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Supporting Information

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Supporting Information

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1 General methods

All reactions were carried out under a positive pressure of nitrogen (5 cm of mercury, or with a spring-loaded silicon oil bubbler set to 100 mbar) and dry solvents. If not otherwise stated, reagents were purchased at the highest commercial quality, the solvents were purchased with Across seal and they were used without further purifications. The starting materials, whenever necessary, were synthesized according to the literature procedures. 1,2,3,5-Tetrakis(carbazol-9-yl)-4,6-dicyanobenzene (4CzIPN) was synthesized according to a reported protocol[1]. Other photocatalysts (in this case, perylene) were commercially available and used without further purification.

Reactions were monitored by thin layer chromatography (TLC) on Macherey-Nagel pre-coated silica gel plates (0.25 mm) and visualized by UV light. Flash chromatography was performed both on Standard flash column chromatography on Merck silica gel (60, particle size: 0.040–0.063 mm) both on *a Biotage® Isolera™ Spektra* system automated with a high-performance flash purification system using silica gel 60 M (particle size 40–63 µm, 230–440 mesh, Merck) using petroleum ether (PE), ethyl acetate (EtOAc), dichloromethane (DCM), methanol (MeOH) as standard solvents.

^{1}H NMR ^{13}C NMR and ^{19}F NMR spectra were recorded on Bruker Avance spectrometers (300 MHz, 75 MHz, 282 MHz, 121 MHz) or (400 MHz, 101 MHz, 376 MHz, 162 MHz) in $CDCl_3$, DMSO-*d6*, and MeOH-*d4* solutions with internal solvent signals (for ^{1}H and ^{13}C) as reference (7.26, 77.2 for $CDCl_3$, 2.50 and 39.5 for DMSO-*d6*, and 3.31, 49.0 for MeOH-*d4*). ^{1}H NMR data are reported as follows: chemical shift (ppm), multiplicity (s = singlet, br. s. = broad singlet, d = doublet, t = triplet, q = quartet, quint = quintet, sext = sextet, hept = heptet, dd = doublet of doublets, ddd = doublet of doublets of doublets, td = triplet of doublets, qd = quartet of doublets, m = multiplet), coupling constants (Hz), and numbers of protons. ^{19}F data are reported as follows: chemical shift (ppm), multiplicity (wherever applicable, s = singlet, d = doublet, t = triplet, q = quartet), coupling constants (Hz), and numbers of fluorine atoms (wherever applicable). Data for ^{13}C NMR are reported in terms of chemical shift, multiplicity (wherever applicable, s = singlet, d = doublet, t = triplet, q = quartet), coupling constants (Hz), and no special nomenclature is used for equivalent carbons.

High-resolution mass spectra (HRMS) were obtained from the central analytic mass spectrometry facilities of the Faculty of Chemistry and Pharmacy, Regensburg University, or were acquired using a Bruker solariX XR Fourier transform ion cyclotron resonance mass spectrometer (Bruker Daltonik GmbH, Bremen, Germany) equipped with a 7 T refrigerated actively shielded superconducting magnet. The samples were ionized in positive ion mode using a MALDI or ESI ionization sources. Chiral HPLC was measured on an Agilent 1100 or 1200 Serie and they are reported according to the IUPAC recommendations 2013.

Gas chromatography-mass spectrometry (GC-MS) was performed on GC Agilent 6890N, inlet: EPC splitsplitless; column: Agilent 19091S-433 HP-5MS 5% phenyl methyl siloxane; MS: quadrupole G2589A EI; Autosampler: Agilent 7683; gas carrier: helium. Gas chromatography (GC) analysis were performed using a capillary column (length: 30 m; diam.: 0.25 mm; film: 0.25 µM) using H_2 gas as a carrier. GC was equipped with an FID detector.

3D-printed photoreactors were 3D-printed with Formlabs “FORM 3” 3D-printer, using Clear V4 or Draft V2 resins.

A Fusion 100-X syringe pump, bought from CHEMYX, has been used to feed reagents.

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[1] Zeitler and co-workers, *J. Am. Chem. Soc*. 2018, **140**, 15353-15365

UV–Vis measurements were performed with a Cary 4000 spectrometer. Electrochemical studies (in this case, cyclic voltammetry) were carried out under an argon atmosphere. The measurements were performed in respective solvents (DMA) containing 0.1 M tetra-*n*-butylammonium tetrafluoroborate using ferrocene/ferrocenium (Fc/Fc^+) as an internal reference. A glassy carbon electrode (working electrode), platinum wire counter electrode, and Ag quasi-reference electrode were employed.

Quantum yield measurements: The quantum yield was measured with a custom-made quantum yield determination setup (for additional details see ref.[2]): translation stages (horizontal and vertical): Thorlabs DT 25/M or DT S25/M; photographic lens with f = 50 mm; magnetic stirrer: Faulhaber motor (1524B024S R) with 14:1 gear (15A); PS19Q power sensor from Coherent; PowerMax software; adjustable power supply "Basetech BT-153 0–15 V/DC 0–3 A 45 W".

[2]U. Megerle, R. Lechner, B. Konig, and E. Riedle *Photochem. Photobiol. Sci*., 2010, **9**, 1400-1406.

2 Description of the Photoredox equipment

The addition reactions were performed with two different reaction set-ups in batch and three different set-ups in flow.

2.1 Plate photoreactor

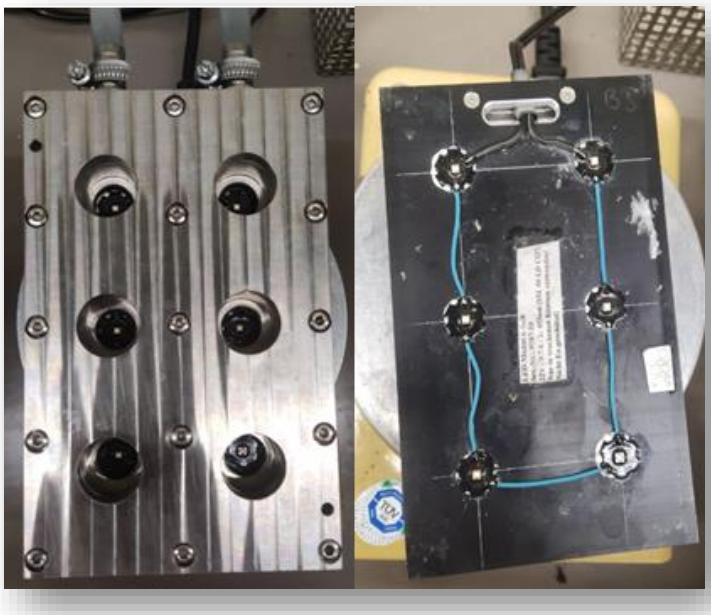


Figure S1 *Photograph of the plate reactor*

The reaction vials for 0.2 – 0.1 mmol scale reactions (5/10/20 mL crimp cap vials) were illuminated from the bottom side with LEDs (in this case with blue LEDs: λ = 455 (± 15) nm, 500 mW – 1.4 W, OSRAM Oslon SSL 80 LDCQ7P-1U3U or Green LEDs: λ = 528 nm, 167 mW, OSRAM Oslon SSL 80 LT-1966) and the temperatures were maintained either at 25/60 °C unless noted otherwise from the side using custom-made aluminum cooling blocks connected to a thermostat.

2.2 Cyclinder photoreactor

Figure S2 *Photograph of the plate reactor*

3D-printed, double jacketed cylindrical reaction vessel (11 cm h x 6.5 cm internal diameter). A 100 cm long strip of blue LEDs (540 mW/cm^2, 24 V) has been sticked on the internal wall of the vessel and the vial of the reaction is placed at the centre of the vessel, 3 cm far from the LEDs. In the

external jacket, water flows to cool down the reaction vessel, it is also possible to use compressed air to further cool the reaction vial.
Led-Specifications: Ledpoint **Blu** LED 2835 120 led/m 24 V with a self-adhesive tape that holds the strip light safely and securely to the photoreactor support. The LEDs wavelength emission profile together with their specific light intensity (expressed as mW/cm^2) have been determined using a compact CCD spectrometer (model CCS200/M) connected to a multimode optical fiber, purchased by Thorlabs. Blu LEDs employed are characterized by an almost monochromatic emission profile showing a maximum of intensity located at ca. 460 nm. The light power intensity was thus checked using a Thorlabs PM200 power meter equipped with a S130VC power head with a Si detector. The measured light intensities, though slightly decreasing by moving the maximum of LEDs emission towards longer wavelengths, resulted to be I = 540.2 mW/cm^2.

2.3 Sublimator photoreactor

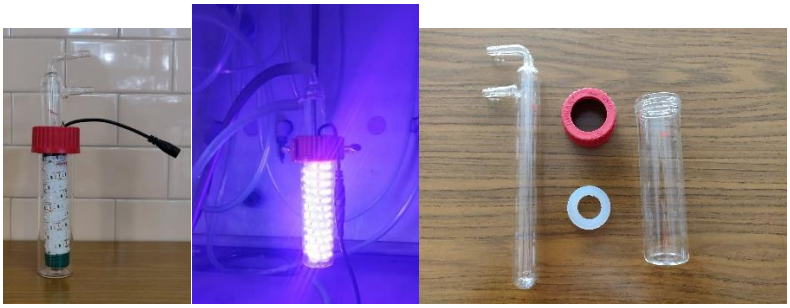


Figure S3 *Photograph of the water-cooled LED photoreactor.*

Construction of the Photoreactor: A making-off video related to the construction of the photoreactor starting from a sublimator apparatus was already reported in literature.[3] The central sublimator glass-piece is first wrapped to the desired length with heavy duty aluminium foil to generate a socket for the LED-strip that possesses high heat conductive properties. Around this first layer is then coiled and glued (double sided adhesive tape) the LED-strip which is further secured in place at the top and bottom with electric isolating tape. The cable is guided through the silicon rubber seal by puncturing it. The final reactor is then assembled as presented in Figure S3.
Led-Specifications: Ledpoint **Blu** LED 2835 120 led/m 24 V with a self-adhesive tape that holds the strip light safely and securely to the photoreactor support. The LEDs wavelength emission profile together with their specific light intensity (expressed as mW/cm^2) have been determined using a compact CCD spectrometer (model CCS200/M) connected to a multimode optical fiber, purchased by Thorlabs. Blu LEDs employed are characterized by an almost monochromatic emission profile showing a maximum of intensity located at ca. 460 nm. The light power intensity was thus checked using a Thorlabs PM200 power meter equipped with a S130VC power head with a Si detector. The measured light intensities, though slightly decreasing by moving the maximum of LEDs emission towards longer wavelengths, resulted to be I = 540.2 mW/cm^2.

[3]F. Herbrik, M. Sanz, A. Puglisi, S. Rossi and M Benaglia, *Chemistry*, 2022, **28**, e202200164.

2.4 Sublimator photoreactor for continuous flow operations PR-1

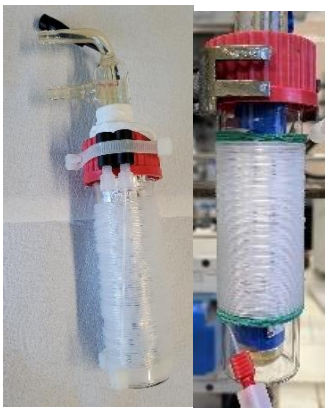


Figure S4 *Photograph of the water-cooled high intensity LED photoreactor for continuous flow operations.*

A versatile LED-based photoreactor for continuous flow reactions was reported for the first time by our group.[3] The goal was to build a photoreactor using only readily available and low-cost equipment that can be found in any organic chemistry laboratory. The photoreactor showed in *Figure S3* can be immersed in any cryo-bath for temperature regulation since the LEDs are *hermetically sealed* inside a Pyrex glass tube to avoid glacier formation, which can obstruct efficient irradiation. The heat generation which tends to burn high power LEDs under sealed conditions is counteracted by wrapping the LED-Strips around a central sublimator glass-piece which is water cooled. With this innovative reactor design, it is possible to run a continuous flow photoreaction at any temperature by simply immersing the photoreactor and coil reactor couple in a temperature-controlled liquid (Ice-mixtures, dry-ice mixtures, cryostat-baths, oil-baths). The here presented Reactor performed for over 300 h and is still fully operational.

2.5 Kessil setup for continuous flow operations PR-2

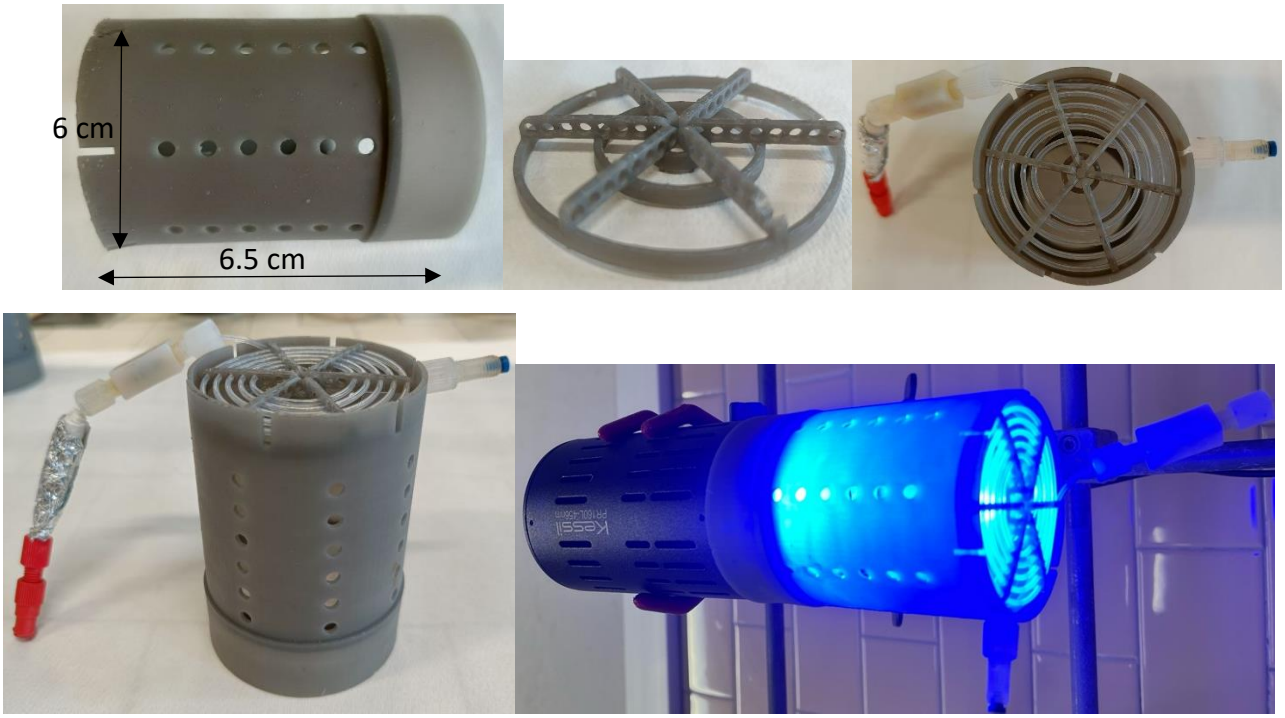


Figure S5 *Photograph of the Kessil setup for continuous flow operations PR-2.*

The photoflow reactor **PR-2** can be 3D printed thanks to .stl file attached. For our setup, we used grey Pro resin from formlabs.

2.6 Sublimator photoreactor for continuous flow operations PR-3

In this photoreactor, the sublimator photoreactor is inserted inside a cylindric 3D printed photoreactor providing a two-sided irradiation of the coil, which is wrapped around the sublimator unit. To further cool the coil reactor, an air vent is placed at the bottom of the continuous flow apparatus (*Figure 4*).

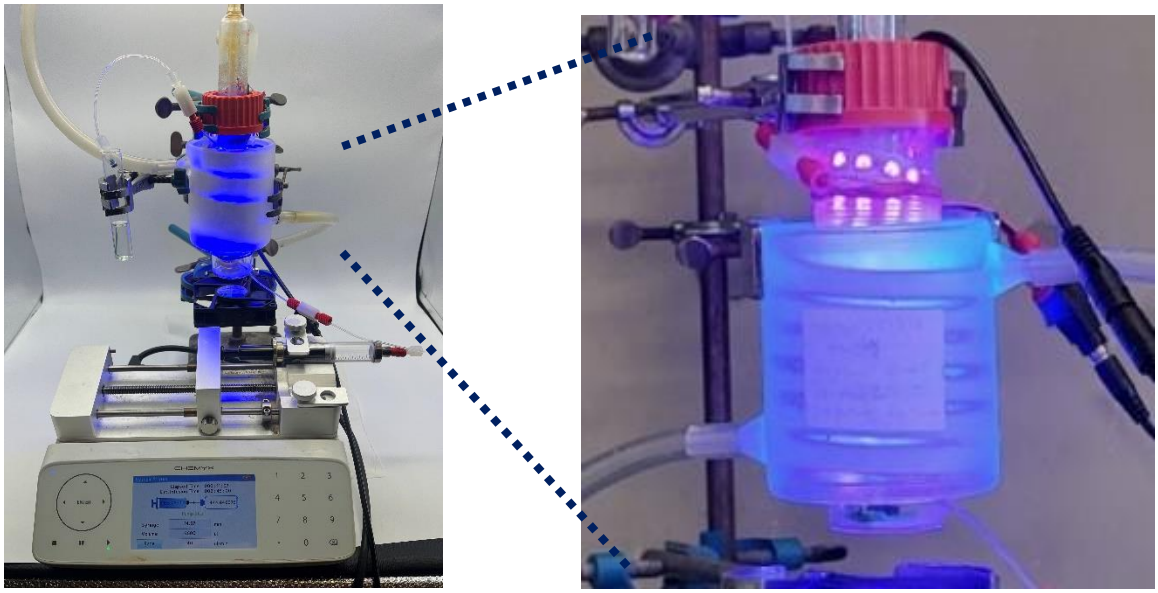


Figure S6. *Photograph of the double photoreactor, composed by the Sublimator reactor inserted inside the cylindrical photoreactor.*

2.7 Continuous Flow Reactor Specification

COIL: All fluidic connections were made by ¼-28-bore finger tight ferules and adapters (connectors, Y- and T-shape) and were purchased by Cole-Parmer seller.

To perform the in-flow investigations, three different coil reactors have been used, described in *Table S1*:

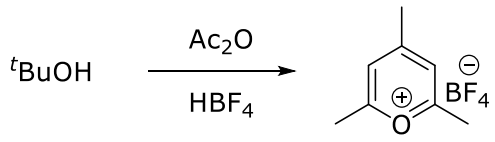
Coil reactor name	Material of construction	Reactor Volume (µL)	Internal diameter (in)	Reactor Length (cm)
CR-1	HPFA	50	0.02	25
CR-2	PFA	50	0.01	100
CR-3	PFA	1357	0.02	670

Table S1 *Specifications for the reactors used in the work. All three coil reactors are made from standard HPLC-Tubing. HPFA = High Purity Fluoropolymer, PFA = Perfluoroalkoxyalkane.*

3 Synthesis and Characterization of the Substrates

3.1 Synthesis of the pyrilium ions

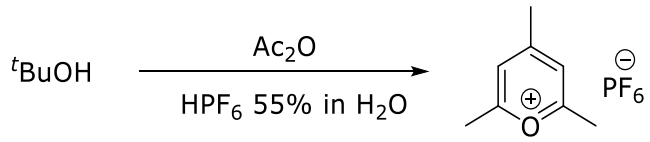
2,4,6-trimethylpyrylium tetrafluoroborate



36 %

A 250 ml two-necked flask was charged with acetic anhydride (591 mmol, 13 eq) and *tert*-butanol (47 mmol, 1 eq), providing a colorless solution. HBF_4 (44 mmol, 0.95 eq) was introduced dropwise with a dropping funnel: the addition was exothermic, the solution turned yellow at first, and then reddish. After completion of the addition, the reaction mixture has been cooled by dipping the flask in an ice bath: the formation of a white precipitate has been observed. The reaction was quenched by the addition of 10 ml of cold Et_2O. The white precipitate has been recovered by filtration under vacuum, washed with cold Et_2O and dried. The desired product was recovered as a white solid in 36 % yield. All the analytical data are in agreement with the literature. [1]
^{1}H NMR (300 MHz, MeOD) δ 7.88 (s, 2H), 2.88 (s, 8H). **^{19}F NMR** (282 MHz, MeOD) δ -154.88.

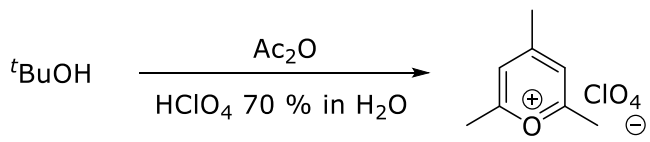
2,4,6-trimethylpyrylium hexafluorophosphates



30 %

Into a 100 ml round bottom 1 neck flask, the acetic anhydride (25 ml, 264 mmol, 8.4 eq) and the ^{t}BuOH (3 ml, 31.1 mmol, 1 eq) were introduced. The addition of the HPF_6 (5 ml, 31.1 mmol, 1 eq) must be done slowly in order to keep the reaction temperature under 90 °C, controlled with a thermometer. After the addition, the reaction mixture was slowly cooled down to room temperature and the precipitate was filtered on a Buckner and washed with Et_2O. The desired product was obtained in 30 % yield (2.5 g) as a light brown solid.
^{1}H NMR (400 MHz, DMSO) δ 7.80 (s, 2H), 2.66 (s, 6H), 2.34 (s, 3H) ppm. **^{19}F NMR** (377 MHz, DMSO) δ -68.76, -70.64 ppm. **^{13}C NMR** (101 MHz, DMSO) δ 177.81, 123.32, 27.37, 23.37, 21.34 ppm. **HRMS (ESI +)** $C_8H_{11}O$: 123.0805 (Calc. Mass 123.0804), **HRMS (ESI -)** PF_6: 144.9649 (Calc. Mass 144.9647).

2,4,6-trimethylpyrylium perchlorate

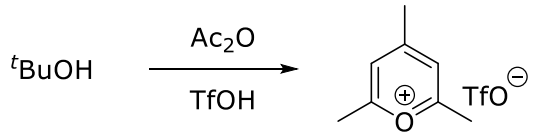


17 %

Into a 100 ml round bottom 3 neck flask, the acetic anhydride (15 ml, 156 mmol, 5 eq) and the ^{t}BuOH (3 ml, 31.1 mmol, 1 eq) were introduced. The reaction mixture was cooled to 0 °C and the addition of the $HClO_4$ (2.7 ml, 31.1 mmol, 1 eq) must be done slowly in order to keep the reaction

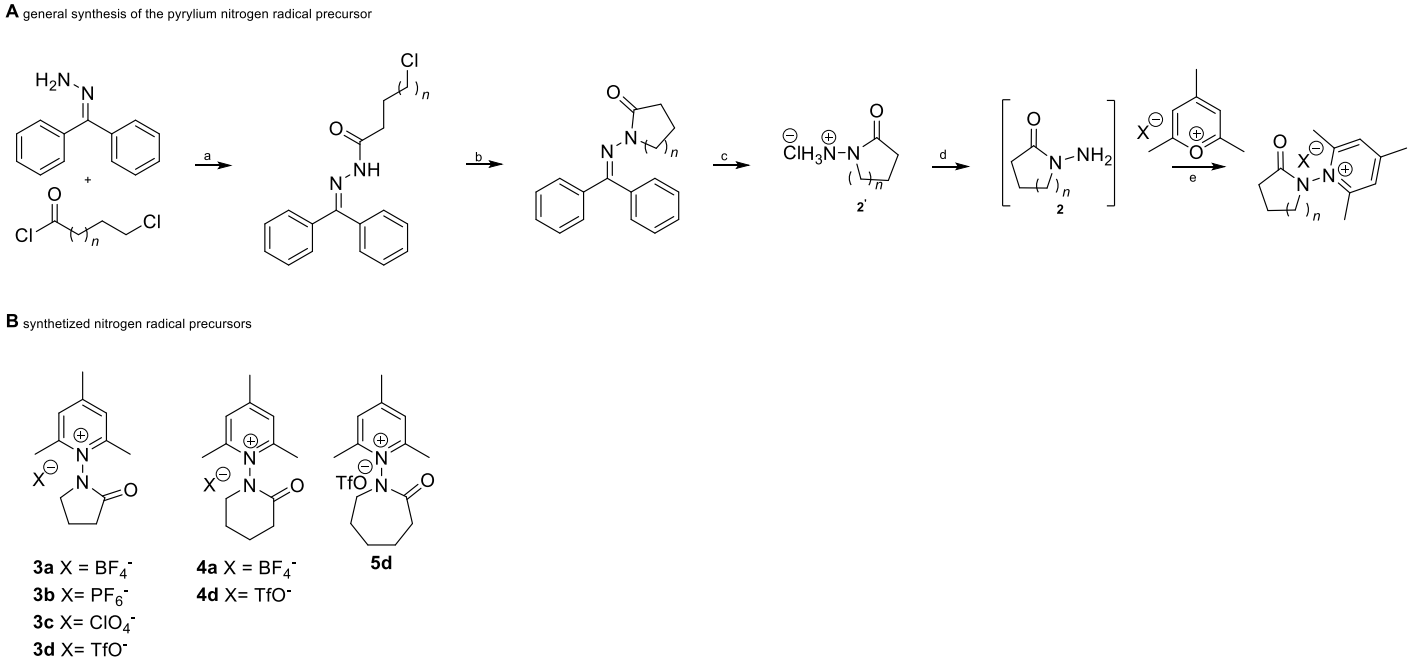
temperature under 100°C, controlled with a thermometer. After the addition, the reaction mixture was slowly cooled down to 0 °C and the precipitate was filtered on a Buckner and washed with AcOH and Et_2O. The desired product was obtained in 17 % yield (1.2 g) as a yellow solid.
^{1}H NMR (400 MHz, DMSO) δ 7.75 (s, 2H), 2.67 (s, 6H), 2.37 (s, 3H) ppm. **^{13}C NMR** (101 MHz, DMSO) δ 177.79, 174.03, 123.25, 23.34, 21.28 ppm. **HRMS (ESI +)** $C_8H_{11}O$: 123.0805 (Calc. Mass 123.0804), **HRMS (ESI -)** ClO_4: 98.9492 (Calc. Mass 98.9491).

2,4,6-trimethylpyrylium triflate



Into a 100 ml round bottom 2 neck flask, the acetic anhydride (15 ml, 156 mmol, 5 eq) and the ^{t}BuOH (3 ml, 31.1 mmol, 1 eq) were introduced. The addition of the TfOH (2.8 ml, 31.1 mmol, 1 eq) was performed with a drip funnel under vigorous stirring controlling with a thermometer that the reaction temperature must be under 90 °C. After the addition, the reaction mixture was slowly cooled down to room temperature, then to 0°C with an ice bath. Et_2O was added and the precipitate was filtered on a Buckner. The desired product was obtained in 34 % yield (2.9 g) as a brown solid.
^{1}H NMR (400 MHz, DMSO) δ 7.81 (s, 2H), 2.66 (s, 6H), 2.34 (s, 3H) ppm. **^{19}F NMR** (377 MHz, DMSO) δ -77.33 ppm. **^{13}C NMR** (101 MHz, DMSO) δ 177.81, 173.98, 123.33, 122.73, 119.53, 23.36, 21.35 ppm. **HRMS (ESI +)** $C_8H_{11}O$: 123.0805 (Calc. Mass 123.0804), **HRMS (ESI -)** CF_3O_3S: 148.9529 (Calc. Mass 148.9526).

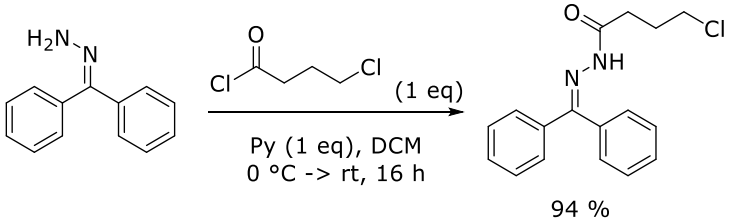
General Procedure for the Synthesis of pyridinium ions 3a-d, 4a, 4d and 5d



Scheme S1 *A) General synthesis of the pyridinium ion precursors; a) Py, CH_2Cl_2, rt, 16 h, b) NaH, THF or DMF, 0 °C -> rt, 16 h, c) HCl aq, THF, rt, 16 h, d) $NaHCO_3$, IPA, rt, 15 min, e) EtOH, rt, 16 h. B) Synthetized nitrogen radical precursors.*

3.2 Synthesis of pyridinium ions 3a-d

4-chloro-*N*'-(diphenylmethylene)butanehydrazide

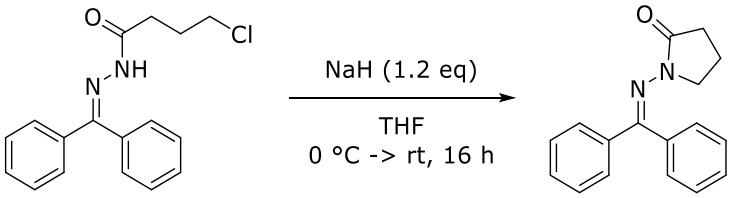


94 %

Into a Schlenk 250 ml flask, the (diphenylmethylene)hydrazine (10 g, 51 mmol, 1eq) was introduced then tree nitrogen-vacuum cycles were done. Dry CH_2Cl_2 (82 ml, 0.62 M) was added, and the reaction mixture was cool down to 0 °C. Pyridine previously distilled (4.1 ml, 51 mmol, 1eq) and the 4-chlorobutanoyl chloride (5.7 ml, 51 mmol, 1 eq) were added through syringes. The reaction mixture was stirred overnight with the ice bath slowly warming up. 30 ml of a saturated solution of K_2CO_3 was added and the two phases were separated. The water phase was extracted with CH_2Cl_2 (2 X 40 ml), the combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a white solid in 89 % yield (13.6 g). All the analytical data are in agreement with the literature. [2]

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (s, 1H), 7.56-7.52 (m, 5H), 7.38-7.33 (m, 3H), 7.25-7.23 (m, 2H), 3.72 (t, *J* = 6.4 Hz, 2H), 3.06 (t, *J* = 7.2 Hz, 2H), 2.25 (p, *J* = 6.8 Hz, 2H).

1-((diphenylmethylene)amino)pyrrolidin-2-one

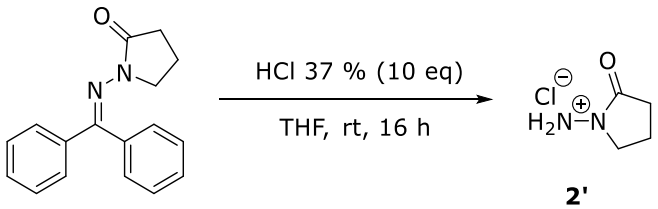


87 %

Into a Schlenk 250 ml flask, 2.1 g of NaH 60% in mineral oil (54.2 mmol, 1.2 eq) were washed with 10 ml of pentane (3 times). Then, 110 ml of dry THF were added and the 4-chloro-*N*'-(diphenylmethylene)butanehydrazide was added portion wise. The reaction mixture was stirred overnight at room temperature. Then, 50 ml of a saturated solution of NH_4Cl were added and the reaction mixture was stirred for 30 minutes. The phases were separated, and the aqueous phase was extracted with AcOEt (2 x 50 ml). The combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a yellow solid in 87 % yield (9.6 g). All the analytical data are in agreement with the literature.[2]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61-7.59 (m, 2H), 7.44-7.41 (m, 4H), 7.35-7.30 (m, 4H), 3.32 (t, *J*= 7.0 Hz, 2H), 2.32 (t, *J*= 8.0 Hz, 2H), 1.92 (p, *J*= 7.5 Hz, 2H) ppm.

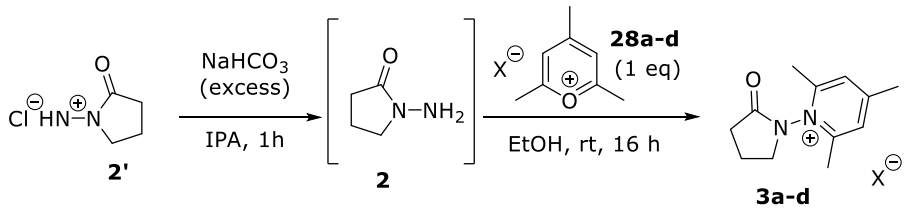
1-aminopyrrolidin-2-one chlorohydrate (2')



Into a 250 ml 1 neck flask, the 1-((diphenylmethylene)amino)pyrrolidin-2-one was dissolved in 61 ml of THF and then, 30 ml of HCl 37 % were added. The reaction mixture was stirred overnight at room temperature. Then, the THF was removed under reduced pressure. The aqueous phase was extracted with AcOEt (3 x 25 ml) and evaporated under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a white solid in 83 % yield (3.3 g). All the analytical data are in agreement with the literature.[2]

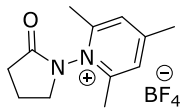
^{1}H NMR (400 MHz, MeOD) δ 3.65 (t, *J*= 6.91 Hz, 2H), 2.44 (t, *J*= 7.93 Hz, 2H), 2.20 (p, *J*= 7.41 Hz, 2H) ppm.

General procedure A: Synthesis of the pyridinium ions **3a-d**



1-aminopyrrolidin-2-one chlorohydrate **2'** (1 eq) was suspended in IPA and solid $NaHCO_3$ was added. The reaction mixture was stirred for 1 hours, and the salts were removed by filtration. The solution was evaporated under reduced pressure obtaining the desired hydrazine **2** as a yellow oil. According to a literature procedure,[1] the hydrazine **2** was dissolved into EtOH (0.3 M) and the pyrylium ion (1 eq) was added. The reaction mixture was stirred overnight at room temperature. Then, Et_2O were added the desired product was filtered on a bucker.

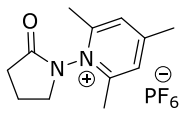
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium tetrafluoroborate (3a)



Prepared according to the general procedure A on 20 mmol scale. The desired product was obtained as a white solid in 84 % yield (4.95 g).

^{1}H NMR (300 MHz, CD_3CN) δ 7.69 (s, 2H), 3.88 (t, *J*=7.0, 2H), 2.64 (d, *J*=4.9, 3H), 2.59 (d, *J*=4.7, 11H), 2.40 (q, *J*=7.5, 2H) ppm. **^{13}C NMR** (75 MHz, CD_3CN) δ 172.58, 163.16, 157.87, 129.61, 124.24, 48.33, 28.17, 22.29, 19.20, 18.16. **^{19}F NMR** (282 MHz, CD_3CN) δ -152.78 ppm. **HRMS (ESI +)** $C_{12}H_{17}N_2O$: 205.1341 (Calc. Mass. 205.1341).

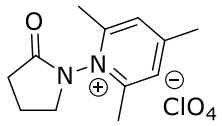
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium hexafluorophosphates (3b)



Prepared according to the general procedure A on 1.46 mmol scale. The desired product was obtained as a white solid in 85 % yield (436 mg).

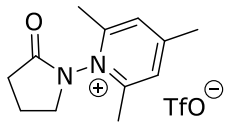
^{1}H NMR (400 MHz, MeOD) δ 7.84 (s, 2H), 4.00 (t, *J* = 7.00, 2H), 2.72 – 2.66 (m, 8H), 2.64 (s, 3H), 2.46 (p, *J*=, 2H) ppm. **^{19}F NMR** (376 MHz, MeOD) δ -72.24, -74.12 ppm. **^{13}C NMR** (101 MHz, MeOD) δ 171.97, 156.90, 128.32, 122.88, 26.93, 20.66, 17.39, 17.03 ppm. **HRMS (ESI +)** $C_{12}H_{17}N_2O$: 205.1335 (Calc. Mass 205.1335), **HRMS (ESI -)** PF_6: 144.96251 (Calc. Mass 144.96247).

2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium perchlorate (3c)



Prepared according to the general procedure A on 1.46 mmol scale. The desired product was obtained as a white solid in 85 % yield (380 mg).
^{1}H NMR (400 MHz, MeOD) δ 7.84 (s, 2H), 4.02 (t, *J* = 7.00, 2H), 2.72 – 2.67 (m, 8H), 2.64 (s, 3H), 2.46 (p, *J* = Hz, 2H) ppm. **^{13}C NMR** (101 MHz, MeOD) δ 173.40, 163.72, 158.28, 129.75, 49.00, 28.36, 22.09, 18.85, 18.45 ppm. **HRMS (ESI +)** $C_{12}H_{17}N_2O$: 205.1335 (Calc. Mass 205.1335), **HRMS (ESI -)** ClO_4: 98.9492 (Calc. Mass 98.9491).

