Supporting Information for

Multiplicity-Driven Photochromism Controls Three-State Fulgimide Photoswitches

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Materials and Methods

Dry solvents were purchased from Acros Organics and Thermo Fisher Scientific, Belgium, and dried over molecular sieves before each reaction. All grade-quality reagents were commercially available compounds used without any further purification and purchased from Merck (Germany), Fluorochem Ltd. (United Kingdom), TCI (Japan) and Penta Chemicals (Czech Republic). Reaction temperatures refer to the temperature of surrounding metal heating block.

Thin-Layer Chromatography (TLC) was performed using silica plates "ALUGRAM SIL G/UV 254" from MACHEREY-NAGEL (Germany). Flash chromatography was performed on an ECOM flash column chromatography system using Silicagel 40–60 μm (Lach-Ner, Czech Republic). Preparative HPLC was performed on a DeltaChrom system from Watrex (Czech Republic) in reverse phase mode. ^{1}H and ^{13}C NMR spectra were recorded on Bruker Avance III™ HD 400 MHz and Bruker Avance III™ HD 400 MHz Prodigy spectrometers (^{1}H at 401 MHz, ^{13}C at 101 MHz, ^{19}F at 377 MHz) or on a Bruker Avance III™ HD 600 MHz spectrometer (^{1}H at 600 MHz, ^{13}C at 151 MHz). Deuterated solvents used in the measurements are stated for each compound. Solvent signals were used as a reference for each ^{1}H and ^{13}C measurement, and an internal standard ($CFCl_3$) was used as reference for ^{19}F measurements and set to 0 ppm. Chemical shifts (δ) are given in ppm and coupling constants (J) in Hz. Signal multiplicity is specified as follows: singlet (s), broad singlet (bs), doublet (d), doublet of doublets (dd), doublet of doublets of doublets (ddd), triplet (t), quartet (q), multiplet (m). If product consists of mixture of isomers, hydrogen atom equivalents are rounded to nearest two tenths.

Liquid chromatography–mass spectrometry (LCMS) was performed to monitor the reaction conversion and to confirm the presence and purity of synthesized products on an LC-MS-2020 system from Shimadzu Corporation (Japan) with UV-vis and ESI-MS detectors on a CORTECS C18+ (2.7 μm, 4.6 × 50 mm) reverse phase-column equipped with a VanGuard (3.9 × 5 mm) pre-column from Waters (USA). All compounds were eluted with a mixture of acetonitrile and water with formic acid (0.1 v/v %) in a gradient mode from 95 to 5% water. LCMS-grade formic acid from VWR (Belgium), HPLC-grade acetonitrile from Fisher Scientific (UK) and Milli-Q water were used for chromatography.

High-resolution electrospray ionization (ESI) mass spectra were recorded on an LTQ Orbitrap XL (Thermo Fisher Scientific, USA) hybrid FT mass spectrometer equipped with a linear ion trap MS and the Orbitrap mass analyser. UV-vis absorption was recorded on Agilent Cary 8454. Fluorescence measurements were recorded on a Horiba Duetta spectrometer. All spectra were measured in cells for fluorescence measurements (3.5 mL volume, 10 mm optical path length, HORIBA).

Kinetic measurements were conducted using custom-designed LED light sources with wavelength maxima at the stated wavelengths (Figure S2-S5). The custom-made cuvette and light-source holder was used in all measurements to ensure that the LEDs had the same position and orientation in relation to the sample, which was perpendicular to the light beam used to measure UV-vis spectrometry. Transient absorption experiments were performed on a commercially available apparatus EOS from Ultrafast Systems. For longer delays, ranging from ns to μs, the pump laser (EKSPLA NT242) was electronically delayed relative to a sub-nanosecond pulsed probe light source (LEUCOS, a photonic crystal fiber-based supercontinuum laser). Each sample in a quartz cuvette with a 2-mm optical path length was randomly moved at 1 mm/s speed throughout the measurement. The stability of the sample was checked by recording steady-state absorption spectra before and after each measurement.

Supplementary Figures and Schemes

Scheme S1. Stereoselectivity of elimination of lactone **2**
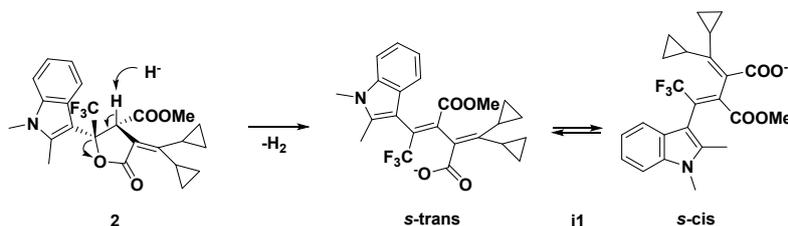
The intermediate **i1** can exist as two isomers, *s*-trans and *s*-cis. We do not know their relative energies, but the final cyclization to fulgimide requires *s*-cis conformation. Therefore, if *s*-trans isomer is present throughout the reaction, it must be in equilibrium with the *s*-cis isomer, which is rapidly consumed in the last step, thus changing the equilibrium to yield exclusively the inactive form of the fulgimide.

Scheme S2. Copper-mediated click reaction of **1d** with benzyl azide
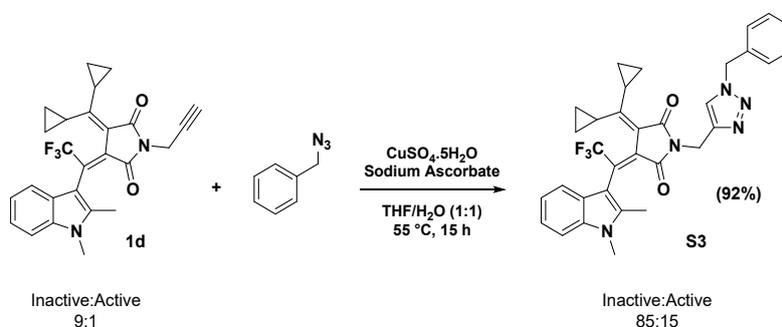
The increase of active form is contributed to time spent on daylight, solvent evaporation at 40°C and the temperature needed for the reaction.

Figure S1. Quenching of anthracene fluorescence by fulgimide **1b** (exponential plot shown in inset).
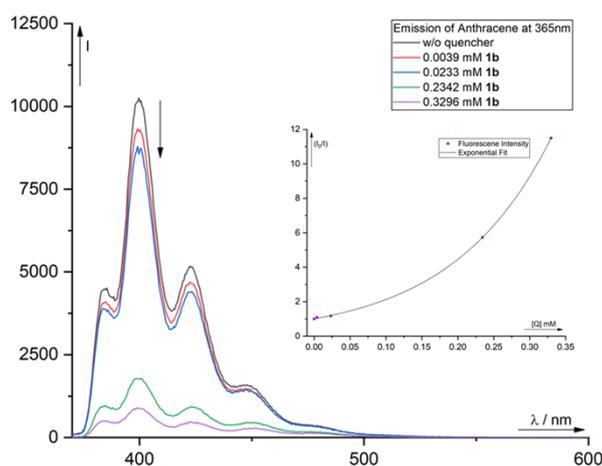
Even though Stern-Volmer analysis should be linear, our quenching was best fitted by an exponential function. This result may be explained by a combination of static and dynamic quenching, as previously described for anthracene by nitroaromatic compound by Airinei et al.[1]

Figure S2. Emission profiles of the 400-nm LED used in this study
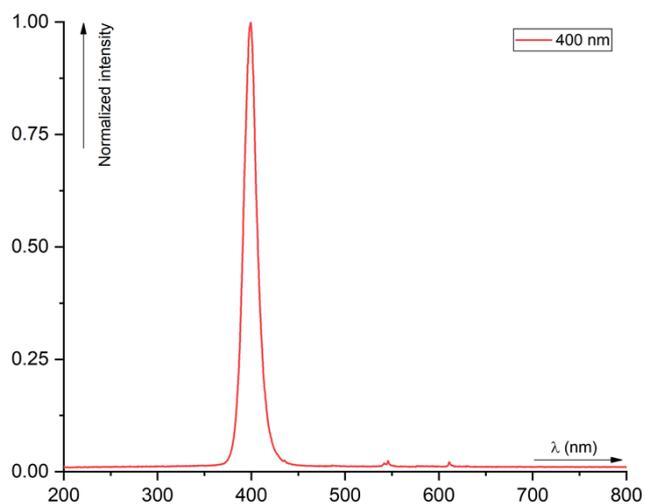
Figure S3. Emission profiles of the 626-nm LED used in this study
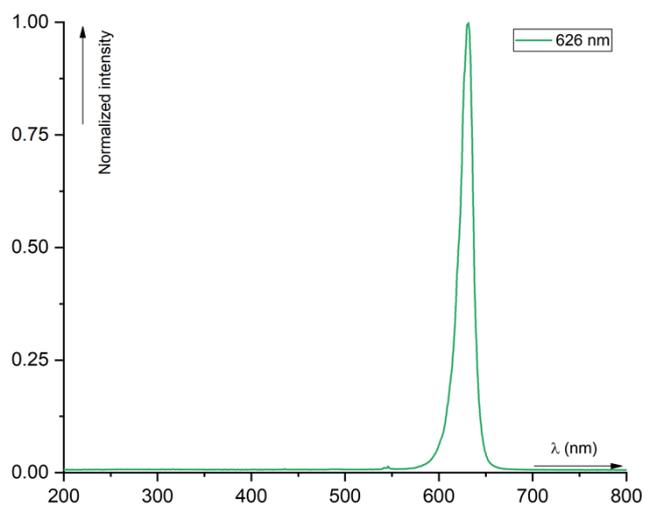
Figure S4. Emission of the 420-nm light source
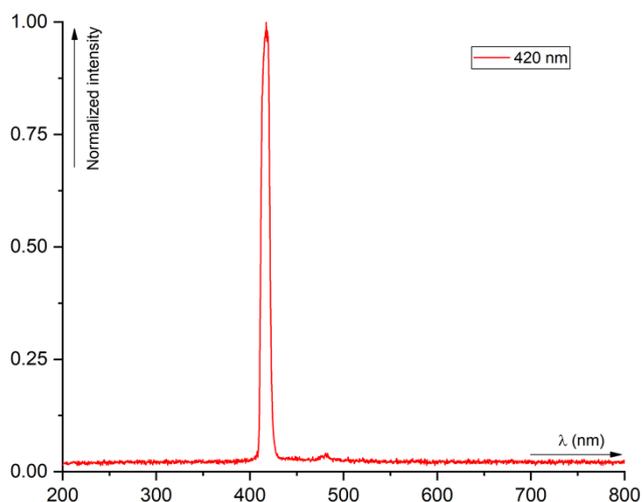
Figure S5. Emission of the 385-nm light source
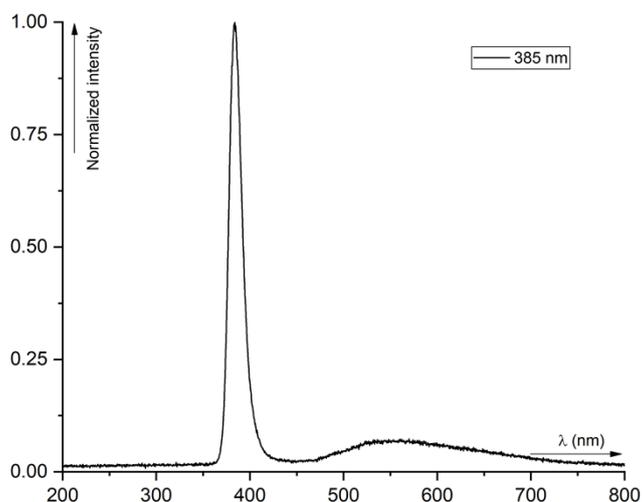
Synthesis of the building blocks

1-(1,2-dimethyl-1*H*-indol-3-yl)-2,2,2-trifluoroethan-1-one[2] S1

A stirred solution of trifluoroacetic acid anhydride (8.6 g, 5.8 mL, 41.0 mmol, 1.1 equiv.) in dry dichloroethane (40 mL) was cooled to 0°C and equipped with a dropping funnel. Once a solution of 1,2-dimethyl-1*H*-indole (5.42 g, 37.3 mmol) in dry dichloroethane (40 mL) was added dropwise, the reaction mixture was warmed to RT and left to react for 3 hours. The reaction was quenched by addition of saturated solution of $NaHCO_3$ and extracted to DCM. The combined organic layers were washed with brine, dried over $MgSO_4$ and evaporated, yielding a yellow solid. Recrystallization from ethyl acetate yielded white needles of product (7.5 g, 31.1 mmol, 84%).
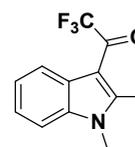
Chemical Formula: $C_{12}H_{10}F_3NO$
Molecular Weight: 241.213

^{1}H NMR (400 MHz, CDCl$_3$) δ 8.08 (m, 1H), 7.40 – 7.31 (m, 3H), 3.78 (s, 3H), 2.82 (s, 3H).

NMR spectra corresponded to the lit. data[2]

Dimethyl 2-(dicyclopropylmethylene)succinate[3] S2

A solution of dimethyl succinate (17 g, 116.3 mmol, 1 equiv.) and dicyclopropylketone (12.8 g, 115.1 mmol, 0.99 equiv.) in *tert*-butanol (25 mL) was added to a refluxing mixture of potassium *tert*-butoxide (13 g, 116.3 mmol, 1 equiv.) in *tert*-butanol (130 mL), and the reaction quickly turned yellow. After 30 minutes of reflux, the reaction was cooled to RT and evaporated to dryness, and the residue was dissolved in 2M NaOH (175 mL) and washed with diethyl ether (175 mL). The water phase was acidified (pH = 1) using conc. HCl and extracted to DCM. Combined

Chemical Formula: C$_{13}$H$_{18}$O$_4$
Molecular Weight: 238.283

organic layers were washed with brine, dried over MgSO$_4$ and evaporated. Residue was dissolved in methanol (450 mL) and acidified using a mixture of conc. HCl and water (100 mL, 1:1, v/v) and left to react overnight. The reaction mixture was evaporated and basified using a saturated solution of NaHCO$_3$, the resulting water phase was extracted to diethyl ether, the combined organic layers were washed with brine and dried over MgSO$_4$, and evaporation yielded slightly yellow oil (8.3 g, 34.8 mmol, 30%), which was used without further purification in the following reaction.

^{1}H NMR (401 MHz, CDCl$_3$) δ 3.73 (s, 3H), 3.66 (s, 3H), 3.56 (s, 2H), 1.73 (ttd, J = 7.7, 5.9, 1.0 Hz, 1H), 1.34 (ttd, J = 8.6, 5.8, 0.9 Hz, 1H), 0.79–0.73 (m, 2H), 0.73–0.67 (m, 2H), 0.66–0.61 (m, 2H), 0.50–0.44 (m, 2H).

NMR spectra corresponded to the lit. data[3]

(±)-Methyl (2R,3S)-4-(dicyclopropylmethylene)-2-(1,2-dimethyl-1H-indol-3-yl)-5-oxo-2-(trifluoromethyl)tetrahydrofuran-3-carboxylate[3] 2

Under an inert atmosphere, **S1** (2.15 g, 8.9 mmol, 1 equiv.) and **S2** (4.25 g, 17.8 mmol, 2 equiv.) were dissolved in dry toluene (125 mL), and a solution of 2 M of LDA in THF/*n*-heptane/ethylbenzene in a 59:28:13 ratio, respectively, (10 mL, 20.1 mmol, 2.25 equiv.) was added over 5 minutes. The reaction mixture was left to react at room temperature for 5 days before being quenched by addition of 1 M HCl, followed by extraction to DCM. The combined organic layers were washed with brine, dried over MgSO$_4$ and evaporated under reduced pressure. The resulting red oil was purified by flash column chromatography (DCM:CyH 1:1 to 9:1), and the fractions containing the product as a mixture of diastereoisomers were collected and evaporated, yielding a

Chemical Formula: C$_{24}$H$_{24}$F$_3$NO$_4$
Molecular Weight: 447.454

slightly yellow oil. The oil was dissolved in a small amount of 2-propanol and sonicated; during the sonification, a white powder precipitated. The powder was collected by filtration and dried under vacuo, affording the target diastereoisomer in a 10:1 mixture with an undesired isomer (1.4 g, 3.13 mmol of mixture; 1.27 g, 2.85 mmol, 32% of target diastereoisomer). This mixture was used without further purification in the following reaction.

^{1}H NMR (401 MHz, CDCl$_3$, target diastereoisomer is, due to blocked rotation, divided to two atropoisomers in 7:3 ratio) δ 8.27 (dt, J = 8.1, 1.1 Hz, 0.3H), 7.61–7.55 (m, d, J = 8.0 Hz, 0.7H), 7.32–7.03 (m, 3H), 5.08 (s, 0.7H), 4.87 (s, 0.3H), 3.67 (s, 2H), 3.64 (s, 1H), 3.12 (s, 1H), 3.08 (s, 2H), 2.67 (s, 2H), 2.62 (s, 1H), 2.43 (q, J = 1.6 Hz, 1H), 1.45–1.26 (m, 1H), 1.07–0.66 (m, 8H).

HRMS (ESI+): calculated for C$_{24}$H$_{24}$F$_3$NO$_4$Na [M+Na]$^+$ 470.1550; found 470.1547.

Synthesis of fulgimides

General procedure for lactone 2 conversion into the inactive *Z* form of fulgimide

Lactone **2** (50 mg, 0.11 mmol, 1 equiv.) was dissolved in dry DMF (2 mL) and sodium hydride (60% dispersion in paraffin oil, 6.7 mg, 0.17 mmol, 1.4 equiv.) was added in one portion. The reaction was monitored by TLC (DCM, R$_f$ = 0). Once the starting material was consumed (typically 1-2 hours), HATU (51 mg, 0.13 mmol, 1.2 equiv.) was added in one portion. After 5 minutes, amine (1.3 equiv.) was added, and the reaction was heated to 50 °C for one hour (general starting conditions, adapted for each amine; conversion assessed by LCMS). Subsequently, the reaction was cooled to RT, and sodium hydride (60%
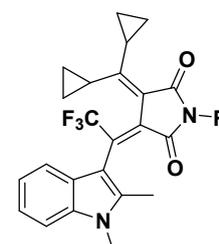
dispersion in paraffin oil, 9 mg, 0.22 mmol, 2 equiv.) was added in one portion. The reaction was monitored by LCMS. Once the starting material was consumed, the reaction was terminated by adding HATU (25.5 mg, 0.17 mmol, 0.6 equiv.) (typically after 30 mins). The reaction was heated to 50°C for 5 minutes, after which the solvent was evaporated under reduced pressure. The crude product was filtered through a pad of silica (eluted with either DCM or EtOAc, depending on R) and then purified by semi-preparative HPLC (acetonitrile/water, gradient from 5% to pure acetonitrile for 45 mins, then 15 mins pure acetonitrile), sometimes separating into inactive and active isomers (active isomer builds up thermally and under prolonged exposure to day light). If so, it was necessary to keep the inactive isomer in the dark and to evaporate the solvent at RT.

^{1}H, ^{19}F and ^{13}C NMR spectra of all prepared inactive forms of fulgimides **1a-h** also showed an atypical behavior due to blocked rotation around the methine carbon. To better understand this blocked rotation, cooled NMR studies were conducted on **1d**, revealing both rotamers (for further details on the characteristic signals and on cooling experiments, see section ^{1}H, ^{19}F and ^{13}C NMR and HRMS Spectra). In some cases, the active and inactive forms were not separated, and their mixture was measured in the given ratios.

^{1}H NMR

Some ^{1}H NMR signals were broadened, not displaying sharp splitting. If measured as a mixture, the signals of each form were assigned and distinguished by colors, with the inactive form in purple and the active form in orange.

^{19}F NMR

As for ^{19}F NMR spectra, the blocked rotation of the inactive form broadened the trifluoromethyl signal and split into broad singlets in a 2:1 ratio, approximately. Recording the spectrum from a mixture of isomers enabled a clear division of the signals, assigned to each isomer.

^{13}C NMR

Because the rotation was blocked and most of carbon atoms were quaternary, most carbon atoms remained invisible. Several carbon atoms gave signal throughout the series of all fulgimides **1a-h** and were thus assigned as usual. Imide substitution was visible in all cases and is highlighted in red.

Fulgimide 1a

Following the general procedure, the target compound was prepared as a yellow solid (32 mg, 0.07 mmol, 61%).

Filtered using DCM. Semi-preparative HPLC yielded 2 fractions: Mixture of the inactive and active forms in a 9:1 ratio and the pure active form.

HRMS (ESI+): calculated for $C_{27}H_{30}F_3N_2O_2$ [M+H]$^+$ 471.2254; found 471.2251.

Chemical Formula: $C_{27}H_{29}F_3N_2O_2$
Molecular Weight: 470.536

^{1}H NMR (401 MHz, CD$_2$Cl$_2$, mixture of inactive and active forms in 9:1 ratio) δ 7.60–6.90 (m, 4H = 3.6H + 0.4H), 3.73 (s, 2.7H), 3.67 (s, 0.3H), 3.62 (td, *J* = 7.2, 1.5 Hz, 0.2H), 3.46–3.28 (m, 2.7H), 3.00 – 2.85 (m, 0.1H), 2.59 – 2.07 (m, 3H = 2.7H + 0.3H), 1.63 (m, 0.2H), 1.59–1.55 (m, 0.9H), 1.49–1.31 (m, 2H = 1.8H + 0.2H), 1.28–1.00 (m, 7.4H = 7.2H + 0.2H), 0.96 (t, *J* = 7.4 Hz, 0.3H), 0.84 (t, *J* = 7.3 Hz, 2.7H), 0.78–0.43 (m, 1.8H), 0.42–0.19 (m, 0.6H), -0.32–-0.42 (m, 0.1H).

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.8, 165.9, 137.0, 121.2, 120.1, 109.4, 104.2, 38.0, 30.3, 30.2, 20.5, 17.0, 15.0, 13.8, 11.4, 11.0–8.1 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.38–-64.56 (m).

Active:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.34–7.26 (bs, 1H), 7.28 (dt, *J* = 8.2, 0.9 Hz, 1H), 7.16 (ddd, *J* = 8.3, 7.1, 1.2 Hz, 1H), 7.08 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 3.67 (s, 3H), 3.62 (td, *J* = 7.2, 1.5 Hz, 2H), 2.92 (s, 1H), 2.22 (s, 3H), 1.63 (m, 2H), 1.37 (m, 2H), 0.96 (t, *J* = 7.4 Hz, 3H), 0.72 (m, 2H), 0.28 (m, 6H), -0.37 (s, 1H).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.25.

Fulgimide 1b

Chemical Formula: $C_{29}H_{29}F_3N_4O_2$
Molecular Weight: 522.572

Following the general procedure, the target compound was prepared as a yellow solid (33 mg, 0.06 mmol, 57%).

Filtered using EtOAc. Semi-preparative HPLC yielded a mixture of the inactive and active forms in a 11:1 ratio.

HRMS (ESI+): calculated for $C_{29}H_{30}F_3N_4O_2$ [M+H]$^+$ 523.2315; found 523.2315.

^{1}H NMR (401 MHz, CD$_2$Cl$_2$, mixture of inactive and active forms in 11:1 ratio) δ 7.65–6.76 (m, 7H = 6.44H + 0.56H), 4.01 (t, J = 7.0 Hz, 0.16H), 3.88–3.78 (m, 1.84H), 3.74 (s, 2.76H), 3.67 (s, 0.4H = 0.24H + 0.16H), 3.43 (t, J = 6.9 Hz, 1.84H), 3.31 (td, J = 8.6, 4.4 Hz, 0.92H), 2.86 (s, 0.08H), 2.59–2.10 (m, 3H = 2.76H + 0.24H), 2.17 (p, J = 6.8 Hz, 0.16H), 2.02–1.90 (m, 1.84H), 1.63–1.51 (m, 0.92H), 1.27–0.97 (m, 5.52H), 0.93–0.19 (m, 2.48H = 1.84H + 0.64H), -0.24–-0.40 (m, 0.08H).

Active imidazole-CH_2 signal is hidden under a N-CH$_3$ (3.67 ppm) singlet based on COSY (0.16H)

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.7, 165.9, 137.5, 137.0, 129.6, 121.4, 120.2, 119.0, 109.5, 104.1, 44.8, 35.5, 30.2, 29.7, 17.2, 15.2, 11.5, 11.1–8.1 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.42–-64.73 (m).

Active:

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.34.

Fulgimide 1c

Following the general procedure, the target compound was prepared as a yellow solid (35 mg, 0.07 mmol, 65%).

Filtered using EtOAc. Semi-preparative HPLC yielded a mixture of the inactive and active forms in a 10:1 ratio.

HRMS (ESI+): calculated for $C_{27}H_{31}F_3N_3O_2$ [M+H]$^+$ 486.2363; found 486.2360.

^{1}H NMR (401 MHz, CD$_2$Cl$_2$ mixture of inactive and active forms in 11:1 ratio) δ 7.60–6.95 (m, 4H = 3.64H + 0.36H), 3.77–3.70 (m, 2.91H = 2.73H + 0.18H), 3.67 (s, 0.27H), 3.55–3.45 (m, 1.82H), 3.41–3.30 (m, 0.91H), 2.97–2.87 (m, 0.09H), 2.54 (t, J = 6.8 Hz, 0.18H), 2.51–2.28 (m, 4.55H = 2.73H + 1.82H), 2.28 (s, 0.54H), 2.22 (s, 0.27H), 2.15 (s, 5.46H), 1.62–1.49 (m, 0.91H), 1.23–0.99 (m, 5.46H), 0.86–0.18 (m, 2.54H = 1.82H + 0.72H), -0.28–-0.42 (m, 0.09H).

Active CH_2 is hidden under N-CH$_3$ (3.73 ppm) singlet based on COSY (0.18H)

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.8, 165.9, 137.0, 121.2, 120.1, 109.4, 104.2, 56.8, 45.5, 36.1, 30.1, 17.1, 15.0, 11.4, 10.8–8.4 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.18–-64.81 (m).

Active:

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.38.

Chemical Formula: $C_{27}H_{30}F_3N_3O_2$
Molecular Weight: 485.551

Fulgimide 1d

Following the general procedure, the target compound was prepared as a yellow solid (30 mg, 0.06 mmol, 58%).

Filtered using DCM. Semi-preparative HPLC yielded the pure active and inactive forms.

HRMS (ESI+): calculated for $C_{26}H_{24}F_3N_2O_2$ [M+H]$^+$ 453.1784; found 453.1782.

Inactive:
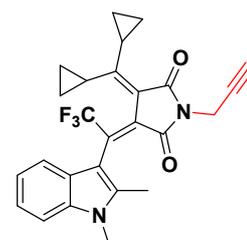
Chemical Formula: $C_{26}H_{23}F_3N_2O_2$
Molecular Weight: 452.477

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.6–7.22 (bs, 1H), 7.34 (d, J = 8.2 Hz, 1H), 7.18 (t, J = 7.6 Hz, 1H), 7.06 (t, J = 7.6 Hz, 1H), 4.24–4.10 (m, 2H), 3.74 (s, 3H), 3.27 (s, 1H), 2.61–2.21 (m, 3H), 2.17 (t, J = 2.6 Hz, 1H), 1.60 (ttd, J = 7.9, 6.0, 1.5 Hz, 1H), 1.25–1.00 (m, 6H), 0.96–0.41 (m, 2H).

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 166.4, 164.7, 137.0, 121.4, 120.2, 109.5, 104.0, 77.6, 71.0, 30.2, 27.1, 17.2, 15.4, 11.5, 11.4–8.2 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.40–-64.62 (m).

