (s, 1H), 7.38 (d, J = 7.5 Hz, 1H), 7.16 – 7.12 (m, 2H), 7.07 (td, J = 8.2, 2.6 Hz, 1H), 6.14 (q, J = 7.9 Hz, 1H), 5.94 (d, J = 17.0 Hz, 1H), 4.29 (d, J = 16.9 Hz, 1H).}$

$^{13}C\text{ NMR (126 MHz, CDCl}_{3}\delta\text{ ppm }= 161.69 (d, J = 248.2 Hz), 156.77 (q, J = 36.8 Hz), 147.49 (q, J = 5.0 Hz), 136.35 (d, J = 7.1 Hz), 135.82 (s), 135.53 (s), 130.37 (s), 129.91 (d, J = 8.2 Hz), 129.52 (s), 129.43 (d, J = 3.3 Hz), 128.90 (q, J = 2.9 Hz), 126.75 (d, J = 1.8 Hz), 121.95 (q, J = 272.2 Hz), 121.07 (q, J = 34.0 Hz), 116.93 (d, J = 21.4 Hz), 116.07 (q, J = 288.5 Hz), 115.90 (d, J = 22.9 Hz), 50.11 (s).}$

$^{19}F\text{ NMR (376 MHz, CDCl}_{3}\delta\text{ ppm } = -57.33 (s, 3F), -67.94 (s, 3F), -114.11 (s, 1F).}$

$\text{HRMS (ESI) (m/z): }[\text{M+Na}]^{+} \text{ called for C}_{18}\text{H}_{10}\text{F}_{7}\text{NONa: 412.0548, found: 412.0531.}$

$^{1}H\text{ NMR (500 MHz, CDCl}_{3}\delta\text{ ppm }= 7.49 – 7.44 (m, 2H), 7.42 (d, J = 5.0 Hz, 2H), 7.38 (d, J = 7.4 Hz,}$
1H NMR (500 MHz, CDCl₃) δ ppm = 7.57 (d, J = 1.8 Hz, 1H), 7.49 – 7.44 (m, 3H), 7.41 (d, J = 7.3 Hz, 1H), 7.37 (d, J = 7.5 Hz, 1H), 7.03 (d, J = 8.3 Hz, 1H), 6.14 (q, J = 7.9 Hz, 1H), 5.92 (d, J = 17.2 Hz, 1H), 4.26 (d, J = 17.2 Hz, 1H).

13C NMR (126 MHz, CDCl₃) δ ppm = 156.83 (q, J = 37.1 Hz), 147.15 (q, J = 5.5 Hz), 141.08 (s), 136.16 (s), 135.58 (s), 135.05 (s), 130.80 (s), 129.89 (s), 129.52 (s), 6.08 (d, J = 17.9 Hz, 1H), 4.41 (d, J = 17.8 Hz, 1H).

19F NMR (376 MHz, CDCl₃) δ ppm = -57.34 (s, 3F), -67.94 (s, 3F).

(d, J = 1.7 Hz), 124.38 (s), 124.15 (s), 122.41 (q, J = 35.3 Hz), 121.68 (q, J = 272.2 Hz), 115.94 (q, J = 288.5 Hz), 50.47 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.57 (s, 3F), -68.00 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{10}$F$_6$N$_2$O$_3$Na: 439.0493, found: 439.0480.

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.43 (s, 3F), -62.63 (s, 3F), -67.97 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{19}$H$_{10}$F$_9$NONa: 462.0516, found: 462.0501.