2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium triflate (3d)

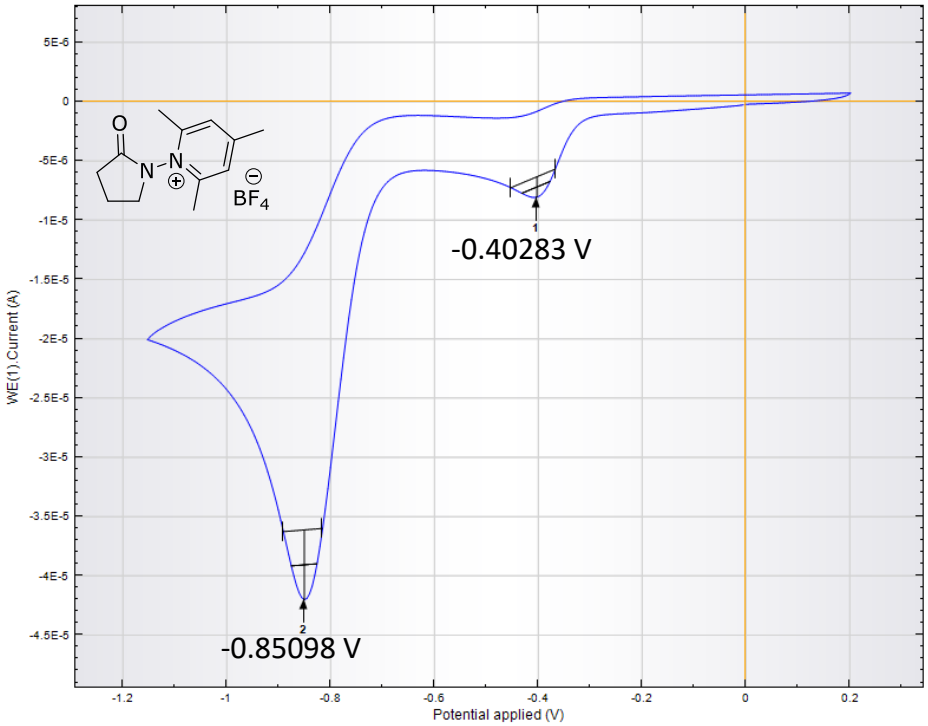


Prepared according to the general procedure A on 1.46 mmol scale. The desired product was obtained as a yellow solid in 55 % yield (287 mg).
^{1}H NMR (400 MHz, MeOD) δ 7.85 (s, 2H), 4.01 (t, *J* = 7.0 Hz, 2H), 2.76 – 2.66 (m, 8H), 2.64 (s, 3H), 2.46 (p, 2H) ppm. **^{19}F NMR** (376 MHz, MeOD) δ -78.47 ppm. **^{13}C NMR** (101 MHz, MeOD) δ 171.93, 162.35, 156.92, 128.32, 26.94, 20.68, 17.42, 17.05 ppm. **HRMS (ESI +)** $C_{12}H_{17}N_2O$: 205.1336 (Calc. Mass 205.1335), **HRMS (ESI -)** CF_3O_3S: 148.9529 (Calc. Mass 148.9526).

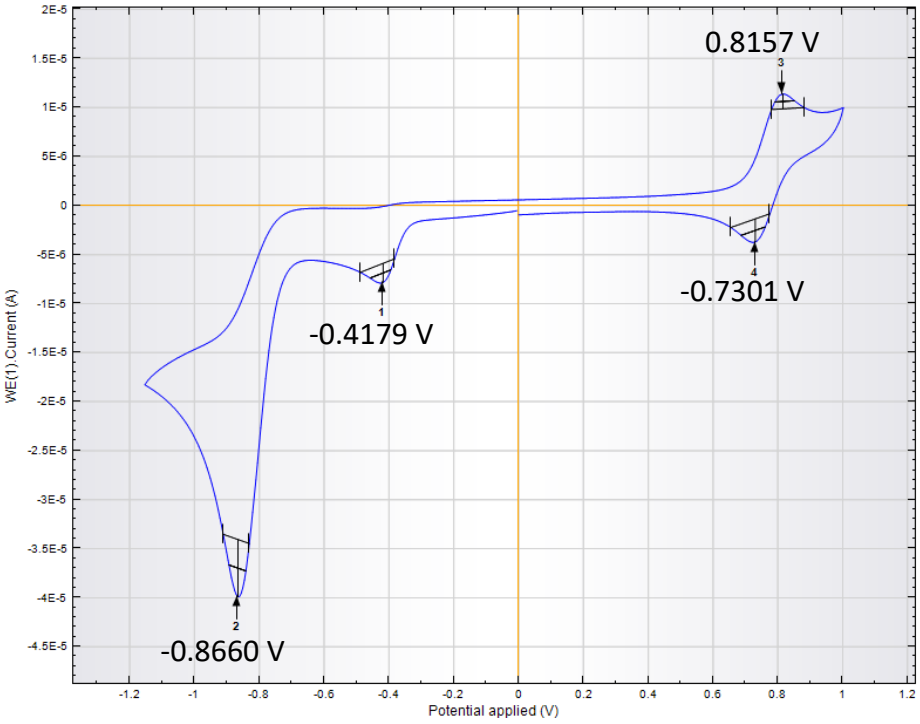
3.3 Cyclic Voltammetry of compounds 3a-d

Measurements are carried out with an **Autolab PGSTAT302N Metrohm**. Working electrode: Glassy Carbon. Counter electrode: Platinum wire. Pseudo reference electrode: Silver wire. Supporting electrolyte: Tetrabutylammonium tetrafluoroborate Fluka 0.1 M. Prior to the measurement the DMA is degassed with argon. All experiments are performed under argon atmosphere. Ferrocene is used as an internal reference for determining the reduction and oxidation potentials. The scan rate was 100 mV s^{-1}.

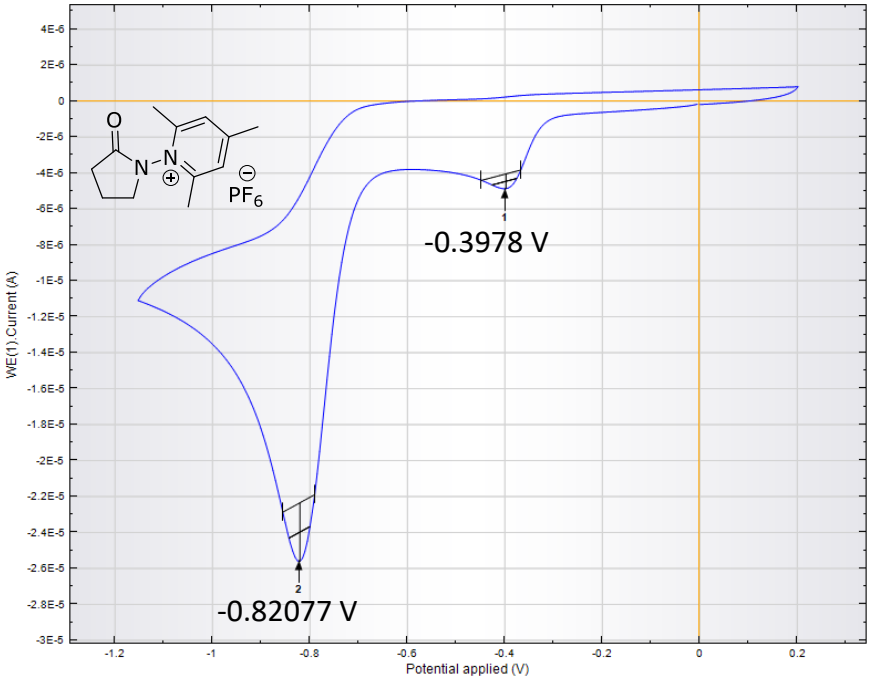
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium tetrafluoroborate (3a)



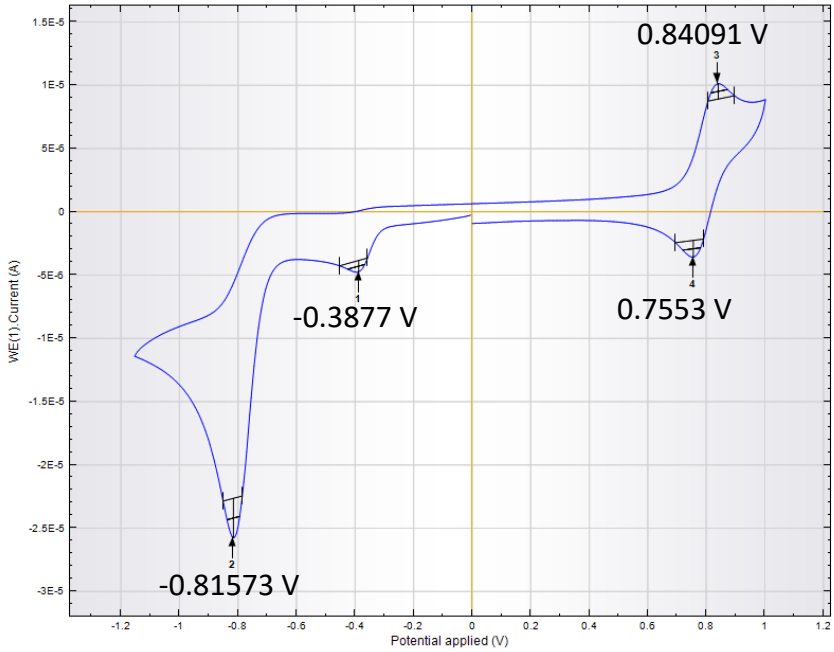
Addition of Ferrocene



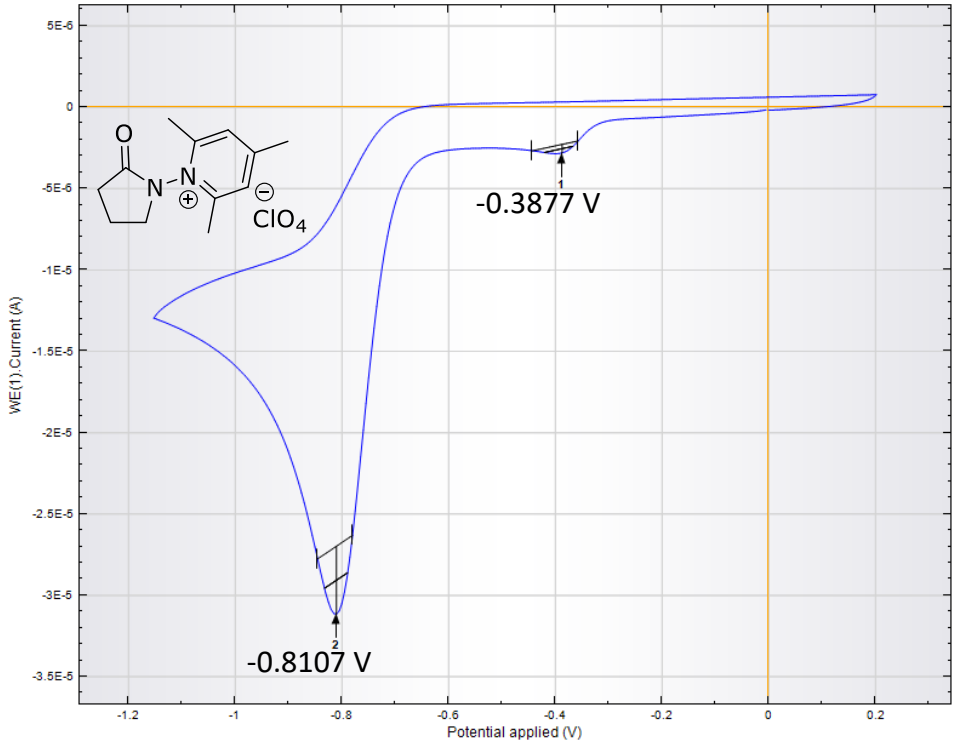
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium hexafluorophosphates (3b)



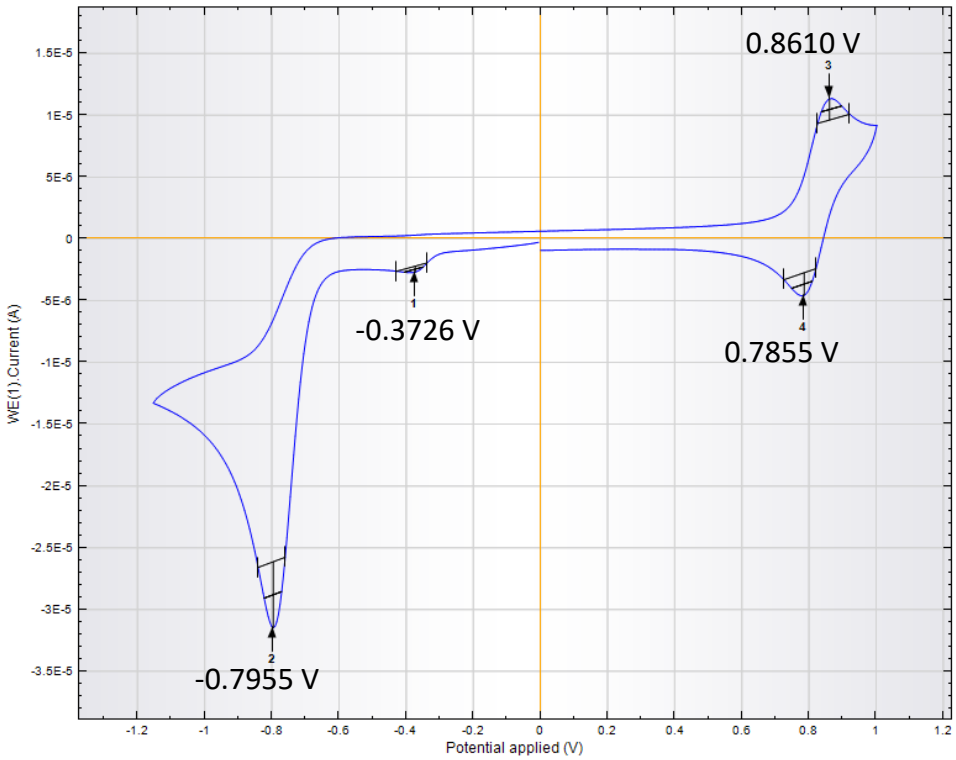
Addition of Ferrocene


0.84091 V
-0.3877 V
0.7553 V
-0.81573 V
WE(1).Current (A)
Potential applied (V)
1.5E-5
1E-5
5E-6
0
-5E-6
-1E-5
-1.5E-5
-2E-5
-2.5E-5
-3E-5
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2

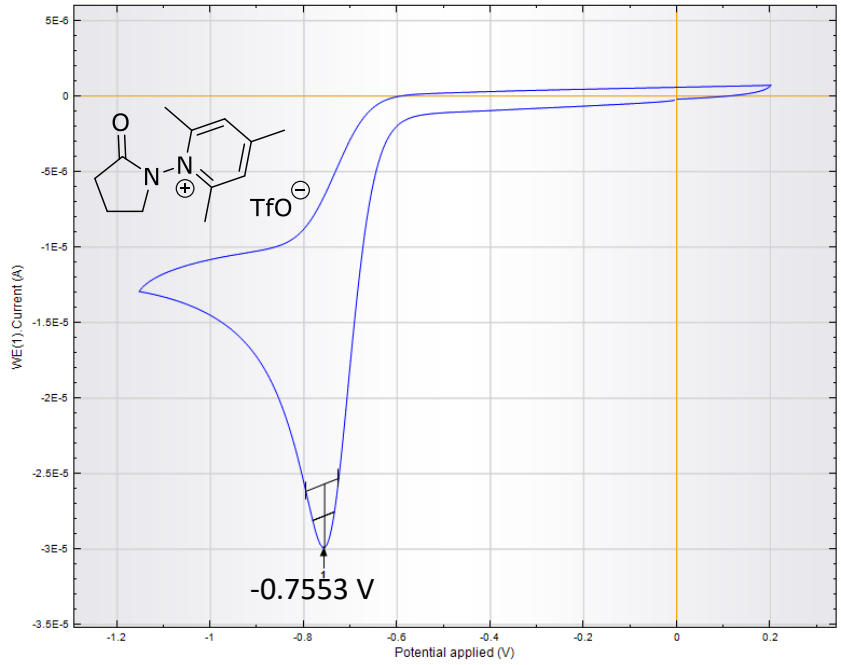
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium perchlorate (3c)

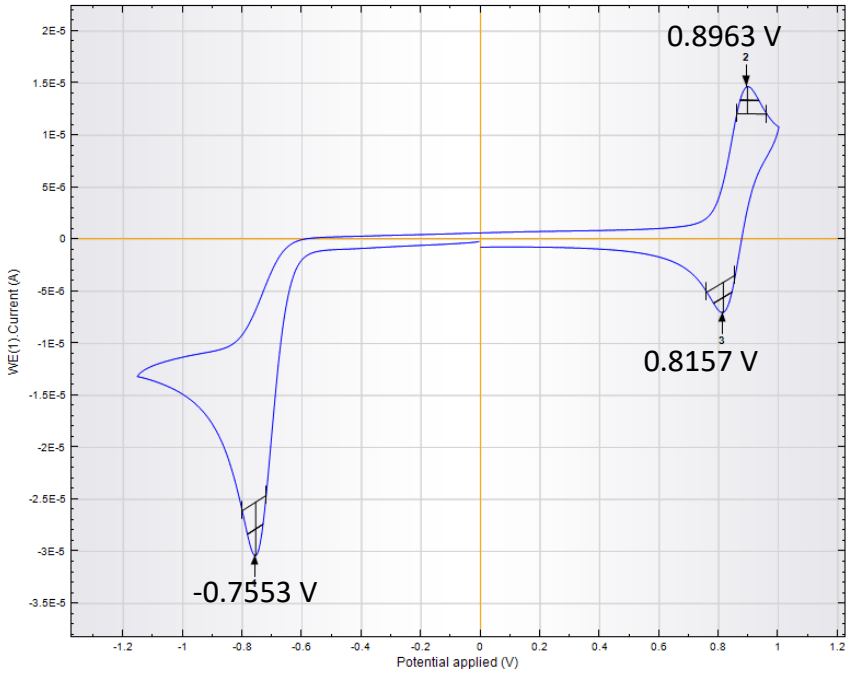


Addition of Ferrocene

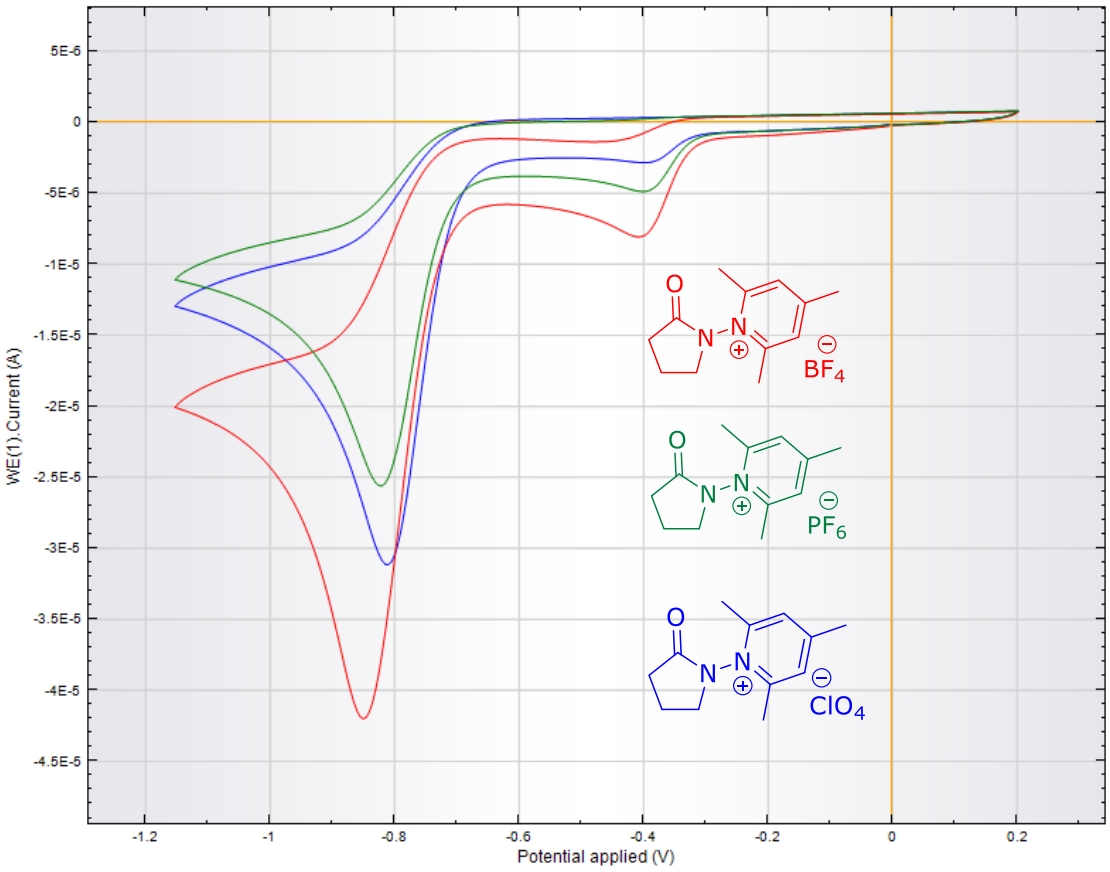


2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium triflate (3d)





Summary


5E-6
0
-5E-6
-1E-5
-1.5E-5
-2E-5
-2.5E-5
-3E-5
-3.5E-5
-4E-5
-4.5E-5
WE(1).Current (A)
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
Potential applied (V)
O
N
N
BF4
O
N
N
PF6
O
N
N
ClO4

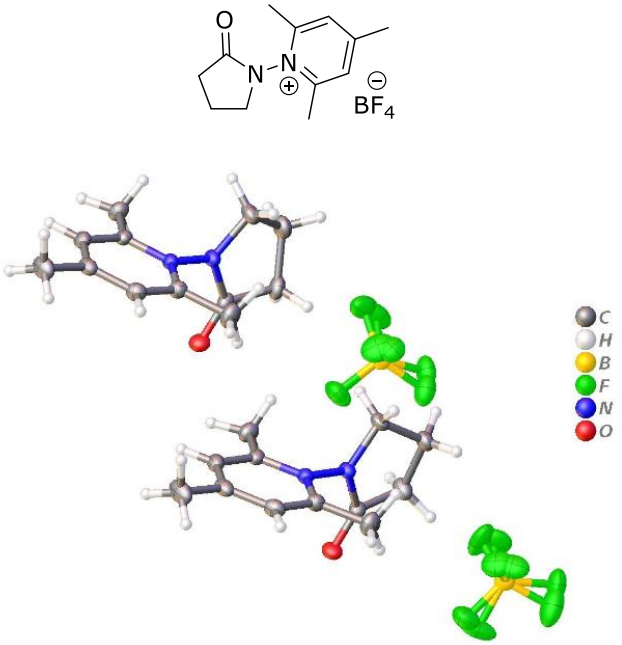
3.4 X Ray analysis of compounds 3a and 3d

2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium tetrafluoroborate (3a)

Experimental. Single clear colourless prism-shaped crystals of **W019_test_Mo2** were used as supplied. A suitable crystal with dimensions 0.15 × 0.12 × 0.07 mm^3 was selected and mounted on a MITIGEN holder with mineral oil on a XtaLAB Synergy R, DW system, HyPix-Arc 150 diffractometer. The crystal was kept at a steady T = 124(2) K during data collection. The structure was solved with the ShelXT 2018/2 (Sheldrick, 2018) solution program using dual methods and by using Olex2 1.5-alpha (Dolomanov et al., 2009) as the graphical interface. The model was refined with olex2.refine 1.5-alpha (Bourhis et al., 2015) using full matrix least squares minimisation on F^2.

Crystal Data. $C_{12}H_{17}BF_4N_2O$, M_r = 292.099, monoclinic, $P2_1/n$ (No. 14), a = 13.3729(3) Å, b = 9.4433(2) Å, c = 22.0836(4) Å, α = 100.639(2)°, $\beta = \gamma$ = 90°, V = 2740.87(10) $Å^3$, T = 124(2) K, Z = 8, Z' = 2, μ(Mo K_α) = 0.126, 117522 reflections measured, 12802 unique (R_{int} = 0.0287) which were used in all calculations. The final wR_2 was 0.1457 (all data) and R_1 was 0.0467 (I≥2 σ(I)).

Compound	**W019_test_Mo2**
Formula	$C_{12}H_{17}BF_4N_2O$
$D_{calc.}$/ g cm^{-3}	1.416
μ/mm^{-1}	0.126
Formula Weight	292.099
Colour	clear colourless
Shape	prism-shaped
Size/mm^3	0.15×0.12×0.07
T/K	124(2)
Crystal System	monoclinic
Space Group	$P2_1/n$
a/Å	13.3729(3)
b/Å	9.4433(2)
c/Å	22.0836(4)
α/°	90
β/°	100.639(2)
γ/°	90
V/$Å^3$	2740.87(10)
Z	8
Z'	2
Wavelength/Å	0.71073
Radiation type	Mo K_α
Θ_{min}/°	2.35
Θ_{max}/°	36.00
Measured Refl's.	117522
Indep't Refl's	12802
Refl's I≥2 σ(I)	9681
R_{int}	0.0287
Parameters	441
Restraints	64
Largest Peak	0.5555
Deepest Hole	-0.2546
GooF	1.0386
wR_2 (all data)	0.1457
wR_2	0.1323
R_1 (all data)	0.0646
R_1	0.0467

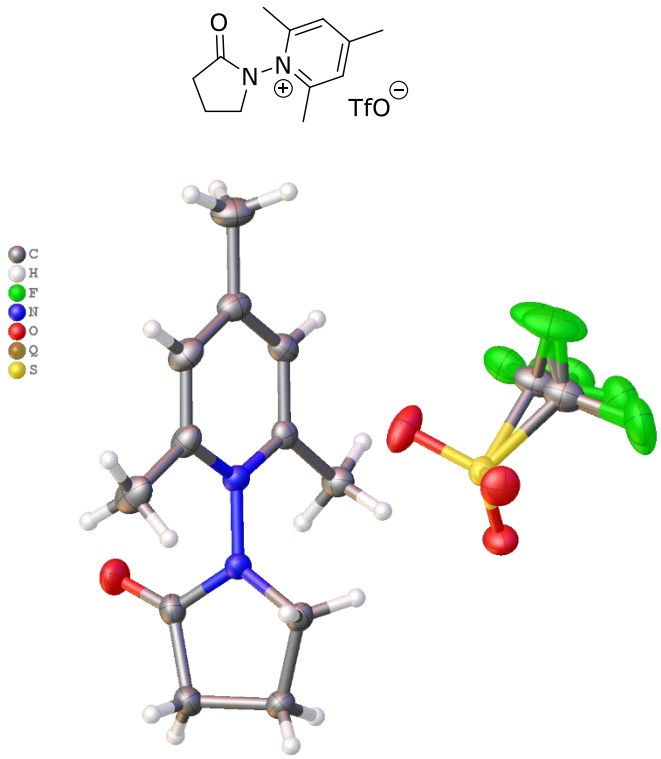


2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium triflate (3d)

Experimental. Single clear colourless prism-shaped crystals of **W017** were used as supplied. A suitable crystal with dimensions 0.20 × 0.11 × 0.05 mm^3 was selected and mounted on a MITIGEN holder inert oil on a XtaLAB Synergy R, DW system, HyPix-Arc 150 diffractometer. The crystal was kept at a steady T = 123.01(10) K during data collection. The structure was solved with the ShelXT 2018/2 (Sheldrick, 2018) solution program using dual methods and by using Olex2 1.5-alpha (Dolomanov et al., 2009) as the graphical interface. The model was refined with ShelXL 2018/3 (Sheldrick, 2015) using full matrix least squares minimisation on F^2.

Crystal Data. $C_{13}H_{17}F_{2.99}N_2O_4S$, M_r = 354.17, monoclinic, $P2_1/c$ (No. 14), a = 12.32450(10) Å, b = 11.64870(10) Å, c = 11.28820(10) Å, β = 95.6680(10)°, $\alpha = \gamma$ = 90°, V = 1612.66(2) Å^3, T = 123.01(10) K, Z = 4, Z' = 1, μ(Cu K$_\alpha$) = 2.282, 32246 reflections measured, 3203 unique (R_{int} = 0.0274) which were used in all calculations. The final wR_2 was 0.0838 (all data) and R_1 was 0.0307 (I≥2 σ(I)).

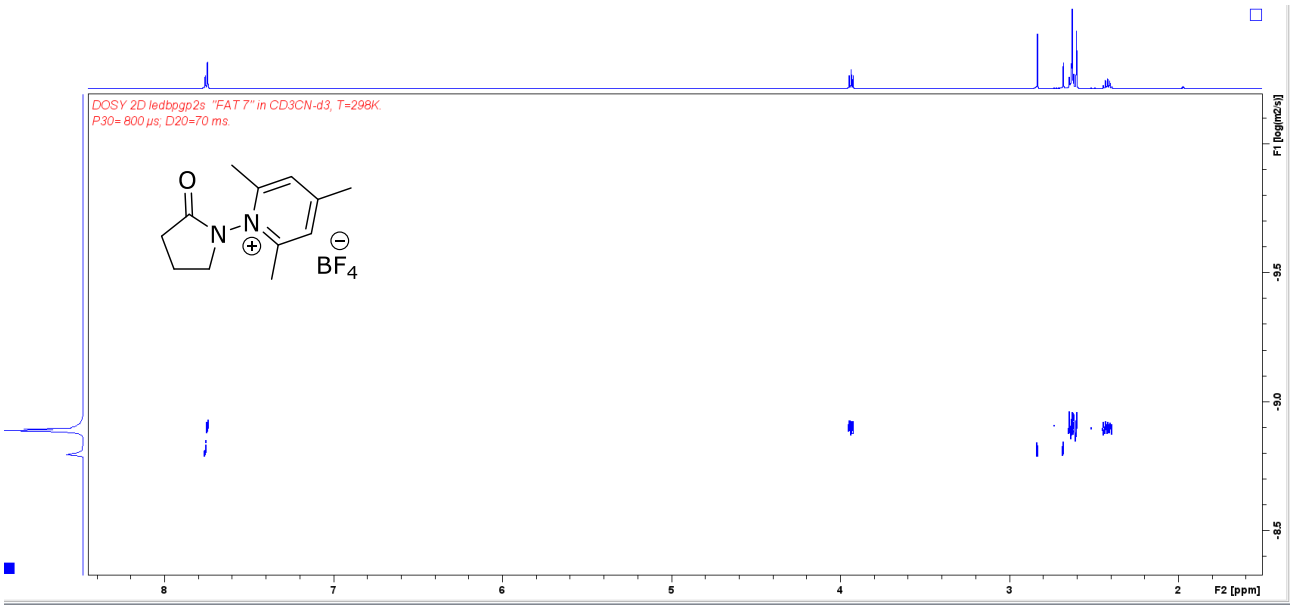
Compound	**W017**
Formula	$C_{13}H_{17}F_{2.99}N_2O_4S$
$D_{calc.}$/ g cm^{-3}	1.459
μ/mm^{-1}	2.282
Formula Weight	354.17
Colour	clear colourless
Shape	prism-shaped
Size/mm^3	0.20×0.11×0.05
T/K	123.01(10)
Crystal System	monoclinic
Space Group	$P2_1/c$
a/Å	12.32450(10)
b/Å	11.64870(10)
c/Å	11.28820(10)
α/°	90
β/°	95.6680(10)
γ/°	90
V/Å^3	1612.66(2)
Z	4
Z'	1
Wavelength/Å	1.54184
Radiation type	Cu K$_\alpha$
Θ_{min}/°	3.604
Θ_{max}/°	73.199
Measured Refl's.	32246
Indep't Refl's	3203
Refl's I≥2 σ(I)	3007
R_{int}	0.0274
Parameters	312
Restraints	95
Largest Peak	0.260
Deepest Hole	-0.442
GooF	1.047
wR_2 (all data)	0.0838
wR_2	0.0827
R_1 (all data)	0.0322
R_1	0.0307



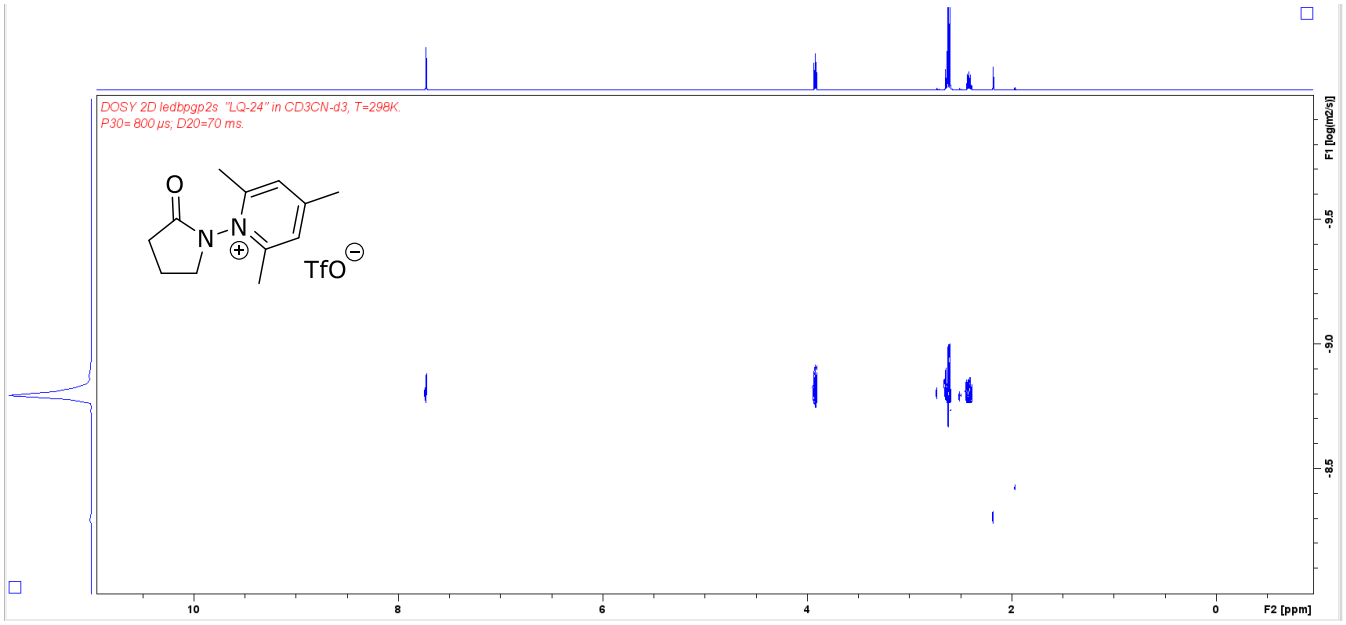
3.5 ^{1}H-DOSY NMR experiments of compounds **3a** and **3d**

All the NMR DOSY experiments were carried out on a Bruker Avance NEO 600 MHz spectrometer (^{1}H base frequency 600.33 MHz), in Acetonitrile-d3, at the temperature of 298 K, using an iProbe BBFO (SmartProbe: 2H pass, 5mm BBF/1H), Z-GRD probe, equipped with a pulsed gradient unit capable of producing magnetic field pulse gradients, in the *z*-direction, of 53.5 G cm^{-1}.
DOSY experiments (Diffusion Ordered Spectroscopy), also called PFG-NMR (Pulsed Field Gradient - NMR), were performed with bipolar gradient pulses, for diffusion, using 2 spoil gradients [D. Wu, A. Chen & C.S. Johnson Jr.; J. Magn. Reson. A 115, 260-264 (1995)].
The length of the magnetic field pulse gradient (δ) was optimized, in correlation with different diffusion time (Δ) values, in order to obtain a 2 to 5% medium residual signal on the whole spectra, in correspondence to the application of 95% of the maximum gradient strength.
The optimized value of δ (p30) was of 0.8 ms, while Δ (d20) was of 70 ms; the pulse gradients (*g*) were incremented from 2 to 95% of the maximum gradient strength, in a linear ramp mode.
DOSY experiment has been acquired with high resolution in direct dimension F2 (32k points), Spectral width (SW) of 12 ppm, and series of 32 spectra (number of gradient increments) in the second dimension F1 (diffusion dimension); the number of scans for each spectrum was 32, with a relaxation delay of 3 s and the and the Eddy current delay (*Te*) was set to 5 ms.
After Fourier transformation and baseline correction, the diffusion dimension was processed with the Bruker TopSpin software package (vs. 4.3.0) obtaining the pseudo-2D map in which the components characterised by different diffusion coefficients are separated along the diffusion axis (indirect axis).