Active:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.37–7.21 (bs, 1H), 7.29 (dt, J = 8.0, 0.8 Hz, 1H), 7.17 (ddd, J = 8.2, 7.0, 1.2 Hz, 1H), 7.08 (ddd, J = 8.0, 7.1, 1.1 Hz, 1H), 4.39 (dd, J = 2.6, 0.6 Hz, 2H), 3.67 (s, 3H), 2.82 (s, 1H), 2.27 (t, J = 2.5 Hz, 1H), 2.23 (s, 3H), 0.83–0.69 (m, 2H), 0.57–0.18 (m, 6H), -0.23–-0.34 (m, 1H).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.53.

Fulgimide 1e

Following the general procedure, the target compound was prepared as a yellow solid (29 mg, 0.06 mmol, 52%).

Filtered using DCM. Semi-preparative HPLC yielded a mixture of the inactive and active forms in a 15:1 ratio.

HRMS (ESI+): calculated for C$_{26}$H$_{26}$F$_3$N$_5$O$_2$ [M+Na]$^+$ 520.1931; found 520.1931.

Chemical Formula: C$_{26}$H$_{26}$F$_3$N$_5$O$_2$
Molecular Weight: 497.522

^{1}H NMR (400 MHz, CD$_2$Cl$_2$, mixture of inactive and active forms in 15:1 ratio) δ 7.65–6.89 (m, 4H = 3.76H + 0.24H), 3.73 (s, 2.94H = 2.82H + 0.12H), 3.67 (s, 0.18H), 3.49 (t, J = 6.9 Hz, 1.88H), 3.40 (t, J = 6.6 Hz, 0.12H), 3.37–3.28 (m, 0.94H), 3.27–3.15 (m, 1.88H), 2.90 (s, 0.06H), 2.58–2.07 (m, 3H = 2.82H + 0.18H), 1.94 (dt, J = 13.5, 6.7 Hz, 0.12H), 1.74 (p, J = 6.8 Hz, 1.88H), 1.61–1.55 (m, 0.94H), 1.23–0.98 (m, 5.64H), 0.88–0.20 (m, 2.36H = 1.88H + 0.48H), -0.32–-0.37 (m, 0.06H).

Active N-CH_2 is hidden under N-CH$_3$ (3.75 ppm) singlet based on COSY (0.12H)

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.7, 165.9, 137.0, 121.3, 120.2, 109.5, 104.1, 49.6, 35.7, 30.2, 27.7, 17.1, 15.1, 11.5, 10.4–9.5 (m).

^{19}F NMR (376 MHz, CD$_2$Cl$_2$) δ -63.31–-64.93 (m).

Active:

^{19}F NMR (376 MHz, CD$_2$Cl$_2$) δ -56.33.

Fulgimide 1f

Following the general procedure, the target compound was prepared as a yellow solid (34 mg, 0.06 mmol, 52%).

Filtered using DCM. Semi-preparative HPLC yielded a mixture of the inactive and active forms in a 6:1 ratio.

HRMS (ESI+): calculated for C$_{30}$H$_{27}$BrF$_3$N$_2$O$_2$ [M+H]$^+$ 583.1203; found 583.1203.

Chemical Formula: C$_{30}$H$_{26}$BrF$_3$N$_2$O$_2$
Molecular Weight: 583.449

^{1}H NMR (401 MHz, CD$_2$Cl$_2$, mixture of the inactive and active forms in a 6:1 ratio) δ 7.66–6.90 (m, 8H = 6.88H + 1.12H), 4.75 (d, J = 1.4 Hz, 0.28H), 4.52 (dd, J = 14.8, 14.5 Hz, 1.72H), 3.72 (s, 2.58H), 3.67 (s, 0.42H), 3.36–3.25 (m, 0.86H), 2.90–2.76 (m, 0.14H), 2.60–2.00 (m, 3H = 2.58H + 0.42H), 1.62–1.53 (m, 0.86H), 1.26–0.97 (m, 5.16H), 0.92–0.15 (m, 2.84H = 1.72H + 1.12H), -0.26–-0.36 (m, 0.14H).

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.3, 165.6, 137.0, 135.9, 131.9, 130.7, 121.9, 121.3, 120.7, 120.2, 109.5 (d, J = 3.6 Hz), 104.1, 41.1, 30.2, 17.2, 15.2, 11.4, 11.1–8.1 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.53–-64.60 (m).

Active:

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.39.

Fulgimide 1g

The general procedure was followed up to amine addition. Prior to amide coupling, glycine tert-butyl ester hydrochloride (23 mg, 0.13 mmol, 1.2 equiv.) was dissolved in dry DMF (1 mL), and sodium hydride (60% dispersion in paraffin oil, 5.4 mg, 0.13 mmol, 1.2 equiv.) was added; the resulting suspension was then added through a syringe filter to the reaction vessel. The amide coupling reaction mixture was then heated to 60°C for 3 hours. A sodium hydride (60% dispersion in paraffin oil, 9 mg, 0.22 mmol, 2 equiv.) was added, and the reaction mixture of the last step was left standing at RT overnight. After this period, HATU (25.5 mg, 0.17 mmol, 0.6 equiv.) was added, and all subsequent steps followed the general procedure, yielding the target compound as a yellow solid (46 mg, 0.09 mmol, 78%).
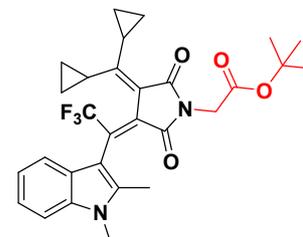
Chemical Formula: C$_{29}$H$_{31}$F$_3$N$_2$O$_4$
Molecular Weight: 528.572

Filtered using DCM. Semi-preparative HPLC yielded the pure inactive and active forms.

HRMS (ESI+): calculated for C$_{29}$H$_{32}$F$_3$N$_2$O$_4$ [M+H]$^+$ 529.2309; found 529.2305.

Inactive:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$, imide part is in red) δ 7.55–7.23 (bs, 1H), 7.32 (d, J = 8.1 Hz, 1H), 7.16 (ddd, J = 8.1, 7.0, 1.2 Hz, 1H), 7.05 (t, J = 7.5 Hz, 1H), 4.10–3.95 (m, 2H), 3.72 (s, 3H), 3.28 (s, 1H), 2.43 (s, 4H), 1.59 (ttd, J = 8.0, 6.0, 1.7 Hz, 1H), 1.38 (s, 9H), 1.25–0.99 (m, 6H), 0.94–0.39 (m, 2H).

^{13}C NMR (101 MHz, CD$_2$Cl$_2$) δ 167.0, 166.3, 165.3, 137.0, 121.3, 120.22, 109.4, 104.1, 82.7, 40.0, 30.2, 28.0, 17.2, 15.3, 11.5, 11.0–9.4 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.38–-64.74 (m).

Active:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.35–7.27 (bs, 1H), 7.29 (dt, J = 8.2, 0.9 Hz, 1H), 7.17 (ddd, J = 8.3, 7.1, 1.2 Hz, 1H), 7.08 (ddd, J = 8.0, 7.0, 1.1 Hz, 1H), 4.26 (s, 2H), 3.68 (s, 3H), 2.87 (s, 1H), 2.24 (s, 3H), 1.46 (s, 9H), 0.84–0.67 (m, 2H), 0.60–0.17 (m, 6H), -0.26–-0.36 (m, 1H).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.58.

Fulgimide 1h

The general procedure was followed up to amine addition. After this step, the reaction was heated to 100°C for 12h. All subsequent steps followed the general procedure, affording the target compound as a yellow solid (18 mg, 0.03 mmol, 31%).

Filtered using DCM. Semi-preparative HPLC yielded only the pure active form.

HRMS (ESI+): calculated for C$_{30}$H$_{28}$F$_3$N$_2$O$_3$ [M+H]$^+$ 521.2047; found 521.2043.
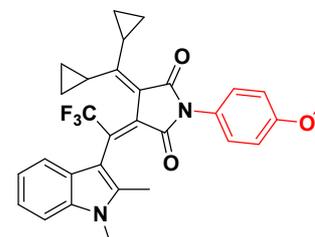
Chemical Formula: C$_{30}$H$_{27}$F$_3$N$_2$O$_3$
Molecular Weight: 520.552

Inactive:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.70–7.21 (bs, 1H), 7.31 (dt, J = 8.2, 0.9 Hz, 1H), 7.17 (t, J = 7.6 Hz, 1H), 7.14–7.03 (m, 3H), 6.89 (d, J = 8.4 Hz, 2H), 3.78 (s, 3H), 3.71 (s, 3H), 3.35 (s, 1H), 2.66–2.08 (m, 2H), 1.62 (ttd, J = 7.9, 6.1, 1.7 Hz, 1H), 1.30–1.02 (m, 6H), 0.96–0.53 (m, 2H).

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.1, 165.2, 159.7, 137.0, 128.4, 124.7, 121.3, 120.2, 114.4, 109.4, 104.1, 55.8, 30.2, 17.3, 15.3, 11.5, 11.4–8.4 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -62.51--65.95 (m).

Product of copper-mediated click reaction of 1d and benzyl azide S3

Once **1d** (16 mg, 0.035 mmol, 1 equiv., ratio of inactive and active forms: 9:1) was dissolved in THF/H$_2$O (1:1, 10 mL), benzyl azide (5.3 mg, 5 uL, 0.04 mmol, 1.1 equiv.) was added to the reaction mixture. The reaction was initiated by adding CuSO$_4$ · 5 H$_2$O (4.4 mg, 0.018 mmol, 0.5 equiv.) and sodium ascorbate (7.7 mg, 0.039 mmol, 1.1 equiv.) and heating to 55°C for 15 hours. The solvent was evaporated under reduced pressure, and the crude product was filtered through a pad of silica using EtOAc as solvent. The product was then purified by semi-preparative HPLC, affording 19 mg (0.032 mmol, 92%) of a yellow powder as a mixture of the inactive and active forms in a 85:15 ratio (based on ^{19}F NMR). The increase of active form is contributed to time spent on daylight, solvent evaporation at 40°C and the temperature needed for reaction.
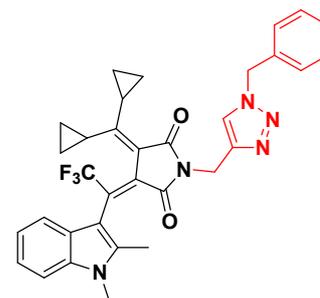
Chemical Formula: C$_{33}$H$_{30}$F$_3$N$_5$O$_2$
Molecular Weight: 585.631

HRMS (ESI+): calculated for C$_{33}$H$_{31}$F$_3$N$_5$O$_2$ [M+H]$^+$ 586.2424.; found 586.2420.

^{1}H NMR (401 MHz, CD$_2$Cl$_2$, mixture inactive and active forms in 15:85 ratio) δ 7.61 (s, 0.15H), 7.57–6.89 (m, 9.85H = 8.5H + 1.35H), 5.50 (s, 0.3H), 5.41 (dd, *J* = 14.9, 14.9 Hz, 1.7H), 4.93–4.83 (m, 0.3H), 4.71–4.59 (m, 1.7H), 3.71 (s, 2.55H), 3.66 (s, 0.45H), 3.29 (bs, 0.85H), 2.85 (bs, 0.15H), 2.65–1.80 (m, 2.55H), 2.20 (s, 0.45H), 1.58–1.50 (m, 0.85H), 1.24–0.97 (m, 5.1H), 0.82–0.19 (m, 2.9H = 1.7H + 1.2H), -0.34 (s, 0.15H).

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$, imide part is in red) δ 167.0, 165.5, 143.1, 137.0, 135.3, 129.4, 129.0, 128.4, 128.4, 123.7, 121.3, 120.1, 109.4, 104.0, 33.2, 30.2, 17.2, 15.2, 11.4, 10.9–7.8 (m).

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -63.27--64.82 (m).

Active:

^{19}F NMR (377 MHz, CD$_2$Cl$_2$) δ -56.40.

Photophysical properties and their measurements

Methods

UV/Vis and kinetics. All spectra and kinetics were recorded in HPLC grade acetonitrile. The inactive form of fulgimide (1 mg) was dissolved in acetonitrile (1 mL), and the solution was diluted 10 times and transferred to a fluorescence cuvette equipped with stirring bar, after which the absorbance was adjusted to 0.7. The solution was then subjected to kinetics measurements under stirring and irradiation. Once equilibrium was reached, the ratios of photostationary states were determined via HPLC PDA signals, as described in **Data Evaluation**.

Deactivation. After three cycles of closing and opening, the sample was subjected to deactivation. Sample was transferred from the fluorescence cuvette to a 3-mL vial equipped with a stirring bar. Once 1 equiv. of anthracene was added (5.6 mM solution in acetonitrile), the sample was deoxygenated (15 minutes in sonic bath with balloon filled with nitrogen and outlet), Under stirring, the sample was then simultaneously irradiated with 385- and 626-nm light for 30 minutes. The ratios were then determined via HPLC PDA signals, as described in **Data Evaluation**.

Data Evaluation

Photostationary states (PSS) were determined by HPLC PDA signals (Figure S5). All chromatograms followed the same pattern, only differing in retention times; therefore, only exemplary one of **1b** is shown. The area of the peaks was adjusted by extinction coefficients to calculate the ratio reached in the PSS.

Spectra of pure forms

Inactive forms and active forms. Inactive forms were determined from either the initial spectrum (because only the inactive form was present sometimes) or from a mixture of the active and inactive forms. The active form was primarily produced upon activation, and the wavelength of the isosbestic point was determined. The ratio of HPLC PDA signals measured at the wavelength of the corresponding isosbestic point then directly indicated the molar ratio between isomers in the mixture. As the ratios had in all PSSs less than 5% of inactive form, the contribution of the inactive form was disregarded. Hence, after activation, the spectrum was assigned to pure active forms. The spectrum of the inactive forms was then determined from the initial mixture (molar ratios were determined based on HPLC PDA signals from isosbestic points). According to the Lambert-Beer law, the spectrum of two species is their sum. As such, from the initial spectrum, the spectrum of the active form multiplied by its molar ratio was subtracted, and the resulting spectrum was divided by the molar ratio of the inactive form.

Closed forms were determined from the spectra of PSS. The ratios calculated based on the HPLC PDA signals measured at the wavelength of the respective isosbestic point made it possible to determine the closed form. According to the Lambert-Beer law, the spectrum is a sum of all absorbing species. Thus, the isosbestic point of photoswitching kinetics was used to determine the proportion between E (adjusted by its extinction coefficient at a given wavelength), Z and C. From the spectrum of PSS, the spectra of E and Z multiplied by their molar ratio were subtracted, and the resulting spectrum was divided by the molar ratio of the inactive form.

Figure S6. Chromatogram exported from PDA (absorbance at 473 nm, the corresponding isosbestic point between E, Z and C forms) of LC of **1d** (peaks at 0.5 min correspond to the dead volume of the apparatus), **Red (1):** Mixture after deactivation (**1d** and 1 equivalent of anthracene in degassed acetonitrile irradiated with 385- and 626-nm light for 30 minutes), **Green (2)** PSS in acetonitrile (626 nm) **Blue (3):** PSS in acetonitrile (420 nm), **Purple (4)**: PSS in acetonitrile (400 nm).
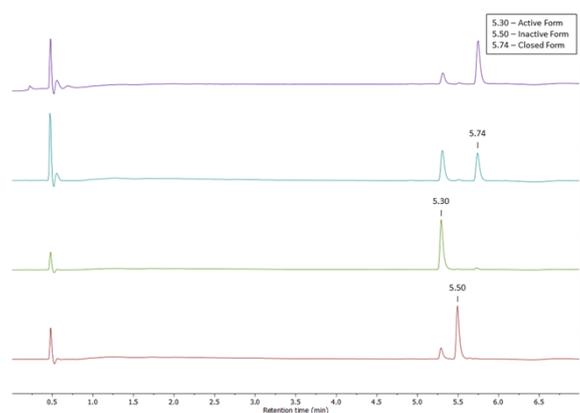
Quantum yields

Quantum yields (Φ) for ring closing and **E**-to-**Z** isomerization were determined using a custom-made LED source with the maximum at 400 nm. Quantum yields for ring opening were determined using a custom-made LED source with the maximum at 626 nm.

Air-saturated solution of fulgimides in acetonitrile ($c \sim 2 \times 10^{-4}$ M) were irradiated to reach photostationary state at the given wavelength. As only the closed form absorbs at 560 nm and no photo-bleaching was observed, the change in absorbance at 560 nm directly corresponds to the change in closed form concentration.

The quantum yields were calculated from the equations below and averaged from 3 independent measurements ($A_{560\,nm}$ = absorbance at 560 nm, t = time (s), V = volume (L), $\mathcal{E}_{(C,\,560\,nm)}$ = molar extinction coefficient of closed form at 560 nm ($M^{-1}cm^{-1}$), b = optical path (cm), I_{corr} = corrected photon flux in acetonitrile (E), I_{MeCN} = photon flux in acetonitrile (E), c_x = concentration of the observed isomer (M), A_{obs} = measured total absorbance at the irradiation wavelength (representing a sum of partial absorbances of each isomer), $\mathcal{E}_{x,obs}$ = molar extinction coefficient at the irradiation wavelength ($M^{-1}cm^{-1}$)). As absorption spectra of isomers can overlap, it is necessary to recalculate the total photon flux (I_{MeCN}) to the real photon flux absorbed by the observed isomer (I_{corr}). This is given by the second equation, where the total photon flux was corrected to the photon flux available for the observed isomer at every given time point, as described by K. Börjesson et al.[4] Next, the quantum yield was calculated from the corrected photon flux by the first equation.

$$\Phi = \frac{\delta A_{560\,nm}}{\delta t} \cdot \frac{V}{\mathcal{E}_{(C,\,560\,nm,\,)} . b . I_{corr}}$$

$$I_{corr} = I_{MeCN} \cdot \frac{c_x . \mathcal{E}_{x,obs}}{A_{obs}} \cdot (1 - 10^{-A_{obs}})$$

$$A_{obs} = c_Z . \mathcal{E}_{Z,obs} + c_E . \mathcal{E}_{E,obs} + c_C . \mathcal{E}_{C,obs}$$

The photon flux of light sources was determined in toluene, following the work published by Reinfelds et al.[2] The photon flux was then adjusted from toluene to acetonitrile, based on the difference in their respective refractive indices (η_{MeCN} = 1.3444, $\eta_{Toluene}$ = 1.4982).[5,6]

$$I_{MeCN} = \frac{(\eta_{MeCN})^2}{(\eta_{toluene})^2} . I_{toluene}$$

Z to E isomerization. Due to the overlapping absorption spectra of **E** and **Z**, the **Z** to **E** isomerization is directly followed by a much more efficient ring closing (**E** to **C**). Therefore, any active **E** isomer present during the initial stages of the isomerization is immediately transformed to the closed form (**C**). Hence, the increase in the absorbance of **C** at 560 nm directly indicates the decrease in the concentration of the inactive isomer (**Z**). For every given time point, real concentration of inactive isomer (**Z**) was determined and corrected photon flux at 400 nm was calculated. Then, for the initial ten $\delta A_{(560nm)}/\delta t$ time steps, quantum yield of isomerization was calculated and averaged, which gave the final quantum yield value ($\Phi_{(Z\text{-}E,\,400\,nm)}$).

Ring closing. As this isomerization directly forms the closed form of fulgimide, the increase in the absorbance of **C** at 560 nm directly corresponds to the change in the ratios of the **E** and **C** isomers. For every given time point,

real concentration of active isomer (E) was determined and corrected photon flux at 400 nm was calculated. Then, for the initial ten $\delta A_{(560nm)}/\delta t$ time steps, quantum yield of isomerization was calculated and averaged, which gave the final quantum yield value ($\Phi_{(E\text{-}C, 400\ nm)}$).

Ring opening. As this isomerization directly leads only to the ring opening from C to E, the decrease in the absorbance of C at 560 nm directly corresponds to the change in the ratios of the isomers. For every given time point, real concentration of closed isomer (C) was determined and corrected photon flux at 626 nm was calculated. Then, for the initial ten $\delta A_{(560nm)}/\delta t$ time steps, quantum yield of isomerization was calculated and averaged, which gave the final quantum yield value ($\Phi_{(C\text{-}E, 626\ nm)}$).

Absorption spectra

Table S1. Absorption spectra of all three forms of fulgimides **1a-h** and PSS reached after irradiation with 420-nm light in acetonitrile ($c \sim 2 \times 10^{-4}$ M).
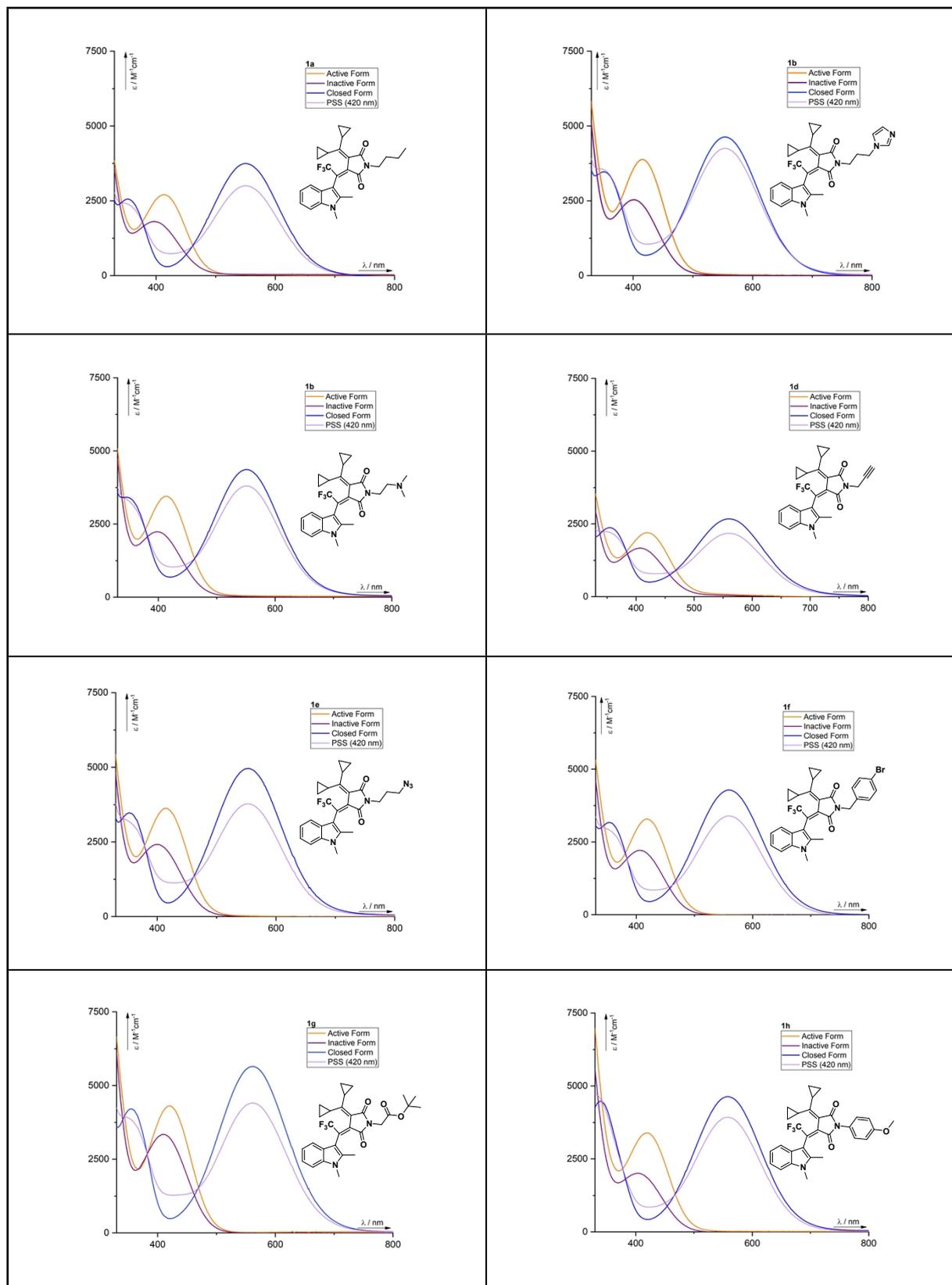
Photoswitching kinetics

All kinetics followed the same pattern, only differing in the time needed to reach PSS as quantum yields differed throughout the series **1a-h**. Therefore, only the photoswitching kinetics of **1b** is shown for illustrative purposes.