$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.67 (s, 1H), 7.61 (d, J = 8.1 Hz, 1H), 7.51 – 7.43 (m, 3H), 7.39 (d, J = 7.4 Hz, 1H), 7.30 (d, J = 8.1 Hz, 1H), 6.19 (q, J = 7.8 Hz, 1H), 6.04 (d, J = 17.5 Hz, 1H), 4.37 (d, J = 17.5 Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.93 (q, J = 36.9 Hz), 147.30 (q, J = 6.3 Hz), 137.81 (s), 135.68 (s), 135.53 (s), 135.45 (s), 130.52 (s), 130.44 (q, J = 32.8 Hz), 129.69 (s), 128.97 (d, J = 2.5 Hz), 128.86 (s), 126.79 (d, J = 1.7 Hz), 126.35 (q, J = 3.8 Hz), 126.21 (d, J = 2.5 Hz), 123.50 (q, J = 272.2 Hz), 121.81 (q, J = 272.2 Hz), 121.59 (q, J = 34.0 Hz), 115.99 (q, J = 288.5 Hz), 50.43 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.43 (s, 3F), -62.63 (s, 3F), -67.97 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{11}$F$_{6}$NOSNa: 462.0516, found: 462.0501.

$^1$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.94 (d, J = 8.2 Hz, 1H), 7.79 (d, J = 8.0 Hz, 1H), 7.47 (t, J = 7.8 Hz, 4H), 7.43 – 7.36 (m, 2H), 6.31 (q, J = 8.0 Hz, 1H), 6.19 (d, J = 17.4 Hz, 1H), 4.38 (d, J = 17.4 Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.82 (q, J = 36.8 Hz), 140.69 (q, J = 5.7 Hz), 138.64 (s), 137.34 (d, J = 15.7 Hz), 136.87 (s), 135.21 (s), 130.03 (s), 129.61 (s), 128.81 (s), 128.16 (s), 127.58 (s), 125.28 (d, J = 4.7 Hz), 122.71 (s), 122.46 (q, J = 272.2 Hz), 122.15 (s), 121.11 (q, J = 34.5 Hz), 116.07 (q, J = 288.5 Hz), 47.41 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -56.66 (s, 3F), -67.75 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{11}$F$_{6}$NOSNa: 450.0363, found: 450.0355.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ ppm = 7.45 (ddd, $J = 7.6$, 6.1, 3.0 Hz, 1H), 7.41 – 7.38 (m, 2H), 7.32 (ddd, $J = 7.5$, 6.6, 5.6 Hz, 3H), 7.23 (d, $J = 6.8$ Hz, 1H), 7.14 (d, $J = 7.6$ Hz, 1H), 6.08 (q, $J = 8.1$ Hz, 2H), 4.15 (d, $J = 18.8$ Hz, 1H), 1.93 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 170.42 (s), 150.91 (q, $J = 5.8$ Hz), 138.88 (s), 137.16 (s), 135.81 (s), 135.12 (s), 130.34 (s), 129.54 (s), 128.83 (s), 128.64 (s), 128.52 (q, $J = 2.5$ Hz), 128.06 (s), 127.25 (s), 127.05 (q, $J = 272.2$ Hz), 119.36 (q, $J = 34.0$ Hz), 48.10 (s), 21.49 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -55.64 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called for C$_{18}$H$_{14}$F$_3$NONa: 340.0925, found: 340.0913.

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$ ppm = 7.45 (ddd, $J = 18.5$, 10.9, 4.1 Hz, 4H), 7.38 (dd, $J = 11.3$, 3.6 Hz, 2H), 7.31 (t, $J = 7.3$ Hz, 1H), 7.16 (d, $J = 7.6$ Hz, 1H), 6.08 – 5.99 (m, 2H), 4.35 (d, $J = 17.1$ Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.85 (q, $J = 36.7$ Hz), 151.20 (t, $J = 4.5$ Hz), 136.63 (s), 135.58 (s), 135.37 (s), 133.55 (s), 130.03 (s), 129.94 (s), 129.33 (s), 128.61 (t, $J = 4.2$ Hz), 128.04 (s), 127.94 (s), 126.68 (d, $J = 1.7$ Hz), 118.97 (m), 117.20 (m), 116.11 (m), 113.8 (m), 50.48 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -67.95 (s, 3F), -85.22 (s, 3F), -106.10 (dt, $J = 278.2$, 7.5 Hz, 1F), -108.85 (dq, $J = 278.2$, 11.3 Hz, 1F).