2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium tetrafluoroborate (3a)

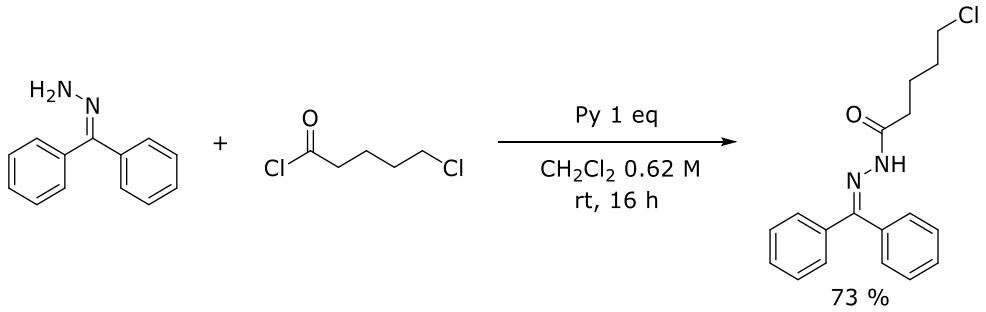


2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium triflate (3d)



3.6 Synthesis of pyridinium ions **4a** and **4d**

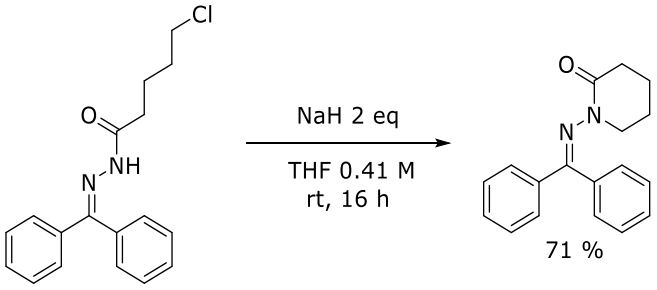
5-chloro-*N'*-(diphenylmethylene)pentanehydrazide



Into a Schlenk 50 ml flask, the (diphenylmethylene)hydrazine (2 g, 10.2 mmol, 1eq) was introduced then tree nitrogen-vacuum cycles were done. Dry CH_2Cl_2 (16 ml, 0.62 M) was added, and the reaction mixture was cool down to 0 °C. Pyridine previously distilled (825 µl, 10.2 mmol, 1eq) and the 5-chloropentanoyl chloride (1.3 ml, 10.2 mmol, 1 eq) were added through syringes. The reaction mixture was stirred overnight with the ice bath slowly warming up. 30 ml of a saturated solution of K_2CO_3 was added and the two phases were separated. The water phase was extracted with CH_2Cl_2 (2 X 40 ml), the combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a white solid in 73 % yield (2.34 g).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (s, 1H), 7.66 – 7.46 (m, 5H), 7.43 – 7.30 (m, 3H), 7.24 (dd, *J* = 7.8, 1.7 Hz, 2H), 3.67 – 3.56 (m, 2H), 2.94 – 2.83 (m, 2H), 1.92 (m, 4H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 174.77, 150.47, 137.05, 131.64, 130.08, 129.96, 129.82, 128.54, 128.51, 127.45, 44.82, 32.34, 32.19, 22.05. **HRMS (ESI +)** $C_{18}H_{19}ClN_2O$: 315.1267 (Calc. Mass. 315.1259).

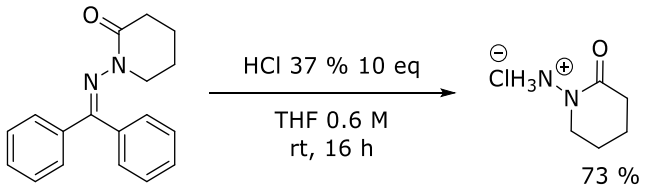
1-((diphenylmethylene)amino)-2-piperidinone



Into a Schlenk 25 ml flask, 357 mg of NaH 60 % in mineral oil (8.9 mmol, 1.2 eq) was washed with 10 ml of pentane (3 times). Then, 19 ml of dry THF were added and the 4-chloro-*N*'-(diphenylmethylene)pentanehydrazide (2.34 g, 1 eq) was added portion wise. The reaction mixture was stirred overnight at room temperature. Then, 50 ml of a saturated solution of NH_4Cl were added and the reaction mixture was stirred for 30 minutes. The phases were separated, and the aqueous phase was extracted with AcOEt (2 x 50 ml). The combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a yellow solid in 71 % yield (1.47 g). All the analytical data are in agreement with the literature.[3]

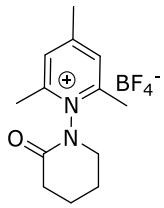
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.71 – 7.65 (m, 2H), 7.49 – 7.20 (m, 8H), 3.41 (t, *J* = 5.7 Hz, 2H), 2.22 (t, *J* = 6.2 Hz, 2H), 1.76 – 1.58 (m, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.54, 164.48, 136.63, 135.25, 131.26, 129.34, 129.27, 128.11, 127.96, 127.51, 50.34, 32.46, 22.91, 21.03.

1-aminopiperidin-2-one hydrochloride



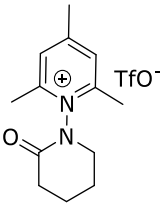
Into a 25 ml 1 neck flask, the 1-((diphenylmethylene)amino)-2-piperidinone (1.47 g, 1 eq) was dissolved in 9 ml of THF and then, 5 ml of HCl 37 % were added. The reaction mixture was stirred overnight at room temperature. Then, the THF was removed under reduced pressure. The aqueous phase was extracted with AcOEt (3 x 25 ml) and evaporated under reduced pressure. The reaction crude was purified by hot crystallization from acetonitrile (10 ml) to provide the desired product as a yellow solid in 73 % yield (573 mg). All the analytical data are in agreement with the literature.[4]
^{1}H NMR (300 MHz, MeOD) δ 5.48 (s, 2H), 3.73 (t, *J* = 5.8 Hz, 2H), 2.53 (t, *J* = 6.4 Hz, 2H), 2.03 (dd, *J* = 5.8, 2.6 Hz, 2H), 1.96 – 1.82 (m, 2H) ppm. **^{13}C NMR** (75 MHz, MeOD) δ 170.62, 50.90, 32.62, 23.76, 21.56 ppm.

2,4,6-trimethyl-1-(2-oxopiperidin-1-yl)pyridinium tetrafluoroborate (4a)



Prepared according to the general procedure A on 0.8 mmol scale. The desired product was obtained as a yellow solid in 66 % yield (145 mg) after purification by flash column chromatography (CH_2Cl_2:MeOH 95:5 -> 85:15).
^{1}H NMR (300 MHz, MeOD) δ 7.83 (s, 2H), 3.91 (t, *J* = 5.9 Hz, 2H), 2.75 (t, *J* = 6.5 Hz, 2H), 2.67 (s, 6H), 2.62 (s, 3H), 2.26 – 2.12 (m, 2H), 2.09 – 1.99 (m, 2H) ppm. **^{19}F NMR** (282 MHz, MeOD) δ -153.80 ppm. **^{13}C NMR** (75 MHz, MeOD) δ 169.41, 163.24, 157.48, 129.90, 52.89, 33.10, 23.86, 21.96, 21.17, 18.78 ppm. **HRMS (ESI +)** $C_{13}H_{19}N_2O$: 219.1499 (Calc. Mass. 219.1497).

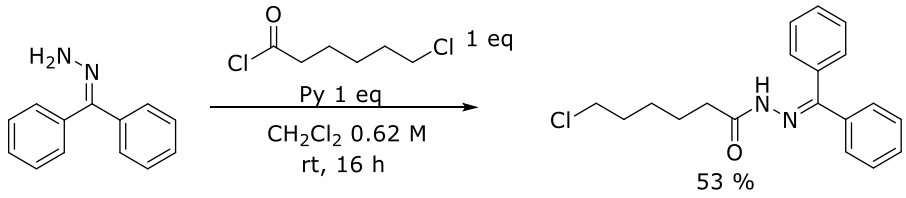
2,4,6-trimethyl-1-(2-oxopiperidin-1-yl)pyridinium triflate (4d)



Prepared according to the general procedure A on 3.8 mmol scale. The desired product was obtained as a yellow solid in 60 % yield (825 mg) after purification by flash column chromatography (CH_2Cl_2:MeOH 95:5 -> 85:15).
^{1}H NMR (300 MHz, MeOD) δ 7.84 (s, 2H), 3.92 (t, *J* = 6.0 Hz, 2H), 2.76 (t, *J* = 6.5 Hz, 2H), 2.68 (s, 6H), 2.64 (s, 3H), 2.27 – 2.13 (m, 2H), 2.06 (m, 2H). **^{19}F NMR** (376 MHz, MeOD) δ -78.49. **^{13}C NMR** (75 MHz, MeOD) δ 167.90, 161.92, 156.19, 128.52, 51.51, 31.75, 22.57, 20.60, 19.85, 17.39. **HRMS (ESI +)** $C_{13}H_{19}N_2O$: 219.1492 (Calc. Mass. 219.1497).

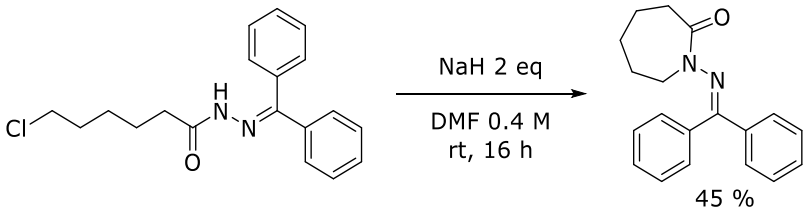
3.7 Synthesis of pyridinium ions 5a

6-chloro-*N'*-(diphenylmethylene)esanehydrazide



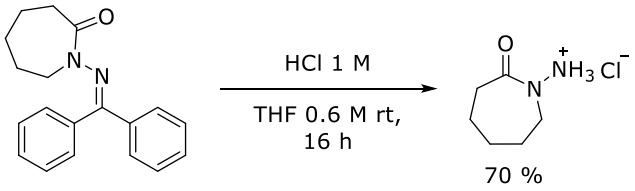
Into a Schlenk 100 ml flask, the (diphenylmethylene)hydrazine **30** (4.6 g, 23.6 mmol, 1 eq) was introduced then tree nitrogen-vacuum cycles were done. Dry CH_2Cl_2 (40 ml, 0.62 M) was added, and the reaction mixture was cool down to 0 °C. Pyridine previously distilled (1.9 ml, 23.6 mmol, 1 eq) and the 6-chloroesananoyl chloride **47** (4 g, 23.3 mmol, 1 eq) were added through syringes. The reaction mixture was stirred overnight with the ice bath slowly warming up. 30 ml of a saturated solution of K_2CO_3 was added and the two phases were separated. The water phase was extracted with CH_2Cl_2 (2 X 40 ml) and the combined organic phases were dried out with Na_2SO_4 and the solvent was removed under reduced pressure. The reaction crude was purified by hot crystallization from IPA (40 ml) to provide the desired product as a white solid in 58 % yield (4.55 g).
^{1}H NMR (300 MHz, $CDCl_3$) δ 8.37 (s, 1H), 7.69 – 7.20 (m, 10H), 3.59 (t, *J* = 6.7 Hz, 2H), 2.89 (t, *J* = 7.5 Hz, 2H), 1.85 (dp, *J* = 23.6, 7.3 Hz, 4H), 1.61 (tdd, *J* = 9.5, 6.4, 3.6 Hz, 2H) ppm. **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.02, 150.22, 137.02, 131.60, 129.95, 129.85, 129.68, 129.33, 128.67, 128.46, 128.41, 128.04, 127.88, 127.34, 44.93, 32.74, 32.43, 26.72, 23.91 ppm.

1-((diphenylmethylene)amino)-2-azepan2-one



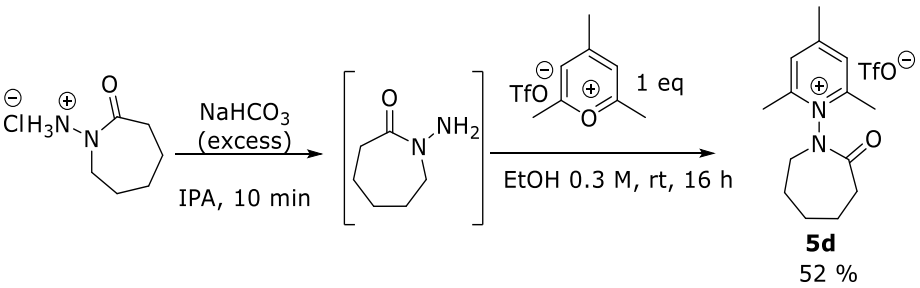
Into a Schlenk 100 ml flask, 740 mg of NaH 60 % in mineral oil (19.3 mmol, 2 eq) was washed with 10 ml of pentane (3 times). Then, 24 ml of dry DMF were added and the 6-chloro-N'-(diphenylmethylene)esanehydrazide (3.17 g, 1 eq) was added portion wise. The reaction mixture was stirred overnight at room temperature. Then, 15 ml of H_2O were added, and the reaction mixture was stirred for 30 minutes. The phases were separated, and the aqueous phase was extracted with AcOEt (2 x 20 ml). The combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on basic alumina (Hexane-AcOEt 7:3 -> 6:4 -> 1:1) to provide the desired product as a yellow solid in 41 % yield (1.150 g).
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.68 – 7.59 (m, 2H), 7.41 – 7.18 (m, 8H), 3.59 – 3.48 (m, 2H), 2.40 – 2.30 (m, 2H), 1.68 – 1.41 (m, 6H) ppm. **^{13}C NMR** (75 MHz, $CDCl_3$) δ 173.55, 170.03, 136.86, 136.07, 131.00, 129.79, 129.23, 129.02, 128.95, 128.35, 128.07, 127.89, 127.86, 127.25, 53.05, 36.95, 29.83, 26.97, 22.83 ppm. **HRMS (ESI+)** $C_{19}H_{20}N_2ONa$: 315.1475 (Calc. Mass 315.1473).

amino-azepan-2-one hydrochloride



Into a 10 ml 1 neck flask, the 1-((diphenylmethylene)amino)-2-azepan-2-one (380 mg, 1 eq) was dissolved in 2 ml of THF and then, 760 µl of HCl 1 M were added. The reaction mixture was stirred overnight at room temperature. Then, the THF was removed under reduced pressure. The aqueous phase was extracted with AcOEt (3 x 25 ml) and evaporated under reduced pressure. The desired product was obtained as a white solid in 70 % yield (150 mg) without purification.
^{1}H NMR (300 MHz, MeOD) δ 3.76 (dd, *J* = 6.6, 2.8 Hz, 2H), 2.68 – 2.58 (m, 2H), 1.89 – 1.73 (m, 4H), 1.76 – 1.60 (m, 2H) ppm. **^{13}C NMR** (75 MHz, MeOD) δ 175.89, 51.83, 35.85, 30.22, 28.27, 23.82 ppm. **HRMS (ESI+)** $C_6H_{13}N_2O$: 129.1026 (Calc. Mass. 129.1028).

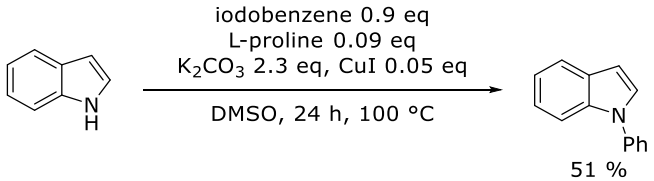
2,4,6-trimethyl-1-(2-oxoazepan-1-yl)pyridinium triflate



Prepared according to the general procedure A on 0.62 mmol scale. The desired product **5d** was obtained as a yellow solid in 52 % yield (123 mg).
^{1}H NMR (300 MHz, MeOD) δ 7.82 (s, 2H), 4.14 – 4.05 (m, 2H), 2.91 – 2.80 (m, 2H), 2.68 (s, 6H), 2.63 (s, 3H), 2.06 (s, 2H), 1.96 – 1.85 (m, 4H) ppm. **^{13}C NMR** (75 MHz, MeOD) δ 174.86, 162.98, 157.71, 129.81, 124.33, 55.03, 36.78, 30.40, 29.17, 23.37, 21.91, 19.96 ppm. **^{19}F NMR** (76 MHz, MeOD) δ -78.50. **HRMS (ESI+)** $C_{14}H_{21}N_2O$: 233.1652 (Calc. Mass 233.1654).

3.8 Synthesis of the Heteroarenes starting materials

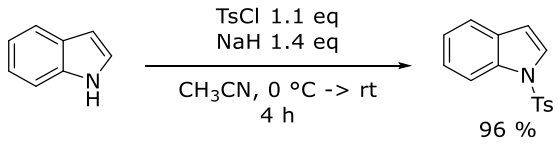
1-phenyl-1H-indole



Into a Schlenk 50 ml flask, 1 g of Indole (8.53 mmol, 1 eq) was introduced, then, tree nitrogen-vacuum cycles were done. Dry DMSO (15.5 ml, 0.5 M) was added. Then, L-proline (88.4 mg, 0.77 mmol, 0.09 eq), K_2CO_3 (2.7 g, 19.6 mmol, 2.3 eq) and CuI (73 mg, 0.38 mmol, 0.05 eq) were added and the reaction mixture was heated up to 100 °C. After 10 minutes, iodobenzene (870 µL, 7,75 mmol) was added dropwise over 25 minutes, then the reaction mixture was stirred at 100 °C for 24 h. After this time, the mixture was cooled down to room temperature and diluted with 15 mL of

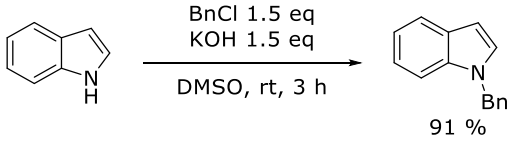
AcOEt. The crude was extracted with brine (3 x 15 mL), the combined organic phases were dried out with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on silica gel (Hexane-AcOEt 98:2) to provide the desired product as a yellow liquid in 51 % yield (745 mg). All the analytical data are in agreement with the literature.[5]
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.74 – 7.65 (m, 1H), 7.62 – 7.47 (m, 7H), 7.42 – 7.31 (m, 2H), 6.73 – 6.65 (m, 1H). **R_f** = 0.25 (Hexane-EtOAc 98:2).

1-(*p*-toluenesulfonyl)-1H-indole



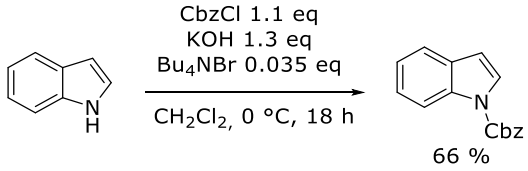
Into a Schlenk 100 ml flask, 480 mg of NaH 60 % in mineral oil (12 mmol, 1.4 eq) were washed with 5 ml of pentane (3 times). Then, 28 ml of dry CH_3CN (0.3 M) were added. Next,1 g of Indole (8.53 mmol, 1 eq) was introduced and the reaction mixture was cool down to 0 °C. After 10 minutes, TsCl (1.3 mL, 9.4 mmol, 1.1 eq) was added through syringe. The reaction mixture was stirred for 4 h with the ice bath slowly warming up. After this time, the reaction was quenched with 15 mL of a s.s. of NH_4Cl and the acqueous phase was extracted with AcOEt (3 x 15 mL). The combined organic phases were dried with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on silica gel (Hexane-AcOEt 95:5 -> 9:1) to provide the desired product as a white solid in 96 % yield (745 mg). All the analytical data are in agreement with the literature.[6]
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.99 (d, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.3 Hz, 2H), 7.60 – 7.48 (m, 2H), 7.26 (s, 4H), 6.65 (d, *J* = 3.7 Hz, 1H), 2.34 (s, 3H). **R_f** = 0.3 (Hexane-EtOAc 9:1)

1-benzyl-1H-indole



Into a Schlenk 10 ml flask, 1 g of Indole (8.53 mmol, 1 eq) was dissolved into 2 mL of dry DMSO (4.2 M). Then, 1.5 mL of benzyl chloride (12.6 mmol, 1.5 eq) were introduced through syringe, the mixture was cool down to 0 °C and 705 mg of KOH were added. The reaction was stirred at room temperature for 3 h. After this time, the mixture was diluted with 20 ml of H_2O and the aqueous phase was extracted with Et_2O (2 x 10 ml). The combined organic phases were washed with brine (2 x 5 mL), dried with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on silica gel (Hexane-AcOEt 99:1 -> 98:2) to provide the desired product as a yellow oil in 91 % yield (1.61 g). All the analytical data are in agreement with the literature.[7]
^{1}H NMR (300 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.6 Hz, 1H), 7.41 – 7.06 (m, 9H), 6.56 (d, *J* = 3.2 Hz, 1H), 5.34 (s, 2H). **R_f** = 0.25 (Hexane-EtOAc 9:1).

Benzyl 1H-indole-1-carboxylate

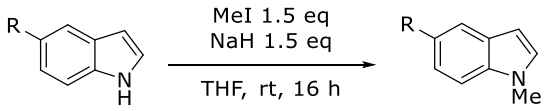


66 %

Into a Schlenk 25 ml flask, 1 g of Indole (8.53 mmol, 1 eq) was dissolved into 8.3 mL of dry CH_2Cl_2 (0.68 M). Then, 100 mg of Bu_4NBr (0.3 mmol, 0,035 eq) and 443 mg of NaOH (11 mmol, 1.3 eq) were added and the mixture was cool down to 0 °C. After that, a solution of 1.3 mL of CbzCl (9.4 mmol, 1.1 eq) in 4.2 mL of dry CH_2Cl_2 was introduced in 10 minutes through syringe. The reaction mixture was stirred overnight with the ice bath slowly warming up. After this time, the crude was diluted with 20 ml of H_2O and the aqueous phase was extracted with CH_2Cl_2 (2 x 20 ml). The combined organic phases were dried with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on silica gel (Hexane-AcOEt 98:2 -> 95:5) to provide the desired product in 66 % yield (1.41 g). All the analytical data are in agreement with the literature. [8]

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.1 Hz, 1H), 7.70 – 7.21 (m, 9H), 6.63 (d, *J* = 3.7 Hz, 1H), 5.49 (s, 2H). **R_f** = 0.27 (Hexane-EtOAc 9:1)

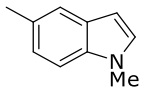
<u>General procedure B</u>: Synthesis of 1-methyl-5-substituted indoles



R = Me, Cl, Br, CF_3

Into a Schlenk 50 ml flask, 300 mg of NaH 60 % in mineral oil (8 mmol, 1.5 eq) was washed with 5 ml of pentane (3 times). Then, 18 ml of dry THF (0.3 M) were added and 1 g of 5-substitutedindole (1 eq) was introduced. The mixture was cool down to 0 °C for 30 minutes and then 500 µL of methyl iodide (8 mmol, 1.5 eq) were added through syringe. The reaction mixture was stirred overnight with the ice bath slowly warming up. After this time, the crude was diluted with 10 ml of H_2O and the aqueous phase was extracted with Et_2O (2 x 15 ml). The combined organic phases were dried with Na_2SO_4, and the solvent was removed under reduced pressure. The reaction crude was purified by column chromatography on silica gel.

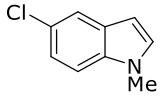
1,5-dimethyl-1H-indole



Prepared according to the general procedure B on 7.6 mmol scale. The desired product was obtained as a yellow oil in 90 % yield (996 mg) after purification by flash column chromatography (Hexane-AcOEt 98:2 -> 95:5). All the analytical data are in agreement with the literature. [9]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 (s, 1H), 7.27 (d, *J* = 8.3 Hz, 1H), 7.12 (d, *J* = 8.7 Hz, 1H), 7.06 (d, *J* = 3.1 Hz, 1H), 6.46 (d, *J* = 3.1 Hz, 1H), 3.81 (s, 3H), 2.52 (s, 3H). **R_f** = 0.4 (Hexane-EtOAc 99:1)

5-Chloro-1-methyl-1*H*-indole

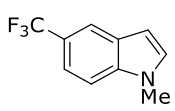


Prepared according to the general procedure B on 6.6 mmol scale. The desired product was obtained as a yellow oil in 90 % yield (983 mg) after purification by flash

column chromatography (Hexane-AcOEt 98:2 -> 95:5). All the analytical data are in agreement with the literature. [9]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 1.9 Hz, 1H), 7.23 (d, *J* = 8.6 Hz, 1H), 7.18 (dd, *J* = 8.7, 2.0 Hz, 1H), 7.07 (d, *J* = 3.1 Hz, 1H), 6.44 (d, *J* = 3.1 Hz, 1H), 3.78 (s, 3H). **R_f** = 0.3 (Hexane-EtOAc 9:1)

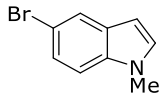
1-methyl-5-(trifluoromethyl)-1H-indole



Prepared according to the general procedure B on 5.4 mmol scale. The desired product was obtained as a white solid in 90 % yield (975 mg) after purification by flash column chromatography (Hexane-AcOEt 95:5-> 9:1). All the analytical data are in agreement with the literature. [9]

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.46 (d, *J* = 8.6 Hz, 1H), 7.39 (d, *J* = 8.7 Hz, 1H), 7.16 (d, *J* = 3.2 Hz, 1H), 6.58 (d, *J* = 3.1 Hz, 1H), 3.84 (s, 3H). **^{19}F NMR** (282 MHz, $CDCl_3$) δ -60.2 (s, 3F). **R_f** = 0.2 (Hexane-AcOEt 9:1).

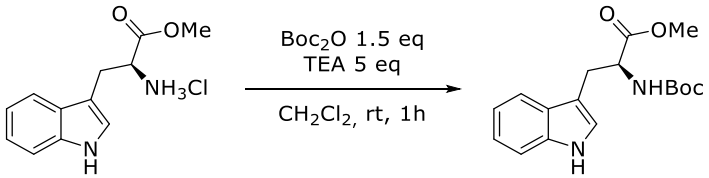
5-Bromo-1-methyl-1*H*-indole



Prepared according to the general procedure B on 5.1 mmol scale. The desired product was obtained as a yellow oil in 90 % yield (964 mg) after purification by flash column chromatography (Hexane-AcOEt 98:2 -> 95:5). All the analytical data are in agreement with the literature. [9]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 1.9 Hz, 1H), 7.31 (dd, *J* = 8.6, 1.9 Hz, 1H), 7.21 – 7.16 (m, 2H), 7.05 (d, *J* = 3.1 Hz, 1H), 6.43 (dd, *J* = 3.1, 0.9 Hz, 1H), 3.77 (s, 3H). **R_f** = 0.25 (Hexane-AcOEt 9:1).

***N*-Boc-L-tryptophan methyl ester**

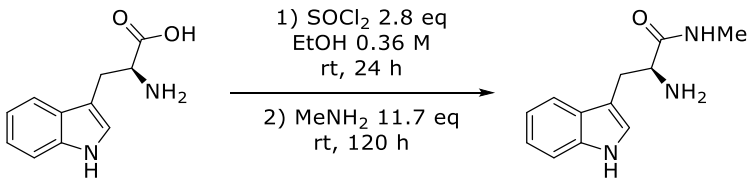


78 %

Into a Schlenk 25 ml flask, 1 g of Tryptophan methyl ester hydrochloride (4 mmol, 1 eq) was dissolved in 4 mL of dry CH_2Cl_2(0.98 M). Then, Et_3N (2, 8 mL, 20 mmol, 5 eq) and Boc_2O (1.31 g, 6 mmol, 1.5 eq) were added. The reaction mixture was stirred ad rt for 1 h. After this time, the solvent was removed under reduced pressure and the crude was purified by column chromatography on silica gel (Hexane-AcOEt 7:3 -> 1:1) to afford the desired product as a white solid in 78 % (989 mg). All analytical data are in agreement with the literature.[10]

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.56 (d, *J* = 7.8 Hz, 1H), 7.40 – 7.31 (m, 1H), 7.20 (t, *J* = 7.4 Hz, 1H), 7.12 (t, *J* = 7.5 Hz, 1H), 7.00 (d, *J* = 2.4 Hz, 1H), 5.08 (d, *J* = 8.2 Hz, 1H), 4.65 (q, *J* = 6.2 Hz, 1H), 3.68 (s, 3H), 3.29 (d, *J* = 5.5 Hz, 2H), 1.43 (s, 9H). **R_f** = 0.53 (Hexane-AcOEt 1:1).

L-tryptophan methylamide

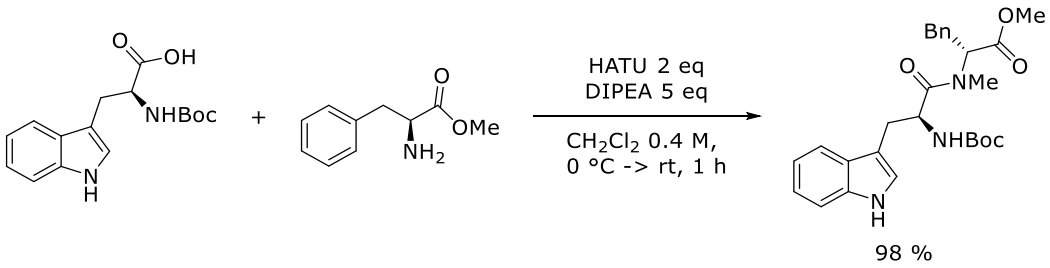


90 %

Into a 100 ml round bottom flask, 2 ml of thionyl chloride (27 mmol, 2.8 eq) were added slowly to 27 mL of EtOH (0.36 M). Then, 2 g of L-Tryptophan (9.8 mmol, 1 eq) was added and the reaction mixture was stirred ad rt for 24 h. After this time, the solvent was removed under reduced pressure. The crude was washed with AcOEt (20 mL) and Petroleum Ether (20 mL) and dried to afford a cream solid. Then a solution of $MeNH_2$ in EtOH (15 mL, 11.7 eq) was added and the reaction mixture was stirred at rt for 120 h. After this time, the crude was diluted with 20 ml of a saturated solution of $NaHCO_3$ and the aqueous phase was extracted with $CHCl_3$ (2 x 15 ml). The combined organic phases were dried with Na_2SO_4, and the solvent was removed under reduced pressure to afford the desired product as a yellow oli in 90 % yield (1.9 g) without any purification. All analytical data are in agreement with the literature.[11]

^{1}H NMR (300 MHz, DMSO) δ 10.64 (bs, 1H), 7.80 (m, 1H), 7.51 (d, *J* = 7.8 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 1H), 7.09 (s, 1H), 7.05 (t, *J* = 7.4 Hz, 1H), 6.96 (t, *J* = 7.3 Hz, 1H), 3.42 (t, *J* = 6.7 Hz, 1H), 3.00 (dd, *J* = 14.2, 5.7 Hz, 1H), 2.81 (dd, *J* = 14.2, 7.1 Hz, 1H), 2.52 (d, *J* = 4.3 Hz, 3H).

Boc- Trp-Phe-OMe



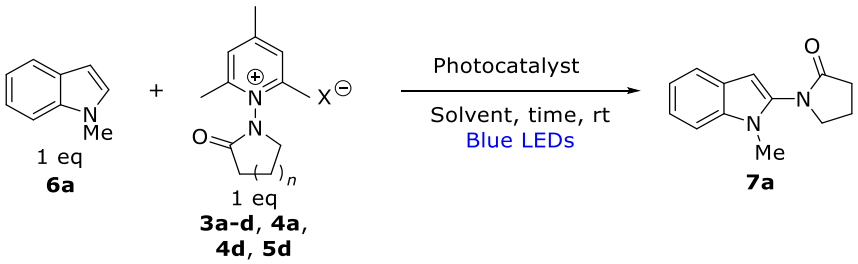
98 %

Into a Schlenk 25 ml flask, 1.5 g of Boc-L Tryptophan (5 mmol, 1 eq) and 1.3 g of L-Phenylalanine-OMe (6 mmol, 1.2 eq) were dissolved in 12.5 mL of dry CH_2Cl_2(0.4 M). The mixture was cooled down to 0 °C and HATU (3.8 g, 10 mmol, 2 eq) was added. After 10 minutes, DIPEA (4.1mL, 25 mmol, 5 eq) was introduced through syringe. The reaction mixture was stirred for 1 h with the ice bath slowly worming up to room temperature. After this time, the crude was diluted with 10 ml of H_2O and the aqueous phase was extracted with CH_2Cl_2 (2 x 15 ml). The combined organic phases were dried with Na_2SO_4, and the solvent was removed under reduced pressure and the crude was purified by column chromatography on silica gel (Hexane-AcOEt 7:3 -> 1:1) to afford the desired product as a white solid in 98 % yield (2.58 g). All analytical data are in agreement with the literature.[12]

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.70 (bs, 1H), 7.66 (d, *J* = 7.7 Hz, 1H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.24 – 7.08 (m, 5H), 7.02 (s, 1H), 6.81 (dd, *J* = 7.6, 1.9 Hz, 2H), 6.31 (d, *J* = 7.6 Hz, 1H), 5.17 (bs, 1H), 4.81 – 4.68 (m, 1H), 4.44 (m, 1H), 3.61 (s, 3H), 3.29 (m, 1H), 3.14 (dd, *J* = 14.4, 6.8 Hz, 1H), 2.94 (d, *J* = 5.9 Hz, 2H), 1.42 (s, 9H).

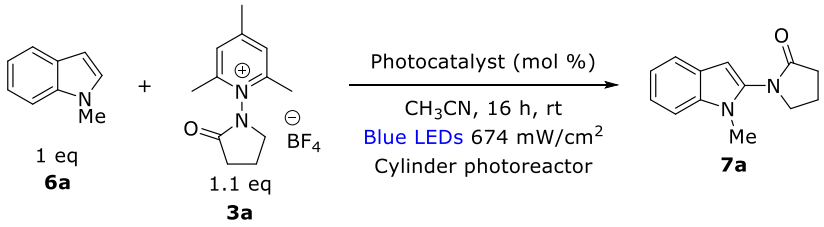
4 Screening of the reaction conditions

General procedure B



Into a 7 ml vial, the nitrogen radical precursor **3a-d**, **4a**, **4d**, **5d** (1 eq, 0.2 mmol), the photocatalyst and the 1-methylindole **6a** (10 eq, 2 mmol) were introduced. The vial was sealed with a septum cap and three nitrogen-vacuum cycles were done. 2 ml of DMA were added and other three nitrogen-vacuum cycles were performed. The reaction mixture was irradiated with Blu LEDs for the appropriate time. After that, the DMA was removed under reduced pressure and the crude was purified with flash column chromatography Hexane-AcOEt 7:3.