Table S2. Kinetics of photoinduced isomerizations of **1b** ($c \sim 2 \times 10^{-4}$ M) in acetonitrile, **A)** Activation followed by immediate closing (400 nm), **B)** Activation (400 and 626 nm), **C)** Ring closure (400 nm), **D)** Ring opening (626 nm).
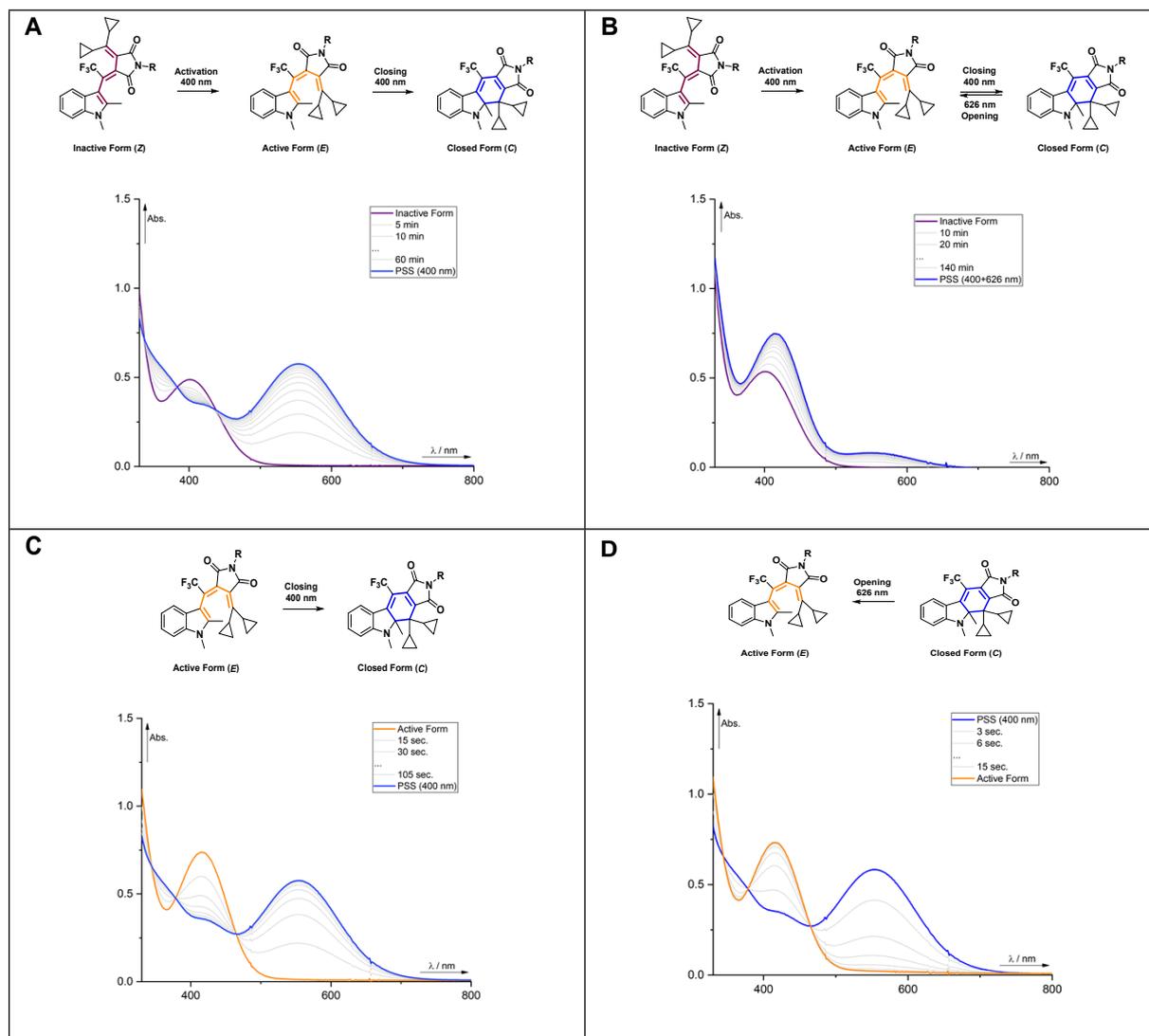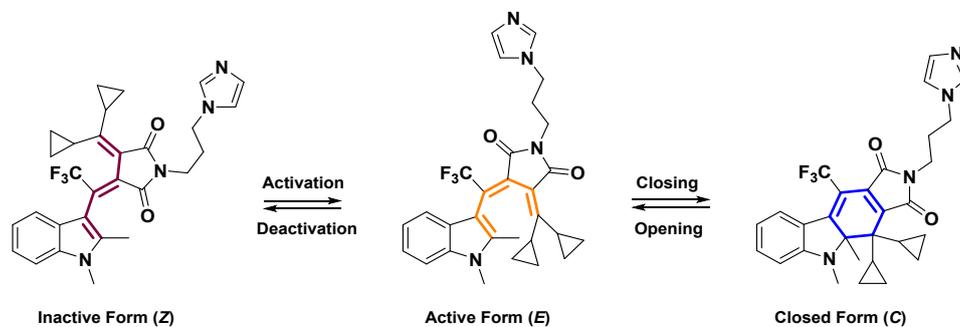
Table S3. Kinetics of photoinduced isomerizations of **1b** ($c \sim 1.2 \times 10^{-4}$ M) with anthracene (1 equivalent) in acetonitrile, **A)** Activation followed by immediate closing of the mixture of inactive and active forms (89:11) (400 nm), **B)** Ring closure (400 nm), **C)** Ring opening (626 nm), **D)** Absorption profiles of all forms of fulgimide **1b** with anthracene.
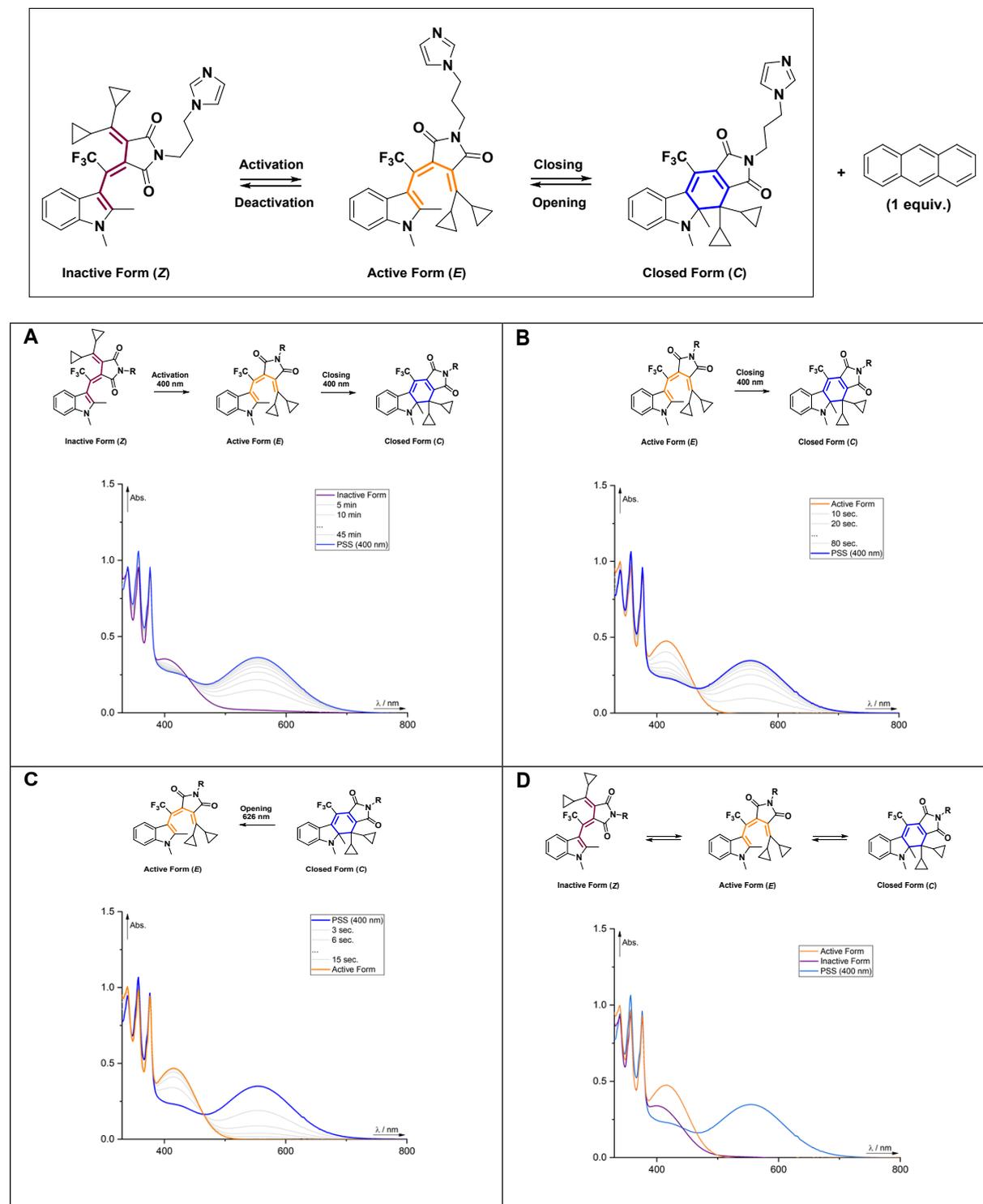
Transient measurements

Figure S7. Exemplary decay traces and the corresponding fit of excited triplet state decay of anthracene ($c \sim 1.7$ x 10^{-4} M) in degassed acetonitrile without quencher (black and yellow) and with the active form of fulgimide **1b** ($c \sim 5.6 \times 10^{-4}$ M) as a quencher (red and green).

	A	B1	B2
1	Equation	y = A1*exp(-x/t1) + y0	
2	y0	0.29611 ± 0.01113	0.20571 ± 0.008
3	A1	0.58009 ± 0.011	0.69852 ± 0.01013
4	t1	31.9286 ± 1.64266	9.51724 ± 0.43005
5	Reduced Chi-Sqr	0.00225	0.00397
6	R-Square (COD)	0.94739	0.95031
7	Adj. R-Square	0.94697	0.94991
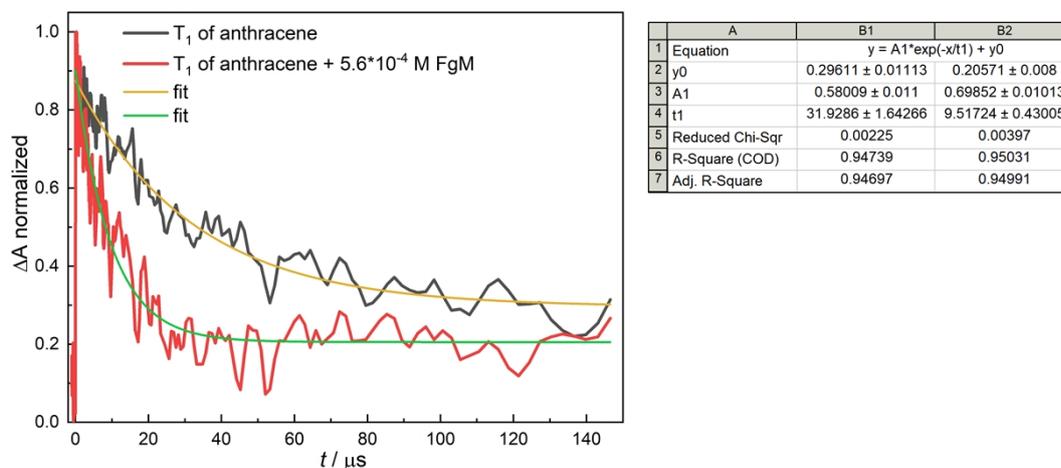
Figure S8. Linear fit of decays of anthracene as a function of the **1b** concentration

	A	B1
1	Equation	y = a + b*x
2	Intercept	22037.08114 ± 5945.67178
3	Slope	1.36823E8 ± 1.79289E7
4	Residual Sum of Squares	1.33016E8
5	Pearson's r	0.9752
6	R-Square (COD)	0.95101
7	Adj. R-Square	0.93468
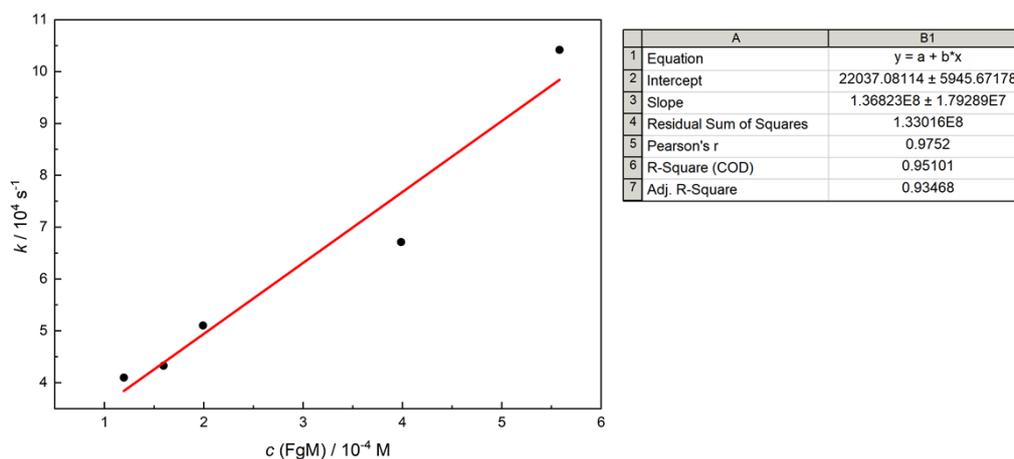
^{1}H, ^{19}F and ^{13}C NMR and HRMS Spectra

Characteristic signals of fulgimides
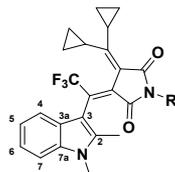
^{1}H NMRs. In its inactive form, free rotation is blocked, broadening hydrogen signals. The signal of the aromatic hydrogen in position 4 is broadened typically between 7.55 and 7.25 ppm. The hydrogens of C-CH_3 are broadened typically between 2.6 and 2.1 ppm. Activation sharpens the peak of hydrogens at position C-CH_3, and the aromatic hydrogens in position 4 are also broadened, albeit to a smaller extent.
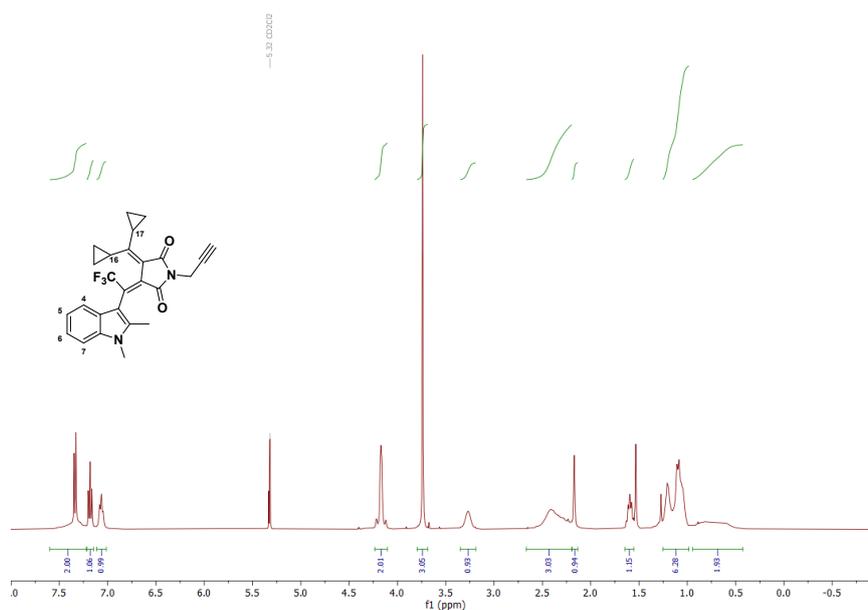
Figure S9. ^{1}H NMR spectrum of the inactive form of compound **1d** in CD$_2$Cl$_2$

Inactive:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.6 – 7.22 (bs, 1H, Ar-*H*, (4)), 7.34 (d, *J* = 8.2 Hz, 1H, Ar-*H*, (7)), 7.18 (t, *J* = 7.6 Hz, 1H, Ar-*H*, (6)), 7.06 (t, *J* = 7.6 Hz, 1H, Ar-*H*, (5)), 4.24 – 4.10 (m, 2H, N-CH_2), 3.74 (s, 3H, N-CH_3), 3.27 (s, 1H, C-*H*, (16)), 2.61 – 2.21 (m, 3H, C-CH_3), 2.17 (t, *J* = 2.6 Hz, 1H, C-*H*), 1.60 (ttd, *J* = 7.9, 6.0, 1.5 Hz, 1H C-*H*, (17)), 1.25 – 1.00 (m, 6H, 3x CH_2), 0.96 – 0.41 (m, 2H, CH_2).
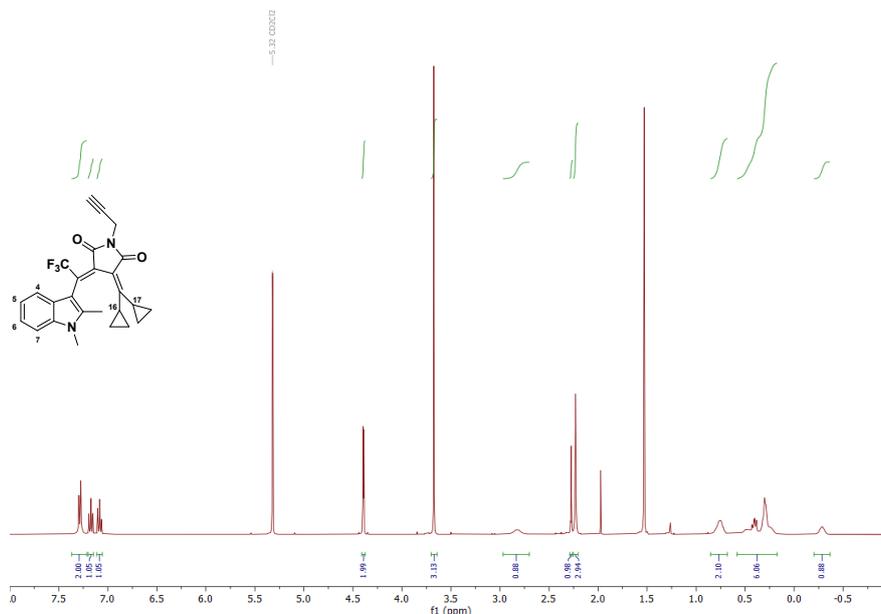
Figure S10. ^{1}H NMR spectrum of the active form of compound **1d** in CD$_2$Cl$_2$

Active:

^{1}H NMR (401 MHz, CD$_2$Cl$_2$) δ 7.37 – 7.21 (bs, 1H, Ar-*H*, (4)), 7.29 (dt, *J* = 8.0, 0.8 Hz, 1H, Ar-*H*, (7)), 7.17 (ddd, *J* = 8.2, 7.0, 1.2 Hz, 1H, Ar-*H*, (6)), 7.08 (ddd, *J* = 8.0, 7.1, 1.1 Hz, 1H, Ar-*H*, (5)), 4.39 (dd, *J* = 2.6, 0.6 Hz, 2H, N-C*H$_2$*), 3.67 (s, 3H, N-C*H$_3$*), 2.82 (s, 1H, C-*H* (16)), 2.27 (t, *J* = 2.5 Hz, 1H, C-*H*), 2.23 (s, 3H, C-C*H$_3$*), 0.83 – 0.69 (m, 2H, C*H$_2$*), 0.57 – 0.18 (m, 6H, 3x C*H$_2$*), -0.23 – -0.34 (m, 1H, C-*H* (17)).

^{19}F NMRs. Blocked rotation of the inactive form splits the signal of trifluoromethyl group into two broadened singlets in a 2:1 ratio, approximately. Activation restores the sharp singlet (sharp signal around -57 ppm corresponds to the active form, and the broadened singlets around -64 ppm correspond to the inactive form).
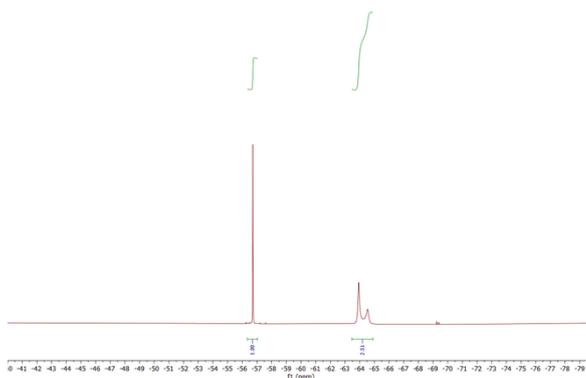
Figure S11. Zoomed ^{19}F NMR spectrum of mixture of inactive and active forms of **1d** in CD$_2$Cl$_2$

^{13}C NMRs. Because the rotation of the inactive form was blocked and most carbon atoms were quaternary, only several carbon atoms were visible in the spectrum. Visible carbon atoms of the fulgide core remained the same through **1a-h**, with minor shifts - two carbonyls (around 167 and 165 ppm), 5 aromatic carbons (around 137 (C8), 121 (C6), 120 (C5), 109 (C7) and 104 (C2) ppm), and signals in aliphatic region (around 30 (C9), 17 (C15), 15 (C16) and 11 (C10) ppm, and a broadened signal around 10 (C18/C19/C20/C21) ppm). The imide substituent was visible in all cases (77.64, 71.00, and 27.11 ppm, for **1d**); in the reported forms, the imide part is indicated in red. Although ^{13}C NMRs were measured from mixtures of active and inactive forms, the low concentration of the active form gave almost no signal.
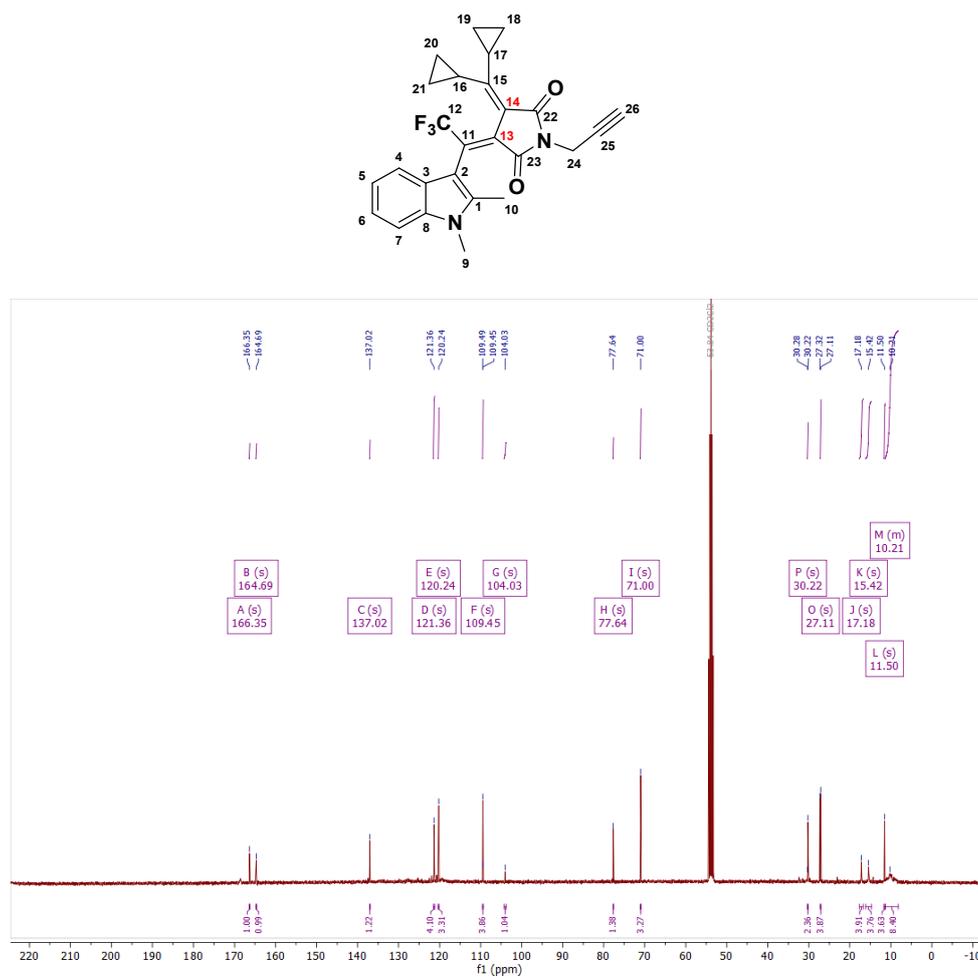
Figure S12. ^{13}C NMR spectrum of the inactive form of **1d** in CD$_2$Cl$_2$

Inactive:

^{13}C NMR (101 MHz, CD$_2$Cl$_2$) δ 166.4, 164.7, 137.0, 121.4, 120.2, 109.5, 104.0, 77.6, 71.0, 30.2, 27.1, 17.2, 15.4, 11.5, 11.4 – 8.2 (m).

Cooling experiments

To better understand the system, cooled ^{1}H, ^{19}F and ^{13}C NMR experiments were conducted in CD$_3$CN on fulgimide **1d**.

^{1}H NMRs

While cooling down, proton NMRs showed a splitting of both of rotamers in an approximately 2:1 ratio, revealing all signals of the compound with their characteristic splitting. Spectra were recorded at 25 °C and -35°C.
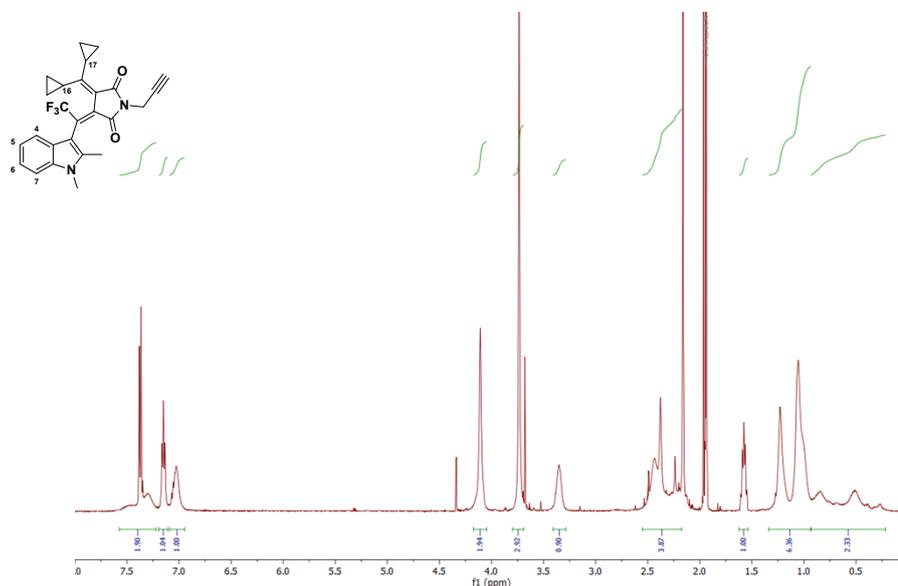
Figure S13. ^{1}H NMR spectrum of the inactive form (with traces (<5%) of the active form) of **1d** in CD$_3$CN measured at room temperature
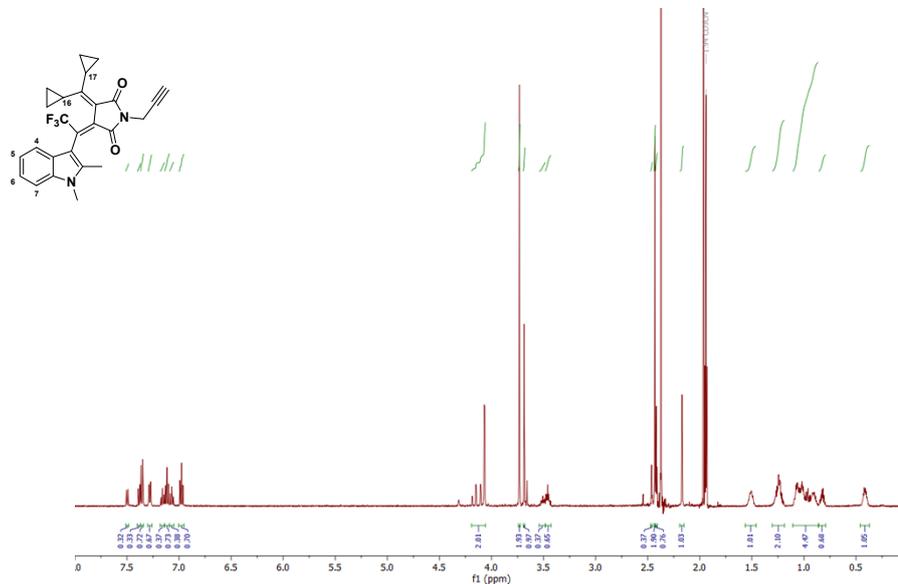
Figure S14. ^{1}H NMR spectrum of the inactive form (with traces (<5%) of the active form) of **1d** in CD$_3$CN measured at -35 °C

Major rotamer:

^{1}H NMR (500 MHz, CD$_3$CN, 238.15 K) δ 7.36 (d, J = 0.8 Hz, 1H, Ar-H, (4)), 7.28 (d, J = 7.9 Hz, 1H, Ar-H, (7)), 7.12 (ddd, J = 8.2, 7.1, 1.2 Hz, 1H, Ar-H, (6)), 6.98 (ddd, J = 8.0, 7.0, 1.0 Hz, 1H, Ar-H, (5)), 4.07 (d, J = 2.5 Hz, 2H, N-CH_2), 3.73 (s, 3H, N-CH_3), 3.48–3.43 (m, 1H, C-H (16)), 2.43 (s, 3H, C-CH_3), 2.42 (t, J = 2.5 Hz, 1H, C-H), 1.56–1.47 (m, 1H, Δ-CH_2), 1.31–1.18 (m, 2H, Δ-CH_2), 1.11–0.86 (m, 4H, Δ-CH_2), 0.86–0.79 (m, 1H, Δ-CH_2), 0.46–0.38 (m, 1H, C-H (17)).

Minor rotamer:

^{1}H NMR (500 MHz, CD$_3$CN, 238.15 K) δ 7.50 (d, J = 7.8 Hz, 1H, Ar-H, (4)), 7.38 (d, J = 8.2 Hz, 1H, Ar-H, (7)), 7.16 (ddd, J = 8.1, 7.0, 1.1 Hz, 1H, Ar-H, (6)), 7.07 (ddd, J = 7.7, 7.0, 0.9 Hz, 1H, Ar-H, (5)), 4.15 (dd, J = 22.2, 2.5 Hz, 2H, N-CH_2), 3.69 (s, 3H, N-CH_3), 3.54–3.48 (m, 1H, C-H (16)), 2.46 (t, J = 2.5 Hz, 1H, C-H), 2.17 (s, 3H, C-CH_3), 1.55–1.46 (m, 1H, Δ-CH_2), 1.30–1.19 (m, 2H, Δ-CH_2), 1.11–0.86 (m, 5H, Δ-CH_2), 0.45–0.38 (m, 1H, C-H (17)).