HRMS (ESI) (m/z): [M+Na]$^+$ called for C$_{19}$H$_{11}$F$_8$NONa: 444.0611, found: 444.0594.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ ppm = 7.46 (dd, $J = 7.1$, 2.7 Hz, 1H), 7.40 (dd, $J = 15.6$, 6.8 Hz, 4H), 7.32 (dd, $J = 15.1$, 7.9 Hz, 2H), 7.16 (d, $J = 7.4$ Hz, 1H), 6.06 (dd, $J = 32.2$, 16.1 Hz, 2H), 4.35 (d, $J =
17.2 Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.86 (q, $J = 36.7$ Hz), 151.11 (t, $J = 4.6$ Hz), 136.68 (s), 135.52 (s), 133.53 (s), 130.02 (s), 129.93 (s), 129.34 (s), 129.27 (s), 128.47 (s), 128.03 (s), 127.95 (s), 126.69 (d, $J = 1.7$ Hz), 118.14 (m), 117.15 (m), 115.75 (m), 114.74 (m), 111.71 (m), 50.43 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -67.96 (s, 3F), -80.21 (s, 3F), -106.10 (tt, $J = 7.5$, 3.2 Hz, 1F), -108.84 (ddd, $J = 23.9$, 10.8, 10.7 Hz, 1F), -126.98 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{11}$F$_{10}$NONa: 494.0579, found: 494.0568.

$^{1}$H NMR (500 MHz, CDCl$_3$) $\delta$ ppm = 7.50 (dd, $J = 12.9$, 6.1 Hz, 2H), 7.44 (dd, $J = 15.7$, 7.5 Hz, 2H), 7.38 – 7.30 (m, 3H), 7.16 (d, $J = 7.3$ Hz, 1H), 6.23 – 6.17 (m, 1H), 6.02 – 5.79 (m, 2H), 4.37 (d, $J = 16.9$ Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ ppm = 156.25 (q, $J = 36.2$ Hz), 147.07 (t, $J = 12.8$ Hz), 136.62 (d, $J = 15.1$ Hz), 134.55 (s), 133.28 (s), 130.25 (s), 129.76 (s), 129.54 (s), 129.34 (s), 128.00 (s), 127.93 (s), 127.30 (d, $J = 1.5$ Hz), 125.26 (dd, $J = 31.8$, 22.4 Hz), 116.24 (q, $J = 288.5$ Hz), 112.81 (t, $J = 230.7$ Hz), 50.80 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -68.12 (s, 3F), -104.62 (ddd, $J = 319.6$, 56.4, 3.8 Hz, 1F), -103.14 (ddd, $J = 319.6$, 54.5, 9.4 Hz, 1F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{18}$H$_{12}$F$_{5}$NONa: 376.0737, found: 376.0725.
\[^{19}\text{F NMR}\] (376 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = -45.50 \) (dd, \( J = 159.8, 5.6 \) Hz, 1F), -47.31 (dt, \( J = 157.9, 13.2 \) Hz, 1F), -67.79 (s, 3F).

\[\text{HRMS (ESI) (m/z): [M+Na]}^+ \text{ for C}_{18}H_{11}ClF_5NONa: 410.0347, \text{found: 410.0338.}\]

\[^{1}\text{H NMR}\] (500 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = 7.35 – 7.29 \) (m, 2H), 7.27 (d, \( J = 6.1 \) Hz, 1H), 7.23 (d, \( J = 7.8 \) Hz, 1H), 7.18 (d, \( J = 6.6 \) Hz, 1H), 7.09 (t, \( J = 7.7 \) Hz, 1H), 6.69 (t, \( J = 8.0 \) Hz, 1H), 6.51 (d, \( J = 8.2 \) Hz, 1H), 5.71 (q, \( J = 8.6 \) Hz, 1H), 4.81 (s, 1H), 3.94 (s, 1H).

\[^{13}\text{C NMR}\] (126 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = 154.10 \) (q, \( J = 5.8 \) Hz), 144.26 (s), 142.18 (s), 135.54 (s), 131.12 (q, \( J = 3.6 \) Hz), 130.41 (s), 129.03 (s), 128.31 (s), 126.44 (s), 125.42 (d, \( J = 0.5 \) Hz), 122.89 (q, \( J = 271.5 \) Hz), 119.00 (s), 117.55 (s), 117.25 (s), 117.15 (q, \( J = 33.4 \) Hz), 46.99 (s).