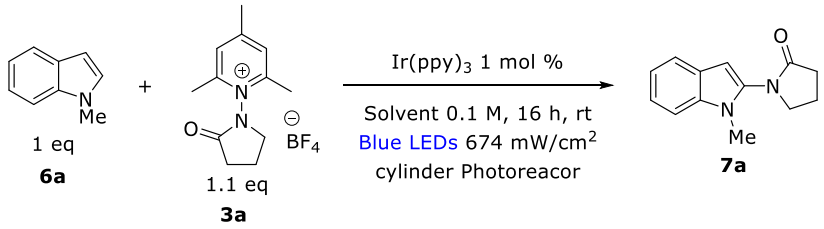
-First tests for the regioselective addition of N lactam radicals to 1-methylindole **6a**



Entry	Photocatalyst (mol %)	7a Yield (%)
1	$[Ru(bpy)_3]Cl_2$ (5)	-
2	$Ir(ppy)_3$ (1)	< 10
3	$Ir(ppy)_3$ (5)	< 10

Table S2 *First tests with nitrogen radical precursor 3a.*

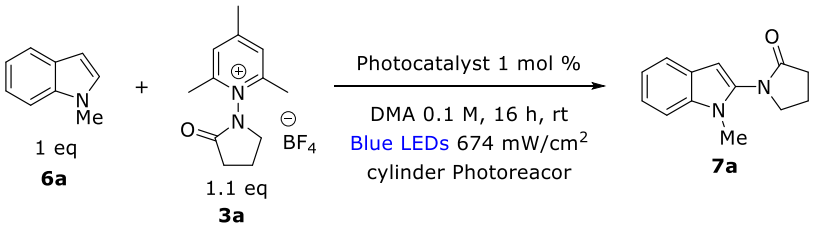
-Solvent screening



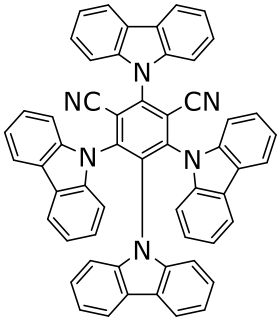
Entry	Solvent	7a Yield (%)
1	DMF	19
2	CH_3CN/DMSO 3:1	9
3	DMSO	13
4	NMP	Traces
5	Acetone	-
6	DMA	30

Table S3 *Solvent screening.*

-Photocatalyst screening



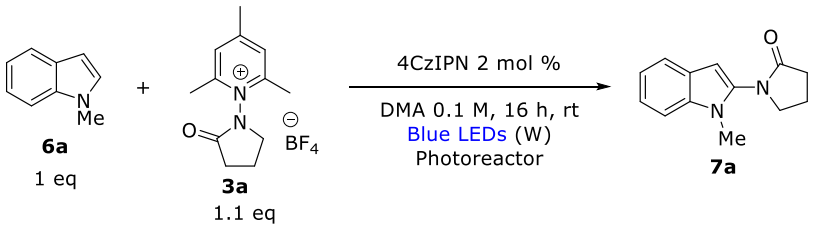
Entry	Photocatalyst	7a Yield (%)
1	Eosin Y	-
2	Ir(p-*t*Bu-ppy)$_3$	26
3	[Ir(dF(CF$_3$)ppy)$_2$(dtppy)]PF$_6$	30
4	Ir(dF-ppy)$_3$	20
5	Ir(p-F(*t*Bu)ppy)$_3$	31
6	[Ir(dtbbpy)(ppy)$_2$]PF$_6$	27
7	[C$_{56}$H$_{72}$IrN$_4$]PF$_6$	18
8	4CzIPN (2 mol %)	32
9	[Ru(bpy)$_3$]Cl$_2$	-



4CzIPN

Table S4 *Photocatalyst screening.*

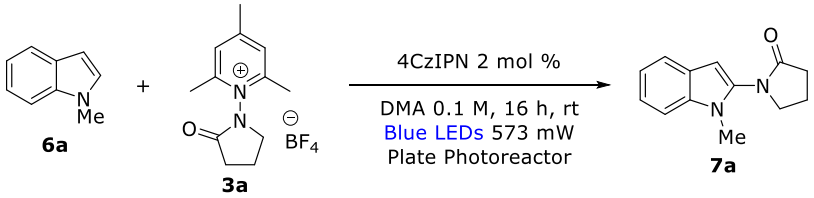
-Set-up screening



Entry	Set-Up (W)	Glassware	7a Yield (%)
1	cylinder (20)	3 mL vial	30
2	cylinder (20)	Schlenk tube	32
3	cylinder (30)	3 mL vial	29
4	cylinder (20)	10 mL sealed vial	38
5	plate (0.573)	5 mL sealed vial	28
6	plate (1.31)	5 mL sealed vial	14
7	plate (0.150)	5 mL sealed vial	< 1

Table S5 *Set-up optimization.*

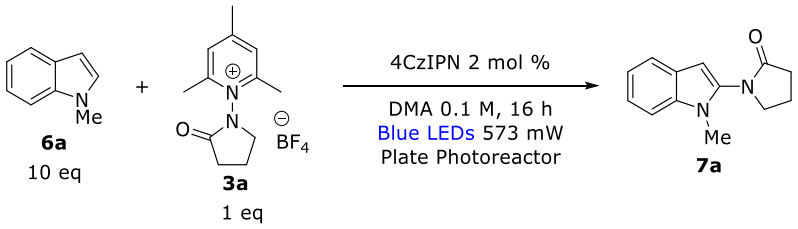
-Stoichiometry screening



Entry	3a eq	6a eq	7a Yield (%)
1	1.2	1	18
2*	1.2	1	17
3	2	1	15
4	1	3	30
5	1	5	66
6	1	7	70
7	1	10	80

Table S6 *Stoichiometry screening. * 0.05 M.*

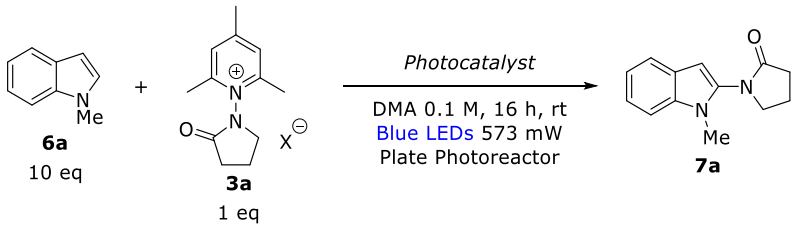
-Temperature screening



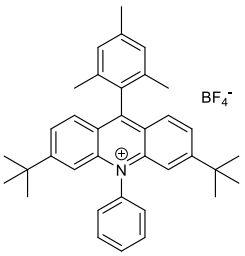
Entry	Temperature (°C)	7a Yield (%)
1	40	50
2	10	65
3	0	50

Table S7 *Temperature screening*

-Photocatalyst loading screening



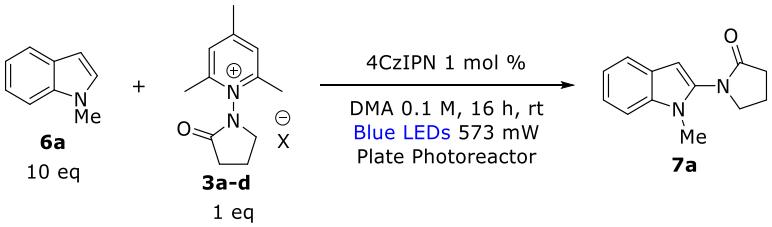
Entry	Photocatalyst (mol %)	X^-	7a Yield (%)
1	4CzIPN (0.5)	BF_4^-	75
2	4CzIPN (1)	BF_4^-	80
3	4CzIPN (5)	BF_4^-	75
4	Acridinium A (1)	TfO^-	32



Acridinium A

Table S8 *photocatalyst loading screening.*

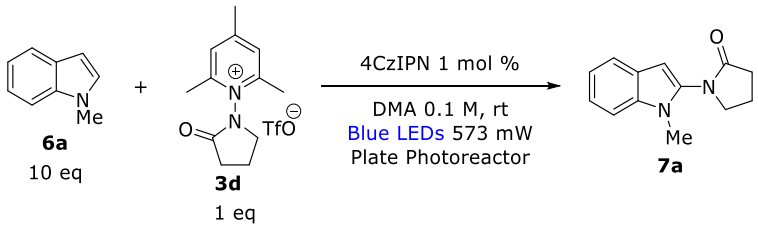
-Nitrogen radical precursor screening



Entry	3	7a Yield (%)
1	b	70
2	c	43
3	d	77

Table S9 *3a-d screening.*

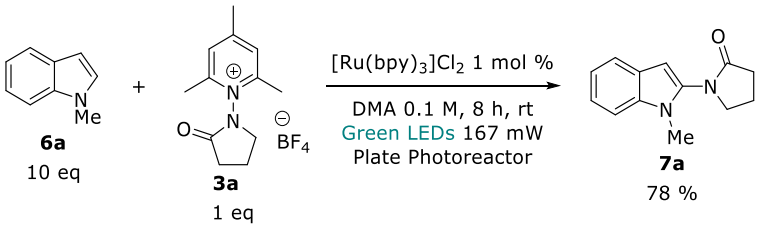
-Time screening



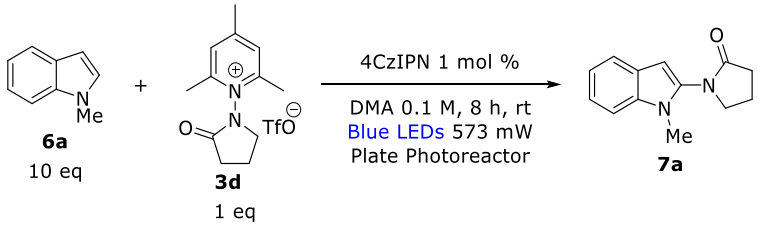
Entry	Time (h)	7a Yield (%)
1	2	5
2	4	40
3	8	80
4	16	80

Table S10 *Time screening.*

-Other suitable reaction conditions



-Control experiments



Entry	Notes	7a Yield (%)
1	no 4CzIPN	< 1
2	no light	< 1
3	no light, 60 °C	< 1

Table S11 *control experiments.*

4.1 Kinetic Studies

The kinetics of the γ-*N* lactams addition reaction with precursors **3a** and **3d** were investigated by taking small aliquots at regular intervals and evaluating the yield using GC analysis.

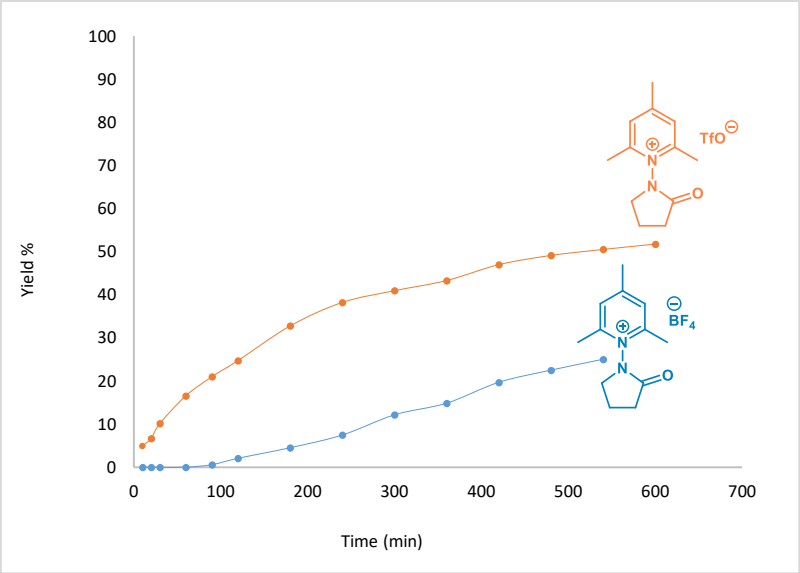
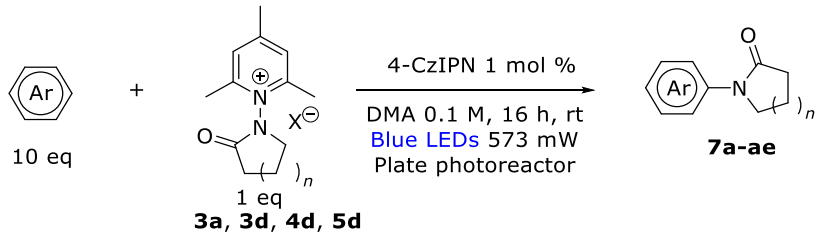


Figure S7 *Kinetic Studies*

Figure S7 shows that the reaction with **3d** is much faster than with **3a**: with **3d** (orange line) some product **7a** is already present after 10 minutes reaction, while with **3a** the first traces of product **7a** appeared after 2 hours (blue line). The tendency to aggregation of compound **3a** as revealed by ^{1}H-DOSY NMR experiments could be responsible of the slower reaction rate observed (section 3.5).

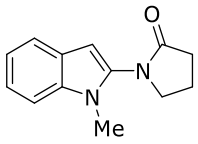
5 Substrate scope

General Procedure C: Photocatalytic addition of lactam radicals to heteroarenes and arenes.



Into a 7 ml vial, the nitrogen radical precursor **3a**, **3d**, **4a**, **4d**, **5d** (1 eq, 0.2 mmol), 1.6 mg of 4-CzIPN (1 mol %) and the heteroarenes (10 eq, 2 mmol) were introduced. The vial was sealed with a septum cap and three nitrogen-vacuum cycles were done. 2 ml of DMA were added and other three nitrogen-vacuum cycles were performed. The reaction mixture was irradiated for 16 hours with Blu LEDs (450 nm, 573 mW) using the plate photoreactor. After that the DMA was removed under reduced pressure and the crude was purified with flash column chromatography.

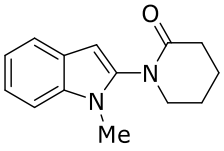
1-(1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7a)



Prepared according to general procedure C, the 1-methylindole **6a** (250 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3) afford the desired product as yellow oil in 80 % yield (34 mg).

^{1}H NMR (300 MHz, CDCl3) δ 7.56 (dt, *J* = 7.8 Hz, *J* = 1.0 Hz, 1H), 7.34 – 7.17 (m, 3H), 7.10 (ddd, *J* = 8.1 Hz, *J* = 6.9 Hz, *J* = 1.2 Hz, 1H), 6.33 (s, 1H), 3.82 (t, *J* = 7.0 Hz, 3H), 3.62 (s, 4H), 2.63 (dd, *J* = 8.5 Hz, *J* = 7.6 Hz, 3H), 2.28 (tt, *J* = 7.8 Hz, *J* = 6.7 Hz, 3H) ppm.**^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.17, 175.72, 135.46, 135.22, 127.15, 126.72, 122.29, 121.92, 120.71, 120.07, 119.21, 109.55, 109.28, 95.36, 51.65, 50.66, 31.18, 30.93, 29.82, 19.53, 19.24, 8.41 ppm. **HRMS (ESI+)** $C_{13}H_{15}N_2O$: 215.1183 (Calc. Mass 215.1184) **R_f** = 0.1 (Hexane-EtOAc 1:1), stained pink with vanillin.

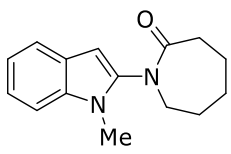
1-(1-methyl-1H-indol-2-yl)piperidin-2-one (7b)



Prepared according to the general procedure C, the 1-methylindole **6a** (250 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as yellow oil in 64 % yield (29 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.66 – 7.49 (m, 1H), 7.30 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.25 – 7.18 (m, 1H), 7.10 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 6.34 (d, *J* = 1.0 Hz, 1H), 3.74 – 3.59 (m, 2H), 3.55 (s, 3H), 2.78 – 2.49 (m, 2H), 2.03 – 1.95 (m, 4H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 171.35, 138.53, 135.21, 126.72, 121.88, 120.87, 119.85, 109.60, 95.69, 52.98, 32.91, 29.84, 29.23, 23.66, 21.53 ppm. **HRMS (ESI +)** $C_{14}H_{16}N_2ONa$: 251.1162 (Calc. Mass 251.1160). **R_f** = 0.24 (Hexane-AcOEt 3:7), stains pink with vanillin.

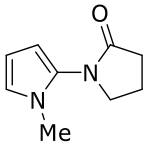
1-(1-methyl-1H-indol-2-yl)azepan-2-one (7c)



Prepared according to the general procedure C, the 1-methylindole **6a** (250 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as yellow oil in 77 % yield (38 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.57 (d, *J* = 7.8 Hz, 1H), 7.30 (d, *J* = 8.1 Hz, 1H), 7.24 – 7.20 (m, 1H), 7.16 – 7.05 (m, 1H), 6.30 (s, 1H), 3.77 (m, 2H), 3.58 (s, 3H), 2.76 (m, 2H), 1.88 (s, 6H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.89, 140.08, 135.00, 126.69, 121.72, 120.75, 119.77, 109.54, 95.05, 54.21, 37.54, 30.03, 29.33, 28.94, 23.61. **HRMS (ESI +)** $C_{15}H_{18}N_2ONa$: 265.1315 (Calc. Mass 265.1317). **R_f** = 0.25 (Hexane-AcOEt 1:1), stains pink with vanillin.

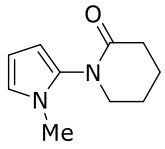
1-(1-methyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7d)



Prepared according to the general procedure C, 1-methylpyrrole **6d** (178 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as yellow oil in 95 % yield (32 mg).

^{1}H NMR (400 MHz, $CDCl_3$): δ 6.53 (dd, *J* = 3.0, 1.8 Hz, 1H), 6.09 (dd, *J* = 3.8, 3.0 Hz, 1H), 5.96 (dd, *J* = 3.8, 1.8 Hz, 1H), 3.69 (t, *J* = 7.0 Hz, 2H), 3.48 (s, 3H), 2.55 (t, *J* = 7.6 Hz, 2H), 2.20 (p, *J* = 7.6 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$): δ 176.03, 131.05, 120.30, 106.98, 103.02, 51.63, 33.33, 30.96, 19.04. **HRMS (ESI +)** $C_9H_{12}N_2O$: 165.1021 (Calc. Mass 165.1022). **R_f** = 0.17 (Hexane-AcOEt 1:1), stains orange with vanillin.

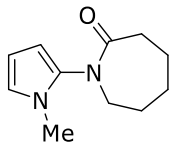
1-(1-methyl-1H-pyrrol-2-yl)piperidin-2-one (7e)



Prepared according to the general procedure C, 1-methylpyrrole **6d** (178 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as yellow oil in 70 % yield (33 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.52 (dd, *J* = 3.0, 1.8 Hz, 1H), 6.08 (dd, *J* = 3.8, 2.9 Hz, 1H), 5.92 (dd, *J* = 3.7, 1.9 Hz, 1H), 3.62 – 3.47 (m, 2H), 3.40 (s, 3H), 2.59 – 2.49 (m, 2H), 1.97 – 1.88 (m, 4H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 171.41, 131.41, 119.62, 106.66, 102.39, 52.79, 32.86, 32.76, 23.59, 21.40. **HRMS (ESI +)** $C_{10}H_{14}N_2O$: 178.11057 (Calc. Mass 178.11006). **R_f** = 0.10 (Hexane-AcOEt 1:1), stains orange with vanillin.

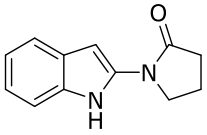
1-(1-methyl-1H-indol-2-yl)azepan-2-one (7f)



Prepared according to the general procedure C, the 1-methylpyrrole **6d** (180 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7) afford the desired product as yellow oil in 86 % yield (33 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.50 (dd, *J* = 3.0, 2.0 Hz, 1H), 6.06 (t, *J* = 3.3 Hz, 1H), 5.87 (dd, *J* = 3.7, 1.9 Hz, 1H), 3.66 (m, 2H), 3.43 (s, 3H), 2.68 (m, 2H), 1.82 (s, 6H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.98, 133.17, 119.32, 106.62, 101.83, 54.06, 37.45, 33.07, 30.00, 28.88, 23.61. **HRMS (ESI +)** $C_{11}H_{16}N_2ONa$: 215.1159 (Calc. Mass 215.1160). **R_f** = 0.25 (Hexane-AcOEt 1:1), stains pink with vanillin.

1-(1H-indol-2-yl)pyrrolidin-2-one (7g)

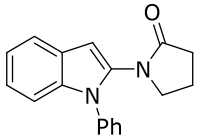


Prepared according to the general procedure C, the Indole (234 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 9:1 -> 8:2 -> 7:3) afford the desired product as white solid in 38 % yield (15 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 10.61 (s, 1H), 7.52 (dt, *J* = 7.3, 1.0, 1.0 Hz, 1H), 7.42 – 7.28 (m, 1H), 7.12 (pd, *J* = 7.1, 7.1, 7.1, 7.1, 1.4 Hz, 2H), 5.81 (dd, *J* = 2.1, 1.0 Hz, 1H), 3.94 – 3.84 (m, 2H), 2.67 (t, *J* =

8.0, 8.0 Hz, 2H), 2.31 – 2.18 (m, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 174.51, 136.54, 132.91, 126.72, 121.13, 120.23, 119.46, 110.94, 85.65, 47.53, 32.19, 18.12. **HRMS (ESI +)** $C_{12}H_{12}N_2O$: 201.1022 (Calc. Mass 201.1022). **R_f** = 0.2 (Hexane-AcOEt 7:3), stains orange with vanillin.

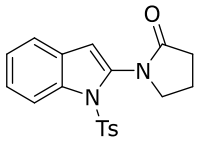
1-(1-phenyl-1H-indol-2-yl)pyrrolidin-2-one (7h)



Prepared according to the general procedure C, the *N*-phenyl indole (386 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3 -> 1:1) afford the desired product as yellow oil in 75 % yield (41 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.74 – 7.56 (m, 1H), 7.56 – 7.37 (m, 5H), 7.25 – 7.11 (m, 3H), 6.58 (s, 1H), 3.40 (t, *J* = 7.0 Hz, 2H), 2.43 (t, *J* = 8.1 Hz, 2H), 1.95 (p, *J* = 7.5 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.33, 136.81, 136.09, 133.58, 129.66, 128.08, 127.23, 126.93, 122.81, 121.07, 120.81, 110.41, 99.53, 51.07, 30.95, 19.13. **HRMS (ESI +)** $C_{18}H_{17}N_2O$: 277.1339 (Calc. Mass 277.1341). **R_f** = 0.26 (Hexane-AcEt 1:1), stains pink with vanillin.

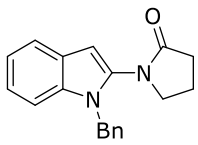
1-(1-tosyl-1H-indol-2-yl)pyrrolidin-2-one (7i)



Prepared according to the general procedure C, the *N*-tosyl indole (543 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7) afford the desired product as yellow solid in 22 % yield (16 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.00 (d, *J* = 8.3 Hz, 1H), 7.78 (d, *J* = 8.1 Hz, 2H), 7.46 (d, *J* = 7.7 Hz, 1H), 7.37 – 7.08 (m, 4H), 6.59 (s, 1H), 3.96 (s, 2H), 2.64 (t, *J* = 8.0 Hz, 2H), 2.32 (d, *J* = 6.3 Hz, 5H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.70, 173.31, 145.18, 135.24, 129.71, 128.50, 127.49, 125.25, 124.03, 121.40, 115.19, 109.00, 52.68, 31.33, 21.71, 19.22. **HRMS (ESI+)** $C_{19}H_{18}N_2O_3SNa$: 377.0938 (Calc. Mass 377.0936). **R_f** = 0.12 (Hexane-AcEt 7:3).

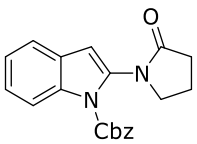
1-(1-benzyl-1H-indol-2-yl)pyrrolidin-2-one (7j)



Prepared according to the general procedure CB, the *N*-benzyl indole (415 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3 -> 6:4) afford the desired product as yellow solid in 36 % yield (21 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.67 – 7.59 (m, 1H), 7.36 – 7.23 (m, 5H), 7.17 (m, 2H), 7.05 (dd, *J* = 7.4, 1.8 Hz, 2H), 6.43 (s, 1H), 5.32 (s, 2H), 3.42 (t, *J* = 7.0 Hz, 2H), 2.52 (t, *J* = 8.1 Hz, 2H), 1.97 (p, *J* = 7.6 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.76, 138.08, 135.51, 134.14, 128.85, 127.56, 126.87, 126.42, 122.31, 120.87, 120.22, 109.96, 97.06, 51.68, 47.05, 31.06, 19.08. **HRMS (ESI +)** $C_{19}H_{19}N_2ONa$: 291.1499 (Calc. Mass 291.1497). **R_f** = 0.31 (Hexane-AcOEt 6:4).

1-(1-benzyloxycarbonyl-1H-indol-2-yl)pyrrolidin-2-one (7k)

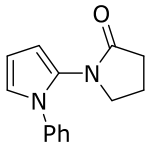


Prepared according to the general procedure C, the *N*-Cbz indole (503 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7) afford the desired product as yellow solid in 12 % yield (8 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.3 Hz, 1H), 7.55 – 7.37 (m, 6H), 7.37 – 7.17 (m, 2H), 6.51 (s, 1H), 5.39 (s, 2H), 3.66 (t, *J* = 7.1 Hz, 3H), 2.21 (t, *J* = 8.1 Hz, 2H), 1.91 (p, *J* = 7.6 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.54, 150.62, 135.26, 134.76, 132.92, 129.29, 129.21, 129.04, 127.66, 125.28,

123.47, 120.97, 115.98, 107.41, 69.47, 51.35, 30.72, 18.82. **HRMS (ESI +)** $C_{20}H_{18}N_2O_3Na$: 357.1214 (Calc. Mass 357.1215). **R_f** = 0.27 (Hexane-AcOEt 1:1).

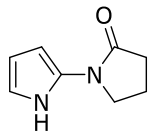
1-(1-phenyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7l)



Prepared according to the general procedure C, *N*-Ph pyrrole (268 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3 -> 6:4 -> 1:1) afford the desired product as yellow oil in 70 % yield (32 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.28 (m, 5H), 6.79 (dd, *J* = 3.2, 1.8 Hz, 1H), 6.26 (t, *J* = 3.4 Hz, 1H), 6.18 (dd, *J* = 3.7, 1.9 Hz, 1H), 3.32 (t, *J* = 7.0 Hz, 2H), 2.40 (t, *J* = 8.1 Hz, 2H), 1.92 (p, *J* = 7.4 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 176.76, 138.74, 129.32, 127.44, 126.38, 124.89, 120.73, 108.36, 106.29, 51.23, 30.78, 18.80. **HRMS (ESI +)** $C_{14}H_{14}N_2O$: 227.1180 (Calc. Mass 227.1179) **R_f** = 0.2 (Hexane-AcOEt 1:1), stains orange with vanillin.

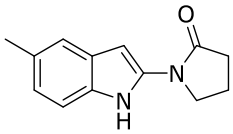
1-(1H-pyrrol-2-yl)pyrrolidin-2-one (7m)



Prepared according to the general procedure C, the pyrrole (138 µ, 2 mmol, 10 eq) was added after the nitrogen-vacuum cycles. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7) afford the desired product as yellow solid in 46 % yield (14 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 10.58 (bs, 1H), 6.58 (td, *J* = 2.7, 1.8 Hz, 1H), 6.10 (q, *J* = 3.1 Hz, 1H), 5.54 (dq, *J* = 3.7, 1.8 Hz, 1H), 3.78 (t, *J* = 7.0 Hz, 2H), 2.59 (t, *J* = 8.2 Hz, 2H), 2.20 (p, *J* = 7.5 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 173.31, 173.18, 130.87, 112.91, 106.64, 92.19, 47.41, 31.92, 18.13. **HRMS (ESI+)** 150.9 (MW 150.18 g/mol). **R_f** = 0.2 (Hexane-AcOEt 1:1), stains orange with vanillin.

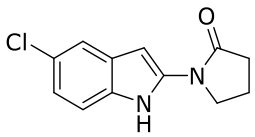
1-(5-methyl-1H-indol-2-yl)pyrrolidin-2-one (7n)



Prepared according to the general procedure C, the 5-methyl Indole (262 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3 -> 6:4 -> 1:1) afford the desired product as white solid in 37 % yield (16 mg).

^{1}H NMR (400 MHz, CDCl3) δ 10.51 (s, 1H), 7.23 (d, J = 8.2 Hz, 1H), 6.96 (dd, J = 8.2, 2.1 Hz, 1H), 5.72 (dd, J = 2.1, 0.9 Hz, 1H), 3.87 (t, J = 7.1, 2H), 2.65 (t, J = 8.1 Hz, 2H), 2.43 (s, 3H), 2.25 (p, J = 7.6 Hz, 2H).**^{13}C NMR** (101 MHz, CDCl3) δ 174.41, 136.57, 131.17, 129.41, 126.96, 122.62, 119.25, 110.60, 85.29, 47.52, 32.18, 21.65, 18.08.**HRMS (ESI +)** $C_{13}H_{14}N_2O$: 214.10985 (Calc. Mass 214.1106). **R_f** = 0.56 (Hexane-AcOEt 1:1), stains orange with vanillin.

1-(5-chloro-1H-indol-2-yl)pyrrolidin-2-one (7o)

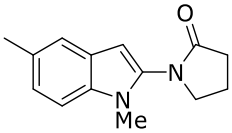


Prepared according to the general procedure C, the 5-chloro Indole (303 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3 -> 6:4 -> 1:1) afford the desired product as white solid in 28 % yield (13 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.66 (s, 1H), 7.45 (d, *J* = 2.1 Hz, 1H), 7.24 (d, *J* = 8.5 Hz, 1H), 7.07 (dd, *J* = 8.5, 2.0 Hz, 1H), 5.74 (dd, *J* = 2.1, 0.9 Hz, 1H), 3.88 (d, *J* = 7.3 Hz, 2H), 2.67 (t, *J* = 8.1 Hz, 2H), 2.28 (p, *J* = 7.6 Hz, 2H).**^{13}C NMR** (101 MHz, $CDCl_3$) δ 174.76, 137.60, 131.26, 127.93, 125.82, 121.33,

118.87, 111.89, 85.39, 47.48, 32.14, 18.12. **HRMS (ESI +)** $C_{12}H_{11}N_2OCl$: 234.05492 (Calc. Mass 234.05544). **R_f** = 0.2 (Hexane-AcOEt 7:3), stains orange with vanillin.

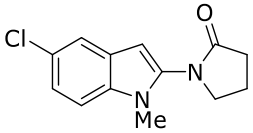
1-(1,5-dimethyl-1H-indol-2-yl)pyrrolidin-2-one (7p)



Prepared according to the general procedure C, the 5-Me Indole (290 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as white solid in 76 % yield (35 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.35 (s, 1H), 7.18 (d, *J* = 8.4 Hz, 1H), 7.04 (dd, *J* = 8.4, 1.5 Hz, 1H), 6.24 (s, 1H), 3.81 (t, *J* = 7.0 Hz, 2H), 3.63 – 3.50 (s, 3H), 2.62 (t, *J* = 8.0 Hz, 2H), 2.43 (s, 3H), 2.27 (p, *J* = 7.3 Hz, 2H).**^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.73, 134.27, 133.82, 129.17, 126.87, 123.50, 120.32, 109.25, 94.79, 51.66, 31.21, 29.85, 21.56, 19.22. **HRMS (ESI +)** $C_{14}H_{17}N_2O$: 229.1343 (Calc. Mass 229.1341). **R_f** = 0.3 (Hexane-AcOEt 3:7), stains purple with vanillin.

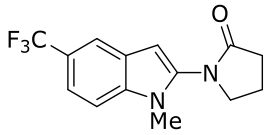
1-(5-chloro-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7q)



Prepared according to the general procedure C, the 5-Cl *N*-Me indole (331 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as white solid in 35 % yield (17.5 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.51 (d, *J* = 1.9 Hz, 1H), 7.20 (d, *J* = 8.7 Hz, 1H), 7.17 (d, *J* = 2.0 Hz, 1H), 6.25 (s, 1H), 3.82 (t, *J* = 7.0 Hz, 2H), 3.60 (s, 3H), 2.62 (t, *J* = 8.0 Hz, 2H), 2.28 (p, *J* = 7.4 Hz, 2H).**^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.75, 135.62, 133.83, 127.60, 125.69, 122.20, 119.98, 110.65, 94.83, 51.51, 31.16, 30.14, 19.27. **HRMS (ESI +)** $C_{13}H_{13}N_2ONaCl$: 271.0614 (Calc. Mass 271.0614) **R_f** = 0.25 (Hexane-AcOEt 1:1), stains pink with vanillin.

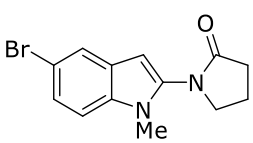
1-(1-methyl-5-trifluoromethyl-1H-indol-2-yl)pyrrolidin-2-one (7r)



Prepared according to the general procedure C, the 5-CF_3 *N*-Me indole (399 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as white solid in 60 % yield (33.4 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85 (s, 1H), 7.44 (d, *J* = 8.7 Hz, 1H), 7.35 (d, *J* = 8.7 Hz, 1H), 6.40 (s, 1H), 3.84 (t, *J* = 7.0 Hz, 2H), 2.63 (t, *J* = 8.0 Hz, 2H), 2.30 (h, *J* = 7.2 Hz, 2H). **^{19}F NMR** (76 MHz, $CDCl_3$) δ -58.30. **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.78, 136.70, 136.19, 125.96, 125.44 (q, J^1_{CF} = 271.2 Hz) 122.35 (q, J^2_{CF} = 31.8 Hz), 118.57 (q, J^3_{CF} = 3.03 Hz), 118.31 (q, J^4_{CF} = 4.47 Hz), 109.83, 96.05, 51.48, 31.12, 30.20, 19.26. **HRMS (ESI +)** $C_{14}H_{13}N_2ONaF_3$: 305.0880 (Calc. Mass 305.0878). **R_f** = 0.1 (Hexane-AcOEt 1:1), stains pink with vanillin.

1-(5-bromo-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7s)

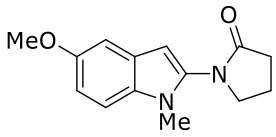


Prepared according to the general procedure C, the 5-Br *N*-Me indole (420 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as white solid in 41 % yield (24 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.67 (d, *J* = 1.9 Hz, 1H), 7.29 (dd, *J* = 8.7, 1.9 Hz, 1H), 7.15 (d, *J* = 8.7 Hz, 1H), 6.25 (s, 1H), 3.82 (t, *J* = 7.0 Hz, 2H), 3,59 (s, 3H), 2.62 (t, *J* = 8.0 Hz, 2H), 2.28 (p, *J* = 7.5 Hz, 2H).**^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.74, 135.49, 134.09, 128.27, 124.73, 123.04, 113.24, 111.08, 94.69,

51.51, 31.17, 30.14, 19.27. **HRMS (ESI +)** $C_{13}H_{13}N_2ONaBr$: 315.0110 (Calc. Mass 315.0109). $\mathbf{R_f}$ = 0.26 (Hexane-AcOEt 3:7), stains pink with vanillin.

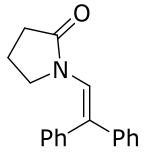
1-(5-methoxy-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7t)



Prepared according to the general procedure C, the 5-OMe *N*-Me indole (322 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 4:6 -> 3:7) afford the desired product as white solid in 98 % yield (33 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18 (d, *J* = 8.8 Hz, 1H), 7.03 (d, *J* = 2.4 Hz, 1H), 6.88 (dd, *J* = 8.8, 2.5 Hz, 1H), 6.25 (s, 1H), 3.83 (s, 3H), 3.80 (t, *J* = 7.0 Hz, 2H), 3.58 (s, 3H), 2.61 (t, *J* = 8.1 Hz, 2H), 2.26 (p, *J* = 7.5 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 175.67, 154.40, 134.65, 130.70, 126.95, 112.07, 110.33, 102.54, 94.98, 55.98, 51.58, 31.15, 29.92, 19.18. **HRMS (ESI +)** $C_{14}H_{16}N_2O_2$: 244.12054 (Calc. Mass 244.12063). $\mathbf{R_f}$ = 0.26 (Hexane-AcOEt 1:1), stains pink with vanillin.

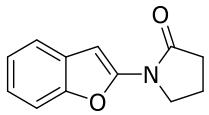
1-(1-phenyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7u)



Prepared according to the general procedure C, the ethene-1,1-diyldibenzene (352 µl, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 8:2 -> 7:3 -> 6:4) afford the desired product as yellow oil in 61 % yield (32 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.54 – 7.40 (m, 1H), 7.34 (m, 3H), 7.21 - 7.17 (m, 7H), 2.97 (t, *J* = 7.2 Hz, 2H), 2.40 (t, *J* = 8.1 Hz, 2H), 1.86 (p, *J* = 7.6 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 175.76, 141.54, 138.93, 132.51, 130.90, 130.14, 128.37, 128.23, 128.16, 127.69, 127.42, 127.09, 127.02, 126.56, 122.54, 48.34, 30.55, 18.90. **HRMS (ESI +)** $C_{18}H_{17}NO$: 264.1384 (Calc. Mass 264.1383) $\mathbf{R_f}$ = 0.3 (Hexane-AcOEt 7:3).

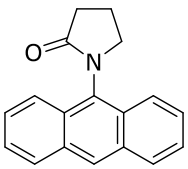
1-(benzofuran-2-yl)pyrrolidin-2-one (7v)



Prepared according to the general procedure C with the nitrogen radical precursor **3a**, the Benzofuran (330 µl, 3 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1) afford the desired product as a yellow solid with 20 % yield (12 mg). All the analytical data are in agreement with the literature.[13]

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.55 – 7.45 (m, 1H), 7.43 – 7.33 (m, 1H), 7.25 – 7.12 (m, 2H), 6.85 (d, *J* = 1.0 Hz, 1H), 4.07 (t, *J* = 7.1, 2H), 2.62 (t, *J* = 8.1 Hz, 2H), 2.24 (p, *J* = 7.7 Hz, 2H). $\mathbf{R_f}$ = 0.66 (Hexane-AcOEt 1:1), stains yellow with vanillin.