^{19}F NMRs

Cooling the inactive form split the fluorine signals into two sharp singlets at -15 °C in a 2:1 ratio.
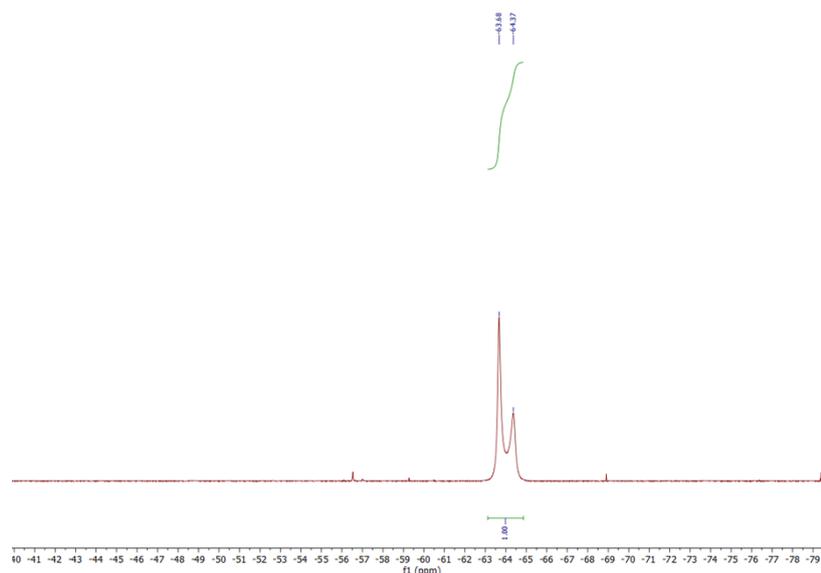
Figure S15. Zoomed-in ^{19}F NMR spectrum of the inactive form of **1d** in CD$_3$CN measured at room temperature
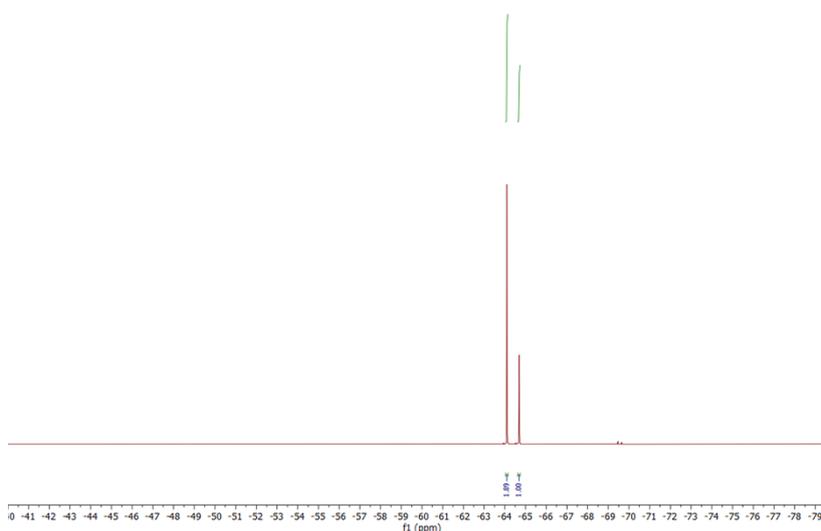
Figure S16. Zoomed-in ^{19}F NMR spectrum of the inactive form of **1d** in CD$_3$CN measured at -15 °C

Major rotamer:

^{19}F NMR (470 MHz, CD$_3$CN, 258.15 K) δ -64.17.

Minor rotamer:

^{19}F NMR (470 MHz, CD$_3$CN, 258.15 K) δ -64.75.

¹³C NMRs.

Cooling the inactive form of **1d** split the carbon signals of both rotamers into two sets of carbon signals after a long measurement period. Quaternary carbons 13 and 14 gave no signal, and they were not found by heteronuclear multiple bond correlation (HMBC) analysis either.
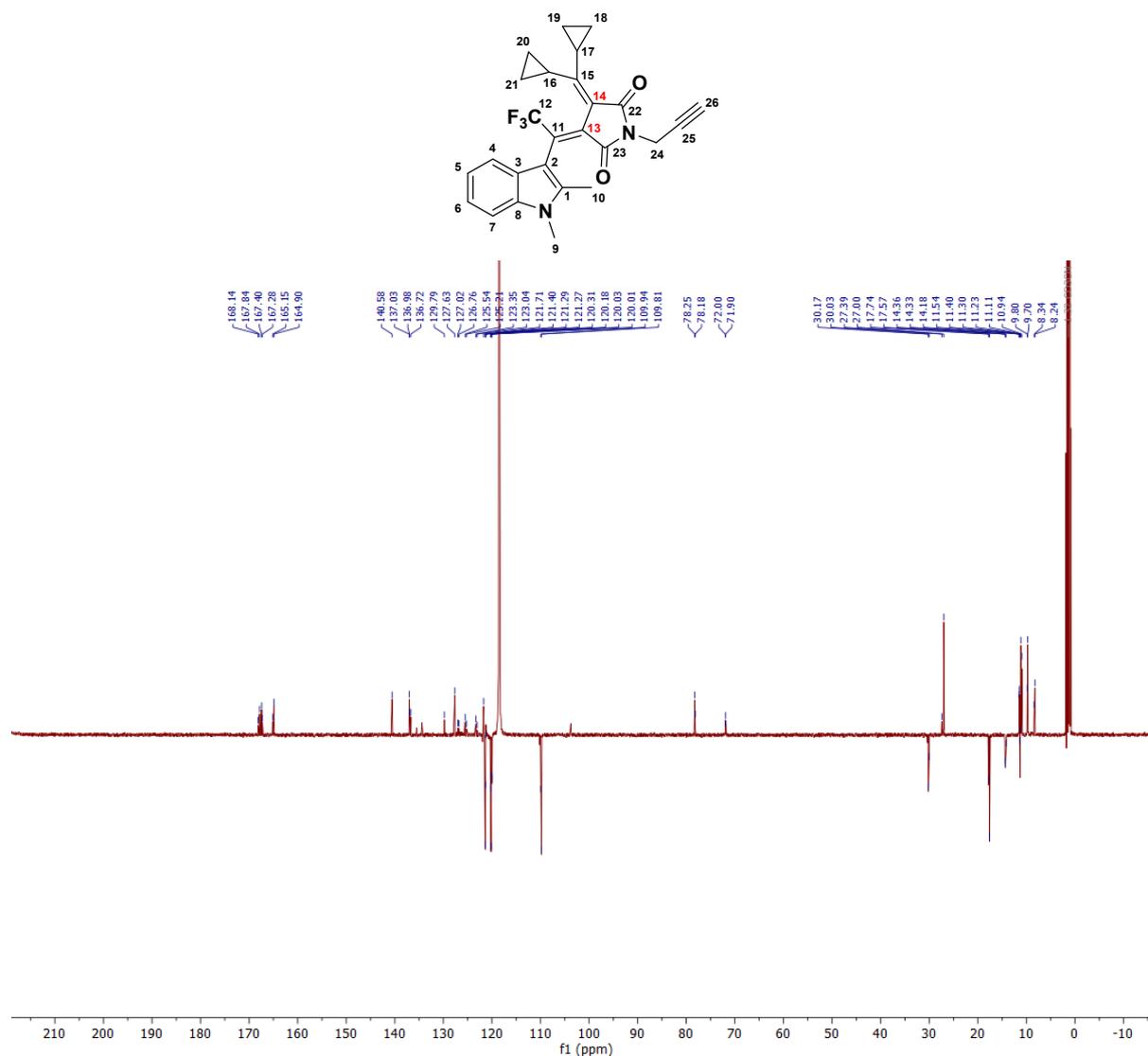
Figure S17. ¹³C APT NMR spectrum of the inactive form of **1d** in CD_3CN measured at -35 °C

Major rotamer:

¹³C NMR (126 MHz, CD_3CN, 238.15 K) δ 167.84 (15), 167.40 (22/23), 164.90 (22/23), 140.58 (1), 137.03 (8), 134.44 (q, J = 2.0 Hz) (11), 127.63 (3), 124.44 (q, J = 275.7 Hz) (12), 121.40 (6), 120.18 (5), 120.02 (d, J = 2.4 Hz) (4), 109.81 (7), 103.76 (2), 78.25 (26), 71.90 (25), 30.17 (9), 27.00 (24), 17.57 (17), 14.34 (q, J = 4.3 Hz) (16), 11.40 (18/19/20/21), 11.30 (10), 11.11 (18/19/20/21), 9.70 (18/19/20/21), 8.24 (18/19/20/21).

Minor rotamer:

¹³C NMR (126 MHz, CD_3CN, 238.15 K) δ 168.14 (15), 167.28 (22/23), 165.15 (22/23), 136.98 (8), 136.72 (1), 135.49 (11), 129.79 (3), 124.13 (q, J = 273.8 Hz) (12), 121.29 (6), 120.31 (5), 118.49 (4), 109.94 (7), 103.70 (2), 78.18 (26), 72.00 (25), 30.03 (9), 27.39 (24), 17.74 (17), 14.19 (q, J = 3.6 Hz) (16), 11.54 (18/19/20/21), 11.20 (10), 10.94 (18/19/20/21), 9.80 (18/19/20/21), 8.34 (18/19/20/21).

The signal of carbon 4, hidden under CD_3CN, was found by HMBC analysis.

Spectra of fulgimides 1a-h

Fulgimide 1a

Inactive Form (in a 10:1 ratio with the active form):
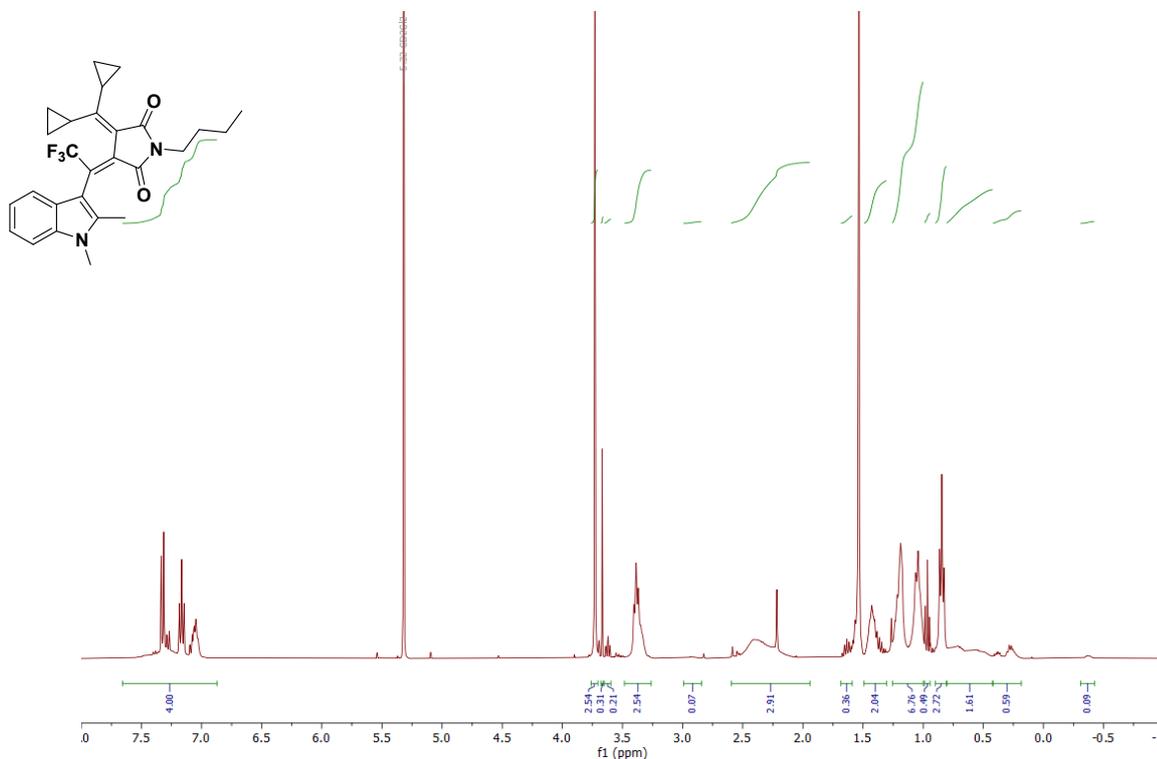
Figure S18. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 10:1 ratio of compound **1a** in CD$_2$Cl$_2$
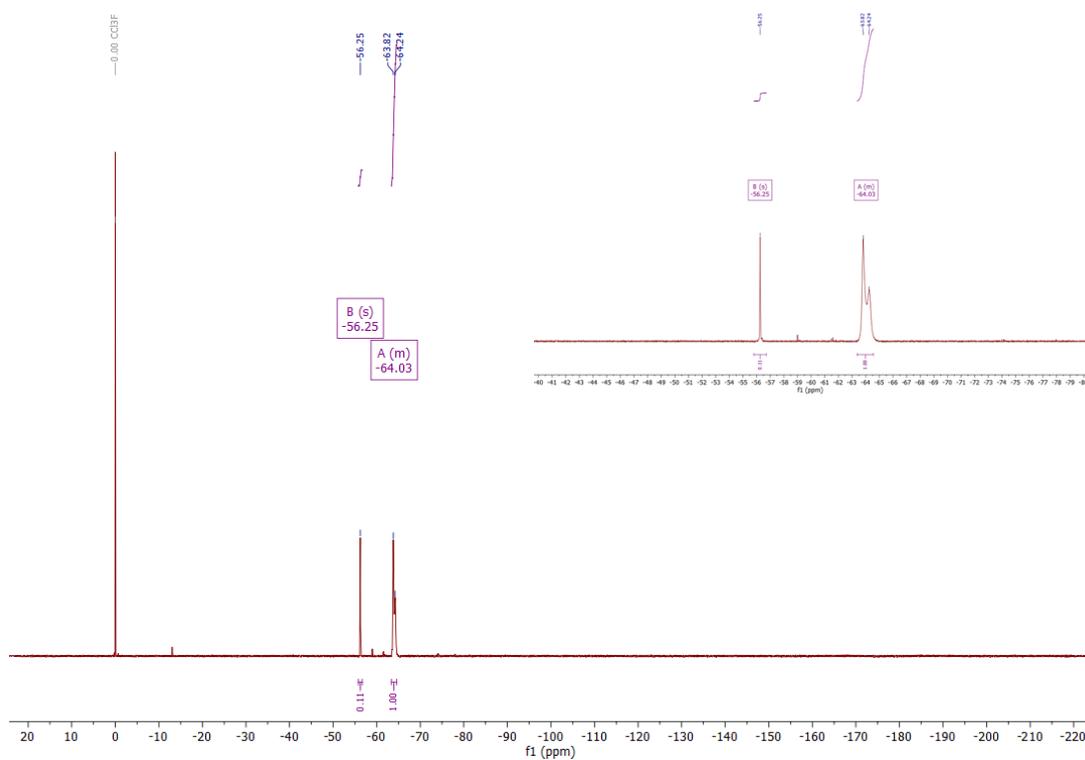
Figure S19. ^{19}F NMR spectrum of a mixture of the inactive and active forms in a 10:1 ratio of compound **1a** in CD$_2$Cl$_2$ with a zoomed-in inset
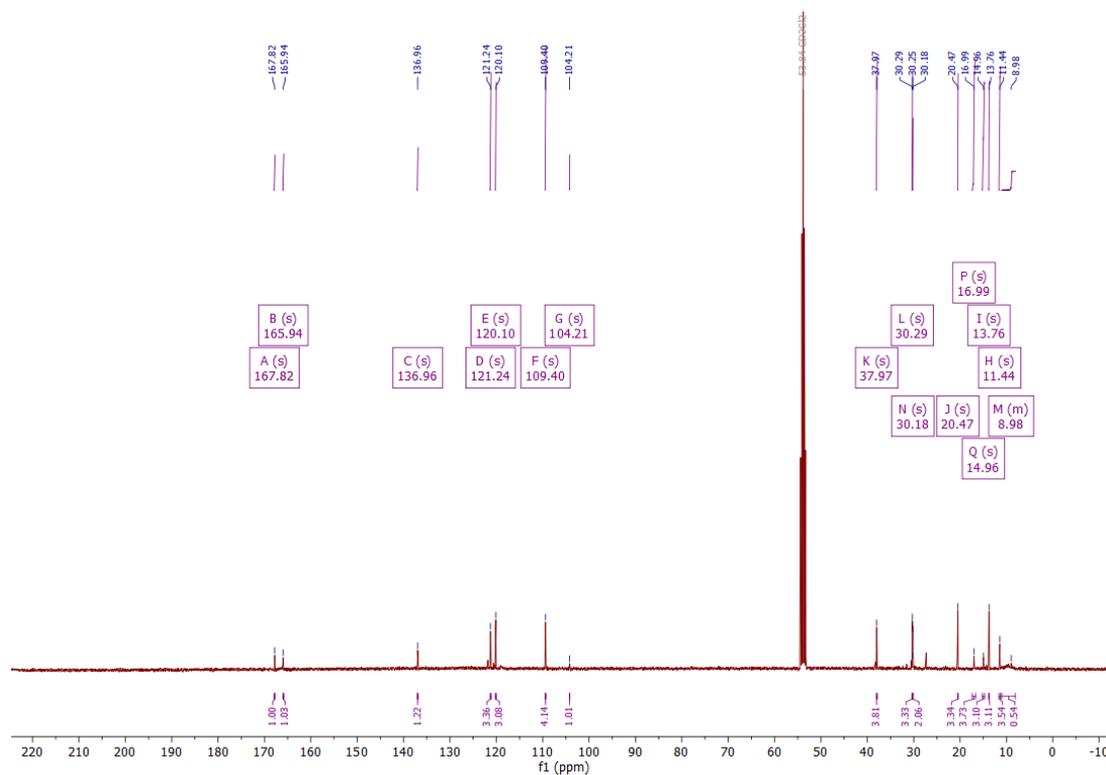
Figure S20. ^{13}C NMR spectrum of the inactive form of **1a** in CD$_2$Cl$_2$

Active Form:
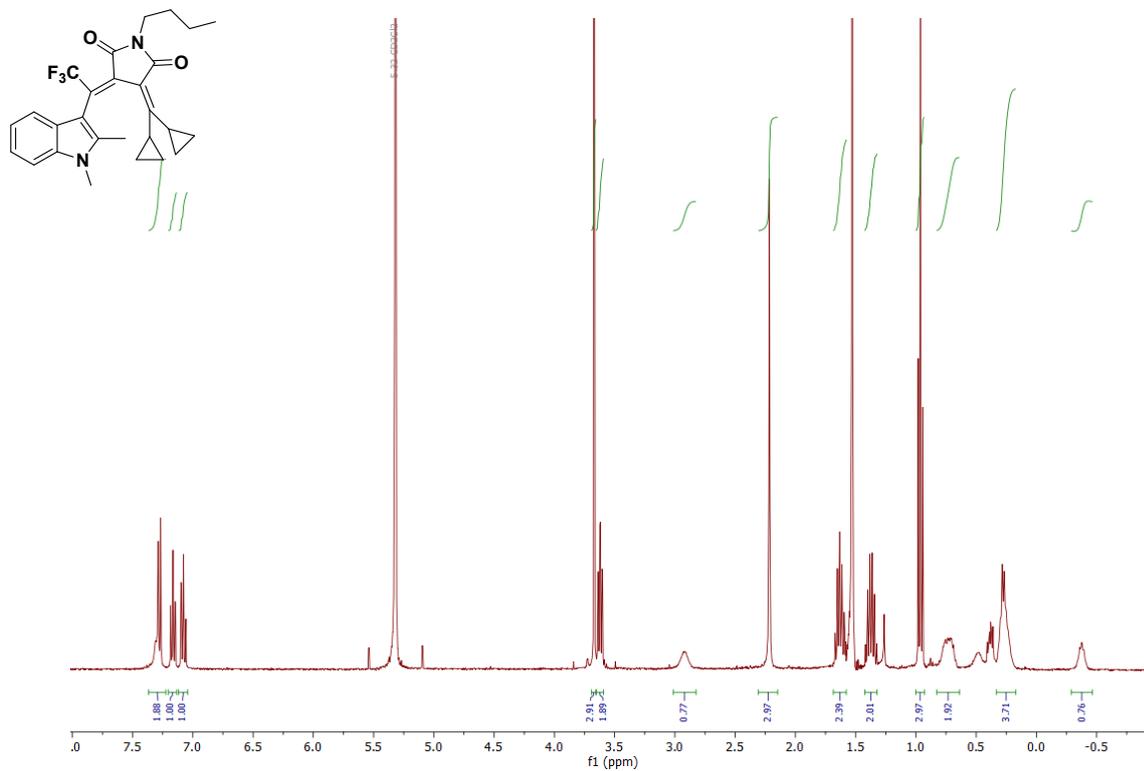
Figure S21. ^{1}H NMR spectrum of the active form of compound **1a** in CD$_2$Cl$_2$

−56.25

1.00

f1 (ppm)
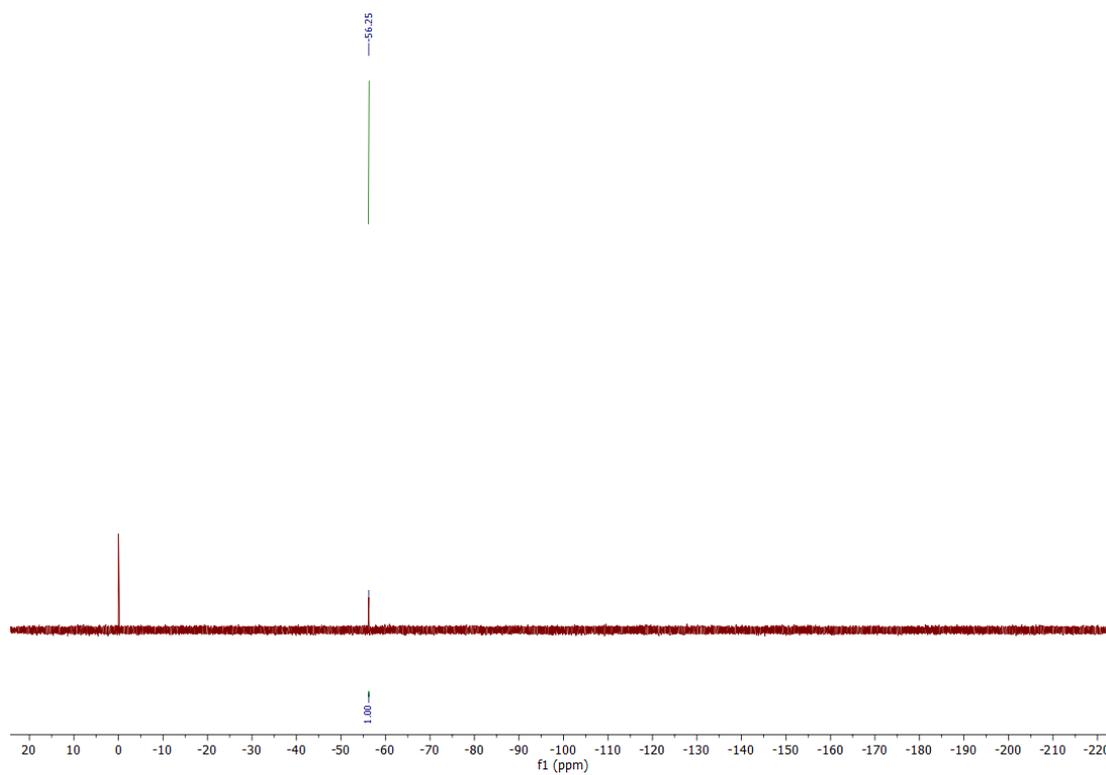
Figure S22. ^{19}F NMR spectrum of the active form of compound **1a** in CD_2Cl_2

471.22512
$C_{27} H_{30} O_2 N_2 F_3$ = 471.22539
-0.57235 ppm

472.22811

473.23060

Relative Abundance

m/z
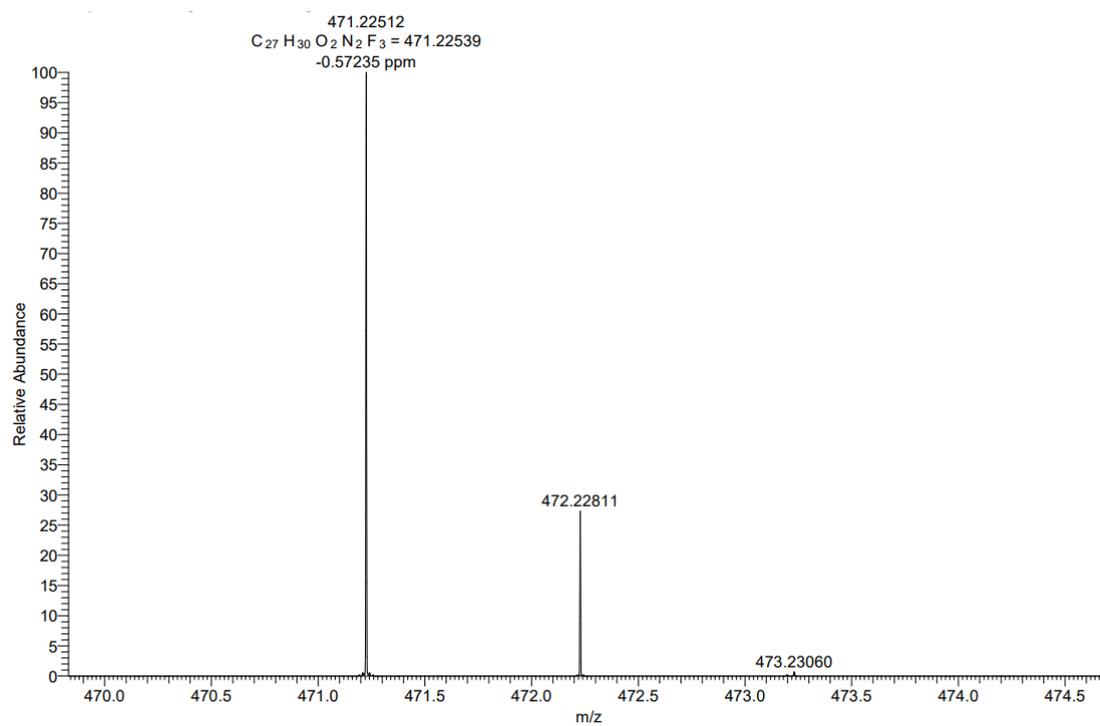
Figure S23. HRMS ESI$^+$ spectrum of compound **1a**