\[^{19}\text{F NMR}\] (376 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = -56.17 \) (s, 3F).

\[\text{HRMS (ESI) (m/z): [M+H]}^+ \text{ for C}_{16}H_{13}F_3N: 276.0992, \text{found: 276.1000.}\]

\[^{1}\text{H NMR}\] (400 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = 8.76 \) (s, 1H), 7.60 – 7.54 (m, 2H), 7.52 – 7.47 (m, 2H), 7.42 (ddd, \( J = 8.0, 4.5, 1.8 \) Hz, 2H), 7.33 (dt, \( J = 14.7, 7.0 \) Hz, 2H), 5.76 (q, \( J = 8.0 \) Hz, 1H).

\[^{13}\text{C NMR}\] (126 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = 159.44 \) (s), 148.79 (q, \( J = 5.7 \) Hz), 143.40 (s), 141.84 (s), 132.18 (s), 130.44 (s), 129.38 (s), 129.23 (s), 128.81 (s), 127.80 (q, \( J = 3.0 \) Hz), 127.32 (s), 125.72 (d, \( J = 0.5 \) Hz), 122.23 (q, \( J = 271.2 \) Hz), 119.78 (q, \( J = 34.3 \) Hz).

\[^{19}\text{F NMR}\] (376 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = -56.51 \) (s, 3F).

\[\text{HRMS (ESI) (m/z): [M+H]}^+ \text{ for C}_{16}H_{11}F_3NO: 290.0793, \text{found: 290.0782.}\]

\[^{1}\text{H NMR}\] (500 MHz, CDCl\textsubscript{3}) \( \delta \text{ppm} = 8.76 \) (s, 1H), 7.57 (ddd, \( J = 7.9, 7.1, 2.0 \) Hz, 2H), 7.52 – 7.48 (m, 2H), 7.42 (ddd, \( J = 8.0, 4.5, 1.7 \) Hz, 2H), 7.33 (dt, \( J = 13.5, 7.1 \) Hz, 2H), 5.76 (q, \( J = 8.0 \) Hz, 1H).
\[ ^{13}C\text{ NMR} (126\text{ MHz, CDCl}_3) \quad \delta \text{ ppm} = 159.44\text{ (s)}, 148.77\text{ (q, } J = 5.7\text{ Hz)}, 143.37\text{ (s), 141.84\text{ (s), 132.20\text{ (s), 130.43\text{ (s), 129.39\text{ (s), 129.24\text{ (s), 128.82\text{ (s), 127.80\text{ (q, } J = 3.0\text{ Hz)}, 127.33\text{ (d, } J = 2.9\text{ Hz), 125.73\text{ (s), 122.22\text{ (q, } J = 271.3\text{ Hz)}, 119.79\text{ (q, } J = 34.4\text{ Hz).}}}

\[ ^{19}F\text{ NMR} (376\text{ MHz, CDCl}_3) \quad \delta \text{ ppm} = -56.52\text{ (s, 3F).}

\[ \text{HRMS (ESI) (m/z): [M+H]^+} \text{ called. for C}_{16}H_{11}F_3N: 274.0844, \text{ found: 274.0829.}}

\[ \text{H NMR (400 MHz, CDCl}_3\text{) } \delta \text{ ppm} = 7.60 - 7.48\text{ (m, 3H), 7.42 (qd, } J = 7.3, 1.7\text{ Hz, 2H), 7.35 (dtt, } J = 6.5, 4.9, 1.5\text{ Hz, 2H), 7.23 (dt, } J = 17.9, 7.5\text{ Hz, 4H), 7.10 (t, } J = 7.8\text{ Hz, 1H), 6.88 (s, 1H), 6.74 (d, } J = 7.9\text{ Hz, 1H), 6.25 (q, } J = 8.3\text{ Hz, 2H), 3.68 (qd, } J = 10.3, 9.8, 4.1\text{ Hz, 1H), 1.80 (dd, } J = 11.6, 4.8\text{ Hz, 1H), 1.75 - 1.52\text{ (m, 4H), 1.32 (dtt, } J = 22.2, 11.3, 5.8\text{ Hz, 2H), 1.23 - 0.96\text{ (m, 3H).}}