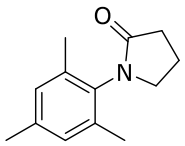
1-(anthracen-9-yl)pyrrolidin-2-one (7x)



Prepared according to the general procedure C, anthracene (356 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-Toluene 9:1 -> Hexane:AcOEt 1:1 -> 3:7 -> 2:8) afford the desired product as white solid in 88 % yield (46 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.49 (s, 1H), 8.05 (d, *J* = 8.3 Hz, 2H), 7.88 (d, *J* = 8.5 Hz, 2H), 7.65 – 7.39 (m, 4H), 3.92 (t, *J* = 7.0 Hz, 2H), 2.89 (t, *J* = 8.1 Hz, 2H), 2.50 (p, *J* = 7.4 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.87, 132.12, 129.14, 128.43, 127.77, 127.03, 125.58, 122.63, 51.32, 31.45, 19.74. **HRMS (ESI +)** $C_{18}H_{15}NONa$: 284.1049 (Calc. Mass 284.1051). $\mathbf{R_f}$ = 0.12 (Hexane: AcOEt 1:1).

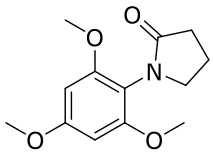
1-(2,4,6-trimethylphenyl)pyrrolidin-2-one (7y)



Prepared according to the general procedure C, mesitylene (336 mg, 2 mmol, 10 eq) was added after the nitrogen-vacuum cycles. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7 -> 2:8) afford the desired product as yellow oil in 30 % yield (12 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.91 (s, 2H), 3.59 (t, *J* = 7.0 Hz, 2H), 2.58 (t, *J* = 8.1 Hz, 2H), 2.27 (s, 3H), 2.22 (p, *J* = 7.6 Hz, 2H), 2.17 (s, 6H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 174.52, 137.91, 135.61, 129.31, 109.75, 48.96, 33.73, 30.88, 20.95, 19.30, 17.63. **HRMS (ESI +)** $C_{13}H_{18}NO$: 204.1385 (Calc. Mass 204.1388) **R_f** = 0.39 (Hexane-AcOEt 3:7).

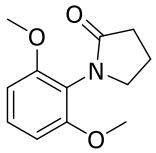
1-(2,4,6-trimethoxyphenyl)pyrrolidin-2-one (7z)



Prepared according to the general procedure C, trimethoxybenzene (336 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7 -> 2:8) afford the desired product as yellow oil in 66 % yield (33 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.13 (s, 2H), 3.78 (s, 3H), 3.77 (s, 6H), 3.56 (t, *J* = 7.1 Hz, 2H), 2.50 (t, *J* = 8.1 Hz, 2H), 2.15 (p, *J* = 7.4 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 175.49, 160.73, 157.35, 108.97, 91.29, 56.05, 55.57, 49.15, 30.87, 18.97. **HRMS (ESI +)** $C_{13}H_{17}NO_4$: 252.1231 (Calc. Mass 252.1230) **R_f** = 0.29 (Hexane-AcOEt 3:7).

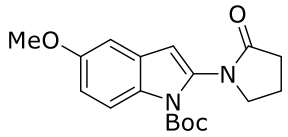
1-(2,6-dimethoxyphenyl)pyrrolidin-2-one (7aa)



Prepared according to the general procedure C, trimethoxybenzene (262 µL, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7 -> 2:8 -> 0:1) afford the desired product as yellow oil in 15 % yield (7 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.14 (d, *J* = 8.7 Hz, 1H), 6.59 (d, *J* = 8.5 Hz, 1H), 6.56 – 6.44 (m, 1H), 3.80 (s, 6H), 3.70 (t, *J* = 7.0 Hz, 2H), 2.53 (t, *J* = 8.1 Hz, 2H), 2.16 (p, *J* = 7.5 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.54, 160.26, 156.02, 129.27, 120.51, 104.72, 99.96, 55.78, 55.70, 50.28, 31.26, 18.97. **HRMS (ESI+)** $C_{12}H_{15}NO_3Na$: 244.0952 (Calc. Mass 244.0950) **R_f** = 0.1 (AcOEt).

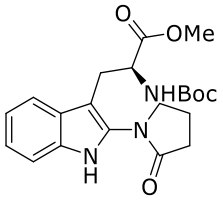
1-((tert-butyloxycarbonyl))-5-methoxy-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7ab)



Prepared according to the general procedure C, 1-(tert-butyloxycarbonyl)-5-methoxyindole (495 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7 -> 2:8 -> 0:1) afford the desired product as yellow oil in 48 % yield (13 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.91 (d, *J* = 9.1 Hz, 1H), 6.96 (d, *J* = 2.6 Hz, 1H), 6.91 (dd, *J* = 9.1, 2.6 Hz, 1H), 6.42 (s, 1H), 3.83 (s, 3H), 3.79 (t, *J* = 7.1 Hz, 2H), 2.55 (t, *J* = 8.1 Hz, 2H), 2.23 (p, *J* = 7.4 Hz, 2H), 1.64 (s, 9H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.18, 156.01, 149.14, 133.77, 129.67, 128.27, 116.66, 113.56, 106.05, 103.36, 84.01, 55.81, 51.34, 31.07, 28.34, 18.99. **R_f** = 0.1 (AcOEt).

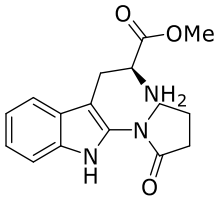
1-(*N*-Boc-OMe-L-tryptophan)pyrrolidin-2-one (7ac)



Prepared according to the general procedure C, *N*-Boc-OMe-L-tryptophan (637 mg, 2 mmol, 10 eq) was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 1:1 -> 3:7 -> 2:8) afford the desired product as yellow solid in 50 % yield (40 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 9.86 (s, 1H), 7.46 (d, *J* = 7.3 Hz, 1H), 7.24 – 7.17 (m, 1H), 7.08 (m, 2H), 5.42 (d, *J* = 8.1 Hz, 1H), 4.56 (d, *J* = 7.2 Hz, 1H), 4.01 (d, *J* = 6.7 Hz, 2H), 3.55 (s, 3H), 3.25 (d, *J* = 6.5 Hz, 2H), 2.59 (t, *J* = 8.1 Hz, 2H), 2.23 (m, 2H), 1.38 (s, 9H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 175.97, 172.79, 155.24, 132.72, 131.74, 127.31, 122.01, 119.82, 118.05, 110.82, 98.20, 79.83, 54.52, 52.27, 49.31, 31.28, 28.28, 27.58, 18.90. **HRMS (ESI+)** $C_{21}H_{27}N_3O_5Na$: 424.1846 (Calc. Mass 424.1848) **R_f** = 0.29 (Hexane-AcOEt 3:7).

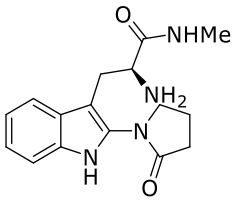
1-(*O*-Me-L-tryptophan)pyrrolidin-2-one (7ad)



Prepared according to the general procedure C, *O*-Me-L-tryptophan hydrochloride (510 mg, 2 mmol, 10 eq) was diluted with AcOEt and washed with a s.s. of $NaHCO_3$ (15 ml x2), the organic phase was dried over Na_2SO_4 and the solvent was removed under reduced pressure. The *O*-Me-L-tryptophan was transfer into the reaction vial with the DMA. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 2:8 -> 0:1 -> AcOEt-MeOH 95:5 + 1 % of TEA -> 9:1 + 1 % of TEA) afford the desired product as yellow oil in 75 % yield (46 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 10.30 (s, 1H), 7.52 (d, *J* = 7.5 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.15 (m, 2H), 4.20 – 4.00 (m, 2H), 3.83 (m, 1H), 3.70 (s, 3H), 3.32 (dd, *J* = 14.6, 5.0 Hz, 1H), 3.11 – 2.92 (m, 1H), 2.57 (t, *J* = 8.1 Hz, 2H), 2.28 – 2.11 (m, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.23, 175.38, 132.91, 132.09, 127.22, 122.04, 119.78, 118.12, 111.05, 98.91, 60.46, 55.05, 52.21, 49.75, 31.35, 29.78, 18.85. **HRMS (ESI+)** $C_{16}H_{20}N_3O_3$: 302.1510 (Calc. Mass 302.1505). **R_f** = 0.15 (AcOEt-MeOH 9:1 + 1 % of TEA).

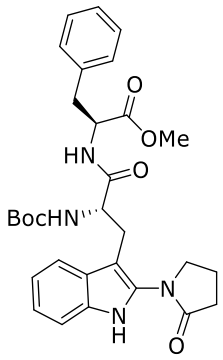
1-(*N*-Me-L-tryptophan)pyrrolidin-2-one (7ae)



Prepared according to the general procedure C, *N*-Me-L-tryptophan (510 mg, 2 mmol, 10 eq) was transfer into the reaction vial with the DMA. The crude mixture was purified by flash column chromatography on silica gel (Hexane-AcOEt 2:8 -> 0:1 -> AcOEt-MeOH 95:5 + 1 % of TEA -> 9:1 + 1 % of TEA) afford the desired product as yellow oil in 50 % yield (30 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 9.98 (bs, 1H), 7.56 (d, *J* = 8.3 Hz, 1H), 7.30 (m, 1H), 7.18-7.10 (m, 2H), 4.28 (m, 0.3H), 4.03 (t, *J* = 7.3 Hz, 2H), 3.94 – 3.79 (m, 0.5H), 3.66 (m, 1H), 3.44 – 3.31 (m, 1H), 2.95 – 2.81 (m, 1H), 2.80 – 2.68 (m, 3H), 2.56 (t, *J* = 8.1 Hz, 2H), 2.20 (t, *J* = 7.5 Hz, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.55, 175.27, 133.02, 131.59, 127.61, 122.27, 120.01, 118.70, 118.40, 111.10, 110.93, 100.74, 59.03, 56.43, 49.88, 31.34, 29.63, 25.92, 18.98. **R_f** = 0.15 (AcOEt-MeOH 9:1)

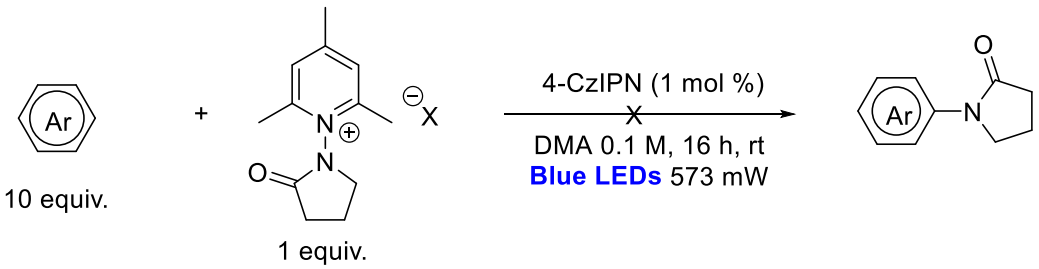
Methyl ((*S*)-2-((*tert*-butoxycarbonyl)amino)-3-(2-(2-oxopyrrolidin-1-yl)-1*H*-indol-3yl)propanoyl)-*L*-phenylalaninate (7af)

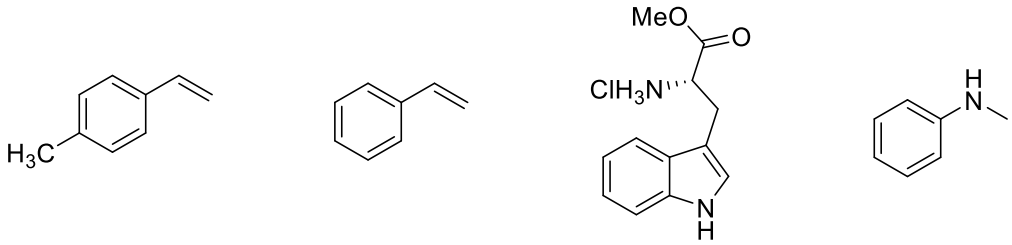


Prepared according to the general procedure C, dipeptide Boc-Trp-Phe-OMe was added with the solids. The crude mixture was purified by flash column chromatography on silica gel (Hexane-Acetone 7:3 -> 1:1) afford the desired product as white solid in 71 % yield (78 mg).

^{1}H NMR (300 MHz, $CDCl_3$) δ 9.89 (bs, 1H), 7.58 (d, *J* = 7.5 Hz, 1H), 7.30 (d, *J* = 7.4 Hz, 1H), 7.20 – 7.03 (m, 5H), 6.87-6.85 (m, 2H), 6.13 (bs, 1H), 5.56 (d, *J* = 7.4 Hz, 1H), 4.51 (m, 1H), 4.39 (q, *J* = 7.5 Hz, 1H), 4.06 (t, *J* = 7.2 Hz, 2H), 3.72 (s, 3H), 3-16 - 3.12 (m, 1H), 2.92 – 2.75 (m, 2H), 2.61 (t, *J* = 8.1 Hz, 2H), 2.24 (p, *J* = 7.6 Hz, 2H), 1.39 (s, 9H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 176.35, 171.20, 171.00, 155.39, 137.15, 135.74, 132.92, 131.55, 129.15, 128.43, 126.91, 122.09, 119.99, 118.39, 110.84, 79.79, 55.77, 52.08, 49.60, 41.03, 38.07, 31.29, 28.27, 27.94, 18.86. **HRMS (ESI+)** $C_{30}H_{36}N_4O_6Na$: 571.2532 (Calc. Mass 571.2533).

6 Unsuccessful results





7 γ-N lactam addition to 1-methylindole 6a in flow conditions

7.1 Building of the calibration Curve

The GC-calibration curve was used to screen the reactor parameters for the photocatalyzed addition in flow of the γ-lactam moiety to 1-methylindole **6a**. Biphenyl was used as an internal standard. Analyses were performed setting the following parameters: inlet temperature 250°C, the column was kept at 50°C for three minutes before starting with the ramp that increases the temperature up to 320°C, with a rate of 25°C/min. Last, the column was kept at 320°C for 1 minute.
Four standard solutions in biphenyl and 1-(1-methyl-1H-indol-2-yl)pyrrolidin-2-one **7a** have been prepared. Biphenyl was purchased from Sigma-Aldrich and crystallized from ethanol before use. 1-(1-methyl-1H-indol-2-yl)pyrrolidin-2-one **7a** was synthesized according to general procedure C, and purified by column chromatography. The four standards solutions have been prepared as reported in *Table S12*.

Solution	[Biphenyl] **(C1)**	[**7a**] **(C2)**	**Ratio C2 / C1**
1	0.047369	0.0101304	0.213862
2	0.047369	0.025902	0.546809
3	0.047369	0.034536	0.729079
4	0.047369	0.077706	1.640428

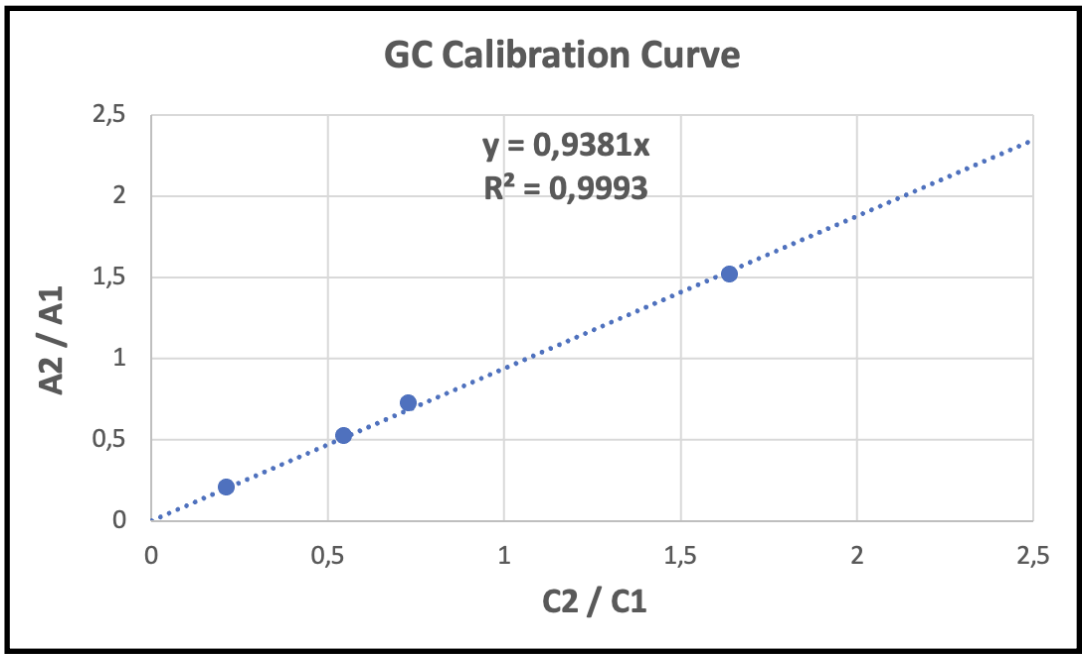
Table S12 *standard solutions for GC calibration curve*

Each solution was injected in the GC-MS; areas of the desired peaks are reported in *Table S13*.

Solution	Biphenyl Area **(A1)**	[**7a**] **(A2)**	**Ratio A2 / A1**
1	305176953	63692253	0.208706
2	301197752	157108035	0.521611
3	312364949	225982523	0.723457
4	311365096	472463263	1.517393

Table S13 *areas of the desired peaks*

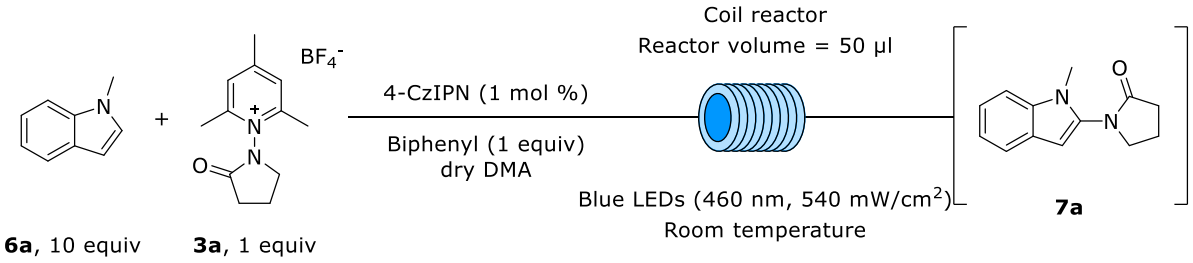
Ratio A2/A1 was linearly correlated to ratio C2/C1. A graph was built reporting on the Y-axis the ratio between areas and on the X-axis the ratio between concentrations. A linear regression was calculated, also considering the axis origin as a further point of the line (*Graph S1*). The equation of the calibration curve was Y = 0.9381017X, with a R^2 = 0.9993115. In order to validate the calibration curve, an independent experiment was performed according to general procedure C; the isolated yield was in agreement with the GC-one.



Graph S1

7.2 General Procedures for in flow photocatalytic addition of the γ-lactam radical to 1-methylindole 6a

General procedure D: tests with **3a** nitrogen radical precursor



*The desired coil reactor (**CR-1**: 25 cm x 0.02" of inner diameter in PFA, 50 µL of volume; **CR-2**: 100 cm x 0.01" of inner diameter in HPFA, 50 µL of volume) was irradiated with the photoreactor **PR-1**.*

Into a 7 ml vial, 58 mg of the nitrogen radical precursor **3a** (1 eq, 0.2 mmol), 30.9 mg of biphenyl (1 eq, 0.2 mmol), 1.6 mg of 4-CzIPN (1 mol %) and 250 µl of 1-methylindole **6a** (10 eq, 2 mmol) were introduced. The vial was sealed with a septum cap and three nitrogen-vacuum cycles were done. DMA (4 ml, 0.05 M or 2 ml, 0.1 M or 1 ml, 0.2 M or 0.4 ml, 0.5 M or 0.2 ml, 0.1 M) was added, and other three nitrogen-vacuum cycles were performed. The mixture was charged in a 5 ml SGE syringe under nitrogen atmosphere, and the whole coil reactor was filled with the reaction mixture. A proper flow rate has been set up using a syringe pump. The first reactor volume has been discharged, then 50 µl has been collected and analyzed by GC-MS.

*RC =Reactor clogged: it was not possible to obtain a reliable yield value.

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-1**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-1**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-1**; **0.05 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-1**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

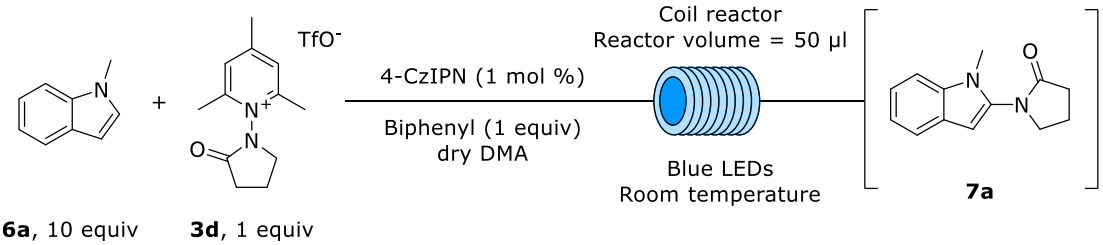
Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-1**; **0.5 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-1**; **1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	RC *
2	30	1.66	RC *
3	45	1.11	RC *
4	60	0.833	RC *

General procedure E: tests with **3d** nitrogen radical precursor



*The desired coil reactor (**CR-1**: 25 cm x 0.02" of inner diameter in PFA, 50 µL of volume; **CR-2**: 100 cm x 0.01" of inner diameter in HPFA, 50 µL of volume) was irradiated with the desired photoreactor (**PR-1**, **PR-2**, **PR-3**).*

Into a 7 ml vial, 71 mg of the nitrogen radical precursor **3d** (1 eq, 0.2 mmol), 30.9 mg of biphenyl (1 eq, 0.2 mmol), 1.6 mg of 4-CzIPN (1 mol %) and 250 µl of 1-methylindole **6a** (10 eq, 2 mmol) were introduced. The vial was sealed with a septum cap and three nitrogen-vacuum cycles were done. DMA (4 ml, 0.05 M or 2 ml, 0.1 M or 1 ml, 0.2 M or 0.4 ml, 0.5 M or 0.2 ml, 0.1 M) was added, and three additional nitrogen-vacuum cycles were performed. The mixture was charged in a 5 ml SGE syringe under nitrogen atmosphere, and the whole coil reactor was filled with the reaction mixture. A proper flow rate was maintained using a syringe pump. The first reactor volume was discharged, then 50 µl were collected and analyzed by GC-MS.

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-1**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	32
2	30	1.66	38
3	60	0.833	51

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-3**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	84
2	30	1.66	86
3	60	0.833	92

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-1**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	39
2	20	2.5	44
3	30	1.66	59
4	60	0.833	55

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	46
2	20	2.5	46
3	30	1.66	82
4	60	0.833	36

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-2**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	82
2	20	2.5	79
3	30	1.66	76

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **0.05 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	30
2	30	1.66	50
3	60	0.833	48

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-3**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	83
2	30	1.66	86
3	60	0.833	84

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	36
2	30	1.66	64
3	60	0.833	68

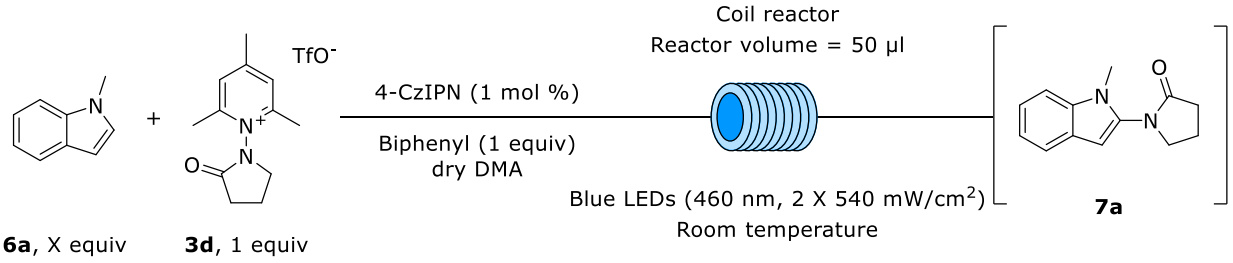
Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	75
2	30	1.66	80
3	60	0.833	81

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **0.5 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	42
2	30	1.66	72
3	60	0.833	74

General procedure F: 1-methylindole **6a** equivalents modulation tests with **3d** nitrogen radical precursor



*The desired coil reactor (**CR-1**: 25 cm x 0.02" of inner diameter in PFA, 50 µL of volume; **CR-2**: 100 cm x 0.01" of inner diameter in HPFA, 50 µL of volume) was irradiated with the photoreactor **PR-2**.*

Into a 7 ml vial, 71 mg of the nitrogen radical precursor **3d** (1 eq, 0.2 mmol), 30.9 mg of biphenyl (1 eq, 0.2 mmol), 1.6 mg of 4-CzIPN (1 mol %) and 1-methylindole **6a** (250 µl, 10 eq, 2 mmol or 125 µl, 5 eq, 1 mmol or 25 µl, 1 eq, 0.2 mmol) were introduced. The vial was sealed with a septum cap and three nitrogen-vacuum cycles were done. DMA (2 ml, 0.1 M or 1 ml, 0.2 M) was added, and three more nitrogen-vacuum cycles were performed. The mixture was charged in a 5 ml SGE syringe under a nitrogen atmosphere, and the coil reactor was filled with the reaction mixture. A proper flow rate was maintained using a syringe pump. The first reactor volume was discharged, then 50 µl were collected and analyzed by GC-MS.

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-3**; **5 equiv** of **6a**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	5	10.0	60
2	15	3.33	78
3	30	1.66	87
4	60	0.833	89

Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **5 equiv** of **6a**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	63
2	20	2.50	72
3	30	1.66	84

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-3**; **1 equiv** of **6a**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	5	10.0	30
2	15	3.33	35
3	30	1.66	42
4	60	0.833	39

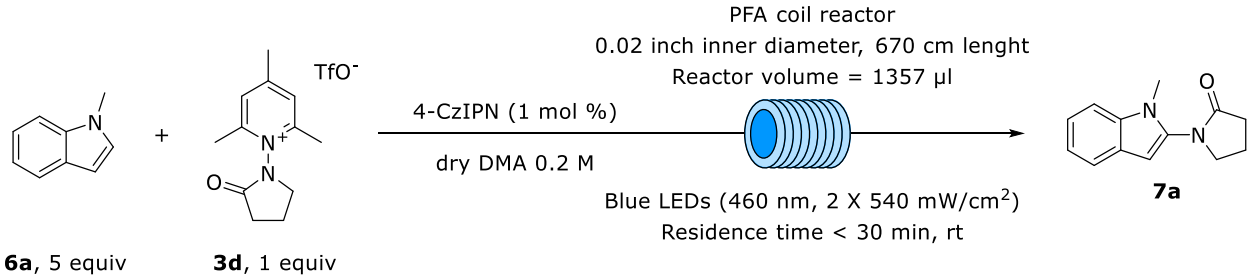
Coil Reactor: CR-2 (0.01'' ID x 100 cm in HPFA, 50µL); **Photoreactor: PR-3**; **1 equiv** of **6a**; **0.1 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	15	3.33	38
2	20	2.50	33
3	30	1.66	37

Coil Reactor: CR-1 (0.02'' ID x 25 cm in PFA, 50µL); **Photoreactor: PR-3**; **3 equiv** of **6a**; **0.2 M**

Entry	t_R (min)	Q (µL/min)	GC-Yield (%)
1	5	10.0	33
2	15	3.33	61
3	30	1.66	60
4	60	0.833	53

7.3 Scale-up tests



*The coil reactor **CR-3** (670 cm x 0.02" of inner diameter in PFA, 1357 µL of volume) was irradiated with the photoreactor **PR-3**.*

In a 25 ml two-necked flask, 355 mg of the nitrogen radical precursor **3d** (1 eq, 1 mmol), 7.9 mg of 4-CzIPN (1 mol %) and 624 µl of 1-Methylindole (5 eq, 5 mmol) were introduced. The flask was sealed with a septum cap and three nitrogen-vacuum cycles were done. 5 ml of dry DMA were then added, and other three nitrogen-vacuum cycles were performed. The mixture was charged in a 10 ml SGE syringe under nitrogen atmosphere, and the whole coil reactor was filled with the reaction mixture. A proper flow rate has been set up using a syringe pump. The first reactor volume has been discharged, then 2000 µl has been collected, dried under high vacuum to removed DMA and purified by flash column chromatography on silica gel (Hexane-AcOEt 7:3) to afford the desired product as a yellow oil.

Entry	t_R (min)	Q (µL/min)	Yield (%)
1	5	271.4	51
2	15	90.46	72
3	30	45.23	86

7.4 Productivity and Space Time Yield Calculations

The performances of the experiments under continuous conditions were evaluated in terms of productivity and space-time yield and compared to the same values calculated for the batch reactions. Productivity is defined as the mmol of product per hour provided by the system:

$$Productivity = \frac{mmol\ limiting\ reagent\ \cdot yield}{time\ (h)}$$

The space-time yield (STY) instead, is defined as the mmol of product per hour, per unit of volume:

$$STY = \frac{mmol\ limiting\ reagent\ \cdot yield}{time\ (h)\ \cdot volume\ (ml)}$$

Time in batch condition: reaction time. Time in flow condition: time to pass the same mmol of limiting agent.

As shown in Table S14. Productivity and Space Time Yield for the regioselective addition of N lactam radicals to arene and heteroarenes were calculated.

Entry	Yield (%)	Productivity ($mmolh^{-1}$)	Rel. factor	STY ($mmolh^{-1}ml^{-1}$)	Rel. factor
Batch 1	80	0.02	-	0.01	-
Batch 2	65	0.016	1	0.016	1
50 µL	87	0.019	1.2	0.35	21
1.38 mL	86	0.47	29	0.34	21

Table S14 *Batch 1: optimized batch conditions (General procedure C; 0.1M, 10 equivalents 1-methylindole **6a**). Batch 2: batch procedure performed with the optimized flow conditions (0.2M, 5 equivalents 1-methylindole **6a**).*

8 Stern-Volmer Analysis

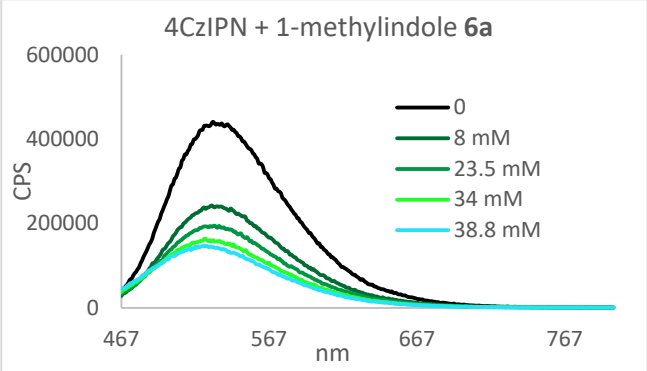
8.1 Quenching experiments with 4CzIPN under air

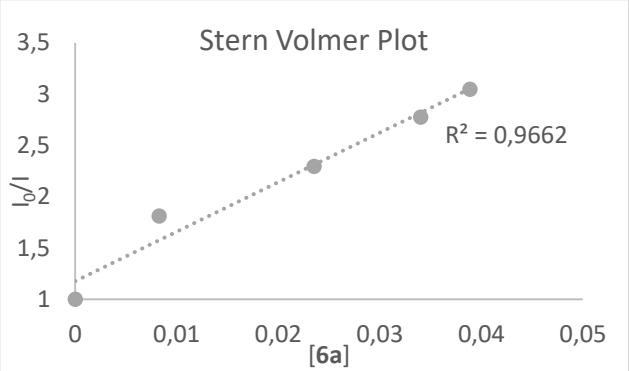
SOLUTION A: 1.0 mg of 4CzIPN (1.27 µmol) were dissolved in 0.98 mL of DMA, then 150 µl of this solution were diluted with 20 ml of DMA in order to obtain a standard photocatalyst solution ~10 µM.