Fulgimide 1b

Inactive Form (in a 11:1 ratio with the active form):
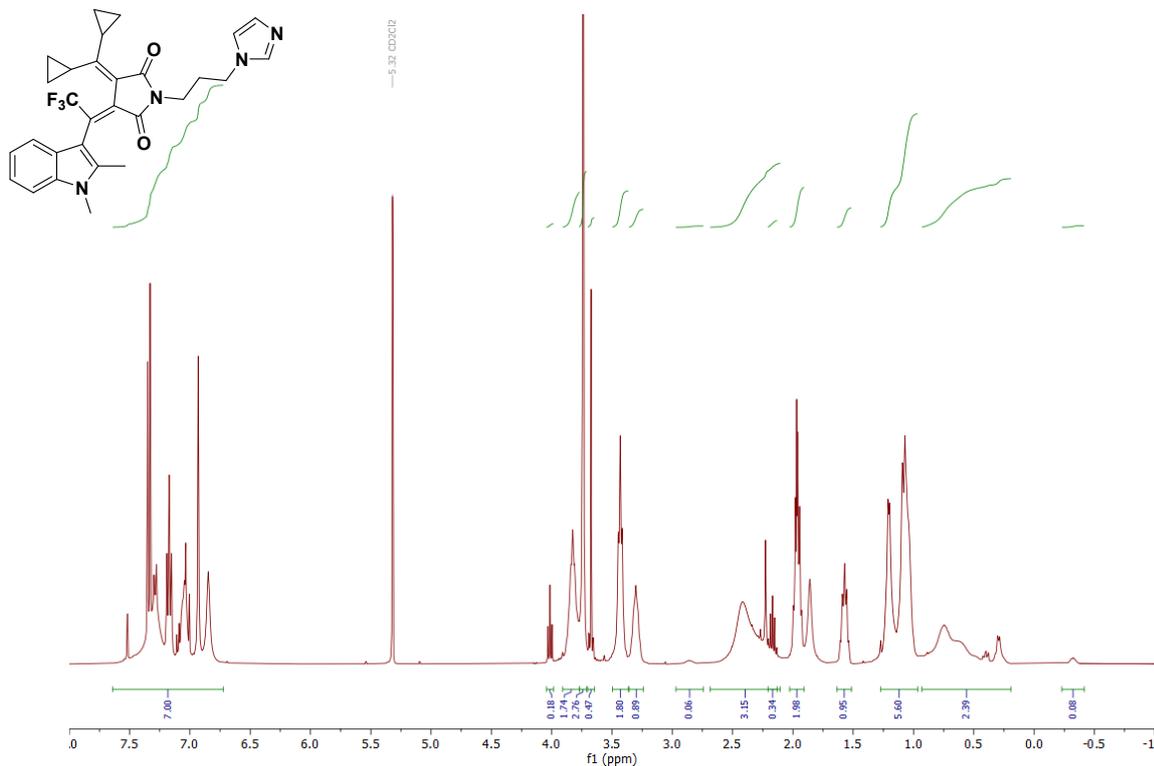
Figure S24. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 11:1 ratio of compound **1b** in CD$_2$Cl$_2$
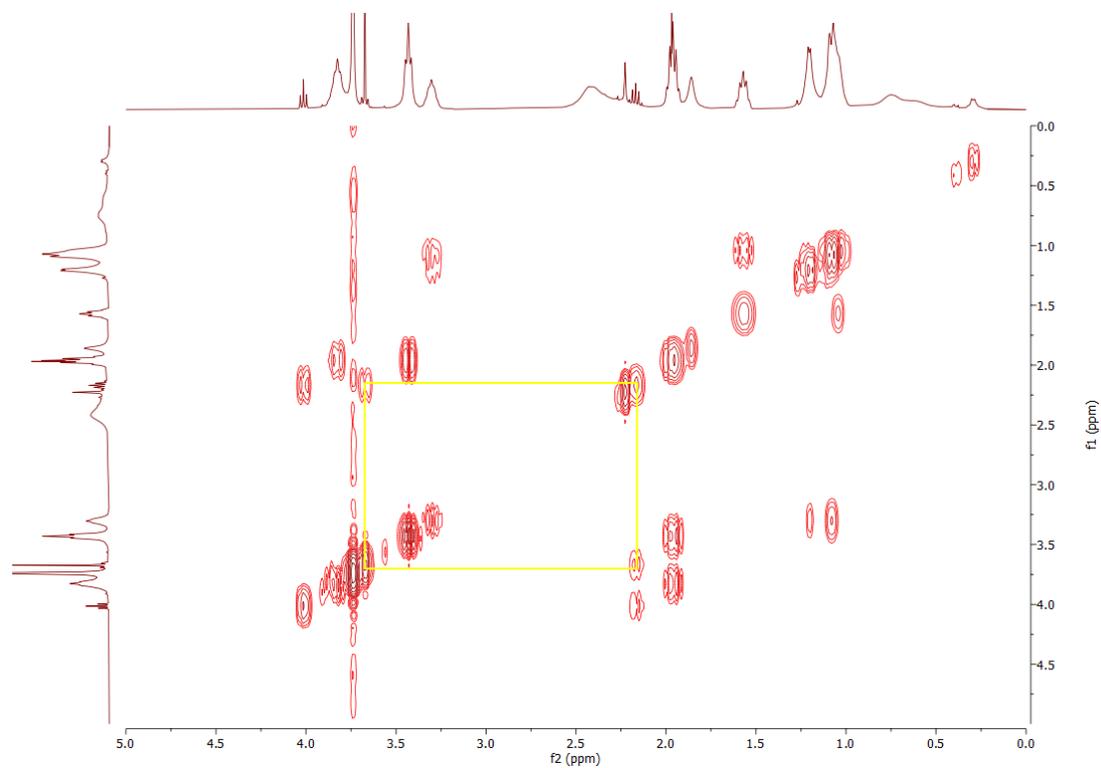
Figure S25. ^{1}H-^{1}H COSY spectrum of a mixture of the inactive and active forms in a 11:1 ratio of compound **1b** in CD$_2$Cl$_2$ zoomed in to reveal the presence of a hidden methylene group
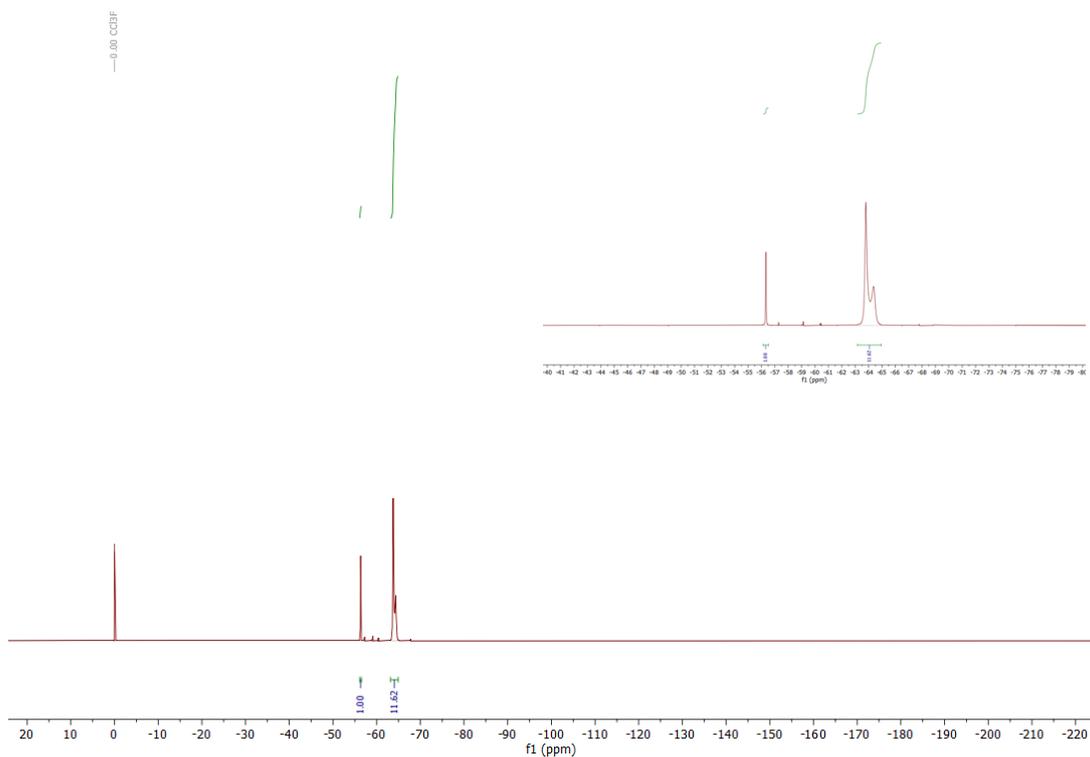
Figure S26. ^{19}F NMR spectrum of a mixture of the inactive and active forms in a 11:1 ratio of compound **1b** in CD$_2$Cl$_2$ with a zoomed-in inset
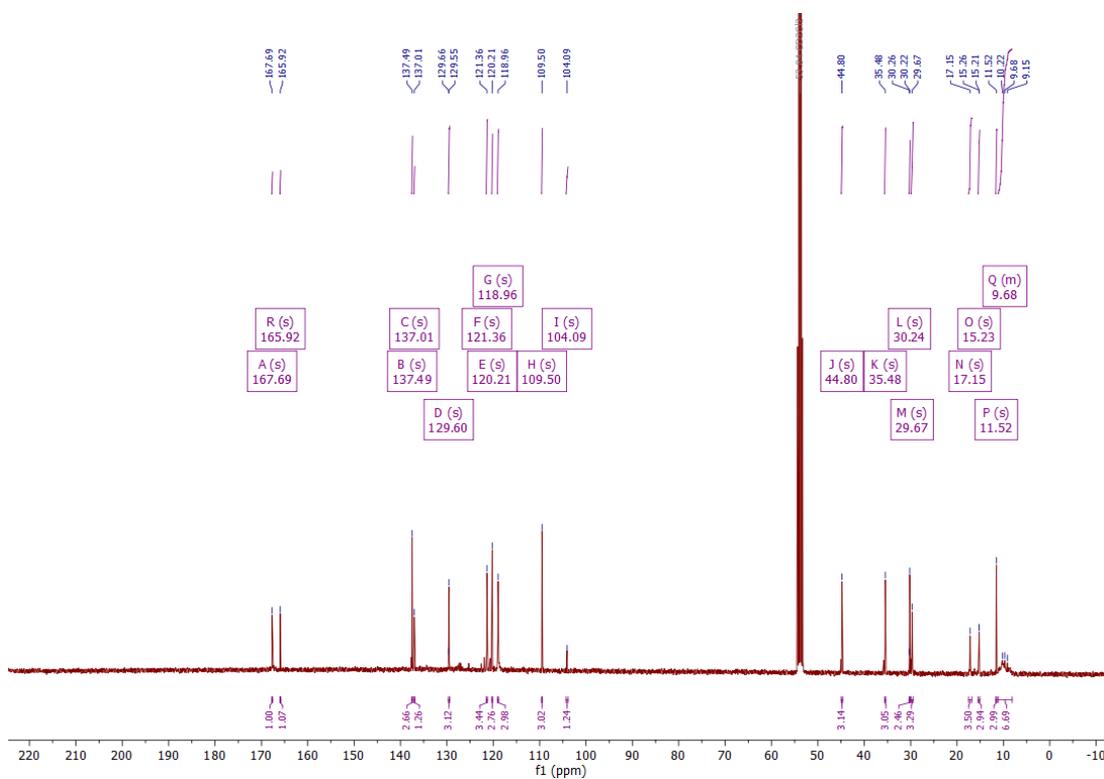
Figure S27. ^{13}C NMR spectrum of the inactive form of **1b** in CD$_2$Cl$_2$
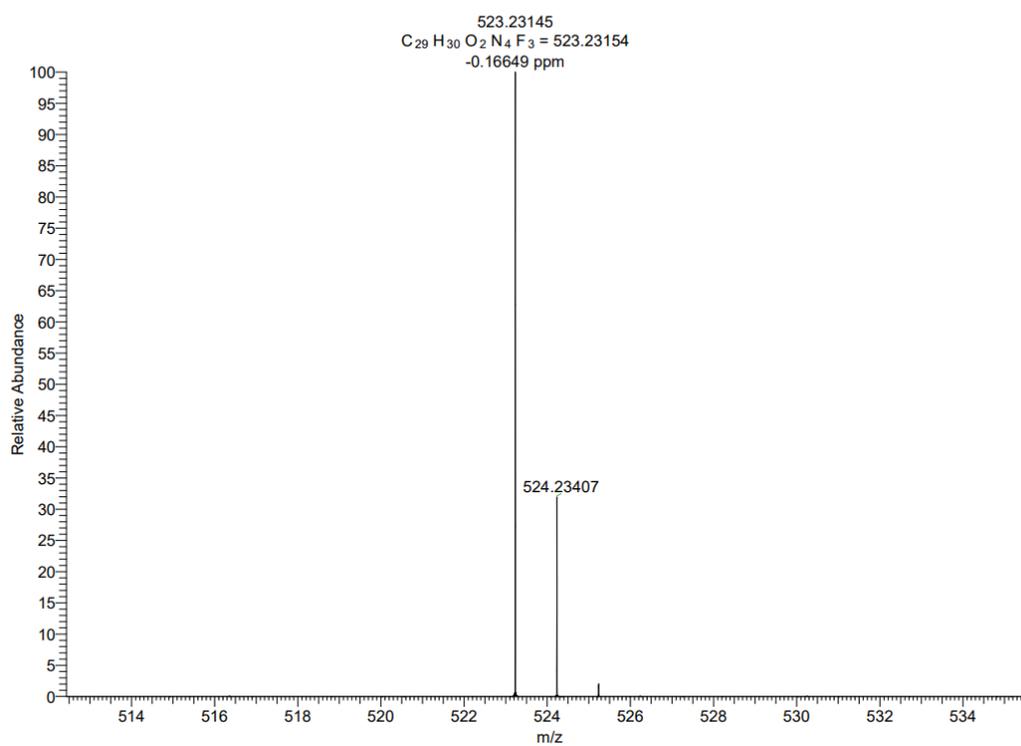
Figure S28. HRMS ESI⁺ spectrum of compound **1b**

Fulgimide 1c

Inactive Form (in a 9:1 ratio with the active form):
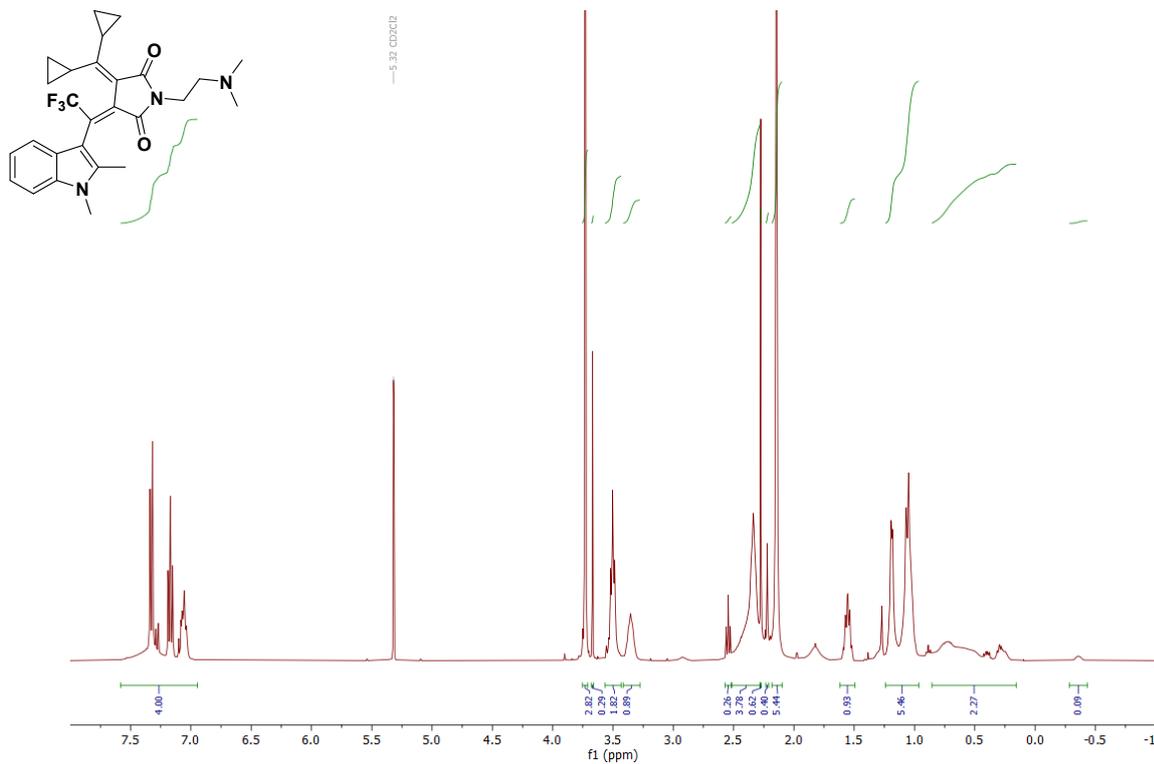
Figure S29. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 9:1 ratio of compound **1c** in CD$_2$Cl$_2$
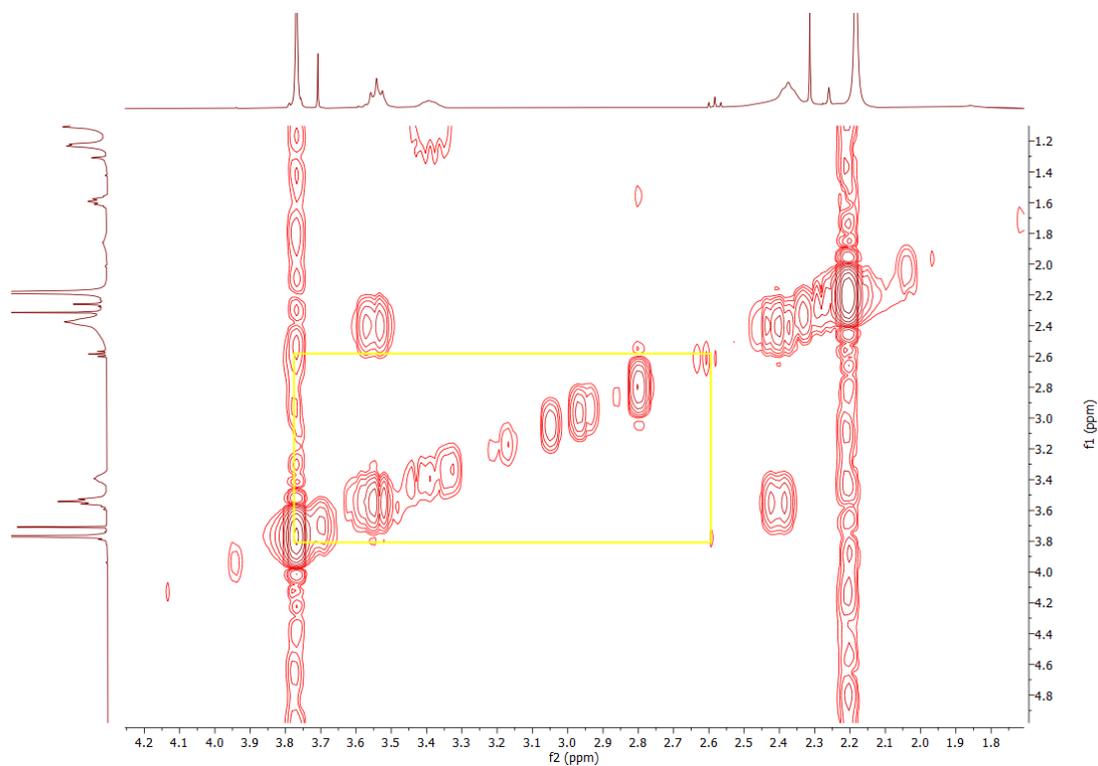
Figure S30. ^{1}H-^{1}H COSY spectrum of a mixture of the inactive and active forms in a 9:1 ratio of compound **1c** in CD$_2$Cl$_2$ zoomed in to reveal the presence of a hidden methylene group
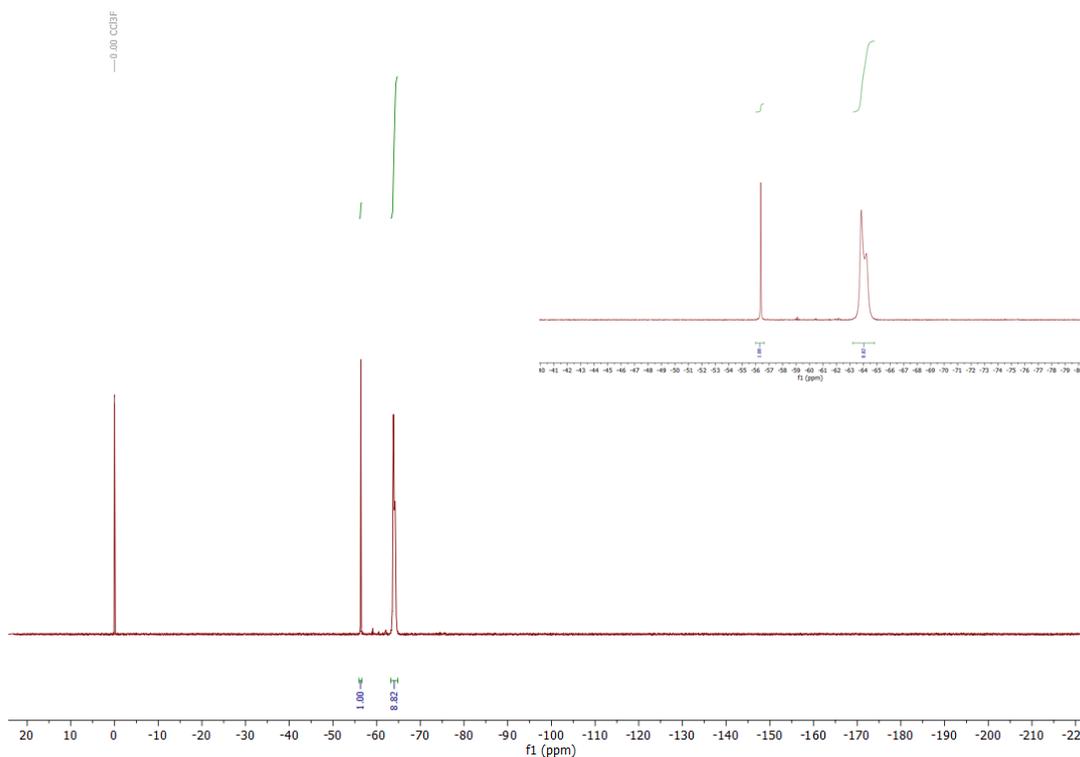
Figure S31. ^{19}F NMR spectrum of a mixture of inactive and active forms in a 9:1 ratio of compound **1c** in CD_2Cl_2 with a zoomed-in inset
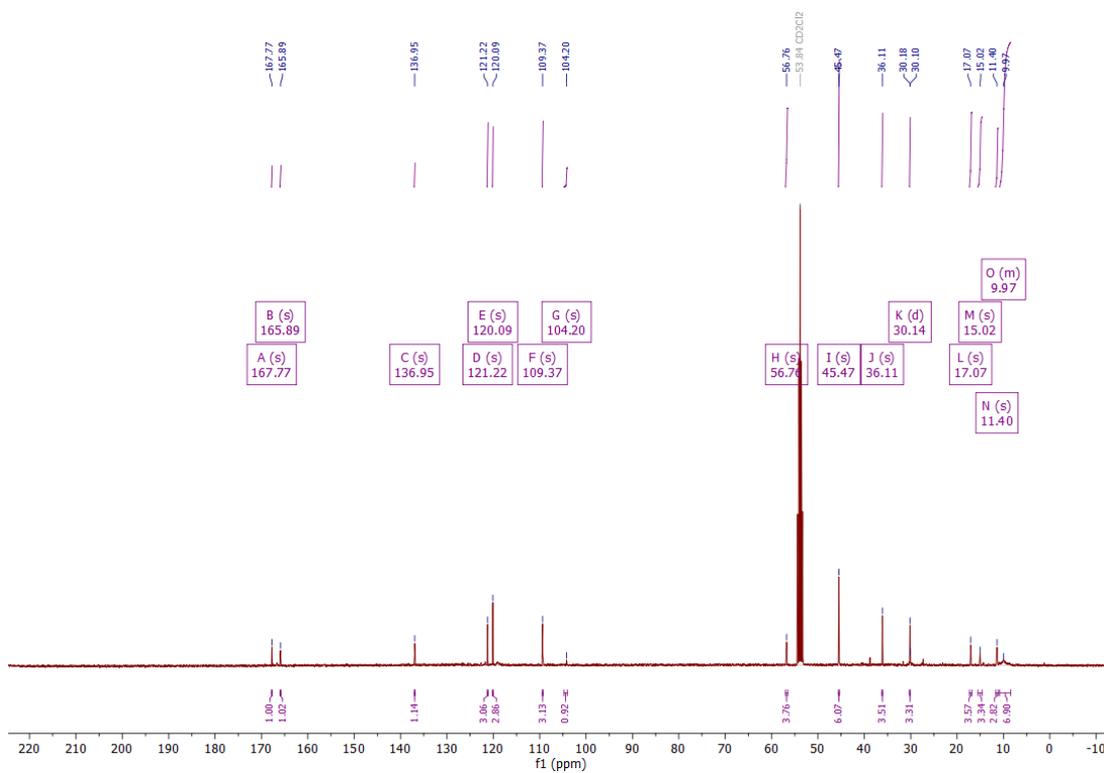
Figure S32. ^{13}C NMR spectrum of the inactive form of **1c** in CD_2Cl_2

486.23602
$C_{27} H_{31} O_2 N_3 F_3$ = 486.23629
-0.54389 ppm

487.23865
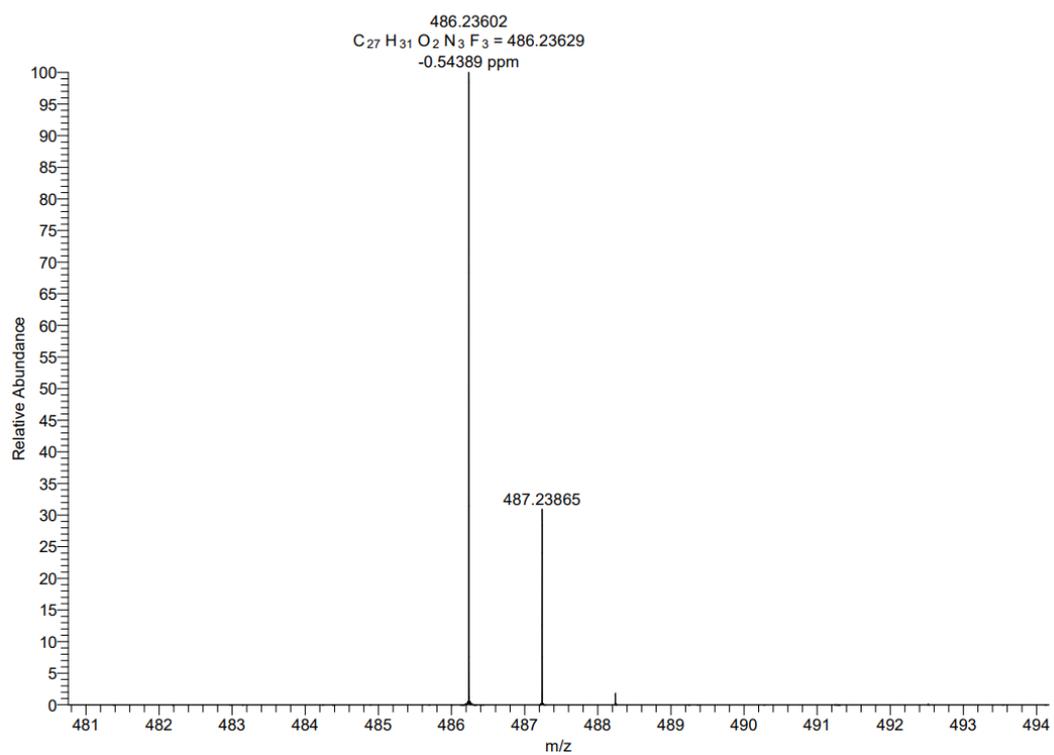
Figure S33. HRMS ESI+ spectrum of compound **1c**