\[ ^{13}C\text{ NMR (126 MHz, CDCl}_3\text{) } \delta \text{ ppm} = 172.70\text{ (s), 167.60\text{ (s), 150.52\text{ (s), 137.10\text{ (s), 135.38\text{ (s), 134.68\text{ (s), 134.14\text{ (s), 133.69\text{ (s), 130.90\text{ (s), 130.63\text{ (s), 129.87\text{ (s), 129.52\text{ (s), 129.50\text{ (s), 129.24\text{ (s), 128.73\text{ (s), 128.37\text{ (s), 127.96\text{ (s), 127.77\text{ (s), 122.50 (q, } J = 270.9\text{ Hz), 119.02 (q, } J = 34.0\text{ Hz), 61.69 (s), 47.96\text{ (s), 33.00 (s), 32.74 (s), 26.91 (s), 25.39 (s), 24.53 (s), 24.50 (s).}}}

\[ ^{19}F\text{ NMR (376 MHz, CDCl}_3\text{) } \delta \text{ ppm} = -56.02\text{ (s, 3F).}

\[ \text{HRMS (ESI) (m/z): [M+Na]^+} \text{ called. for C}_{30}H_{27}F_3O_2N_2Na: 527.1930, \text{ found: 527.1923.}}

\[ \text{H NMR (500 MHz, CDCl}_3\text{) } \delta \text{ ppm} = 7.47 - 7.40\text{ (m, 4H), 7.35 (t, } J = 7.3\text{ Hz, 2H), 7.31 (d, } J = 7.4\text{ Hz, 1H), 7.15 (d, } J = 7.5\text{ Hz, 1H), 6.18 (t, } J = 14.3\text{ Hz, 1H), 6.00 (d, } J = 16.9\text{ Hz, 1H), 4.35 (d, } J = 17.0\text{ Hz, 1H), 3.93 (s, 3H).}\]

\[ ^{13}C\text{ NMR (126 MHz, CDCl}_3\text{) } \delta \text{ ppm} = 164.22\text{ (t, } J = 34.4\text{ Hz), 156.85 (q, } J = 36.5\text{ Hz), 147.44 (t, } J = 5.3\text{ Hz).}
Hz), 136.96 (s), 135.72 (d, $J = 8.6$ Hz), 133.37 (s), 129.71 (s), 129.52 (s), 129.44 (s), 129.15 (s), 129.92 
(s), 129.79 (s), 126.47 (s), 122.50 (t, $J = 23.4$ Hz), 116.11 (q, $J = 288.0$ Hz), 111.65 (t, $J = 251.0$ Hz), 
53.73 (s), 50.55 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -67.81 (s, 3F), -94.81 (dd, $J = 270.7, 7.5$ Hz, 1F), -102.17 (dd, $J 
= 270.7, 7.5$ Hz, 1F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{14}$F$_5$NO$_3$Na: 434.0792, found: 434.0774.

$^{19}$F NMR (376 MHz, CDCl$_3$) $\delta$ ppm = -67.77 (s, 3F), -104.29 (ddd, $J = 303.3, 108.5, 5.8$ Hz, 1F), -106.89 
(ddd, $J = 303.3, 108.5, 5.8$ Hz, 1F).

$^{31}$P NMR (162 MHz, CDCl$_3$) $\delta$ ppm = 6.44 (t, $J = 110.16$ Hz, 1P).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{22}$H$_{21}$F$_5$NO$_4$PNa: 512.1026, found: 512.1045.