4CzIPN vs 1-methylindole **6a** in DMA under air equilibration

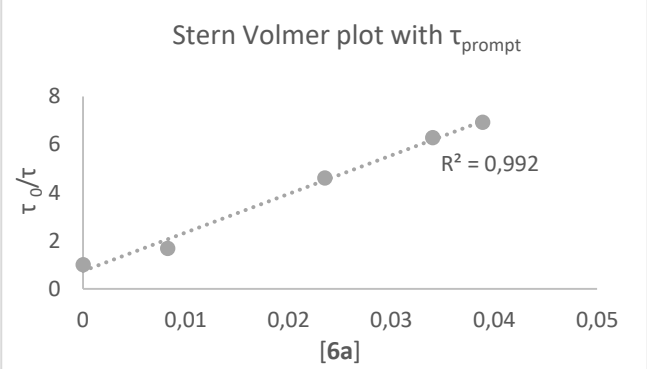
Solution 1: 50 µl of 1-methylindole **6a** (0.4 mmol) were dissolved into 4 ml of Solution A. Then, after recording the photoluminescence and the lifetime spectra of solution A, an increasing amount of solution 1 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

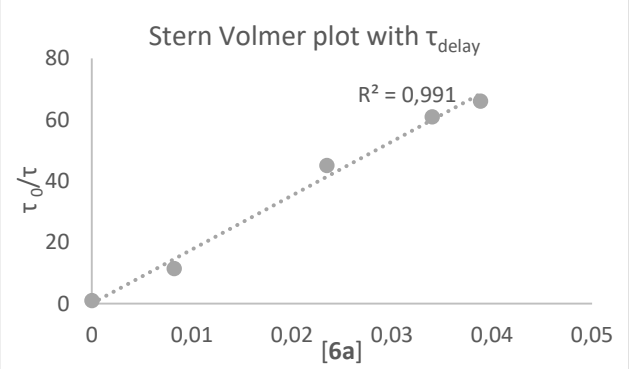
Photoluminescence





Lifetime

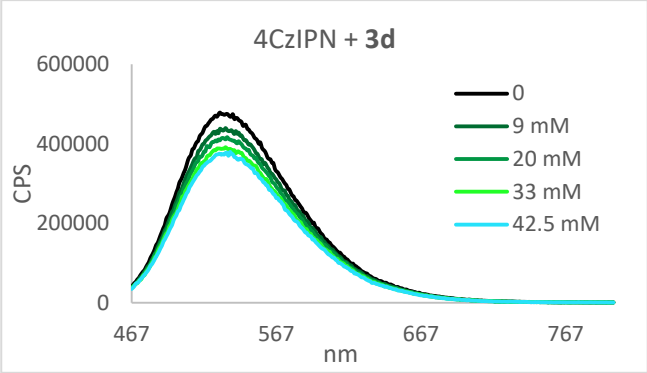


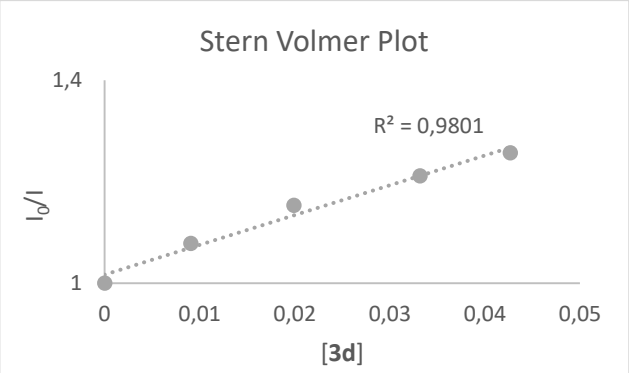


4CzIPN vs nitrogen radical precursor **3d** in DMA under air equilibration

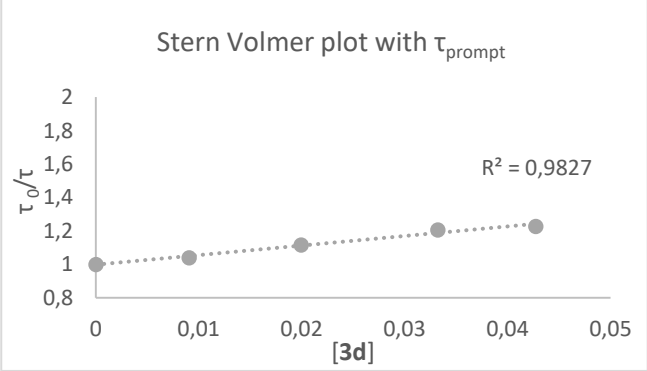
Solution 2: 141.1 mg of nitrogen radical precursor **3d** (0.398 mmol) were dissolved into 4 ml of Solution A. Then, after recording the photoluminescence and the lifetime spectra of solution A, an increasing amount of solution 2 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

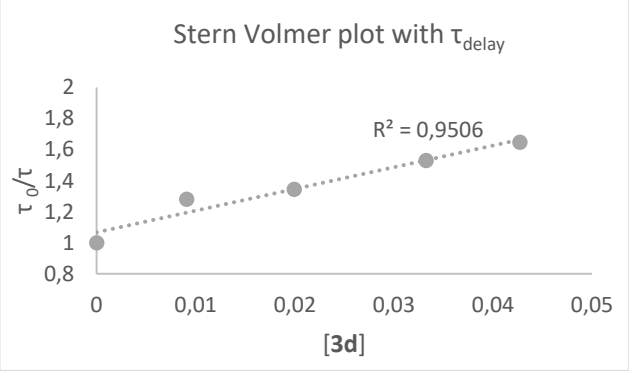
Photoluminescence





Lifetime

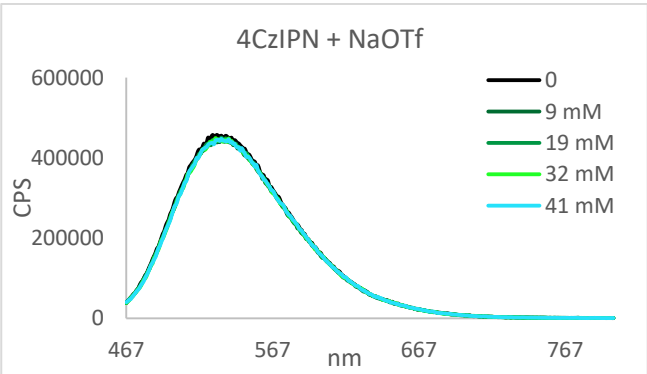


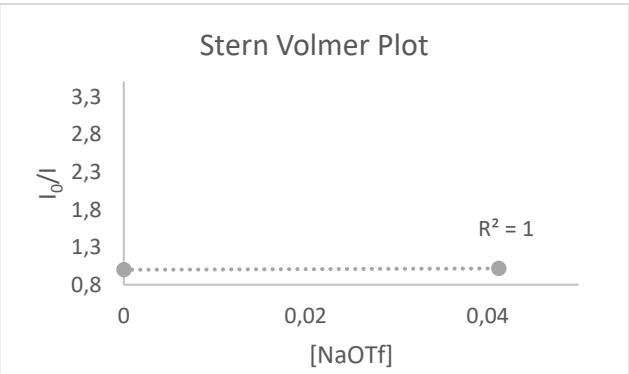


4CzIPN vs NaOTf salt in DMA under air equilibration

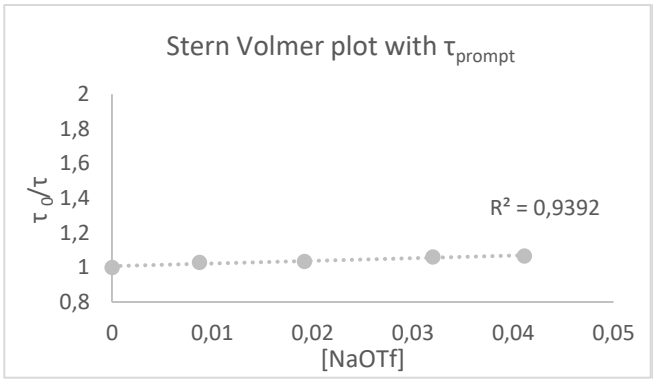
Solution 3: 66.2 mg of NaOTf (0.385 mmol) were dissolved into 4 ml of Solution A. Then, after recording the photoluminescence and the lifetime spectra of solution A, an increasing amount of solution 3 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

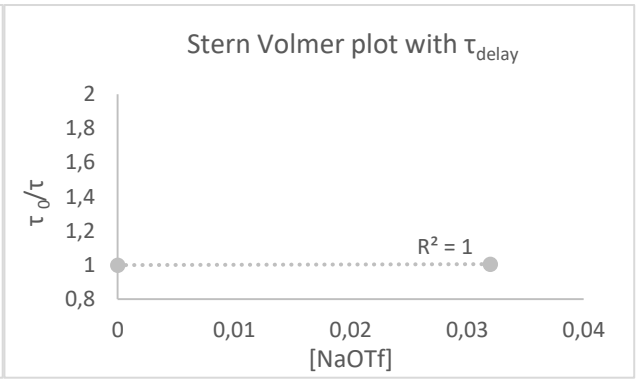
Photoluminescence





Lifetime

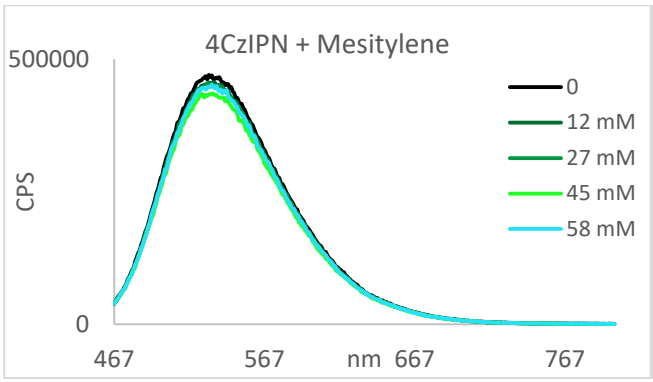


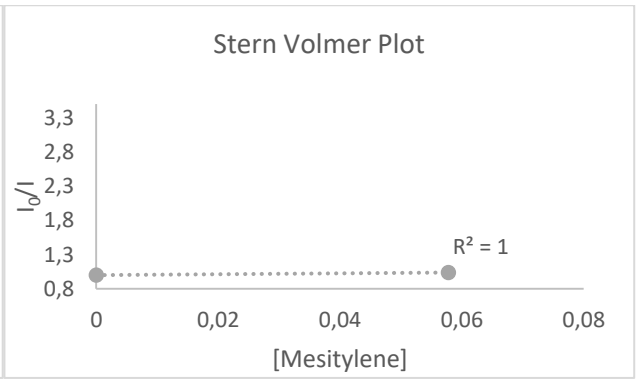


4CzIPN vs Mesitylene in DMA under air equilibration

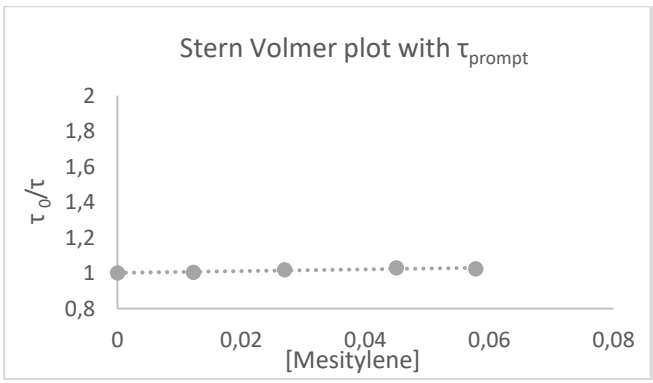
Solution 4: 56 µl of mesitylene (0.40 mmol) were dissolved into 4 ml of Solution A. Then, after recording the photoluminescence and the lifetime spectra of solution A, an increasing amount of solution 4 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

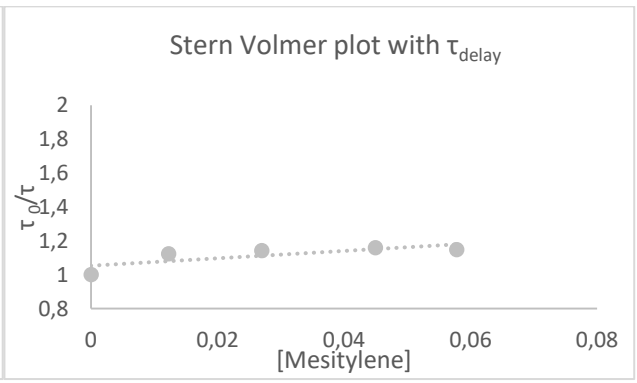
Photoluminescence



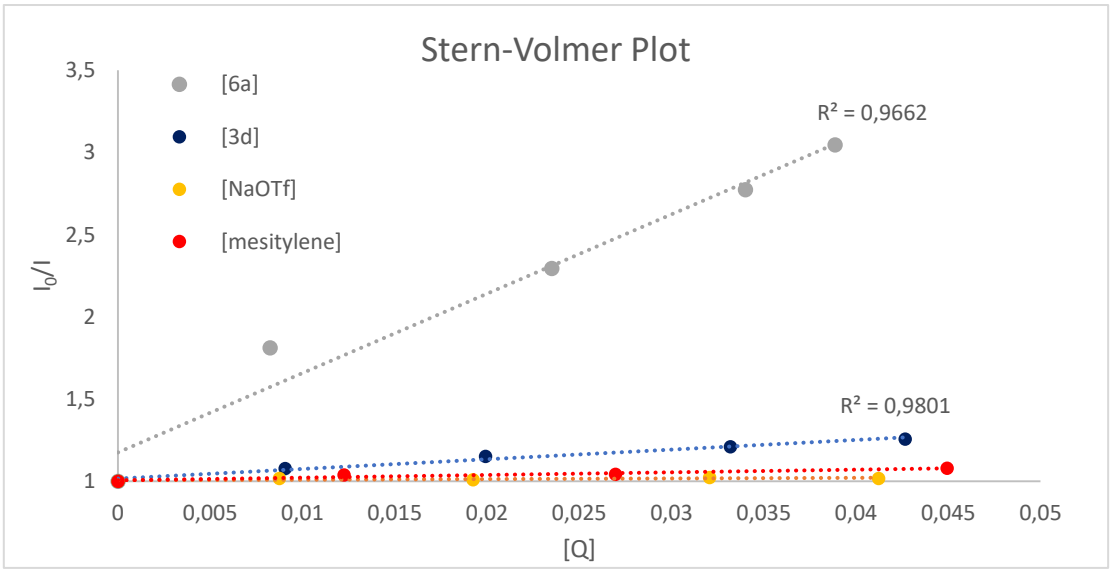


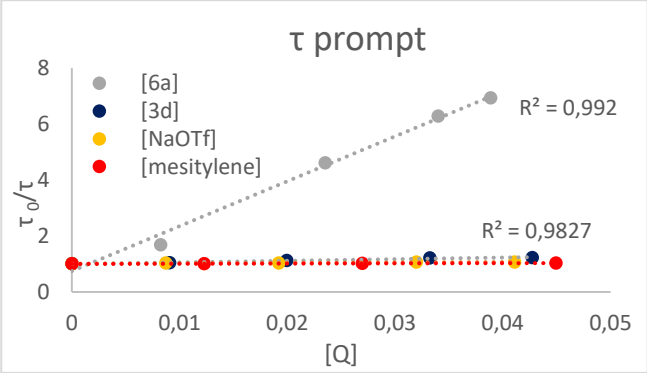
Lifetime

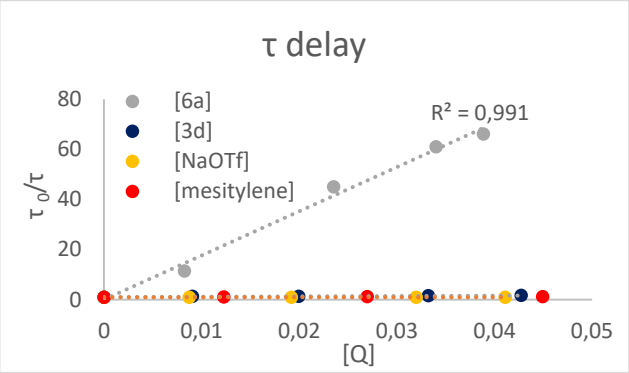




Summary


Stern-Volmer Plot
[6a]
[3d]
[NaOTf]
[mesitylene]
R² = 0,9662
R² = 0,9801
I0/I
[Q]
3,5
3
2,5
2
1,5
1
0
0,005
0,01
0,015
0,02
0,025
0,03
0,035
0,04
0,045
0,05


τ prompt
[6a]
[3d]
[NaOTf]
[mesitylene]
R² = 0,992
R² = 0,9827
τ0/τ
[Q]
8
6
4
2
0
0
0,01
0,02
0,03
0,04
0,05


τ delay
[6a]
[3d]
[NaOTf]
[mesitylene]
R² = 0,991
τ0/τ
[Q]
80
60
40
20
0
0
0,01
0,02
0,03
0,04
0,05

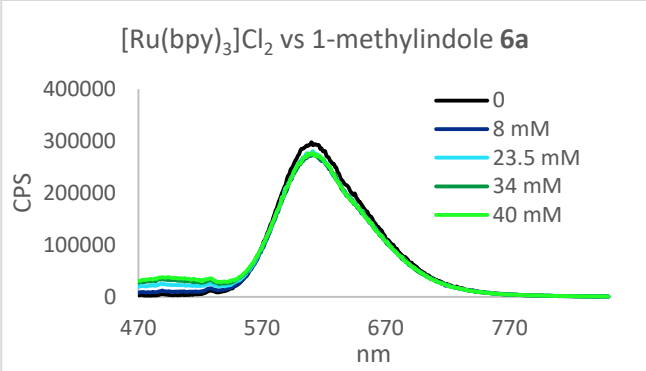
8.2 Quenching experiments with $[Ru(bpy)_3]Cl_2$ under air

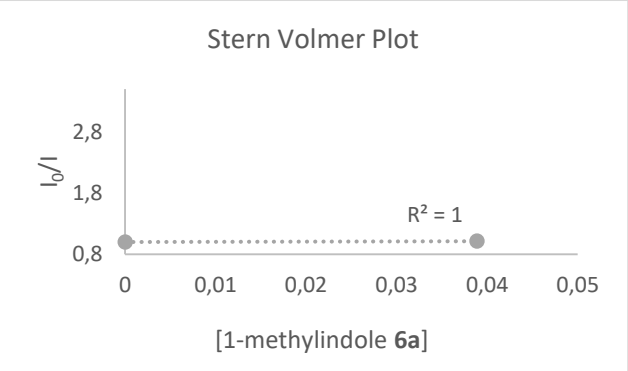
SOLUTION B: 1.5 mg of $[Ru(bpy)_3]Cl_2$ (2 µmol) were dissolved in 1.54 mL of DMA, then 150 µl of this solution were diluted with 20 ml of DMA in order to obtain a standard photocatalyst solution ~10 µM.

$[Ru(bpy)_3]Cl_2$ vs 1-methylindole **6a** in DMA under air equilibration

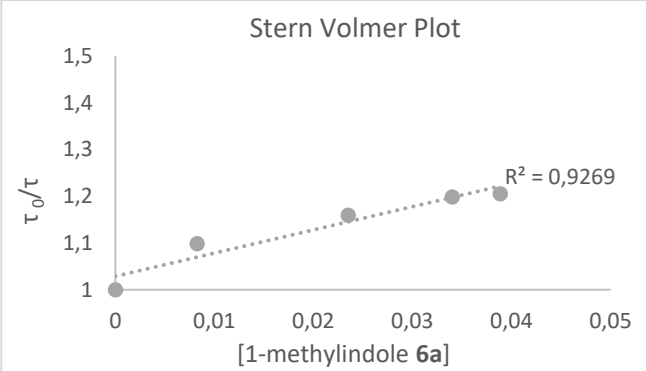
Solution 5: 50 µl of 1-methylindole **6a** (0.4 mmol) were dissolved into 4 ml of Solution B. Then, after recording the photoluminescence and the lifetime spectra of solution B, an increasing amount of solution 5 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

Photoluminescence





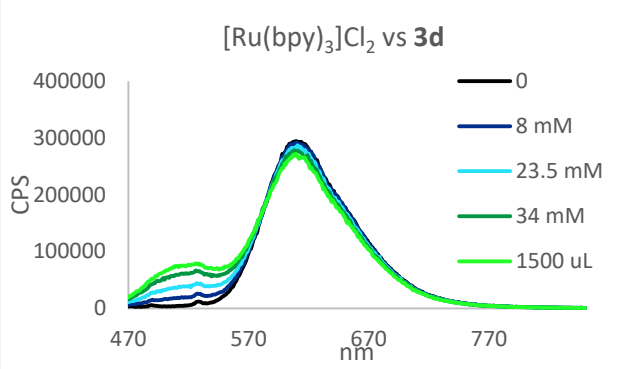
Lifetime

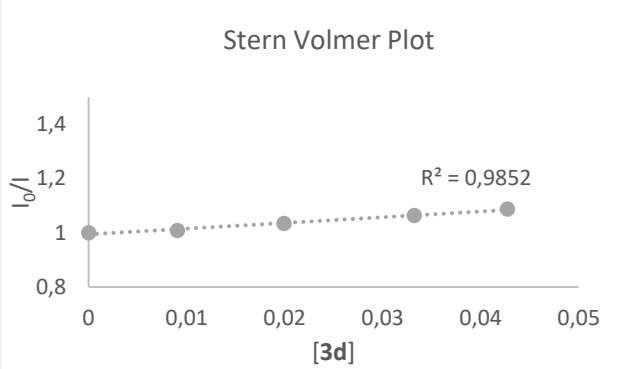


$[Ru(bpy)_3]Cl_2$ vs radical precursor **3d** in DMA under air equilibration

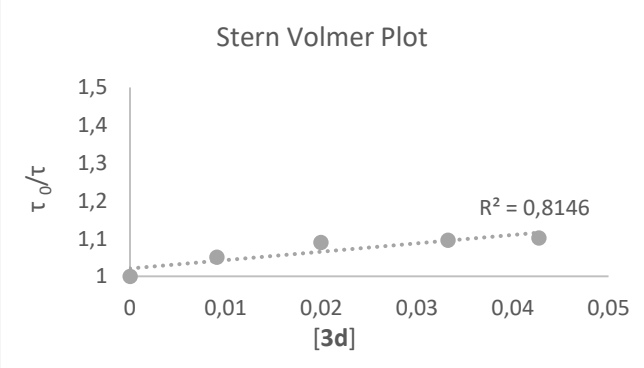
Solution 6: 141.3 mg of nitrogen radical precursor **3d** (0.399 mmol) were dissolved into 4 ml of Solution B. Then, after recording the photoluminescence and the lifetime spectra of solution B, an increasing amount of solution 6 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

Photoluminescence





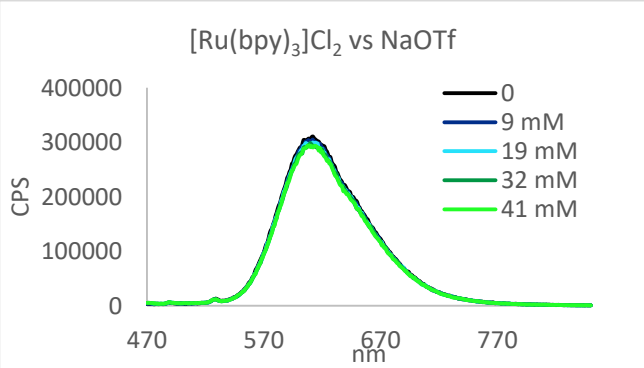
Lifetime

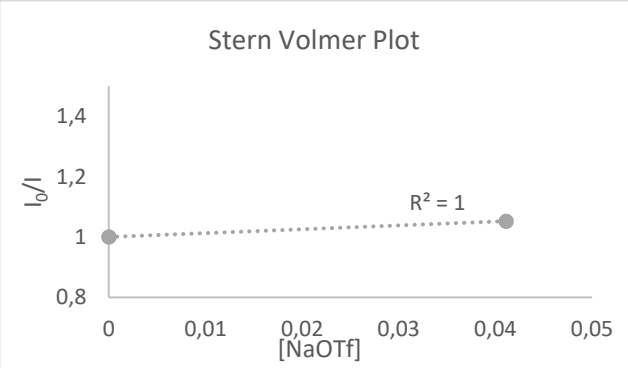


$[Ru(bpy)_3]Cl_2$ vs NaOTf in DMA under air equilibration

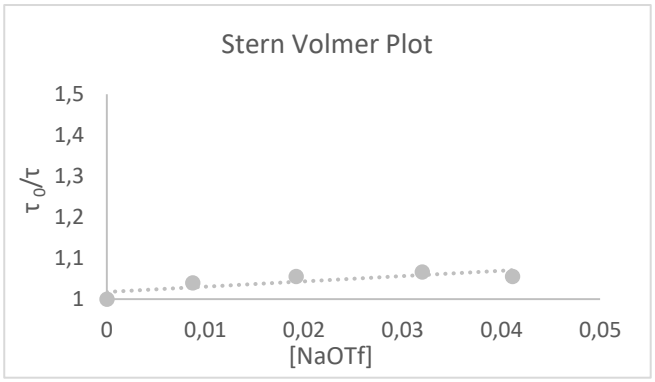
Solution 7: 66.0 mg of NaOTf (0.384 mmol) were dissolved into 4 ml of Solution B. Then, after recording the photoluminescence and the lifetime spectra of solution B, an increasing amount of solution 7 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

Photoluminescence





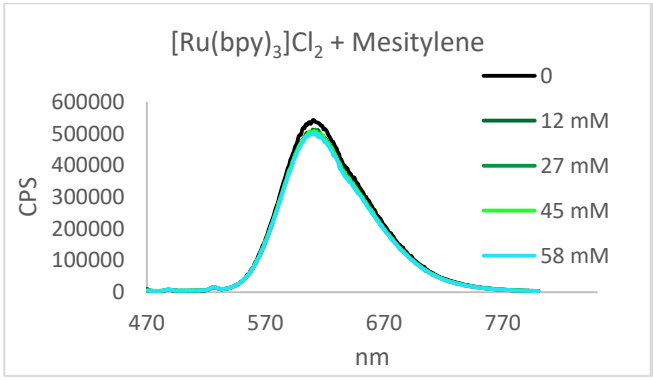
Lifetime

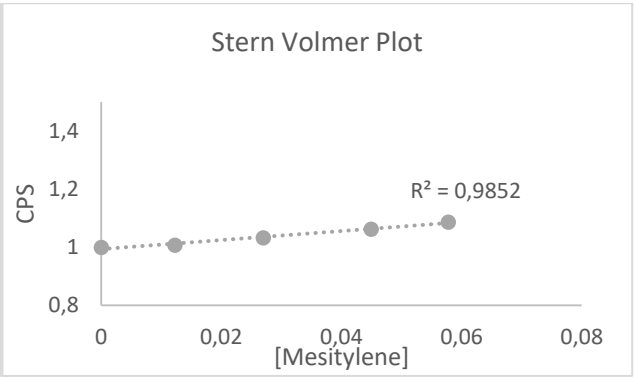


$[Ru(bpy)_3]Cl_2$ vs Mesitylene DMA under air equilibration

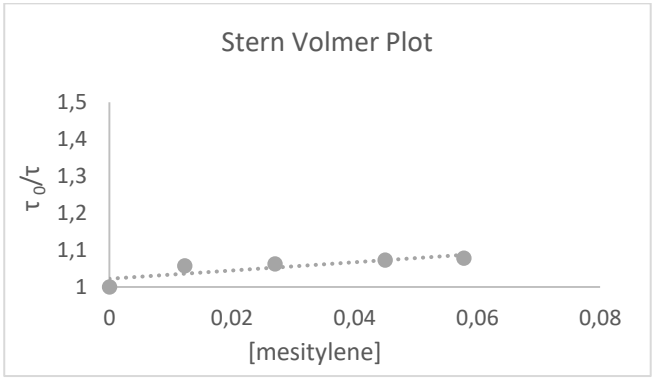
<u>Solution 8</u>: 56.0 µl of mesitylene (0.40 mmol) were dissolved into 4 ml of Solution B. Then, after recording the photoluminescence and the lifetime spectra of solution B, an increasing amount of solution 8 was added in order to study the changing of the quencher concentration vs the I_0/I and τ_0/τ.

Photoluminescence

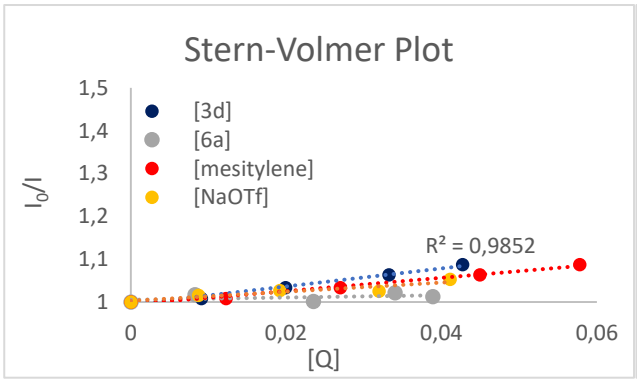


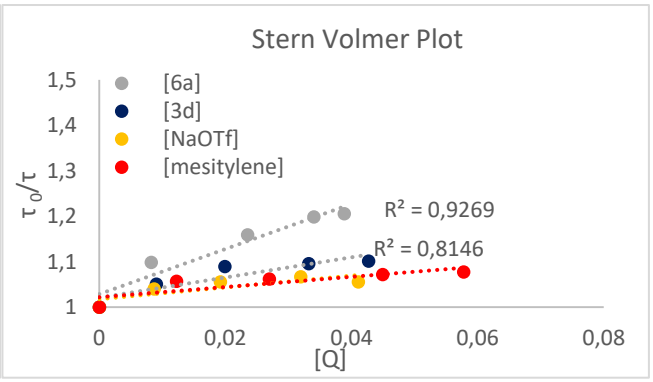


Lifetime



Summary


Stern-Volmer Plot
1,5
1,4
1,3
1,2
1,1
1
I_0/I
[3d]
[6a]
[mesitylene]
[NaOTf]
$R^2 = 0,9852$
0
0,02
0,04
0,06
[Q]


Stern Volmer Plot
1,5
1,4
1,3
1,2
1,1
1
τ_0/τ
[6a]
[3d]
[NaOTf]
[mesitylene]
$R^2 = 0,9269$
$R^2 = 0,8146$
0
0,02
0,04
0,06
0,08
[Q]

9 DFT Calculations

9.1 Computational details

Density functional theory (DFT) calculations were performed using the Gaussian 16 program and the results were produced with GaussView 6.0. For the calculation of global and local electrophilicity index, B3LYP functional was used and the geometries of studied radicals were optimized at the UB3LYP/6-311+G(d,p) level of theory, followed by frequency calculations at the same level. Each optimized radical geometry has been used to calculate the adiabatic energy of the corresponding cation and ion. The Hirshfield charges have also been calculated on each structure.

To extract the values of the Hirshfield charges, the .fchk file generated by Gaussian has been analysed in MultiWFN 3.3.9.

The Fukui indices were calculated with the following equations:

$$f^{+} = q(N) - q(N+1)$$

$$f^{-} = q(N-1) - q(N)$$

Where q(N) is the Hirshfield charge of the radical, q(N+1) is the anion, and q(N-1) is the cation.

9.2 Optimized Structures, Cartesian Coordinates, Fukui indices, and Energies

5-terms cycle

	Lactam^{+}	Lactam$^{\cdot}$	Lactam^{-}	
Electronic Energy (EE)	-285,65500	-286,03732	-286,11816	Hartree
EE + Zero-point Energy		-285,94170		Hartree
EE + Thermal Free Energy Correction		-285,97136		Hartree

	Coordinates			Hirshfield charges			Fukui indeces	
	X	Y	Z	q(N+1)	q(N)	q(N-1)	f^{+}	f^{-}
C	1,26462	-0,84251	0,10707	-0,05978	-0,00650	0,06688	0,05328	0,07337
C	-0,88234	-0,03792	-0,00597	0,06080	0,16063	0,22892	0,09984	0,06829
C	1,40771	0,67301	-0,18199	-0,07463	-0,04902	-0,01500	0,02561	0,03403
H	1,89775	-1,49043	-0,50691	-0,01397	0,04995	0,13273	0,06392	0,08279
H	1,53210	-1,07685	1,15282	-0,02642	0,05472	0,15502	0,08113	0,10030
H	2,20014	1,13815	0,40542	-0,00662	0,03743	0,07802	0,04406	0,04059
H	1,64348	0,82567	-1,23830	0,00371	0,03564	0,07992	0,03193	0,04427
N	-0,11868	-1,21288	-0,05760	-0,36194	-0,09235	0,14261	0,26959	0,23496
O	-2,09880	-0,05325	-0,05328	-0,44769	-0,23048	-0,02998	0,21721	0,20050
C	0,00520	1,20078	0,13929	-0,08184	-0,05434	-0,01768	0,02750	0,03667
H	-0,07709	1,55421	1,17312	0,00574	0,04664	0,08611	0,04090	0,03948
H	-0,34635	2,00527	-0,50707	0,00436	0,04810	0,09262	0,04374	0,04452

6-terms cycle

	$Lactam^+$	$Lactam^{\cdot}$	$Lactam^-$	
Electronic Energy (EE)	-324,99770	-325,36449	-325,41878	Hartree
EE + Zero-point Energy		-325,23924		Hartree
EE + Thermal Free Energy Correction		-325,27009		Hartree

	Coordinates			Hirshfield charges			Fukui indeces	
	X	Y	Z	q(N+1)	q(N)	q(N-1)	f^+	f^-
C	-0,88765	-1,31604	0,19377	-0,05148	-0,00171	0,06096	0,04977	0,06267
C	-1,75234	-0,05742	-0,07265	-0,07599	-0,03945	0,01836	0,03654	0,05781
C	-0,99886	1,21579	0,32075	-0,05584	-0,04148	-0,01488	0,01436	0,02659
C	0,38360	1,25801	-0,35934	-0,07967	-0,04990	-0,00153	0,02977	0,04837
H	-1,57750	2,10276	0,04771	0,00183	0,03840	0,09344	0,03658	0,05504
H	-2,01115	-0,02834	-1,13596	0,00164	0,03397	0,07227	0,03233	0,03829
H	-2,68721	-0,15573	0,48649	-0,01522	0,04075	0,09259	0,05597	0,05184
H	-0,74169	-1,42319	1,27998	-0,02203	0,04297	0,11404	0,06500	0,07107
H	-1,38470	-2,21567	-0,17295	-0,00702	0,04036	0,09072	0,04738	0,05036
H	0,26169	1,37878	-1,44171	0,00888	0,04243	0,07557	0,03356	0,03314
H	1,00716	2,07626	0,00417	-0,00475	0,04543	0,09757	0,05017	0,05215
H	-0,86786	1,24668	1,40838	0,00962	0,03270	0,06037	0,02308	0,02767
C	1,12486	-0,05014	-0,09903	0,09254	0,16648	0,21589	0,07395	0,04941
O	2,24868	-0,12369	0,35412	-0,40245	-0,27208	-0,14590	0,13037	0,12618
N	0,39916	-1,18475	-0,45859	-0,39813	-0,07853	0,17064	0,31960	0,24917

7-terms cycle

	$Lactam^+$	$Lactam^{\cdot}$	$Lactam^-$	
Electronic Energy (EE)	-364,33367	-364,68702	-364,73106	Hartree
EE + Zero-point Energy		-364,53305		Hartree
EE + Thermal Free Energy Correction		-364,56605		Hartree

	Coordinates			Hirshfield charges			Fukui indeces	
	X	Y	Z	q(N+1)	q(N)	q(N-1)	f^+	f^-
C	-0,4544	-1,62565	0,08018	-0,045869	-0,001164	0,055392	0,044705	0,056556
C	-1,76552	-0,80414	-0,007653	-0,076028	-0,038785	0,017115	0,037243	0,0559
C	-1,65725	0,646849	0,479214	-0,054787	-0,045988	-0,026375	0,008799	0,019613
C	-0,71068	1,534681	-0,351975	-0,058343	-0,046424	-0,028606	0,011919	0,017818
C	0,781972	1,378894	-0,022525	-0,074989	-0,049759	-0,021965	0,02523	0,027794
H	-0,15445	-1,7323	1,131442	-0,01725	0,034829	0,088087	0,052079	0,053258
H	-2,10953	-0,81447	-1,046848	0,000691	0,032755	0,067115	0,032064	0,03436
H	-1,35277	0,666404	1,533774	0,008969	0,02799	0,049664	0,019021	0,021674
H	-0,88078	1,343526	-1,417029	0,009432	0,028596	0,046374	0,019164	0,017778
H	-0,63969	-2,62002	-0,332929	-0,012935	0,043188	0,097332	0,056123	0,054144

H	-2,51484	-1,34108	0,583294	-0,023177	0,038364	0,093428	0,061541	0,055064
H	-2,66127	1,082203	0,446979	0,002679	0,034149	0,081254	0,03147	0,047105
H	-0,97239	2,583992	-0,185965	-0,00349	0,034227	0,069856	0,037717	0,035629
H	1,388477	1,971372	-0,716465	0,01177	0,049559	0,088259	0,037789	0,0387
H	1,002813	1,764841	0,97797	0,001747	0,04291	0,078377	0,041163	0,035467
C	1,35311	-0,03479	-0,055478	0,111864	0,17059	0,217878	0,058726	0,047288
O	2,441721	-0,31625	0,404778	-0,390724	-0,27728	-0,117891	0,113444	0,159389
N	0,582467	-0,9928	-0,706147	-0,387711	-0,077341	0,144988	0,31037	0,222329

9.3 Electrophilicity calculation

To calculate the value of electrophilicity, the Electronic Energy (EE) has been used. Here are reported the equations to calculate the electrophilicity indices:

$$IP = Ionization\ Potential = E^{+} - E^{0}$$

$$EA = Electronic\ Affinity = E^{0} - E^{-}$$

$$\mu = Electronic\ Chemical\ Potential = -\frac{EA + IP}{2}$$

$$\eta = Chemical\ Hardness = \frac{IP - EA}{2}$$

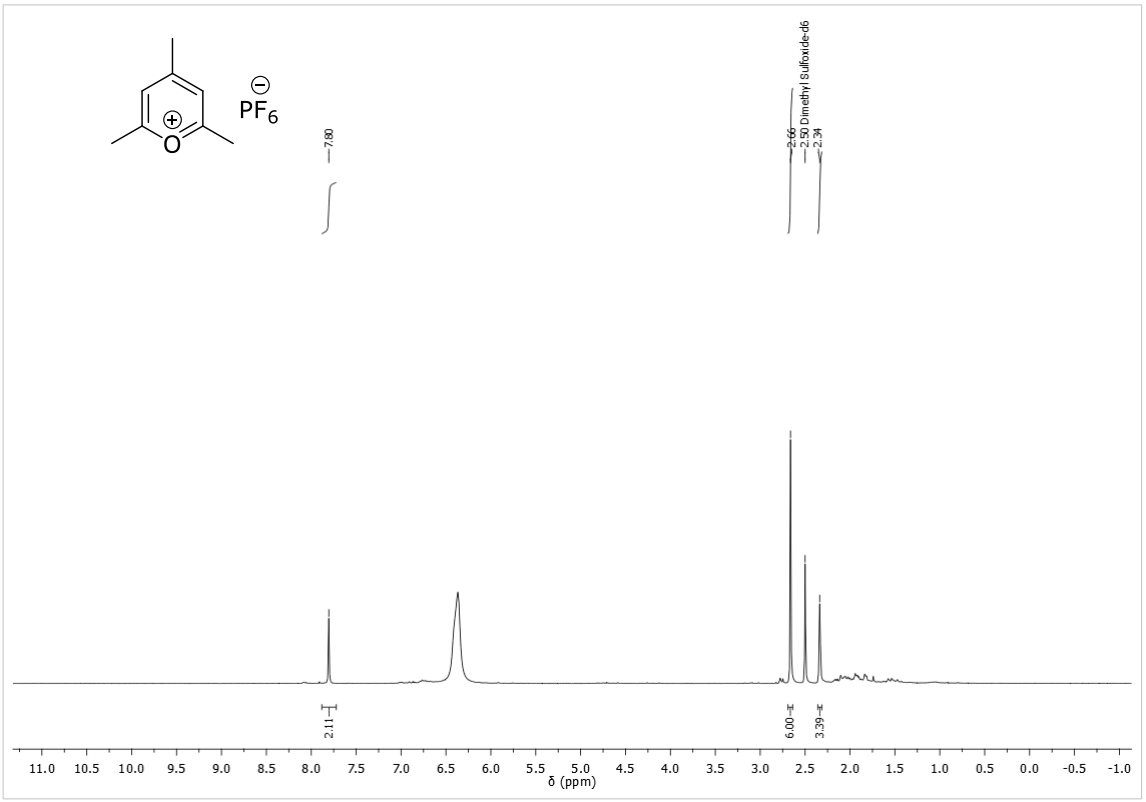
$$\omega^{+} = Global\ Electrophilicity = \frac{\mu^{2}}{2\eta}$$