Fulgimide 1d

Inactive Form:
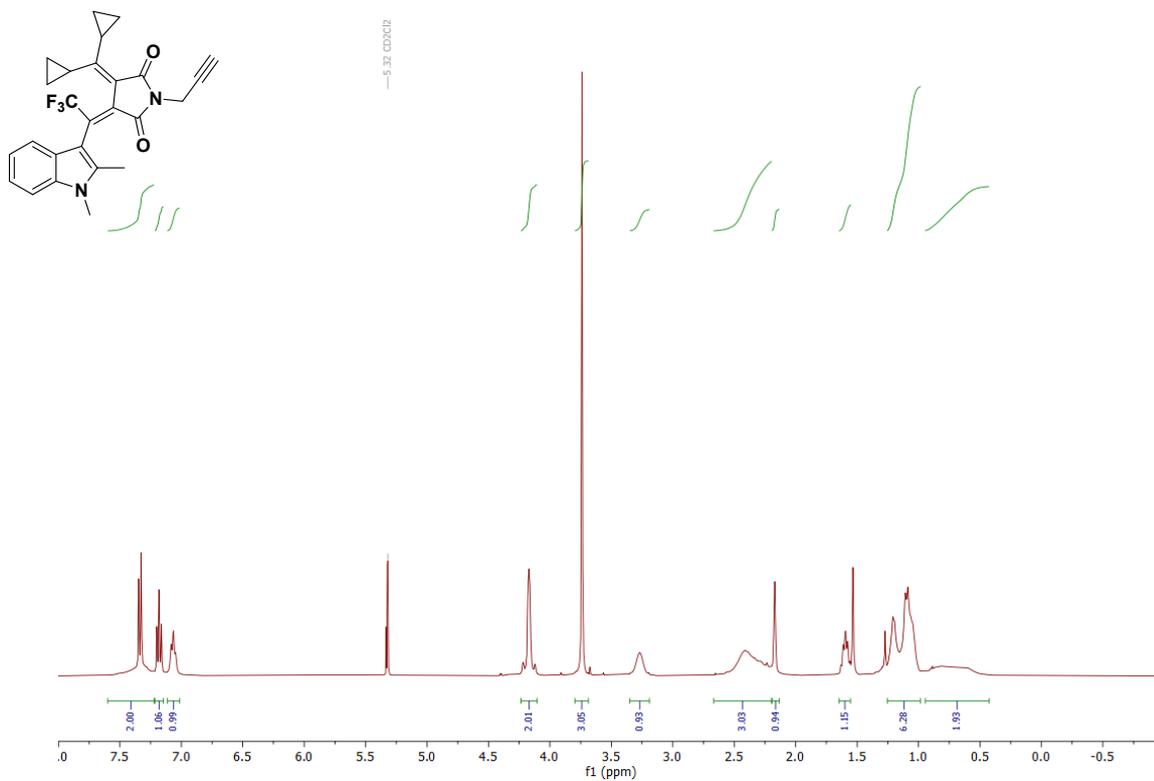
Figure S34. ^{1}H NMR spectrum of the inactive form of compound **1d** in CD_2Cl_2
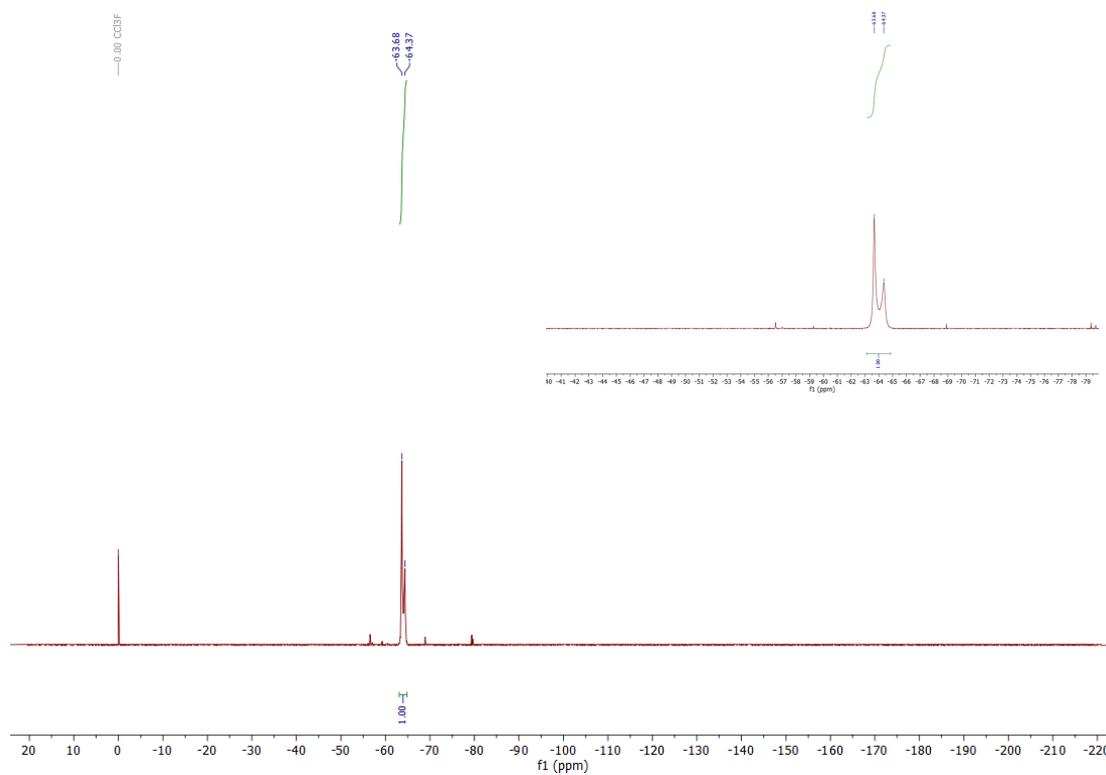
Figure S35. ^{19}F NMR spectrum of the inactive form of compound **1d** in CD_2Cl_2 with a zoomed-in inset
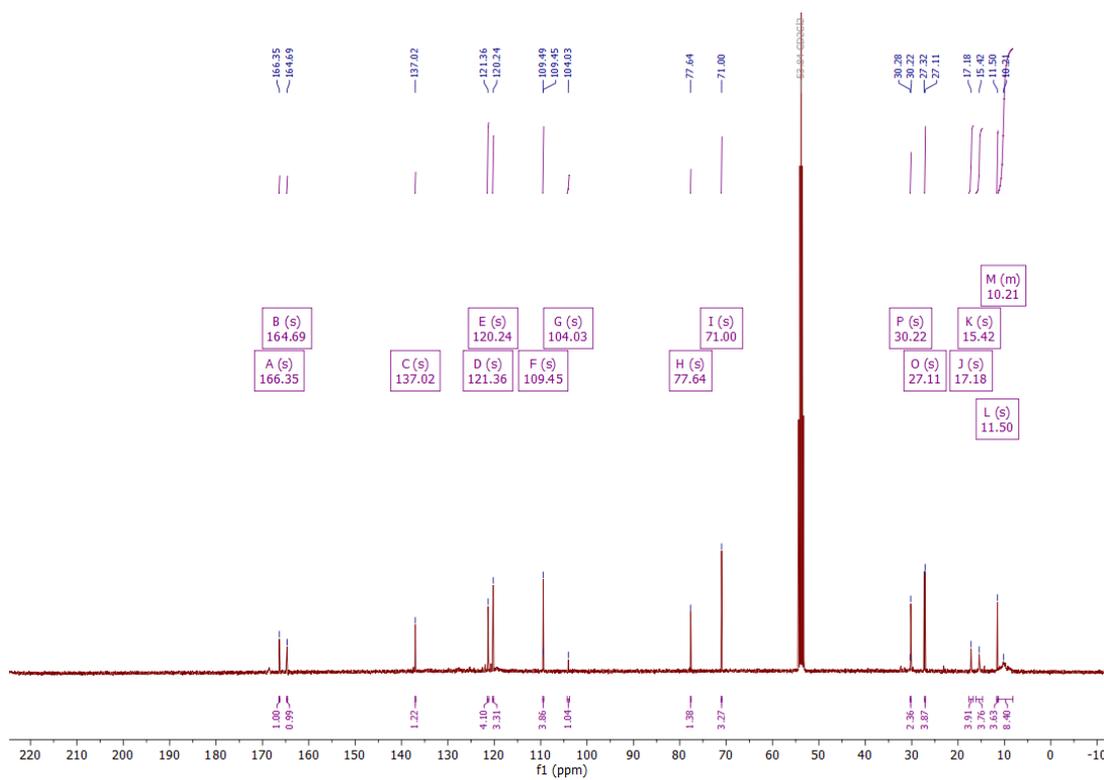
Figure S36. ^{13}C NMR spectrum of the inactive form of **1d** in CD$_2$Cl$_2$

Active Form:
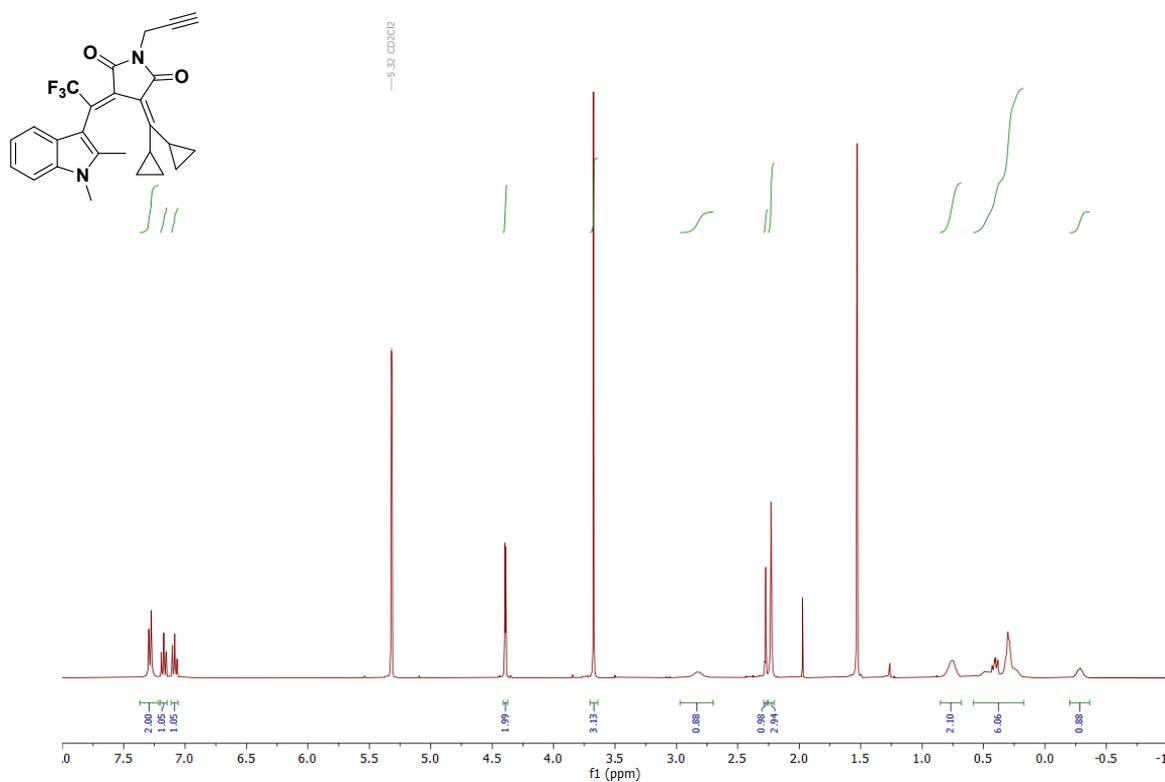
Figure S37. ^{1}H NMR spectrum of the active form of compound **1d** in CD$_2$Cl$_2$
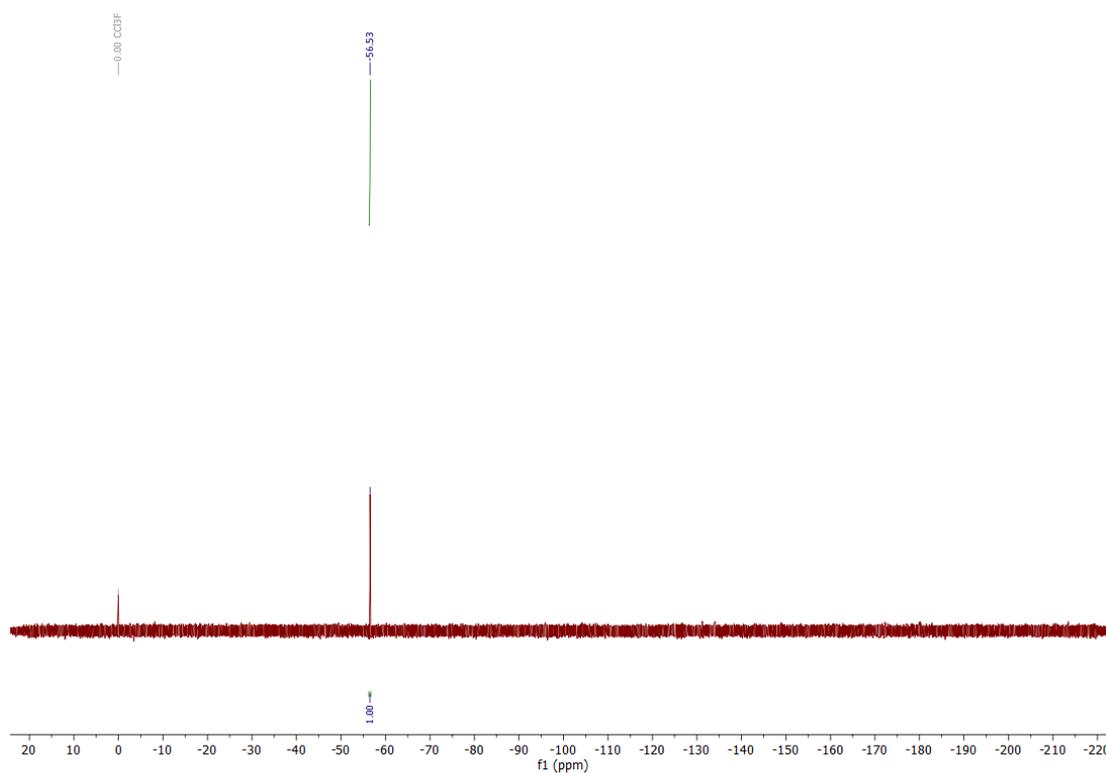
Figure S38. ^{19}F NMR spectrum of the active form of compound **1d** in CD$_2$Cl$_2$ with a zoomed-in inset

453.17820
C$_{26}$H$_{24}$O$_2$N$_2$F$_3$ = 453.17844
-0.52025 ppm

454.18132

455.18386
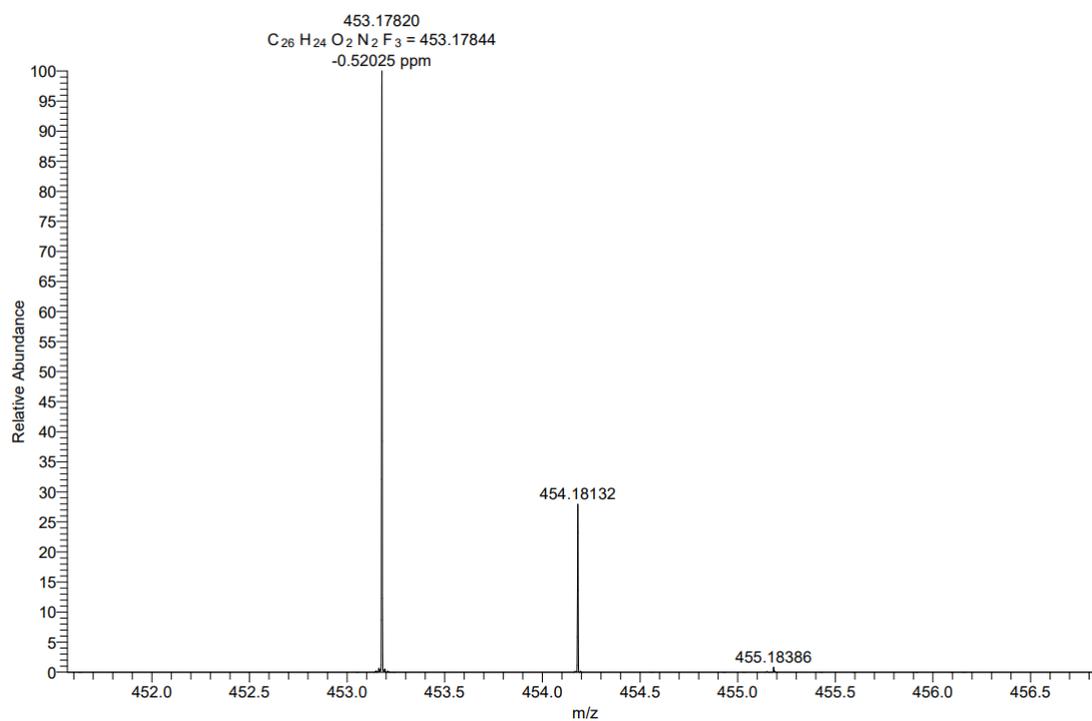
Figure S39. HRMS ESI$^+$ spectrum of compound **1d**

Fulgimide 1e

Inactive Form (in a 15:1 ratio with the active form):
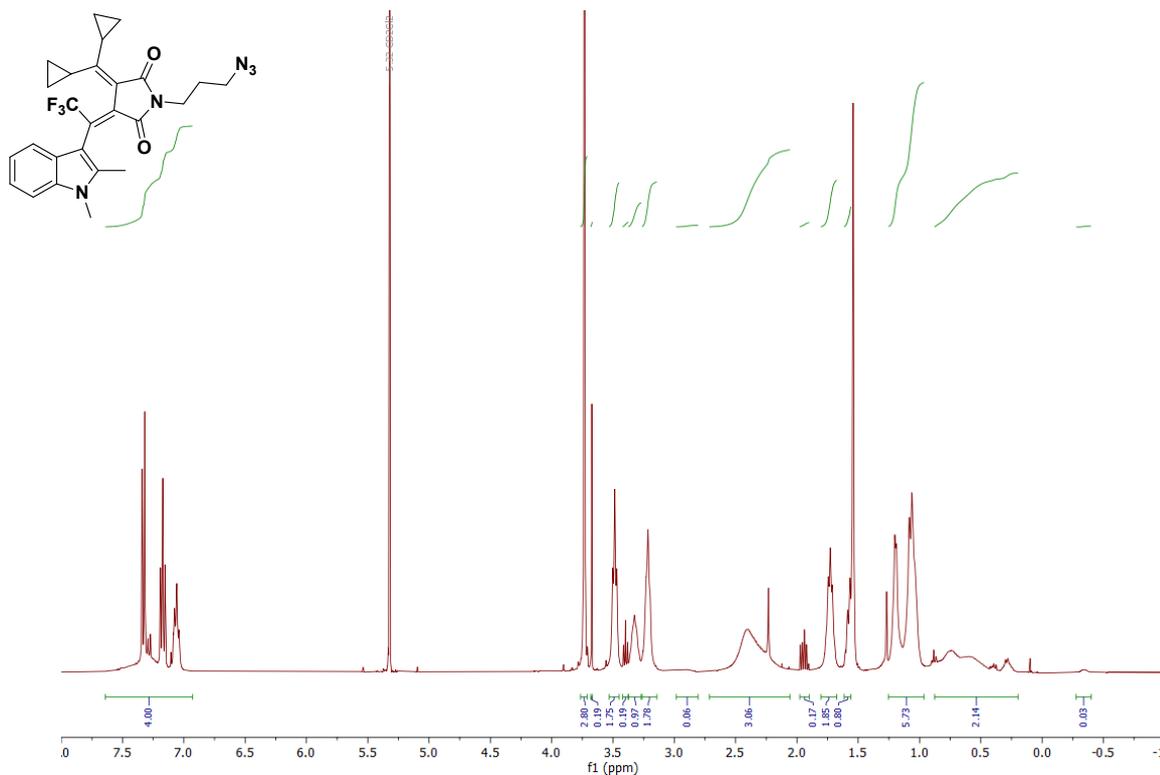
Figure S40. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 15:1 ratio of compound **1e** in CD$_2$Cl$_2$
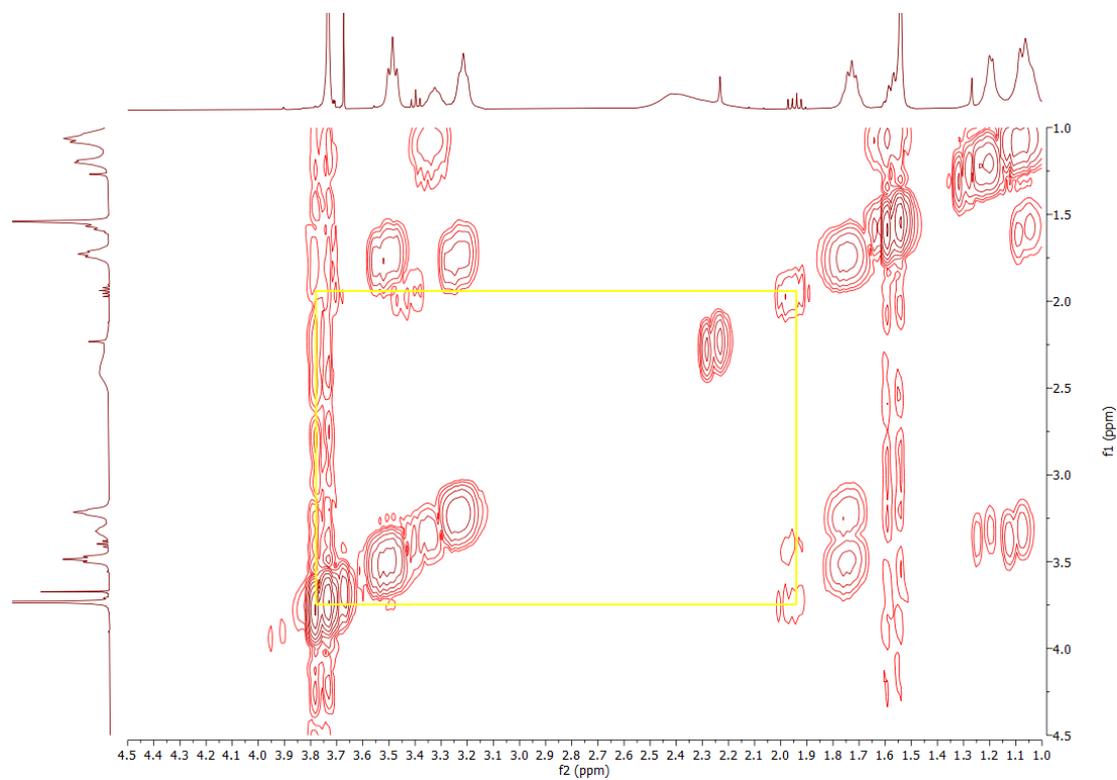
Figure S41. ^{1}H-^{1}H COSY spectrum of a mixture of the inactive and active forms in a 15:1 ratio of compound **1e** in CD$_2$Cl$_2$ zoomed in to reveal the presence of a hidden methylene group
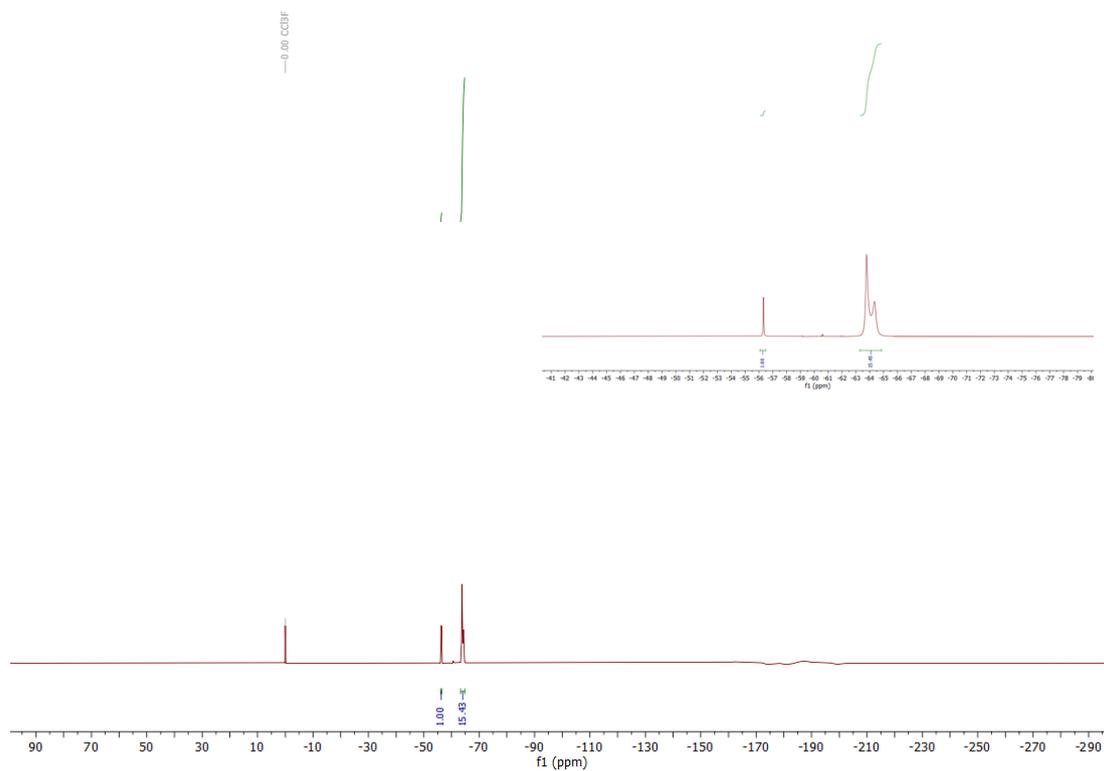
Figure S42. ^{19}F NMR spectrum of a mixture of the inactive and active forms in a 15:1 ratio of compound **1e** in CD$_2$Cl$_2$ with a zoomed-in inset
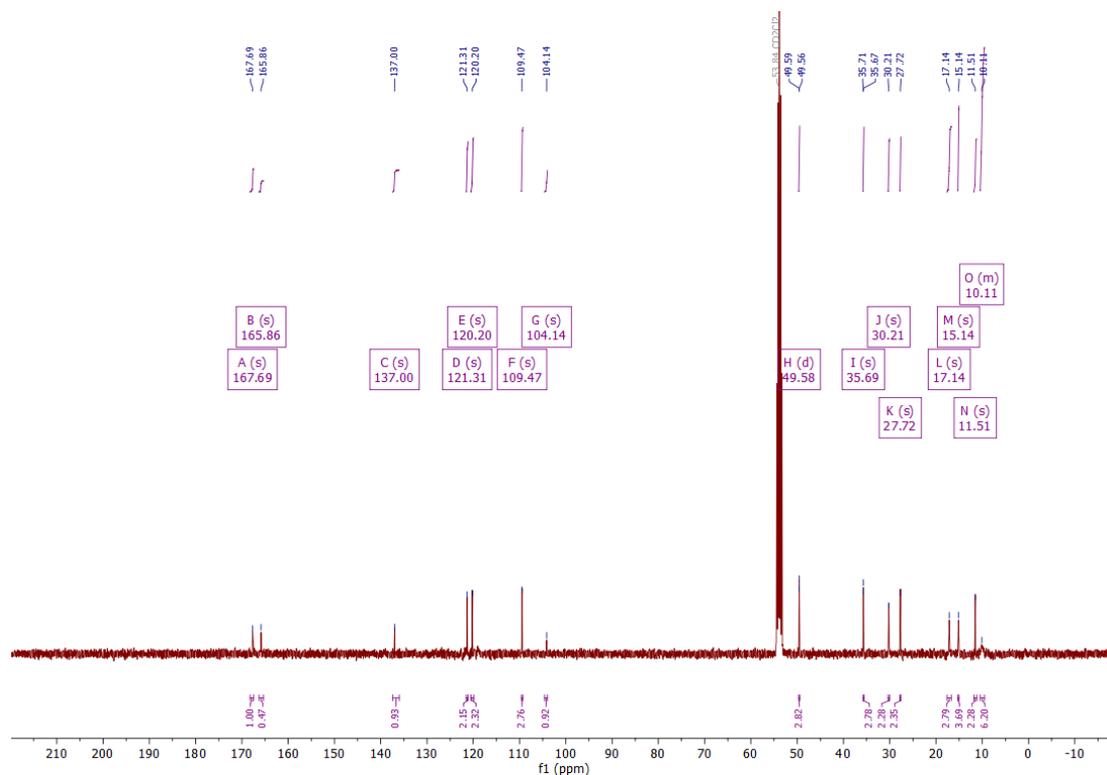
Figure S43. ^{13}C NMR spectrum of the inactive form of **1e** in CD$_2$Cl$_2$
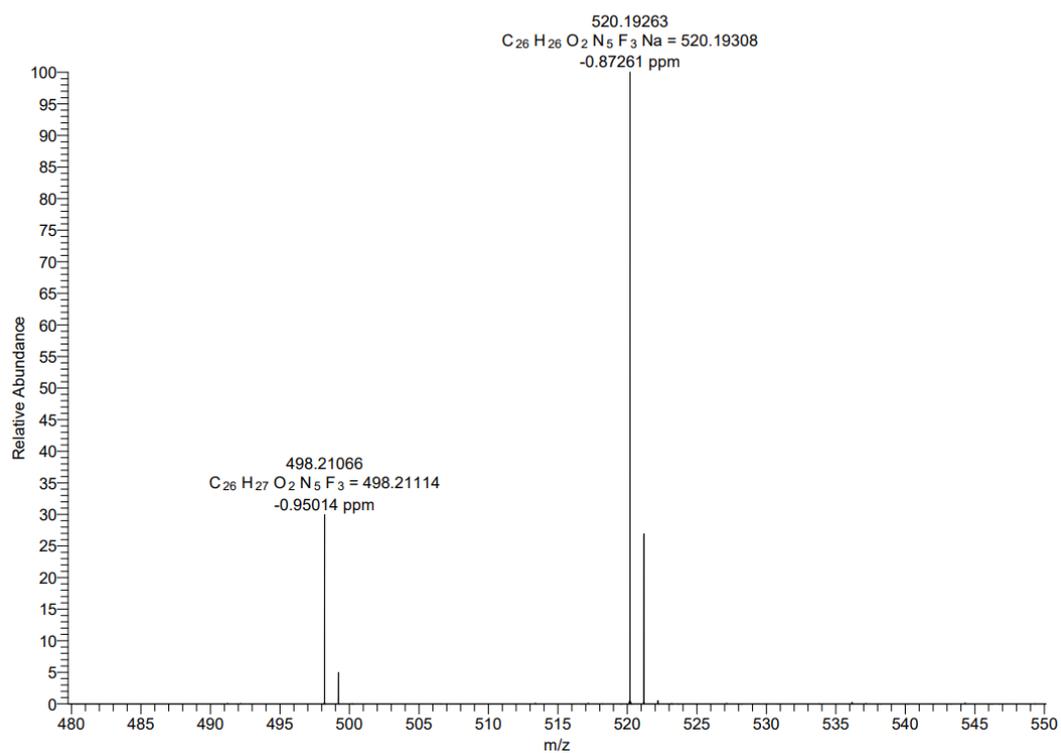
Figure S44. HRMS ESI⁺ spectrum of compound **1e**