$^{1}$H NMR (500 MHz, CDCl$_3$) $\delta$ ppm = 7.51 (dd, $J = 7.8, 1.5$ Hz, 1H), 7.30 (tt, $J = 5.1, 2.3$ Hz, 4H), 7.20 
(dd, $J = 6.5, 3.0$ Hz, 2H), 7.14 (td, $J = 7.7, 1.6$ Hz, 1H), 6.72 (d, $J = 7.9$ Hz, 1H), 5.66 (d, $J = 14.1$ Hz, 
1H), 4.27 (d, $J = 14.0$ Hz, 1H), 2.43 (t, $J = 7.0$ Hz, 2H), 1.69 – 1.61 (m, 2H), 1.07 (t, $J = 7.4$ Hz, 3H).
$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 157.17 (q, $J = 35.8$ Hz), 139.56 (s), 135.30 (s), 132.94 (s), 129.89 (s), 129.51 (s), 128.95, 128.51 (s), 128.07 (s), 127.67 (s), 123.91 (s), 116.37 (q, $J = 288.6$ Hz), 97.06 (s), 76.17 (s), 53.80 (s), 22.07 (s), 21.51 (s), 13.52 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -68.36 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{20}$H$_{18}$F$_3$NONa: 368.1540, found: 368.1523.

$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.65 (dd, $J = 7.8$, 1.6 Hz, 1H), 7.55 (ddd, $J = 5.1$, 2.8, 1.6 Hz, 2H), 7.43 – 7.36 (m, 4H), 7.32 – 7.27 (m, 3H), 7.26 – 7.19 (m, 3H), 6.83 (d, $J = 7.9$ Hz, 1H), 5.72 (d, $J = 14.0$ Hz, 1H), 4.39 (d, $J = 14.1$ Hz, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 157.33 (q, $J = 36.0$ Hz), 139.67 (s), 135.12 (s), 132.76 (s), 131.75 (s), 130.02 (s), 129.53 (s), 129.14 (s), 129.02 (s), 128.58 (s), 128.52 (s), 128.16 (s), 123.30 (s), 122.31 (s), 116.41 (q, $J = 288.5$ Hz), 95.61 (s), 84.56 (s), 54.07 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -68.28 (s, 3F).


$^1$H NMR (500 MHz, CDCl$_3$) δ ppm = 7.83 (d, $J = 1.1$ Hz, 1H), 7.78 (dd, $J = 7.7$, 1.2 Hz, 1H), 7.51 – 7.34 (m, 4H), 7.18 (d, $J = 7.7$ Hz, 1H), 6.21 (q, $J = 8.0$ Hz, 1H), 6.02 (d, $J = 17.3$ Hz, 1H), 4.36 (d, $J = 17.4$ Hz, 1H), 1.39 (s, 12H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.86 (q, $J = 36.6$ Hz), 148.26 (q, $J = 5.7$ Hz), 136.67 (s), 136.43 (s), 135.95 (s), 135.71 (s), 135.52 (s), 129.96 (s), 129.37 (s), 128.79 (d, $J = 3.1$ Hz), 127.38 (s), 126.63

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(d, J = 2.1 Hz), 122.14 (q, J = 271.1 Hz), 120.30 (q, J = 34.3 Hz), 116.04 (q, J = 287.7 Hz), 84.23 (s),
50.72 (s), 24.86 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -57.05 (p, J = 7.6 Hz, 3F), -67.88 (q, J = 7.4 Hz, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{24}$H$_{22}$F$_6$NO$_3$BNa: 520.1500, found: 520.1513.

$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 8.60 (dd, J = 4.8, 1.6 Hz, 1H), 7.36-7.26 (m, 3H), 7.20-7.12
(m, 3H), 7.06-7.00 (m, 1H), 5.76 (d, J = 14.2 Hz, 1H), 4.26 (d, J = 14.2 Hz, 1H), 3.46 (s, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ ppm = 156.78 (q, J = 36.4 Hz), 150.41 (s), 142.05 (s), 137.80 (s),
137.14 (s), 134.44 (s), 129.48 (s), 128.84 (s), 128.54 (s), 123.20 (s), 116.10 (q, J = 288.5 Hz), 83.29
(s), 78.65 (s), 53.67 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -68.29 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{16}$H$_{11}$F$_3$N$_2$ONa: 327.0725, found: 327.0721.