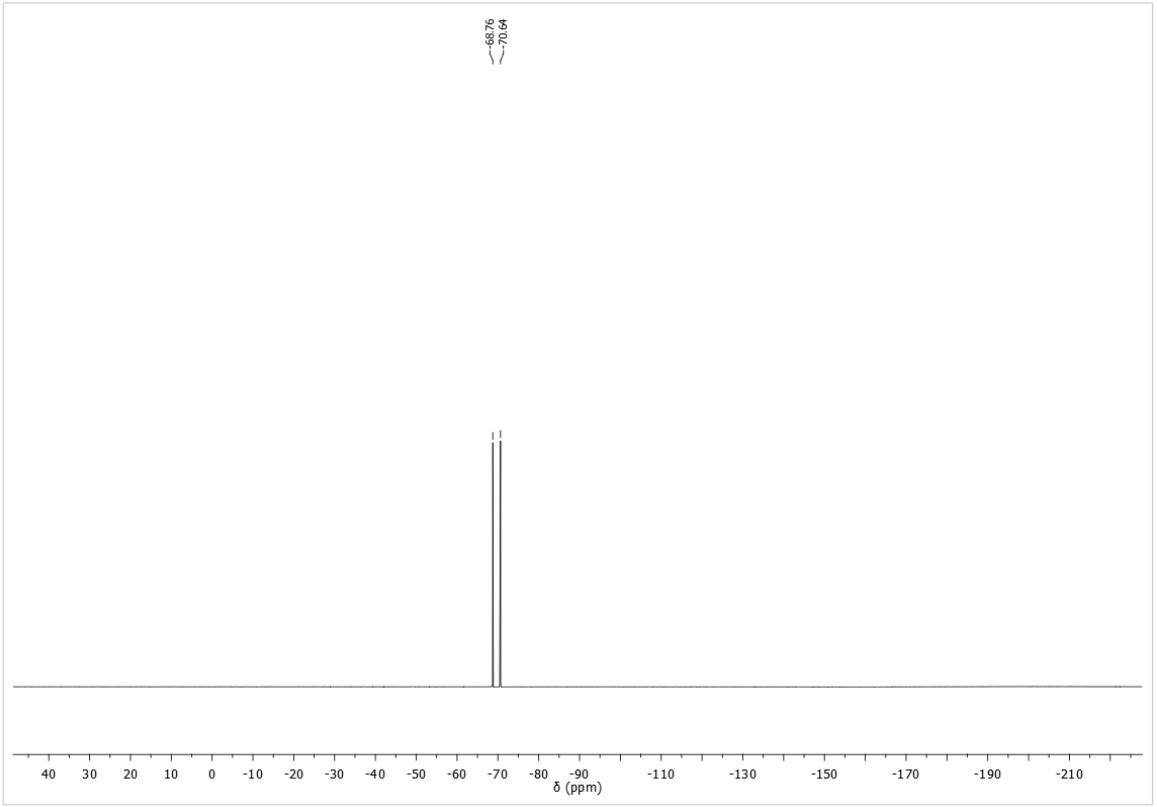
$$\omega_X^{+} = Local\ Electrophilicity\ on\ atom\ X = \omega^{+} f_X^{+}$$

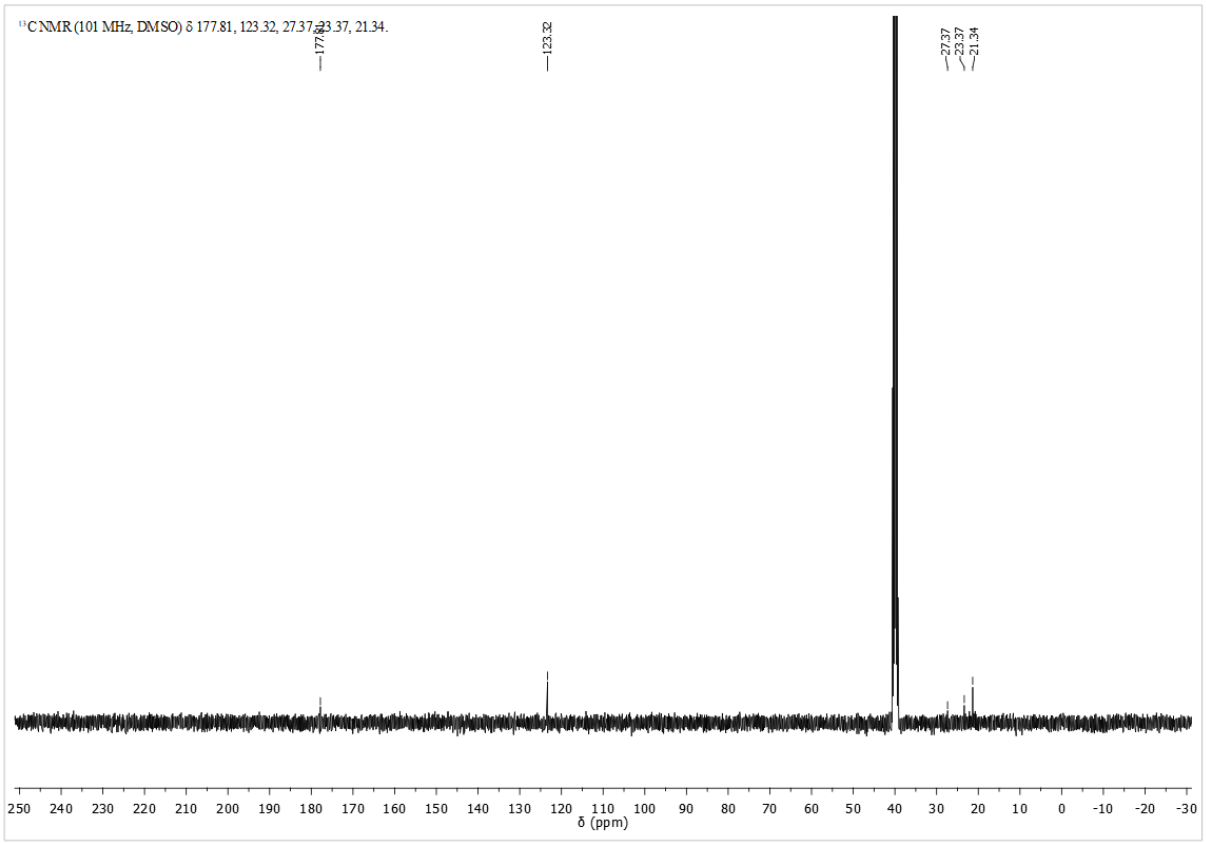
	IP (eV)	EA (eV)	m (eV)	h (eV)	w^{+} (eV)	w_N^{+} (eV)
5- terms cycle	10,40341	2,199878	-6,30164	4,101764	4,840685	1,305
6- terms cycle	9,980977	1,477252	-5,72911	4,251862	3,859809	1,233591
7- terms cycle	9,615228	1,198308	-5,40677	4,20846	3,47314	1,077959

10 NMR Spectra

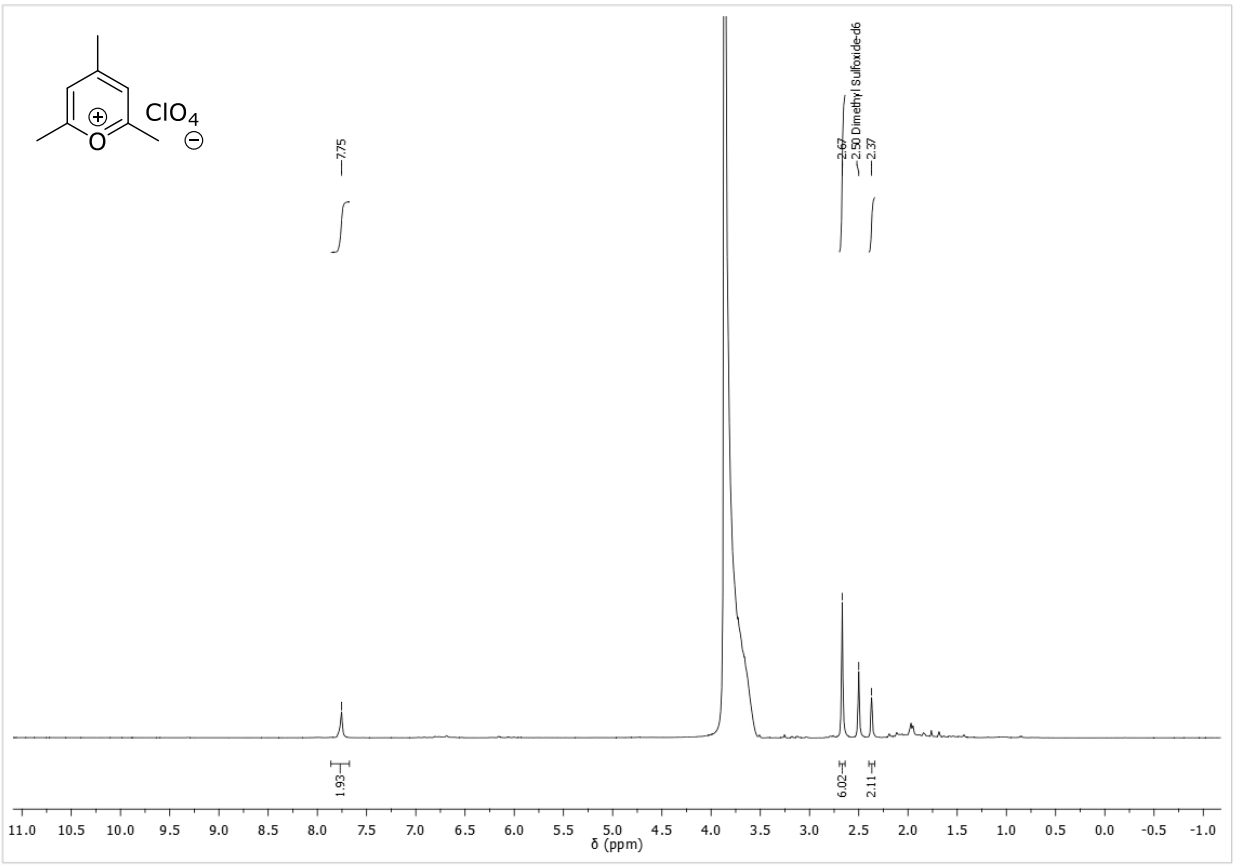
2,4,6-trimethylpyrylium hexafluorophosphates

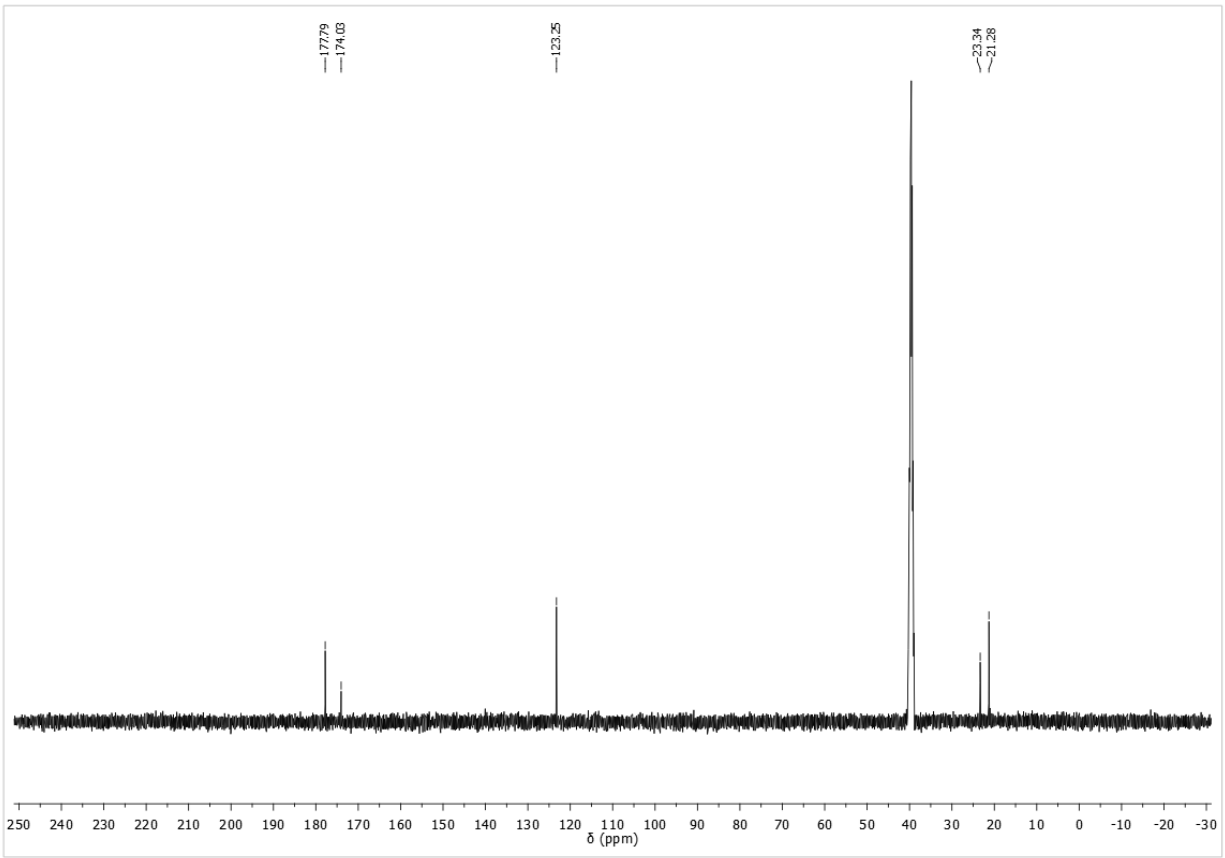




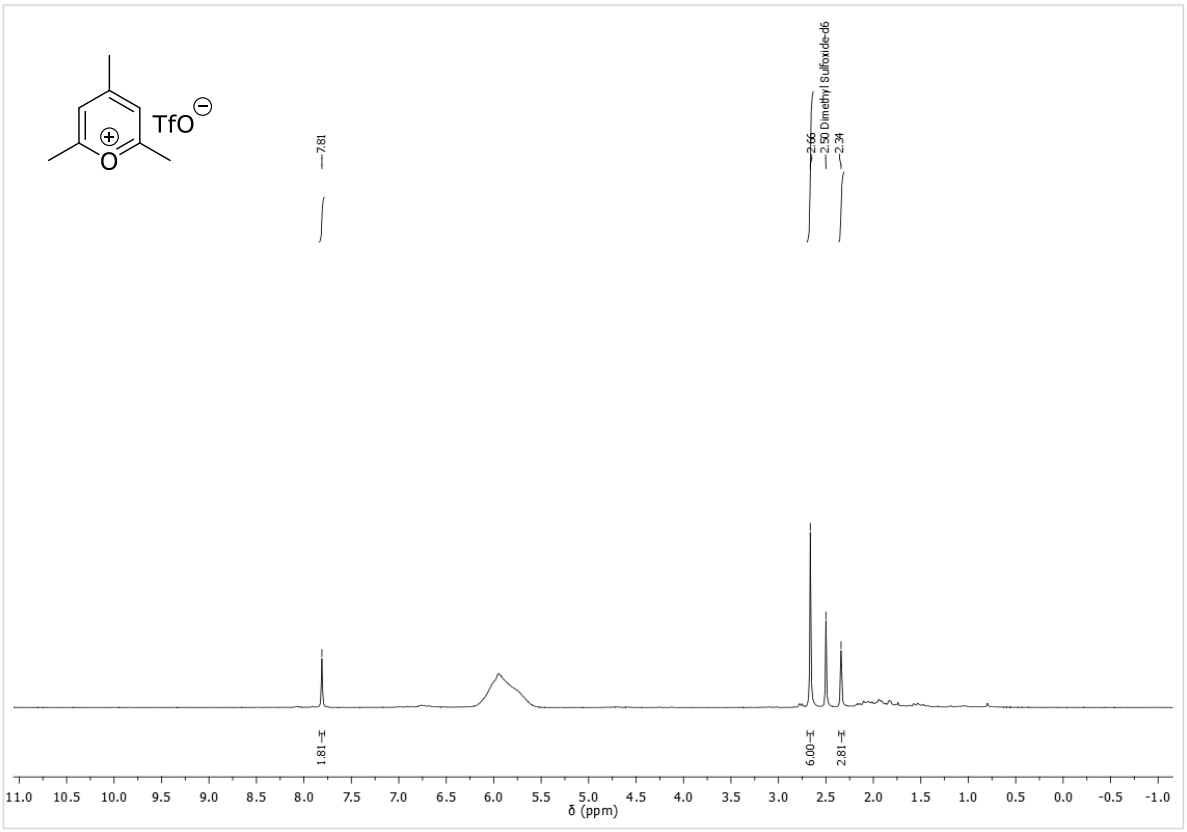

13C NMR (101 MHz, DMSO) δ 177.81, 123.32, 27.37, 23.37, 21.34.
177.81
123.32
27.37
23.37
21.34
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30
δ (ppm)

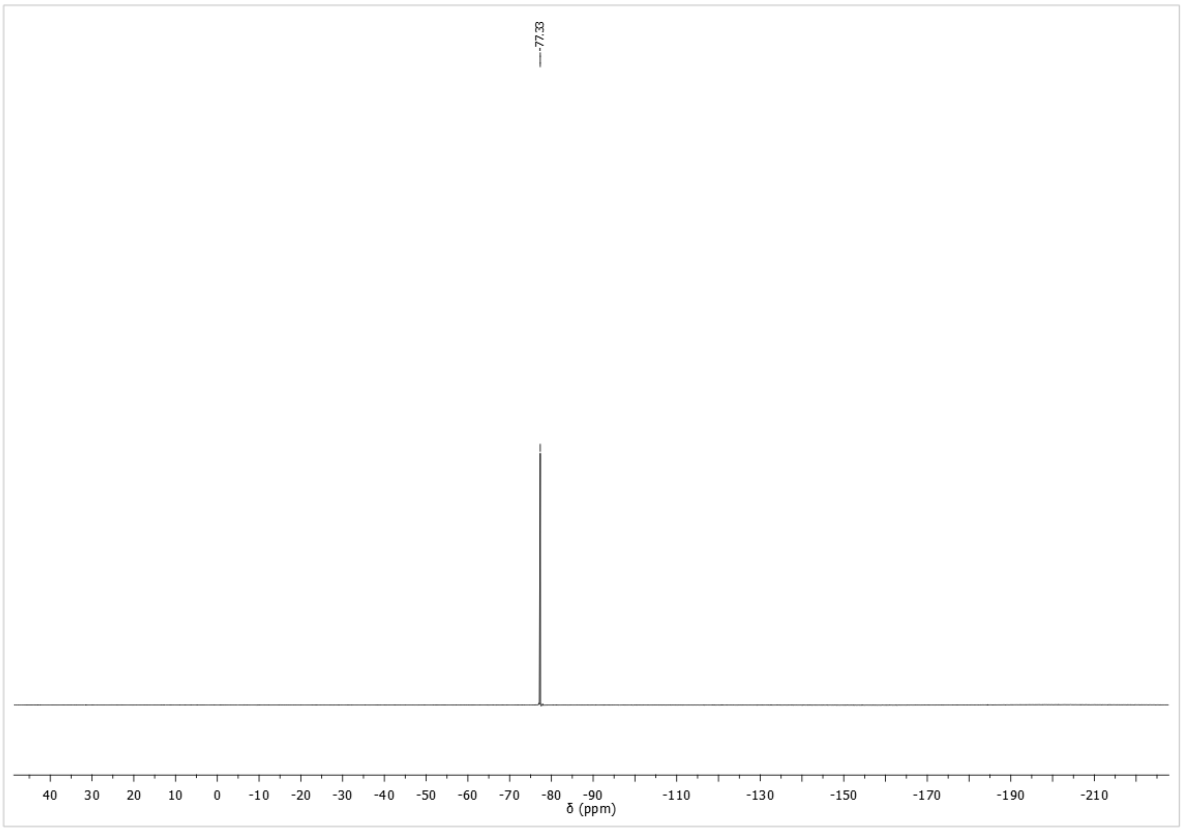
2,4,6-trimethylpyrylium perchlorate

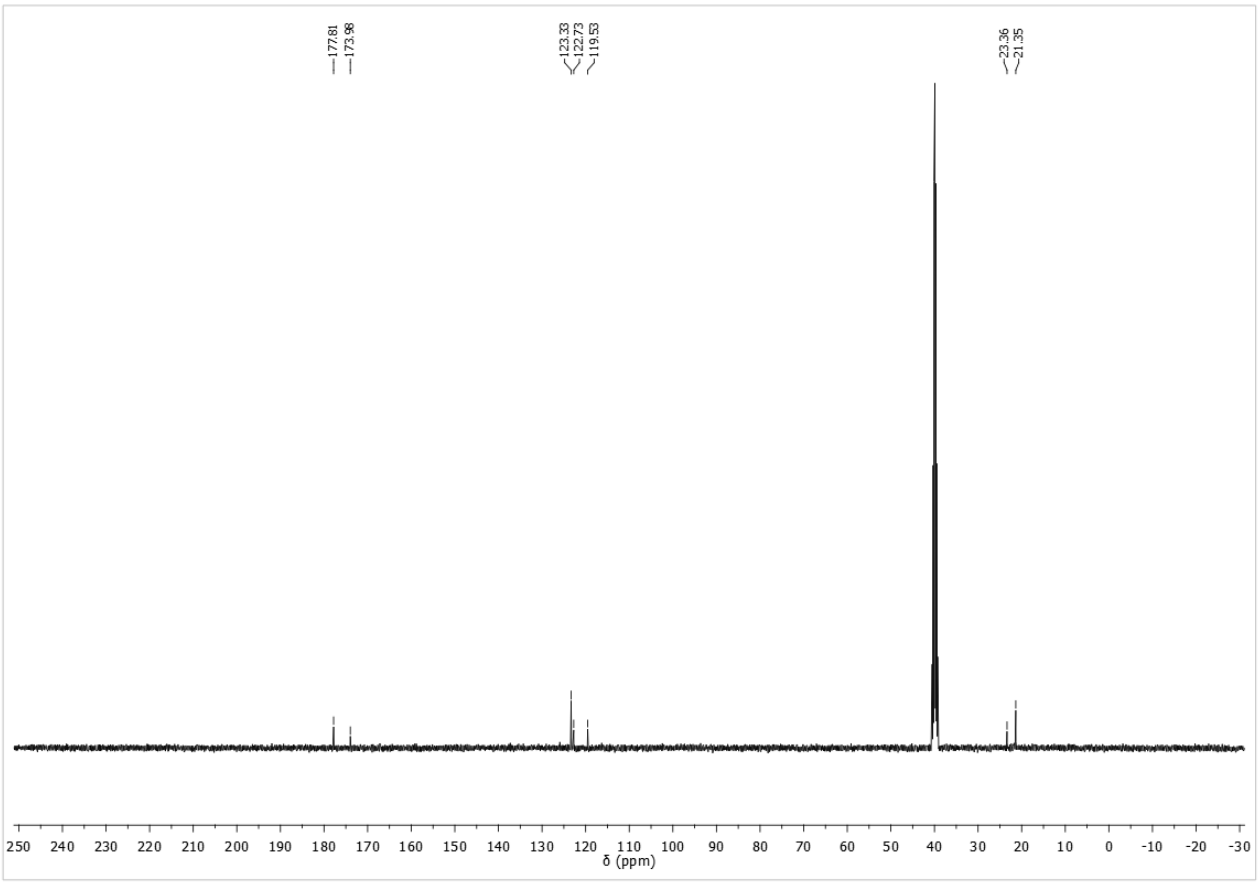




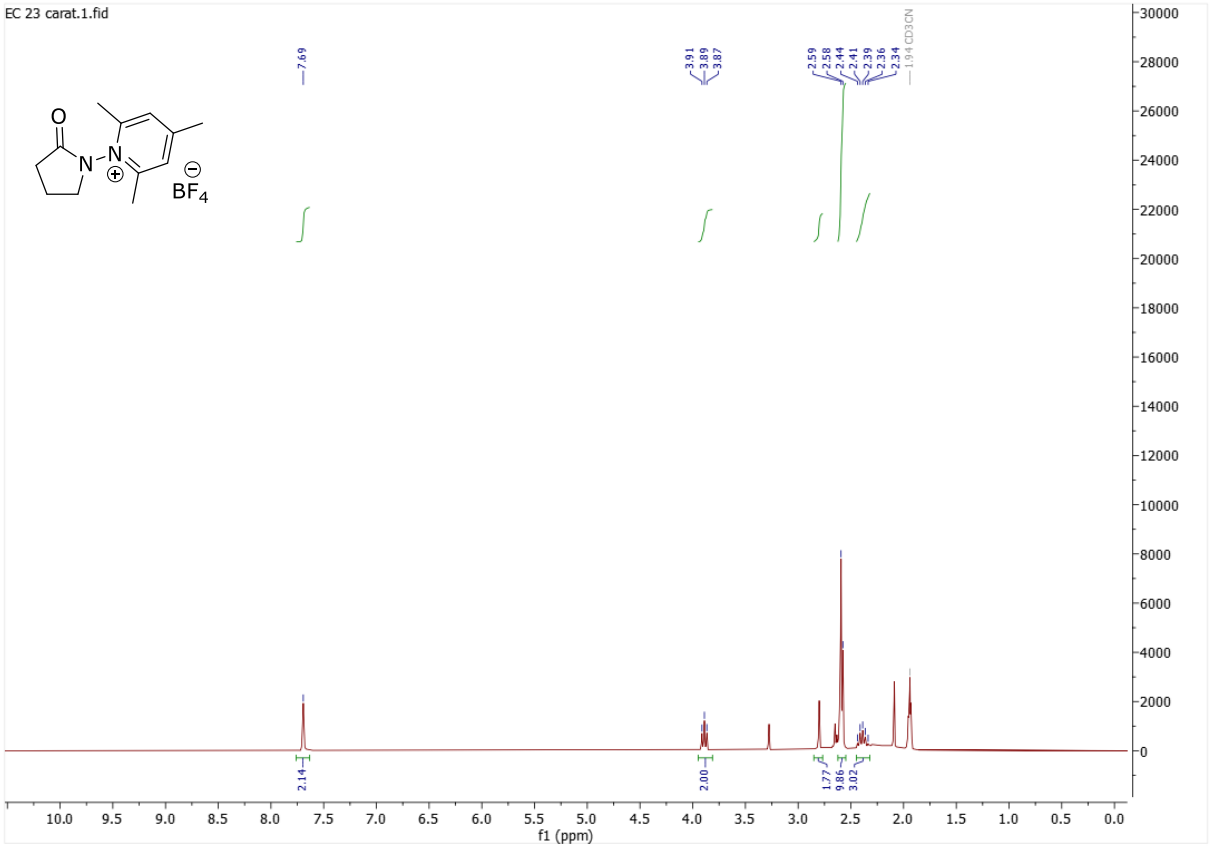
2,4,6-trimethylpyrylium triflate

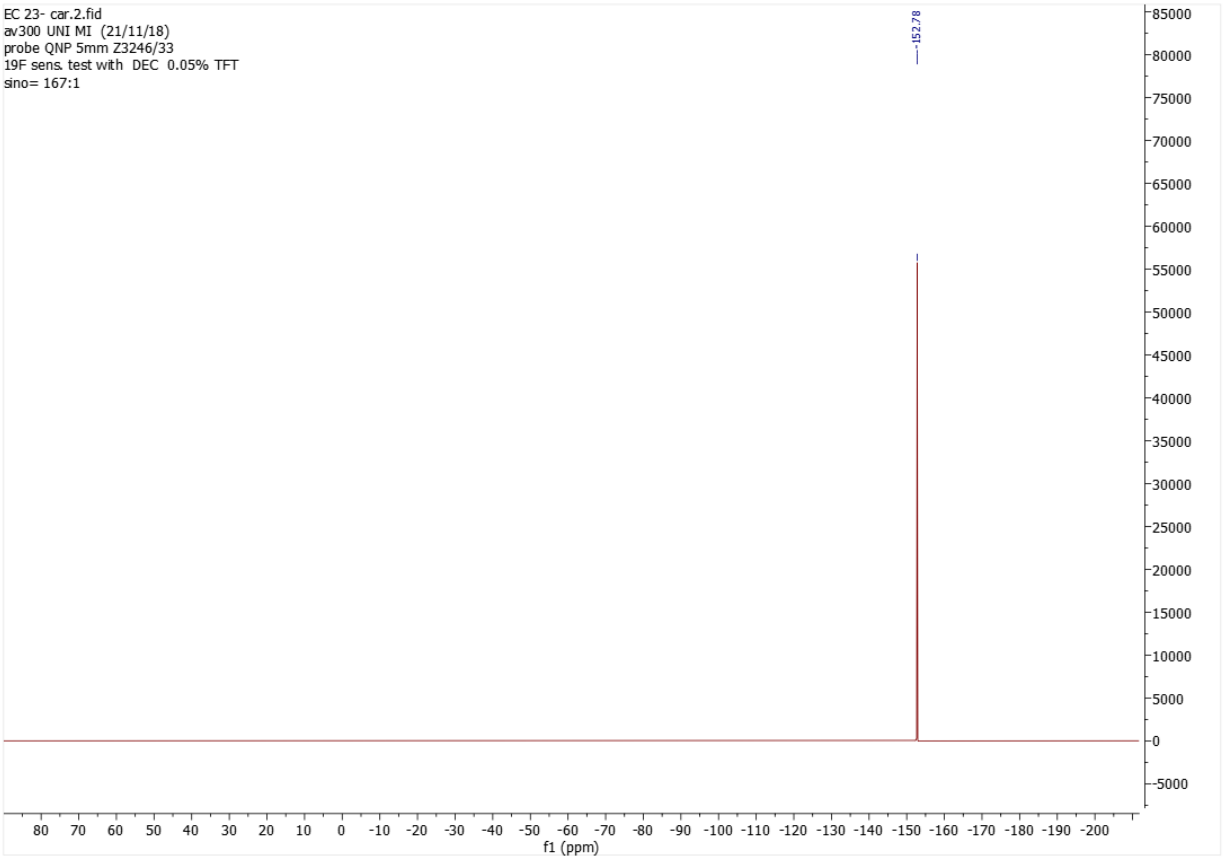


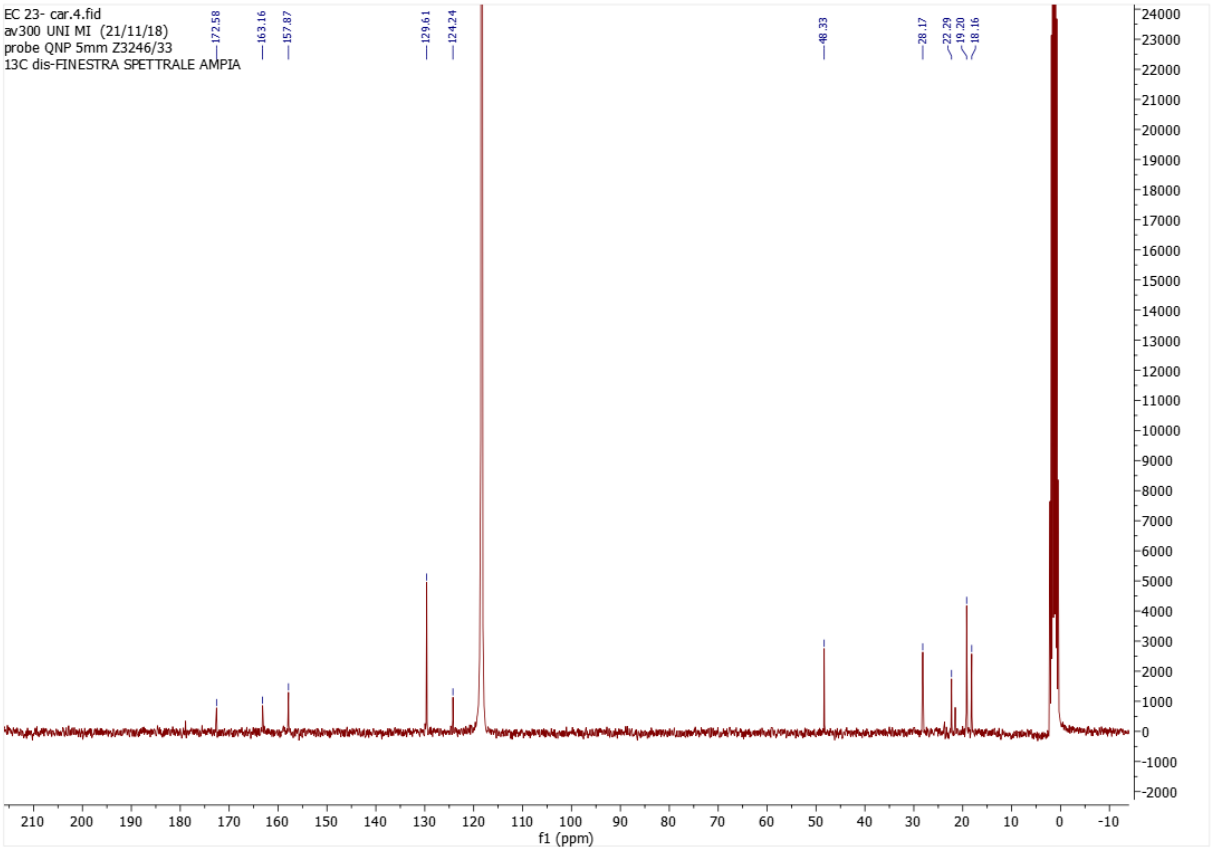



177.81
173.98
123.33
122.73
119.53
23.36
21.35
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30
δ (ppm)

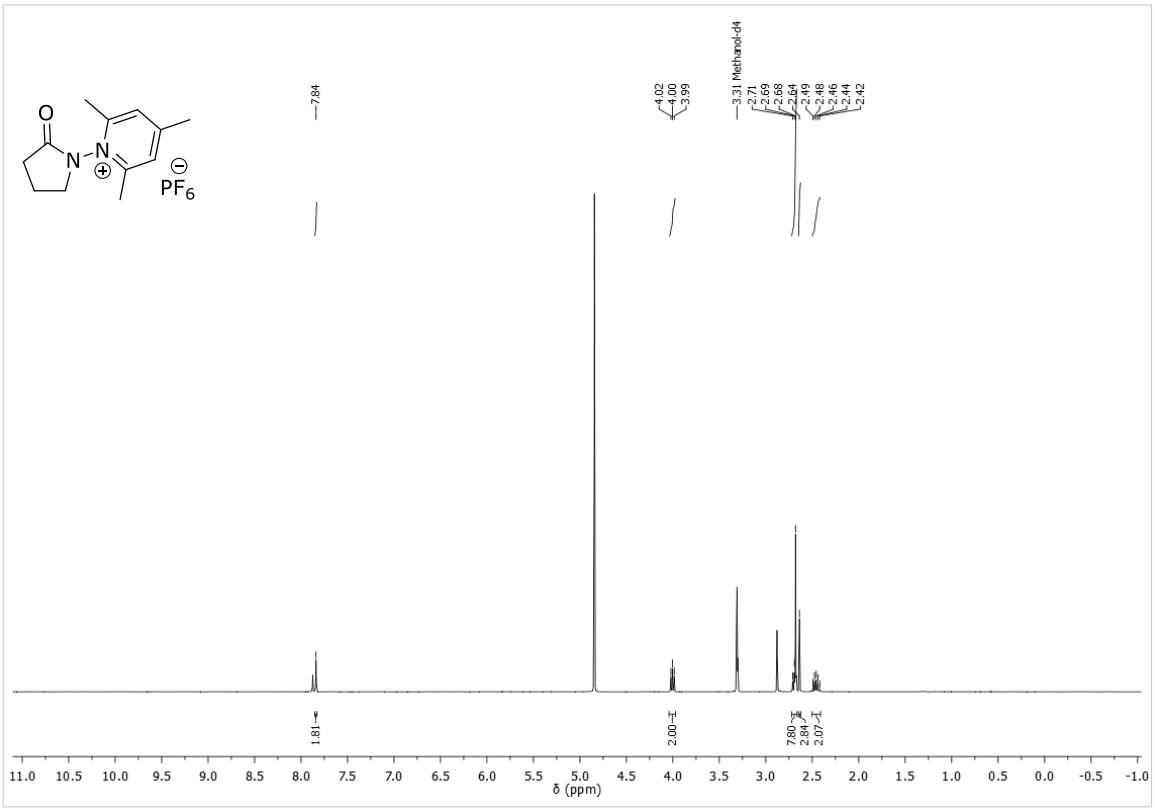
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium tetrafluoroborate (3a)