Fulgimide 1f

Inactive Form (in a 6:1 ratio with the active form):
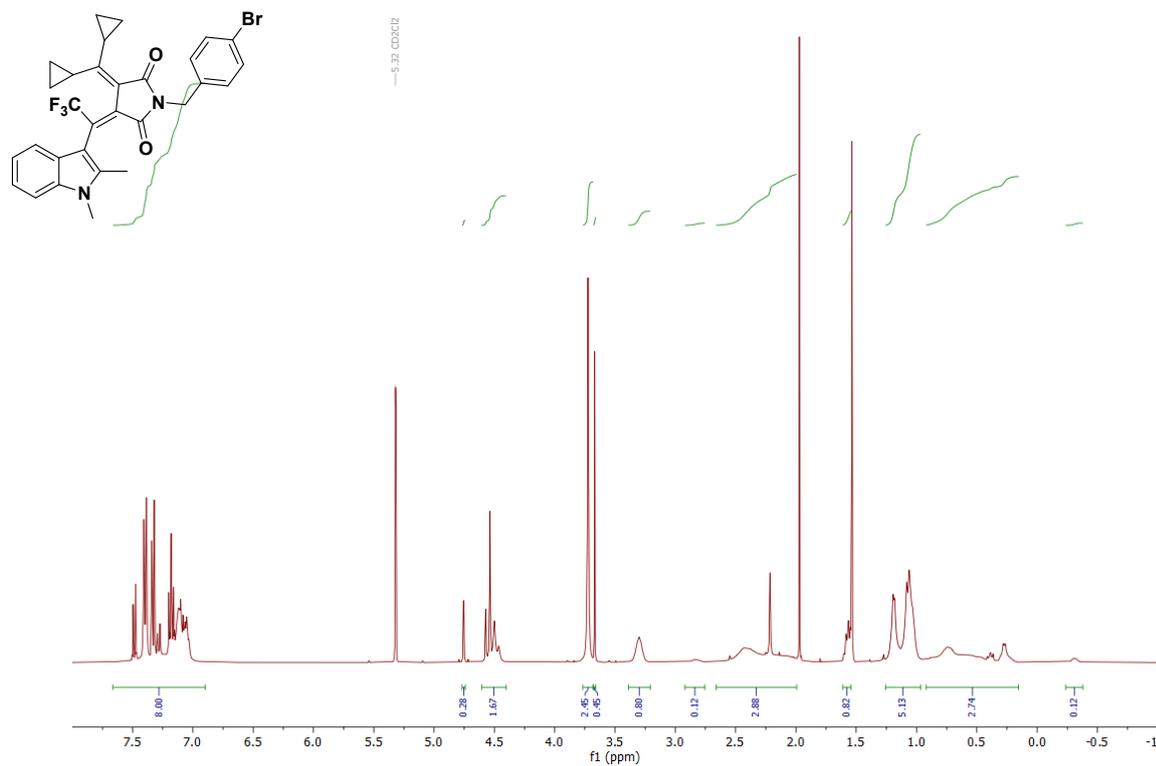
Figure S45. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 6:1 ratio of compound **1f** in CD$_2$Cl$_2$
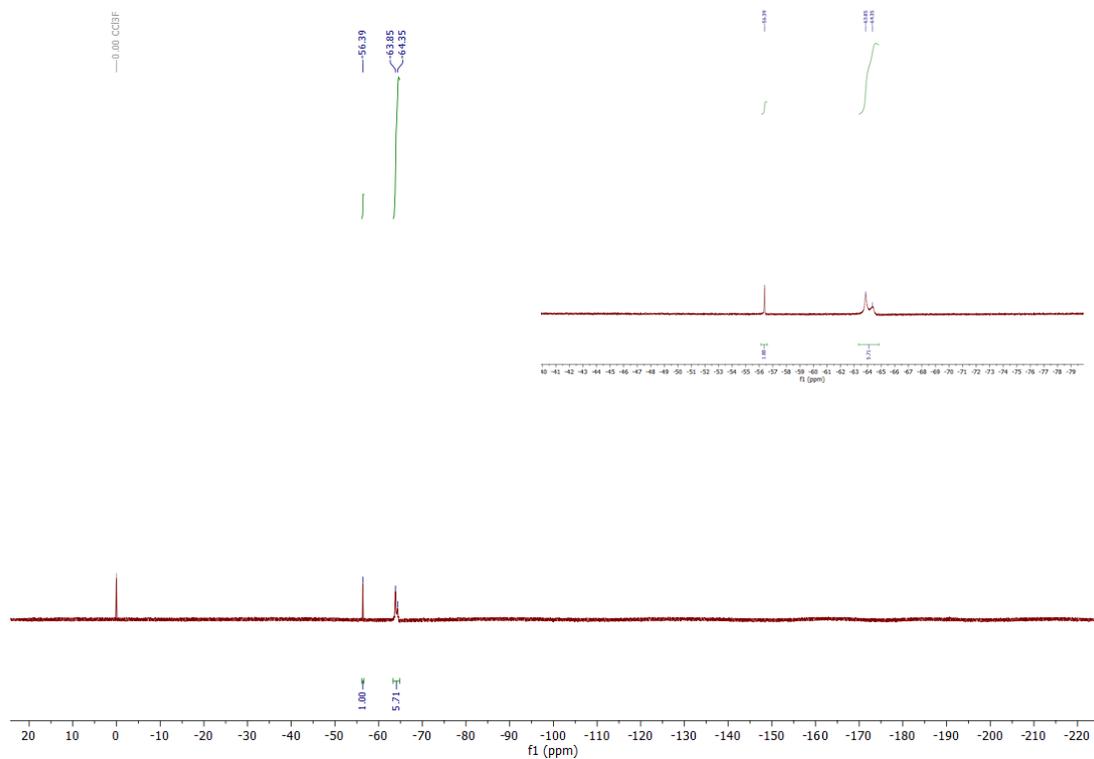
Figure S46. ^{19}F NMR spectrum of a mixture of the inactive and active forms in a 6:1 ratio of compound **1f** in CD$_2$Cl$_2$ with a zoomed-in inset
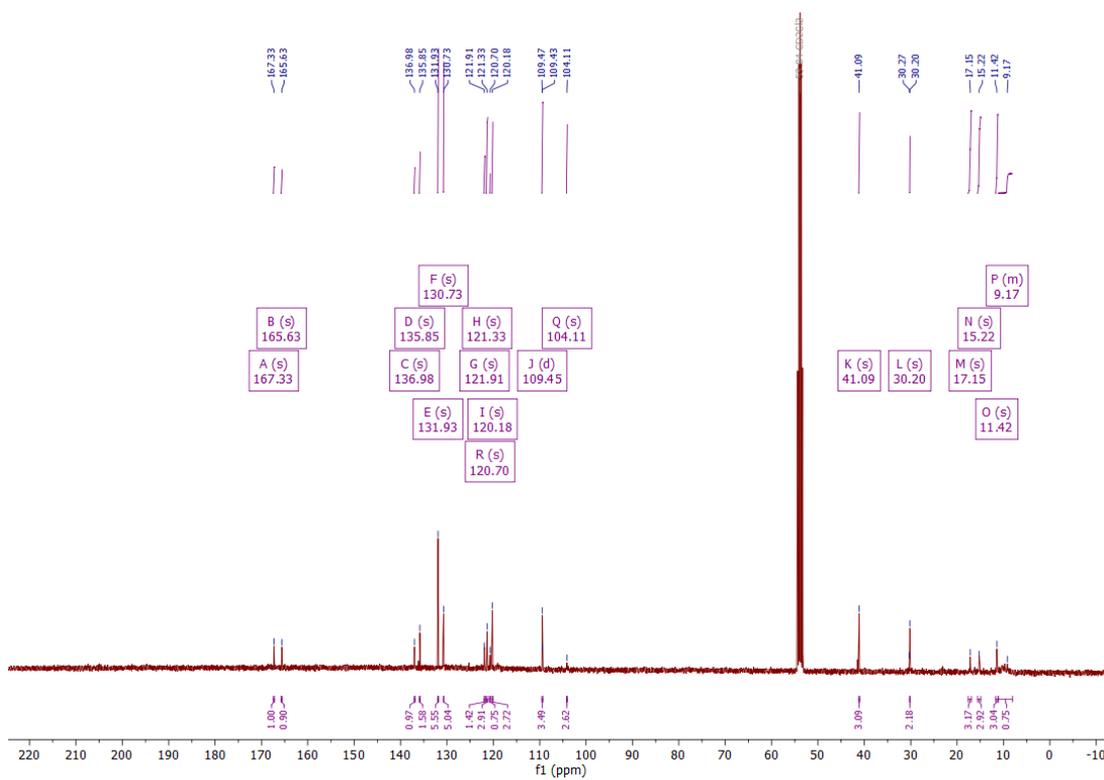
Figure S47. ^{13}C NMR spectrum of the inactive form of **1f** in CD_2Cl_2
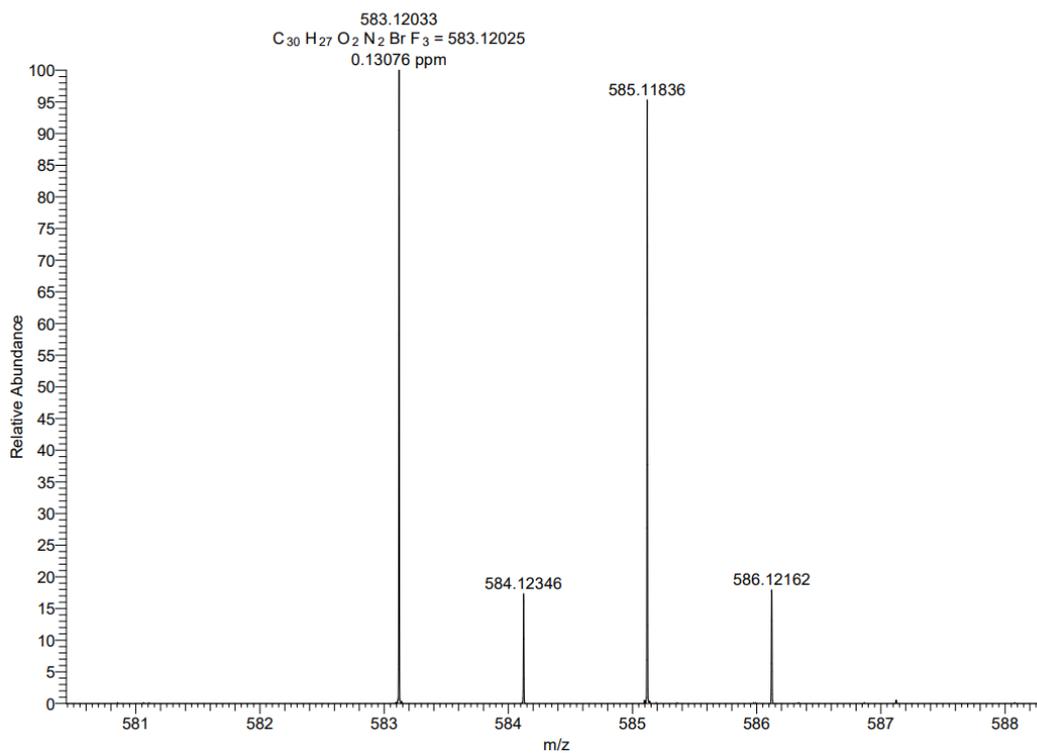
Figure S48. HRMS ESI$^+$ spectrum of compound **1f**

Fulgimide 1g

Inactive Form:
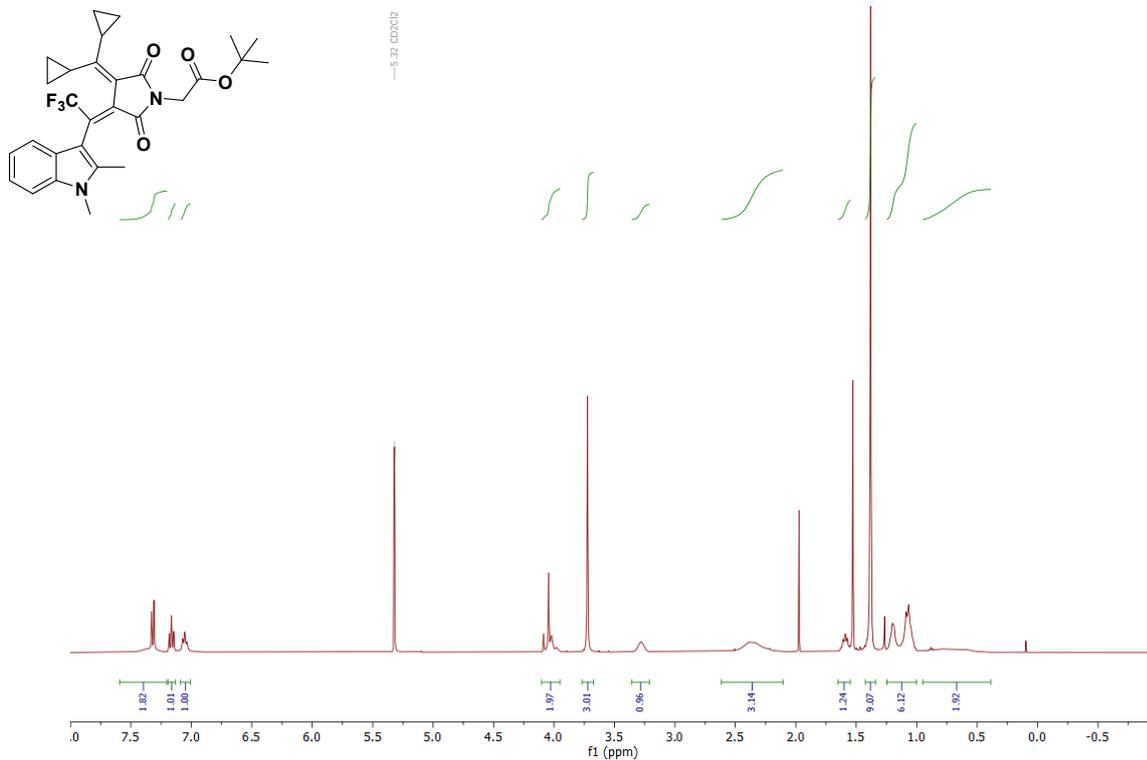
Figure S49. ^{1}H NMR spectrum of the inactive form of compound **1g** in CD$_2$Cl$_2$
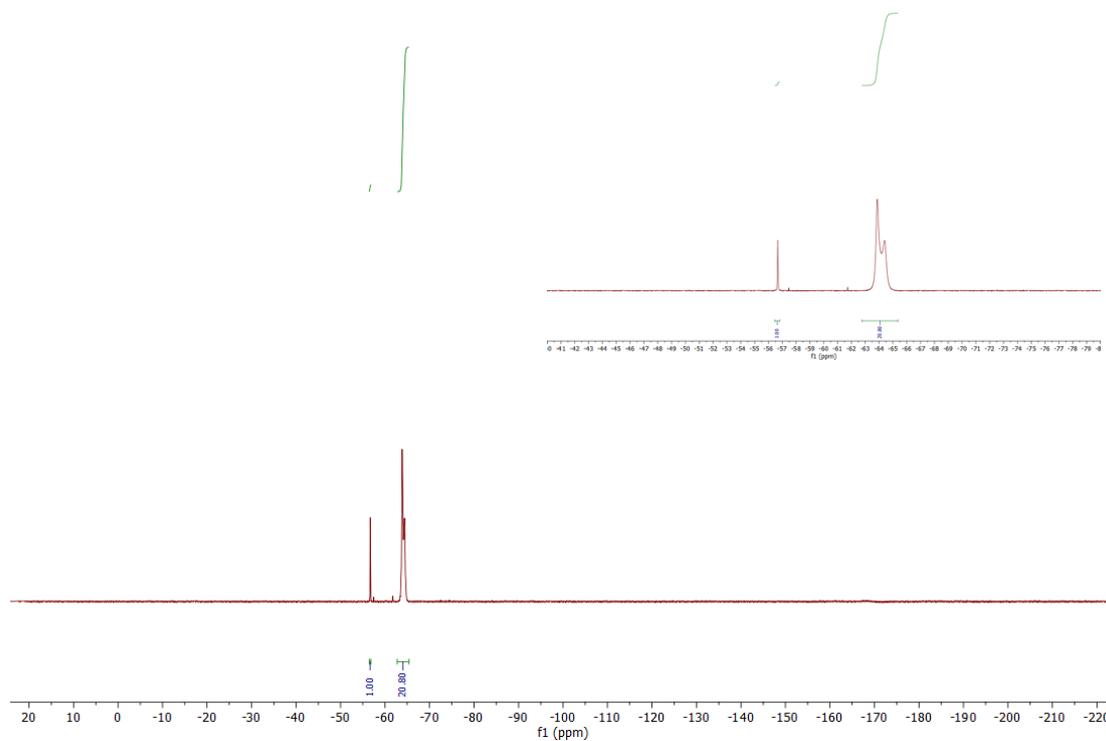
Figure S50. ^{19}F NMR spectrum of the inactive form (with traces of active form) of compound **1g** in CD$_2$Cl$_2$ with a zoomed-in inset
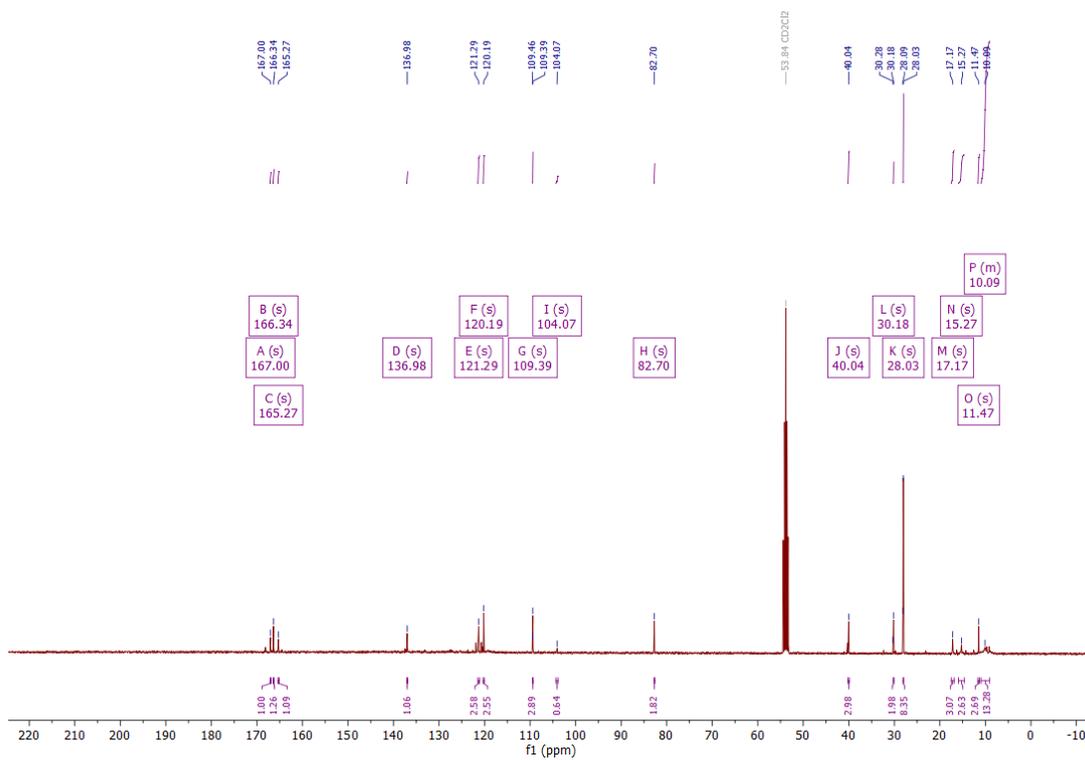
Figure S51. ^{13}C NMR spectrum of the inactive form of **1g** in CD_2Cl_2

Active Form:
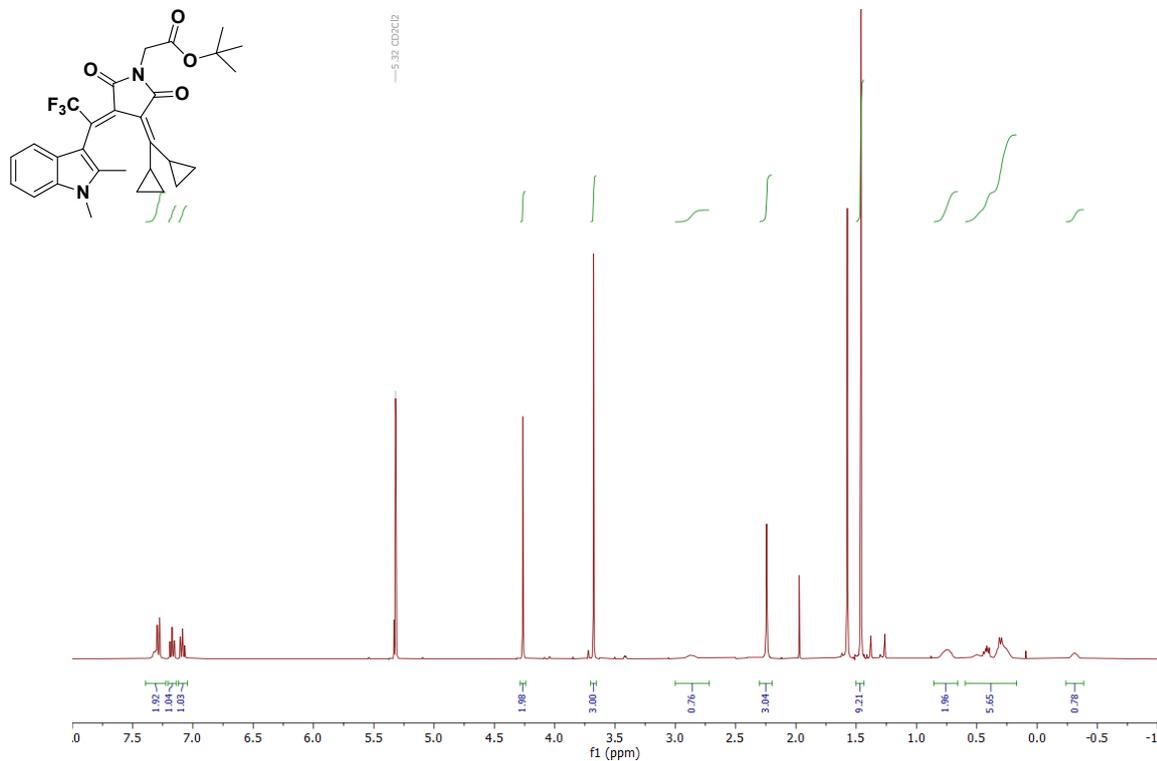
Figure S52. ^1H NMR spectrum of the active form of compound **1g** in CD_2Cl_2
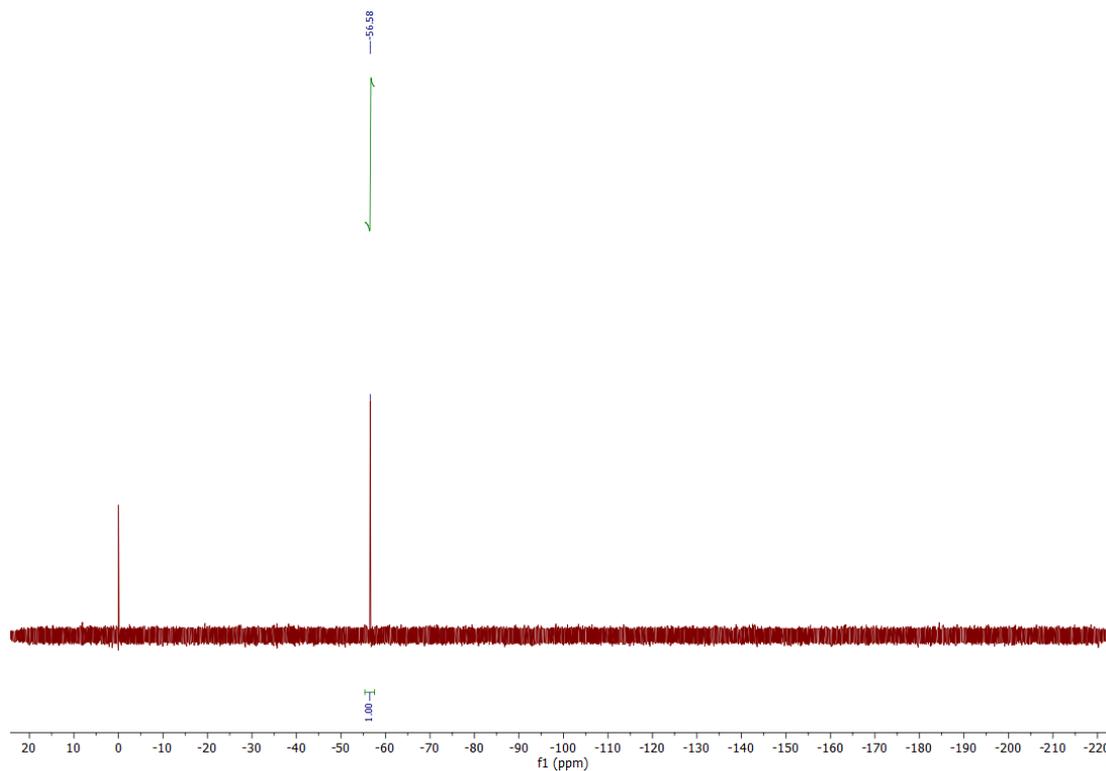
Figure S53. ^{19}F NMR spectrum of the active form of compound **1g** in CD$_2$Cl$_2$ with a zoomed-in inset
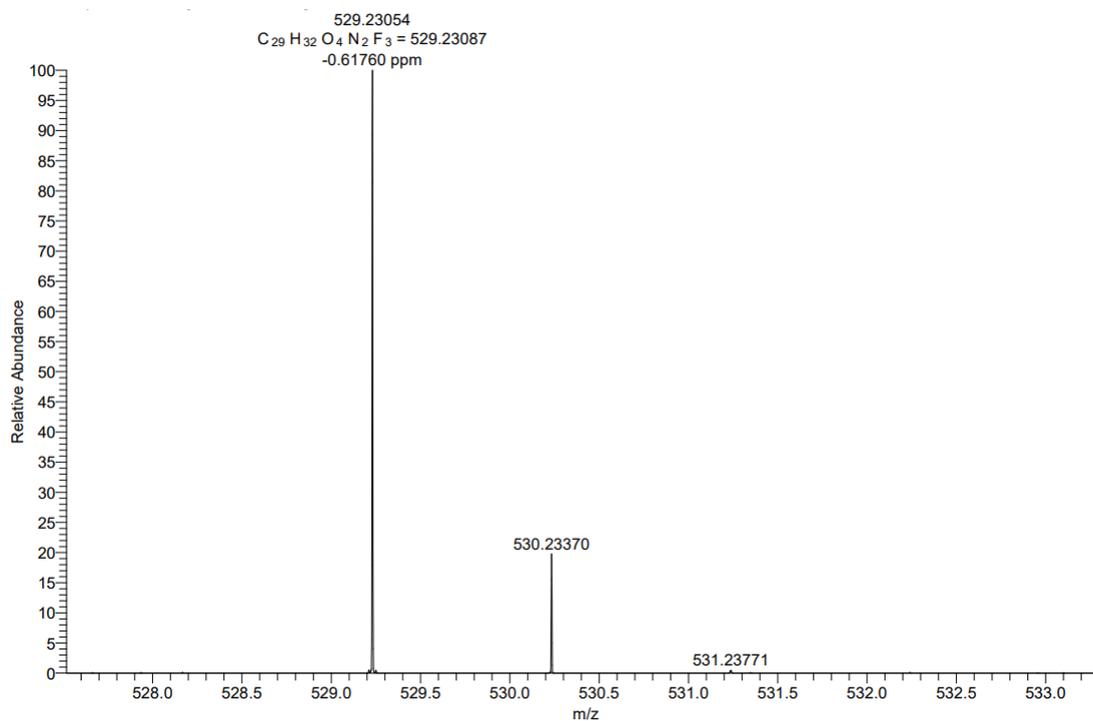
Figure S54. HRMS ESI$^+$ spectrum of compound **1g**