$^1$H NMR (400 MHz, CDCl$_3$) δ ppm = 7.81 (dd, J = 7.7, 1.5 Hz, 1H), 7.49 (td, J = 7.6, 1.2 Hz, 1H), 7.41
(td, J = 7.7, 1.6 Hz, 1H), 7.29 – 7.25 (m, 3H), 7.15 (dd, J = 6.8, 2.6 Hz, 2H), 6.85 (d, J = 7.8 Hz, 1H),
5.43 (d, J = 14.3 Hz, 1H), 4.33 (d, J = 14.3 Hz, 1H), 2.45 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ ppm = 198.14 (s), 156.65 (dd, J = 69.9, 34.4 Hz), 136.54 (s), 135.67 (s),
135.14 (s), 132.41 (s), 131.56 (s), 130.16 (s), 129.84 (s), 129.42 (s), 128.57 (s), 128.13 (s), 117.93 (s),
115.06 (s), 55.51 (s), 28.73 (s).

$^{19}$F NMR (376 MHz, CDCl$_3$) δ ppm = -68.30 (s, 3F).

HRMS (ESI) (m/z): [M+Na]$^+$ called. for C$_{17}$H$_{14}$F$_3$NO$_2$Na: 344.0874, found: 344.0892.
\[ \text{N} \text{O} \text{F} \text{C} \text{F} \text{C} \text{NH} \text{COCF}_3 \]

**1H NMR (400 MHz, CDCl}_3 \) \( \delta \text{ppm} = 8.07 (s, 1H), 7.73 (d, \( J = 2.2 \) Hz, 1H), 7.53 (td, \( J = 8.2, 2.0 \) Hz, 1H), 7.46 (ddd, \( J = 14.7, 7.4, 1.7 \) Hz, 2H), 7.42 – 7.36 (m, 2H), 7.17 (d, \( J = 8.4 \) Hz, 1H), 6.15 (q, \( J = 7.9 \) Hz, 1H), 5.95 (d, \( J = 17.4 \) Hz, 1H), 4.32 (d, \( J = 17.1 \) Hz, 1H).

**13C NMR (101 MHz, CDCl}_3 \) \( \delta \text{ppm} = 156.91 (q, \( J = 37.0 \) Hz), 154.96 (q, \( J = 38.0 \) Hz), 147.54 (q, \( J = 5.6 \) Hz), 135.82 (s), 135.60 (s), 134.68 (s), 131.69 (s), 130.37 (s), 129.58 (s), 129.23 (s), 128.91 (d, \( J = 2.8 \) Hz), 126.74 (d, \( J = 1.8 \) Hz), 123.22 (s), 121.68 (s), 121.24 (q, \( J = 34.6 \) Hz), 120.94 (s), 116.02 (d, \( J = 287.7 \) Hz), 115.57 (q, \( J = 288.9 \) Hz), 100.03 (s), 50.28 (s).

**19F NMR (376 MHz, CDCl}_3 \) \( \delta \text{ppm} = -57.34 (s, 3F), -67.92 (s, 3F), -75.67 (s, 3F).

**HRMS (ESI) (m/z): \( [\text{M+Na}]^+ \) called. for \( \text{C}_{20}\text{H}_{11}\text{F}_9\text{N}_2\text{O}_2\text{Na} \): 505.0575, found: 505.0591.
3. NMR spectra for the products
The document contains a 1H NMR spectrum showing peaks at various ppm values. The peaks are labeled with chemical shifts, and the spectrum includes structures of chemical compounds. The first structure is labeled as TEMPO engaged in a reaction, and the second structure contains a group marked as CF₃.
The image contains 1H and 13C NMR spectra for two different compounds. The spectra show the chemical shifts in parts per million (ppm) for both protons (H) and carbon (C) atoms. The 1H NMR spectra are shown at the top and bottom, and the 13C NMR spectra are between them. The compounds are represented by their structural formulas.