Fulgimide 1h

Inactive Form:
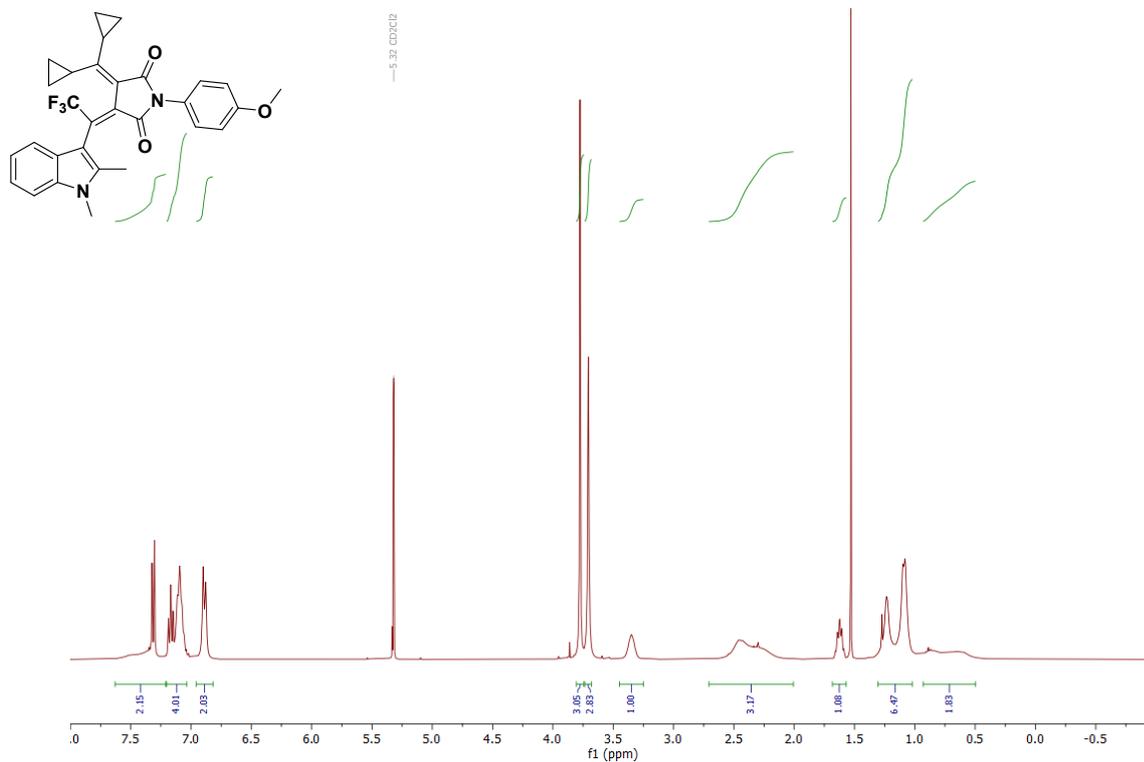
Figure S55. ^{1}H NMR spectrum of the inactive form of compound **1h** in CD$_2$Cl$_2$
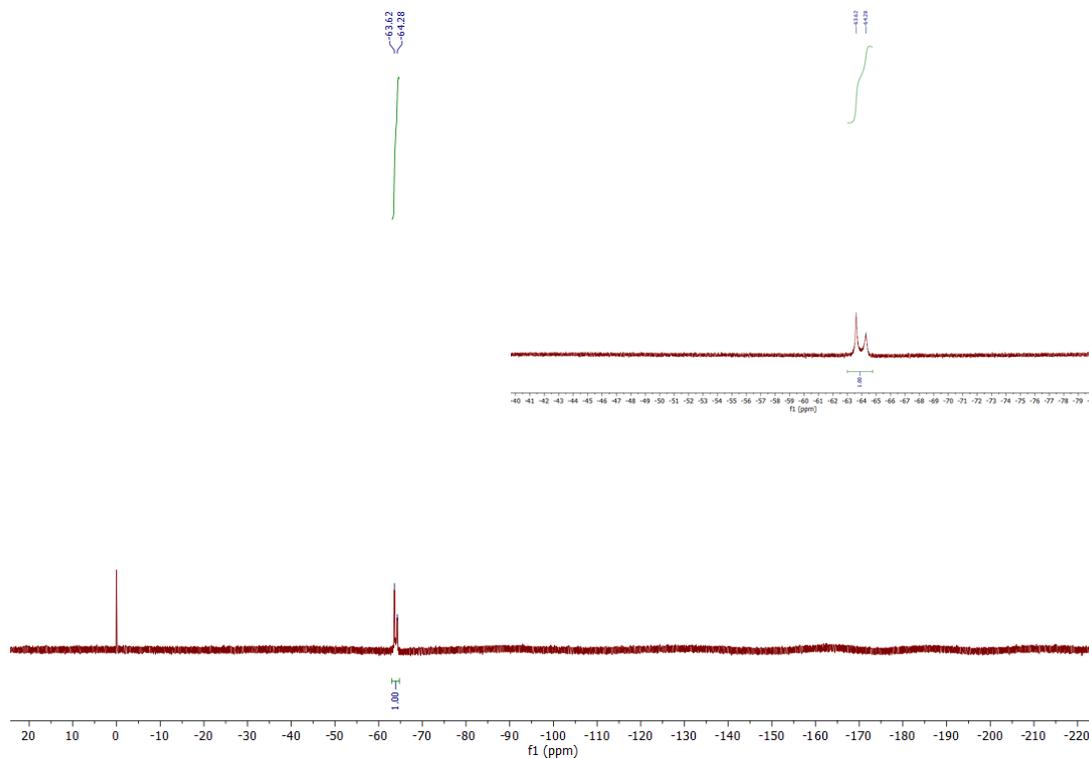
Figure S56. ^{19}F NMR spectrum of the inactive form of compound **1h** in CD$_2$Cl$_2$ with a zoomed-in inset
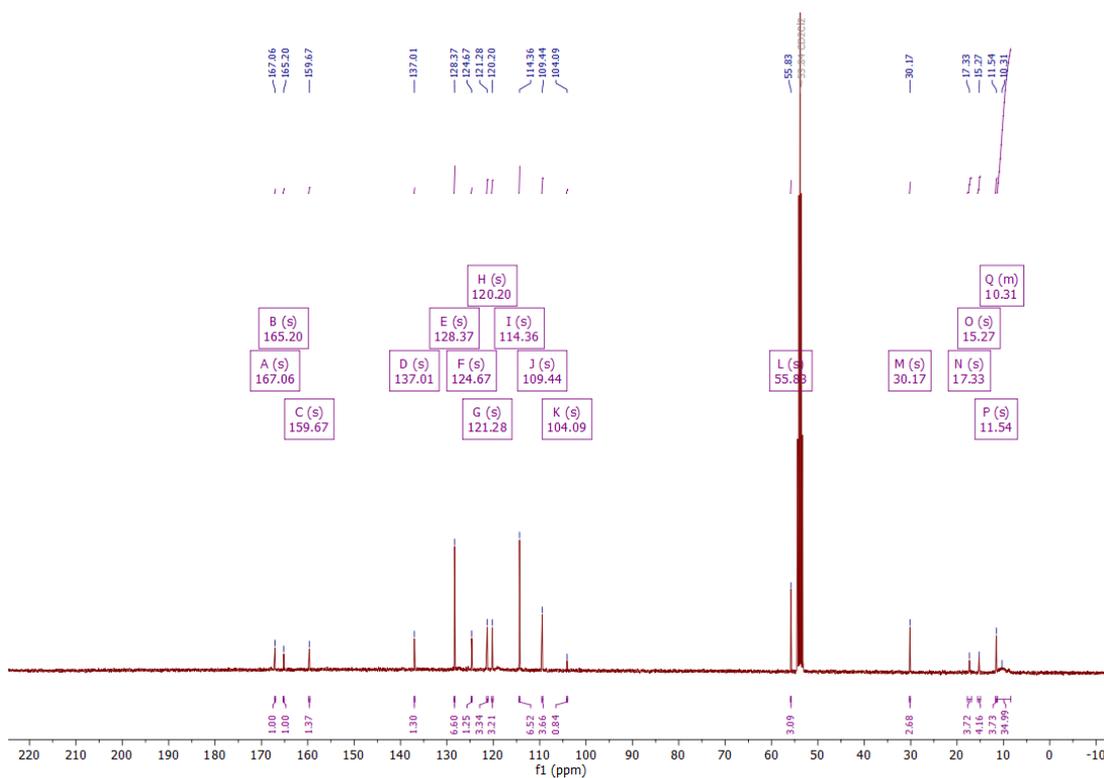
Figure S57. ^{13}C NMR spectrum of the inactive form of **1h** in CD$_2$Cl$_2$
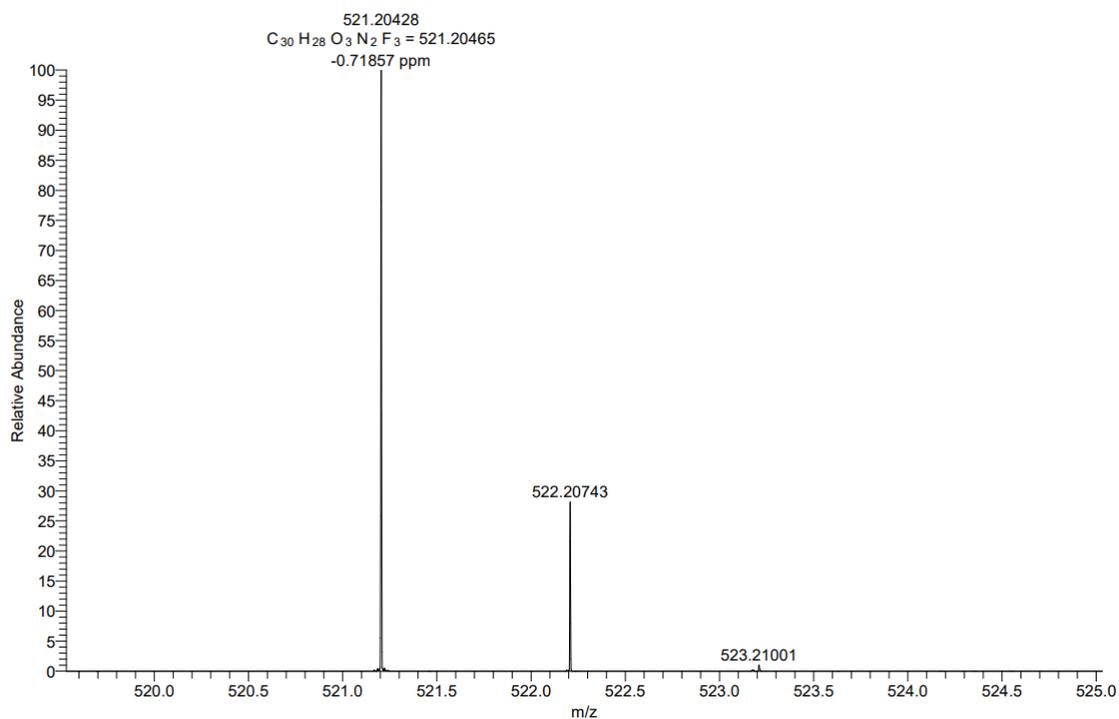
Figure S58. HRMS ESI$^+$ spectrum of compound **1h**

Product of copper-mediated click reaction of 1d and benzyl azide S3

Inactive Form (in a 85:15 ratio with the active form):
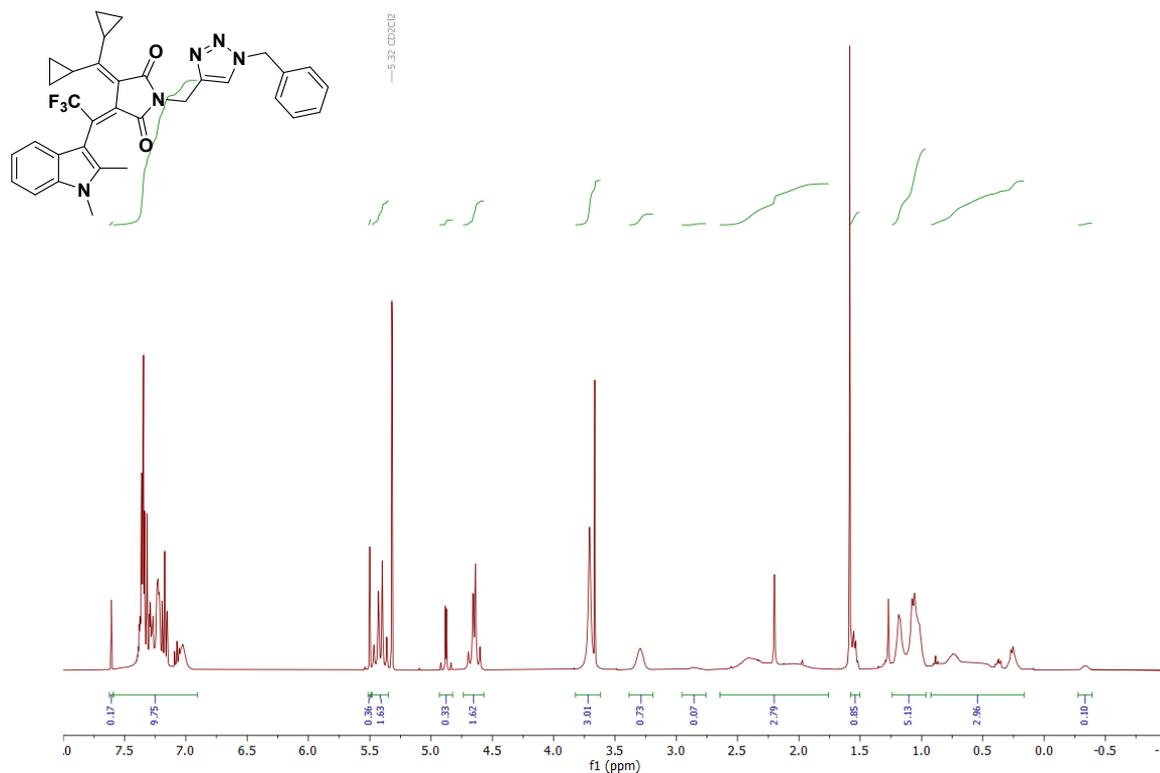
Figure S59. ^{1}H NMR spectrum of a mixture of the inactive and active forms in a 85:15 ratio of compound **S3** in CD$_2$Cl$_2$
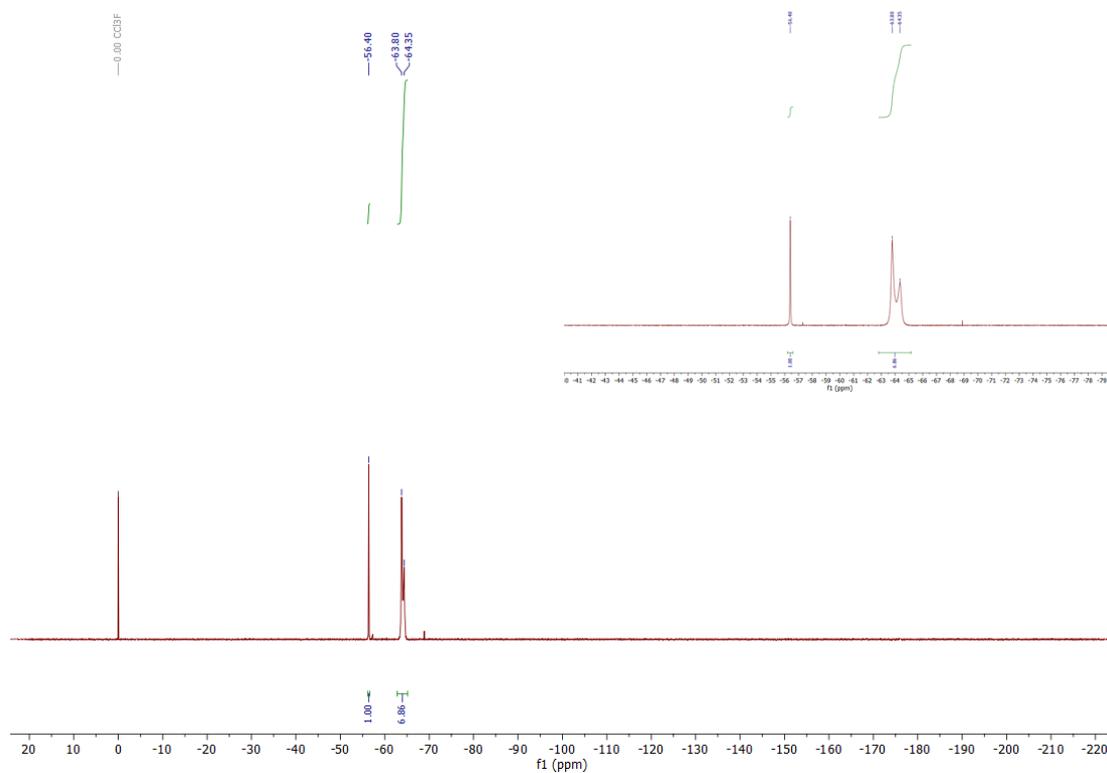
Figure S60. ^{19}F NMR spectrum of a mixture of the inactive and active forms in a 85:15 ratio of compound **S3** in CD$_2$Cl$_2$ with a zoomed-in inset
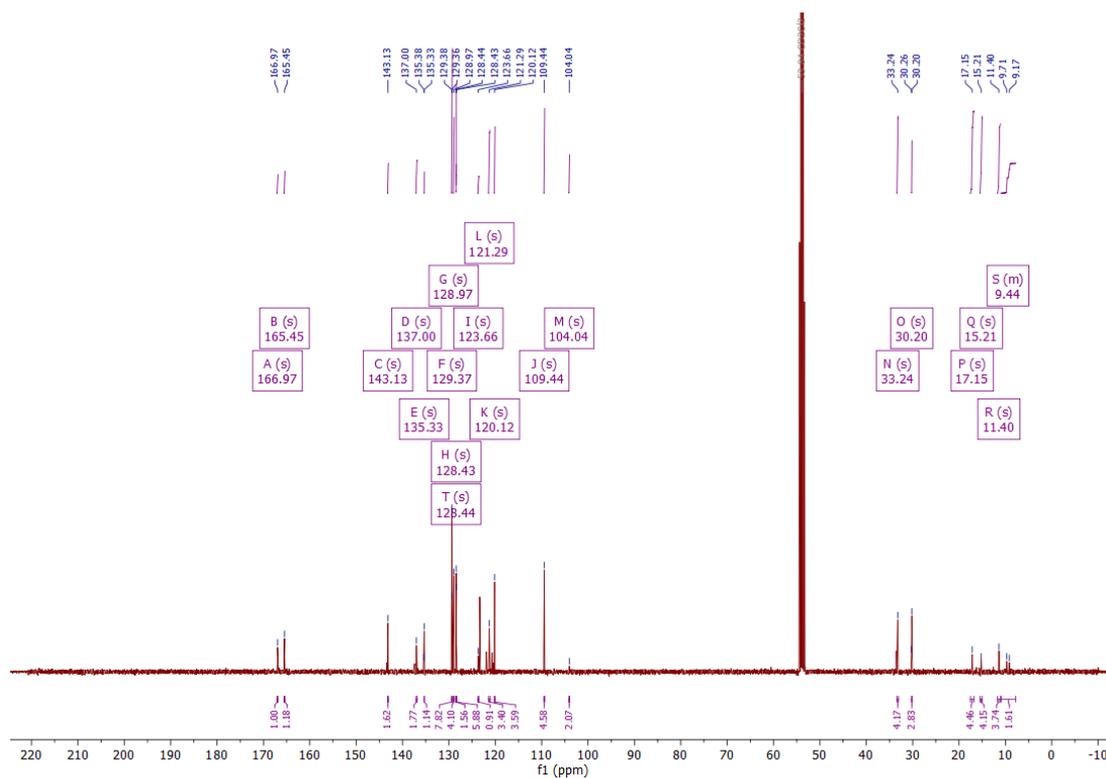
Figure S61. ^{13}C NMR spectrum of the inactive form of **S3** in CD_2Cl_2
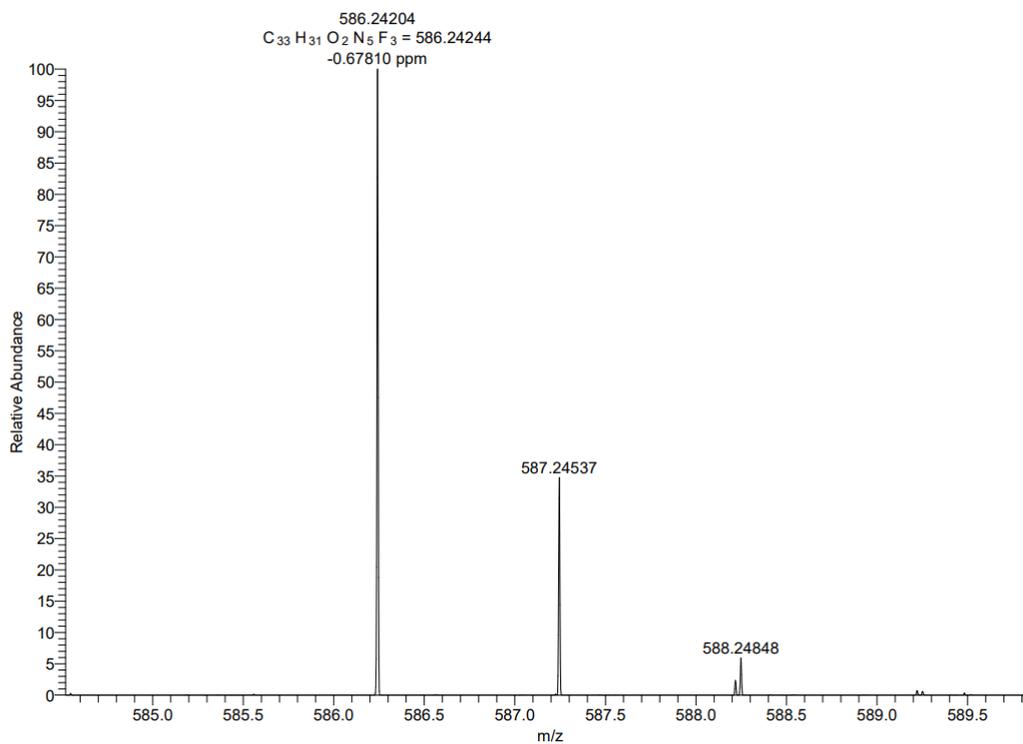
Figure S62. HRMS ESI$^+$ spectrum of compound **S3**

Methyl (2R,3S)-4-(dicyclopropylmethylene)-2-(1,2-dimethyl-1H-indol-3-yl)-5-oxo-2-(trifluoromethyl)tetrahydrofuran-3-carboxylate[3] 2
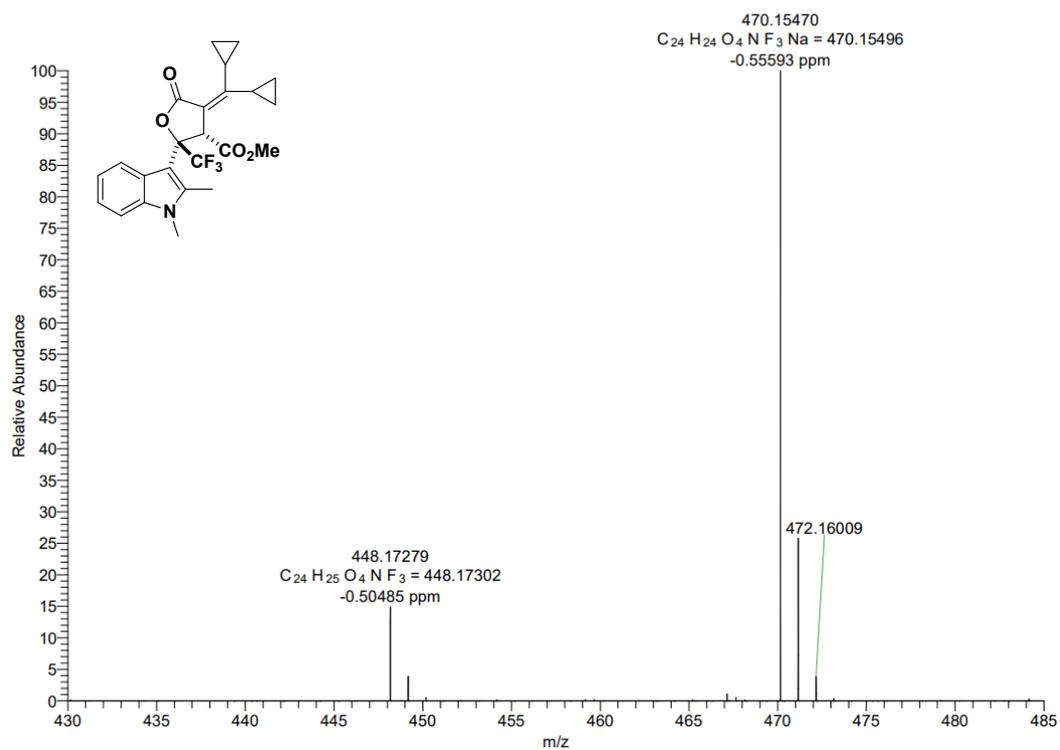
Figure S63. HRMS ESI⁺ spectrum of compound **2**

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