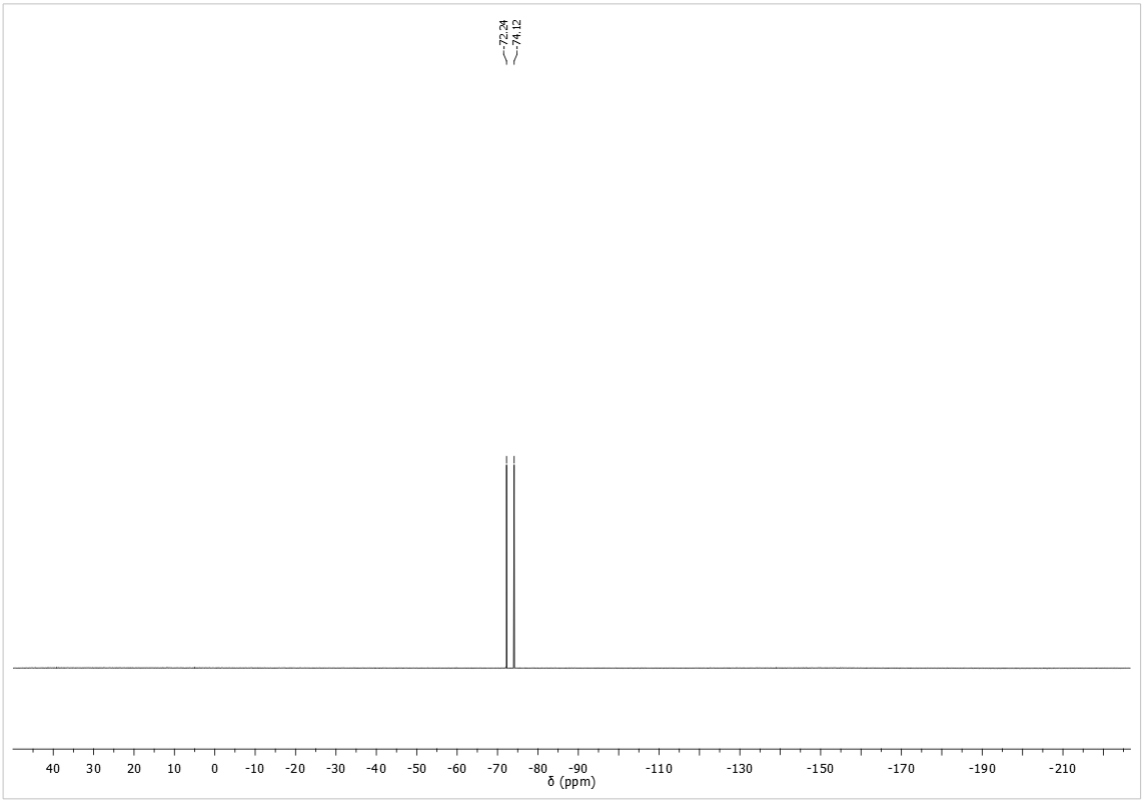


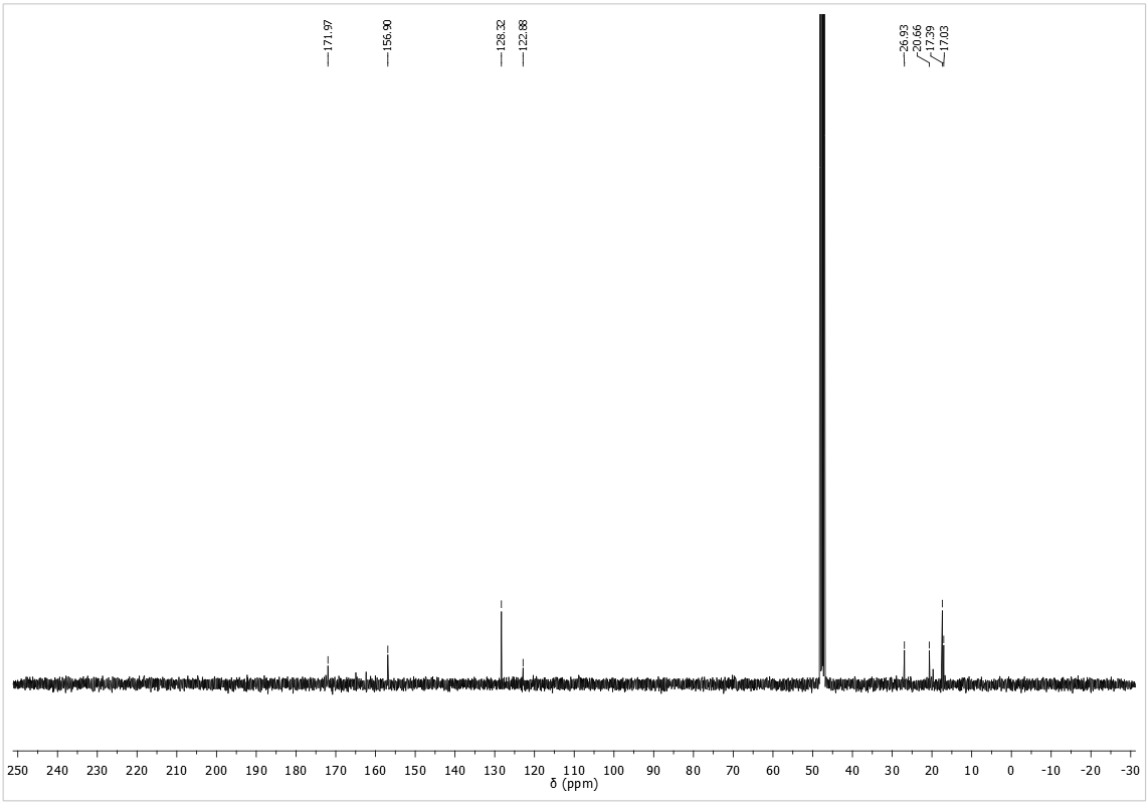



EC 23- car.4.fid
av300 UNI MI (21/11/18)
probe QNP 5mm Z3246/33
13C dis-FINESTRA SPETTRALE AMPIA
172.58
163.16
157.87
129.61
124.24
48.33
28.17
22.29
19.20
18.16
f1 (ppm)

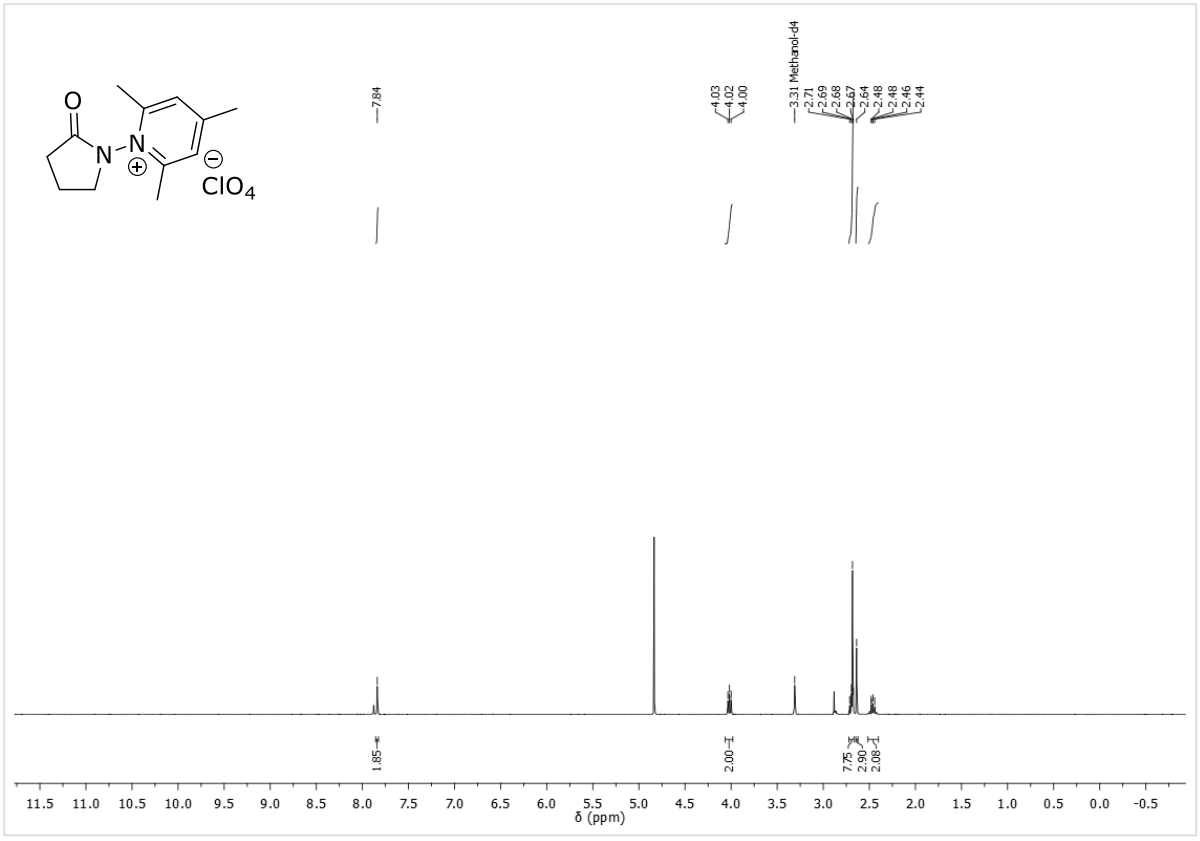
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium hexafluorophosphates (3b)

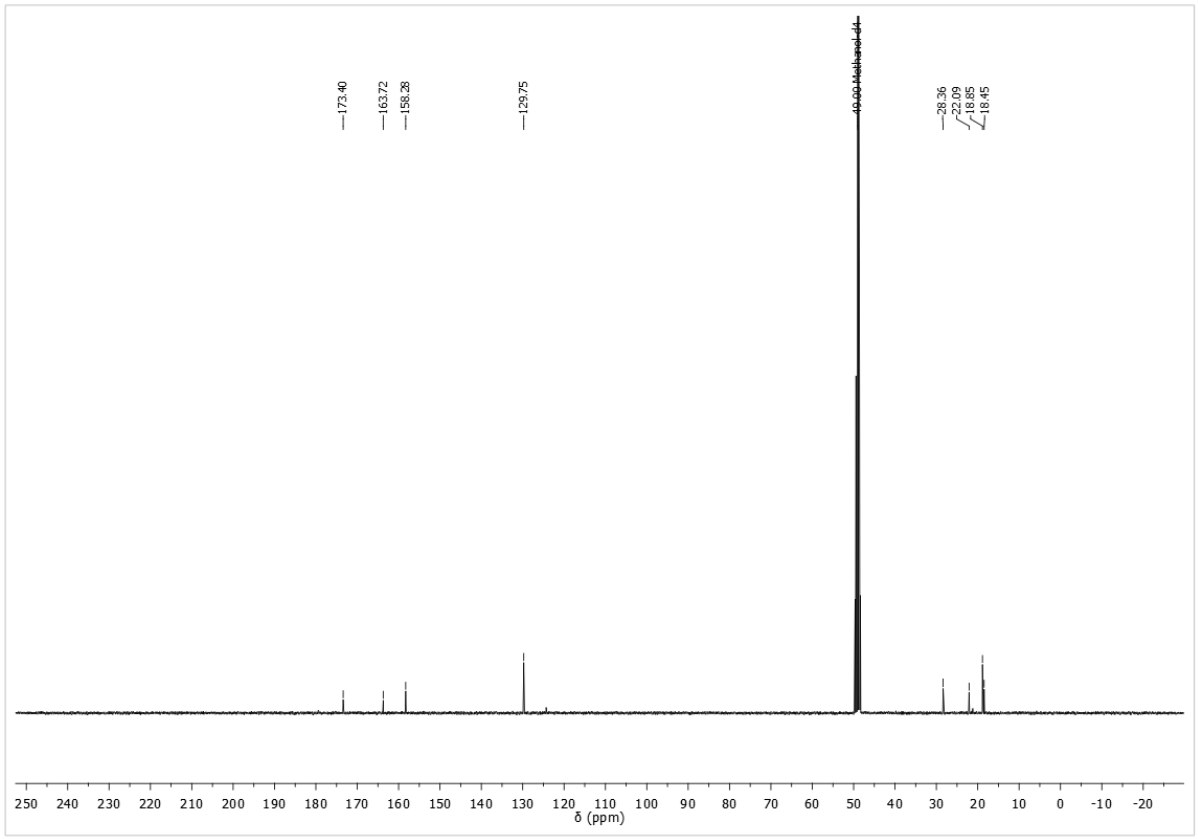




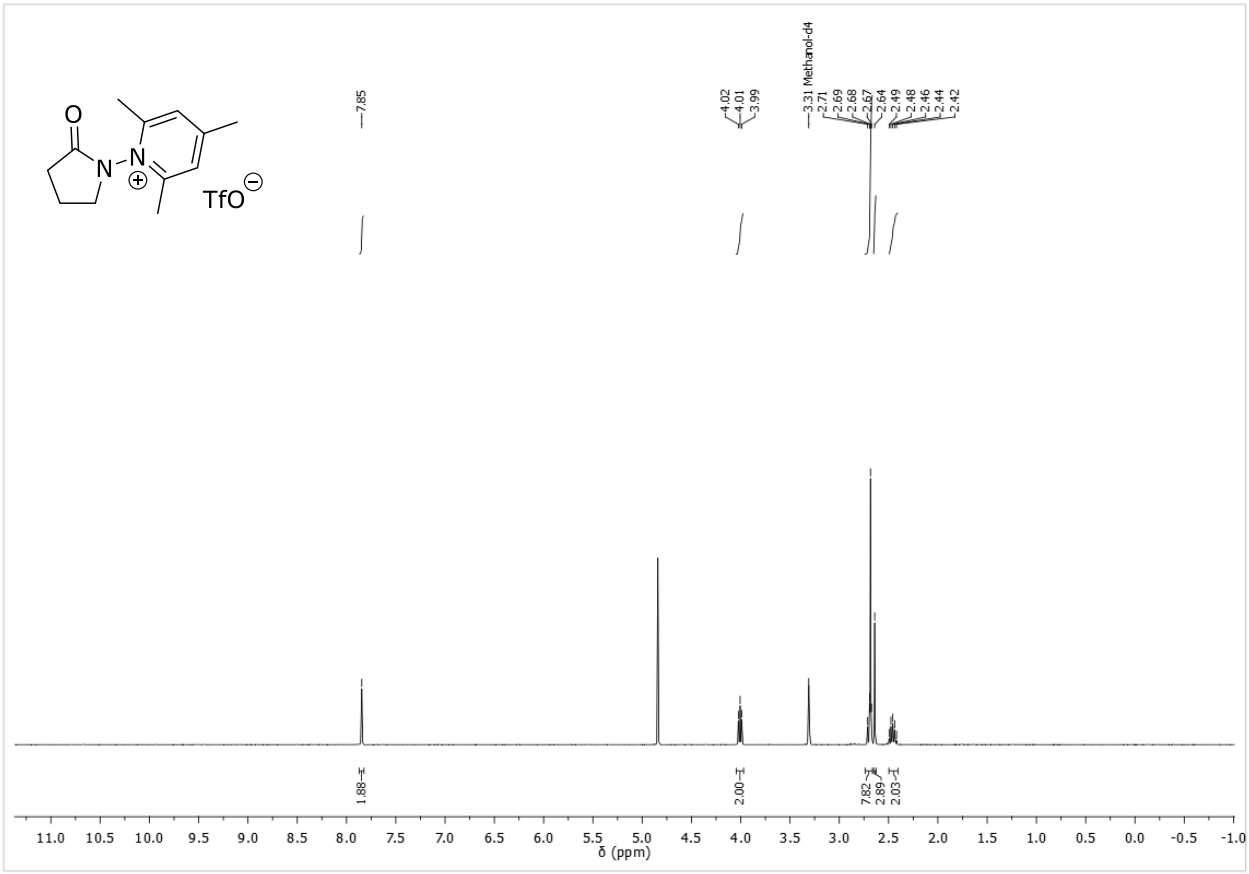

171.97
156.90
128.32
122.88
26.93
20.66
17.39
17.03
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30
δ (ppm)

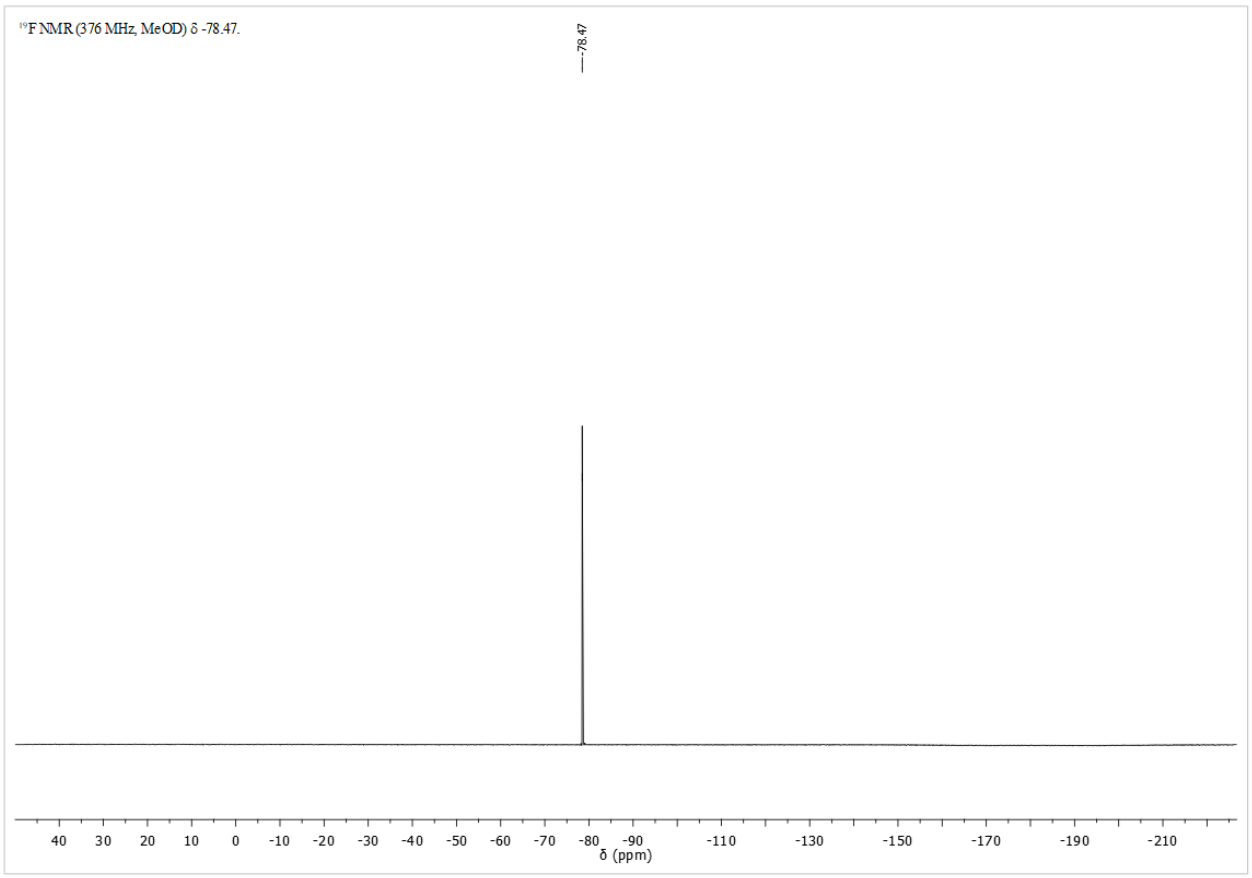
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium perchlorate (3c)

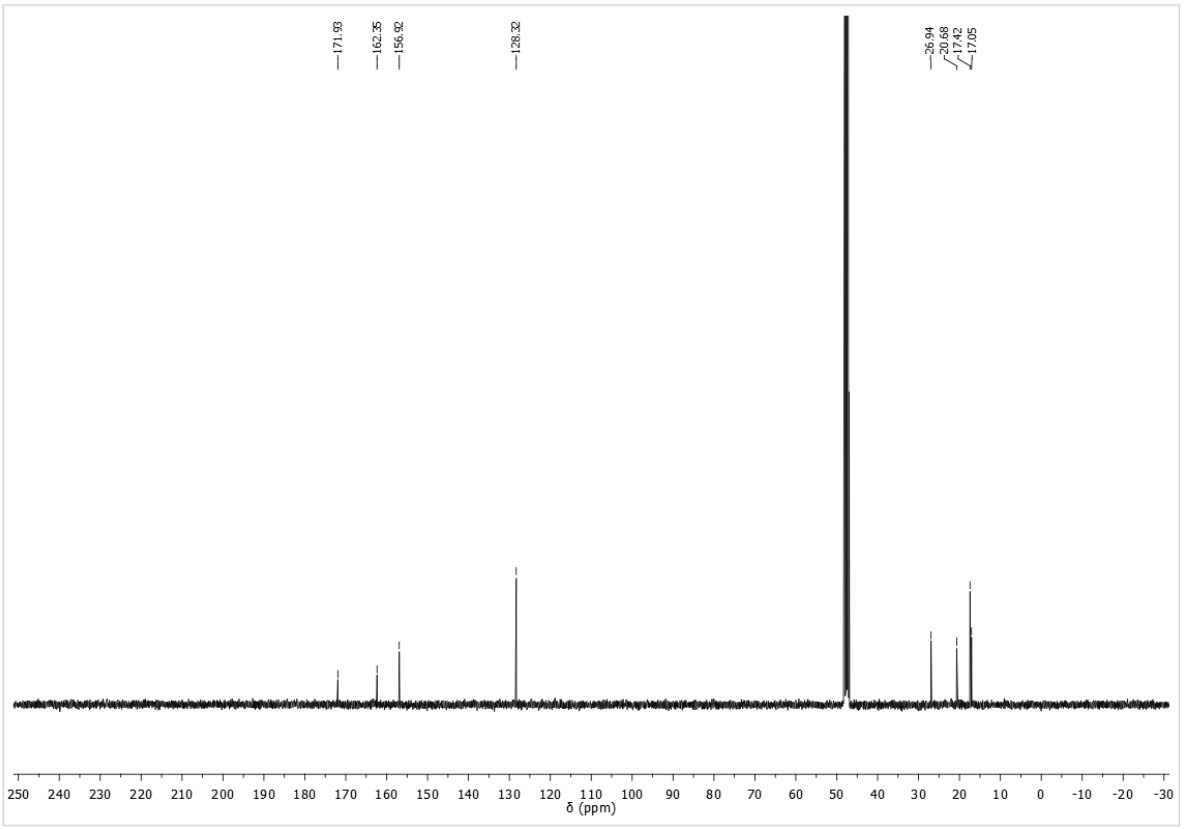




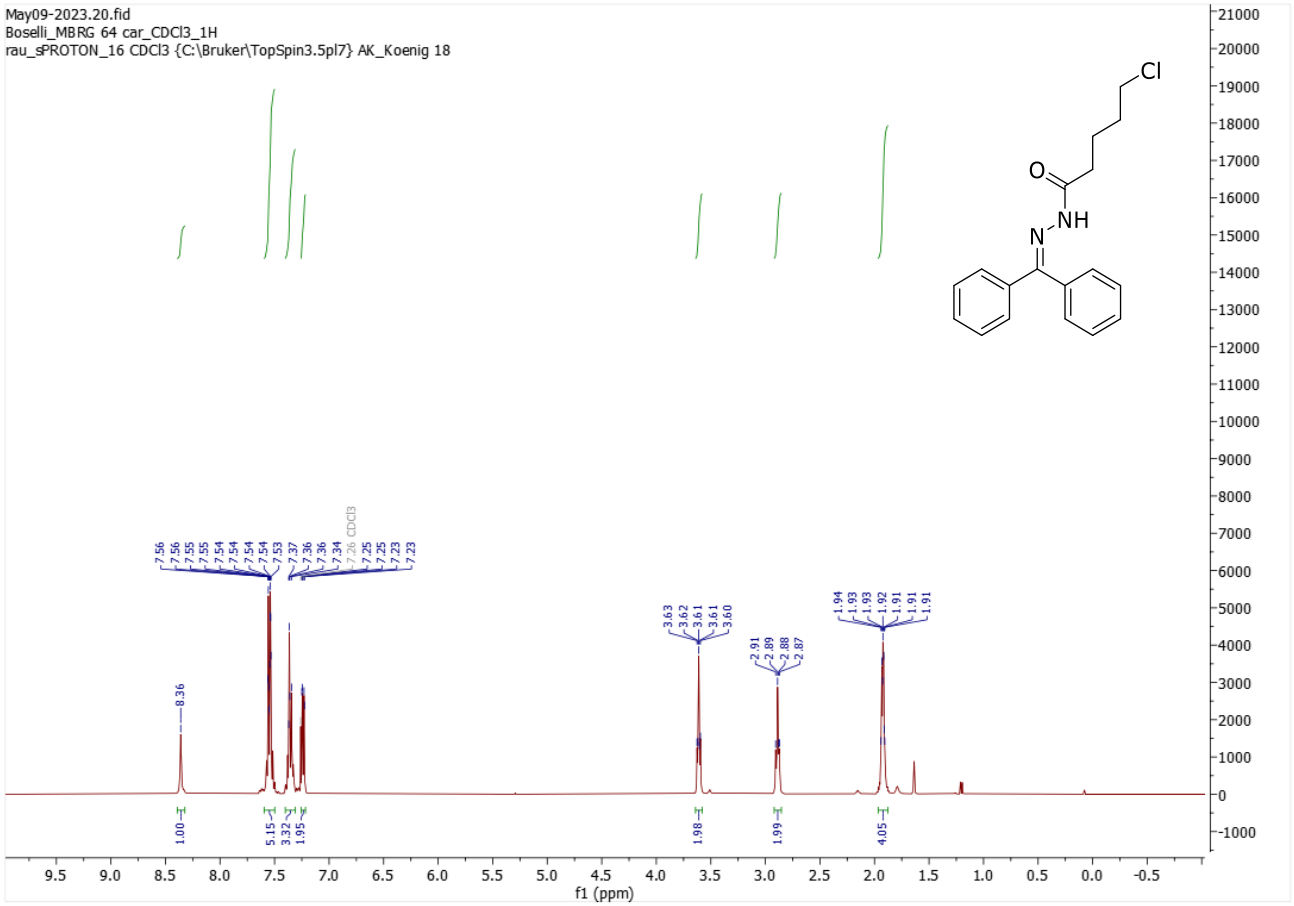
2,4,6-trimethyl-1-(2-oxopyrrolidin-1-yl)pyridinium triflate (3d)

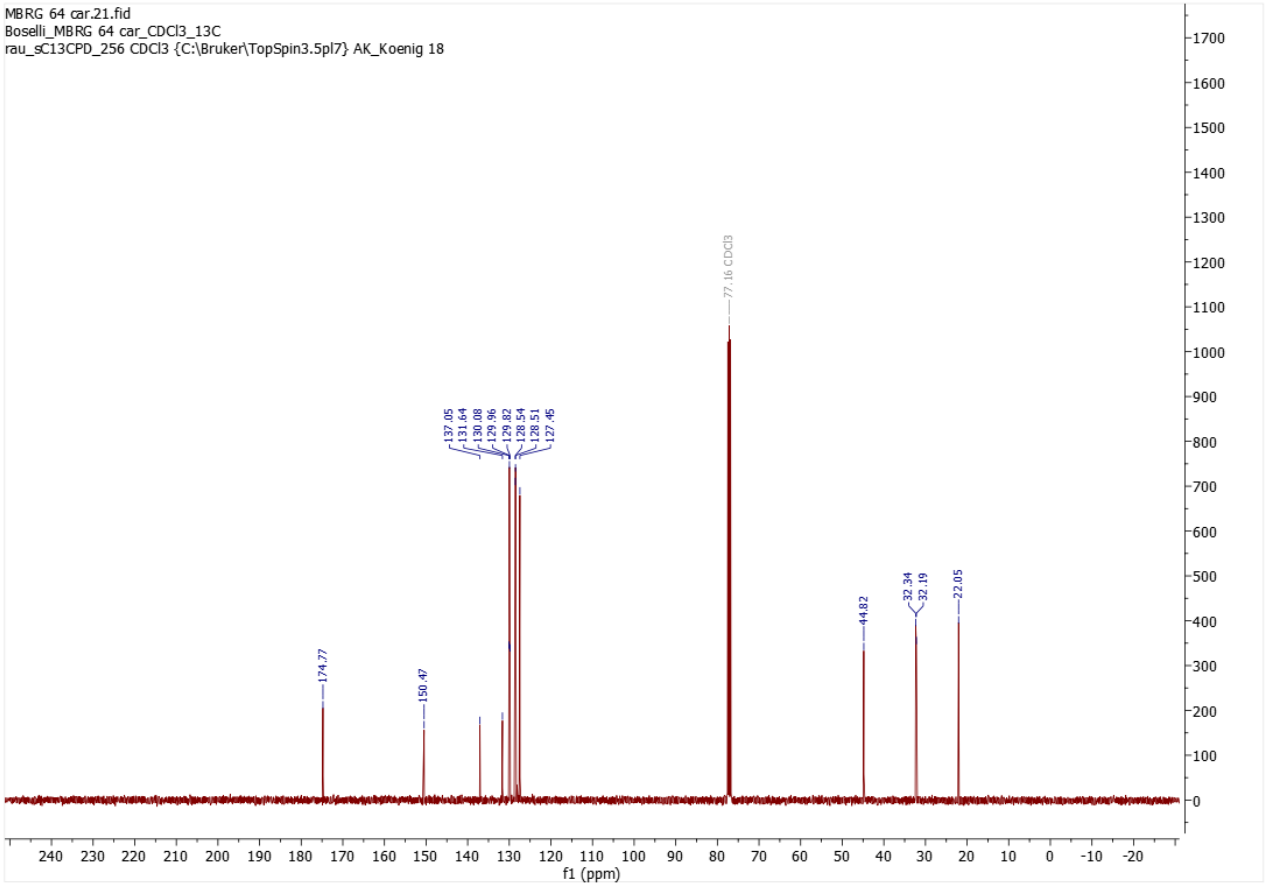




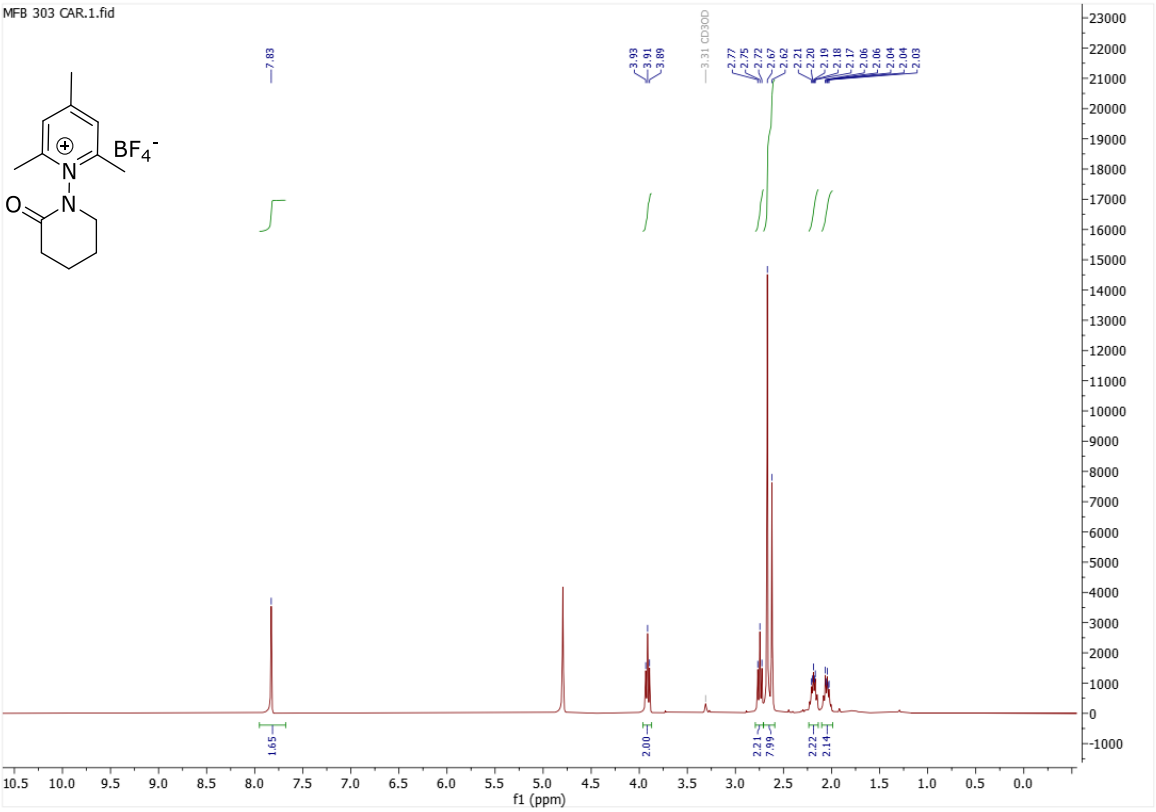

171.93
162.35
156.92
128.32
26.94
20.68
17.42
17.05
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30
δ (ppm)

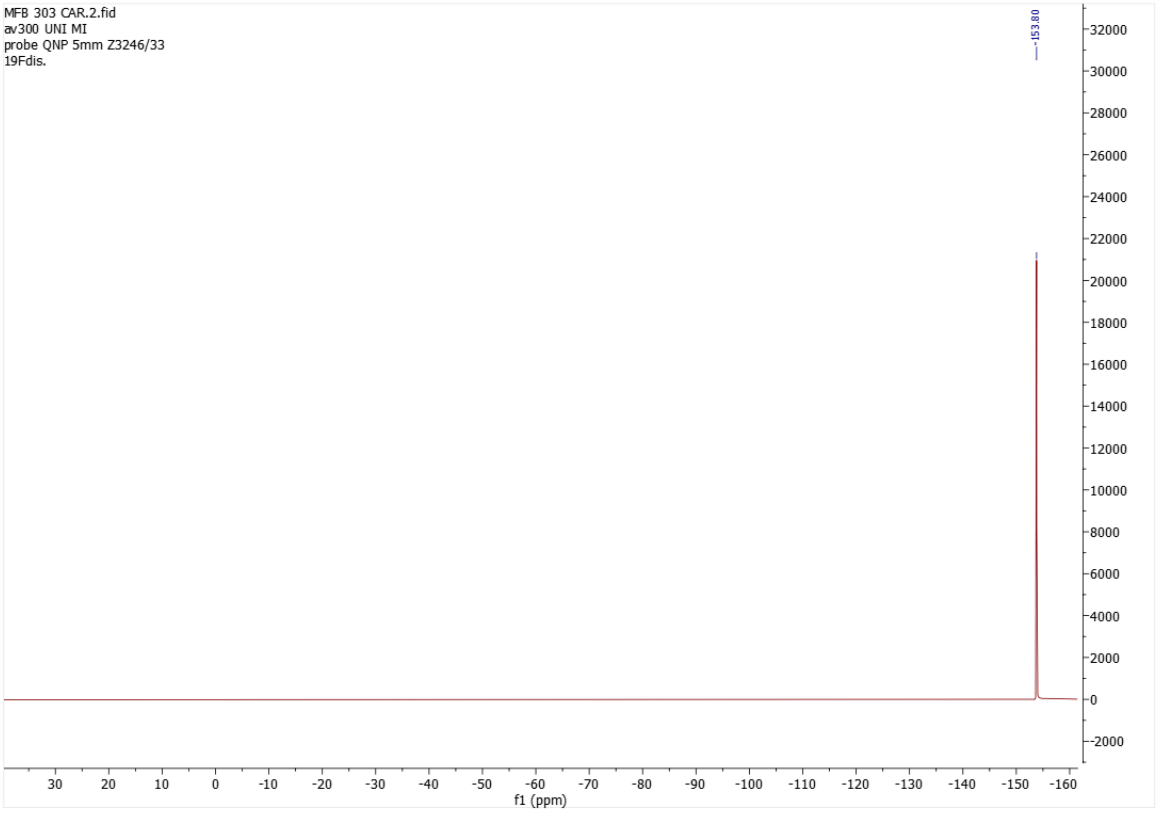
4-chloro-*N'*-(diphenylmethylene)pentanehydrazide

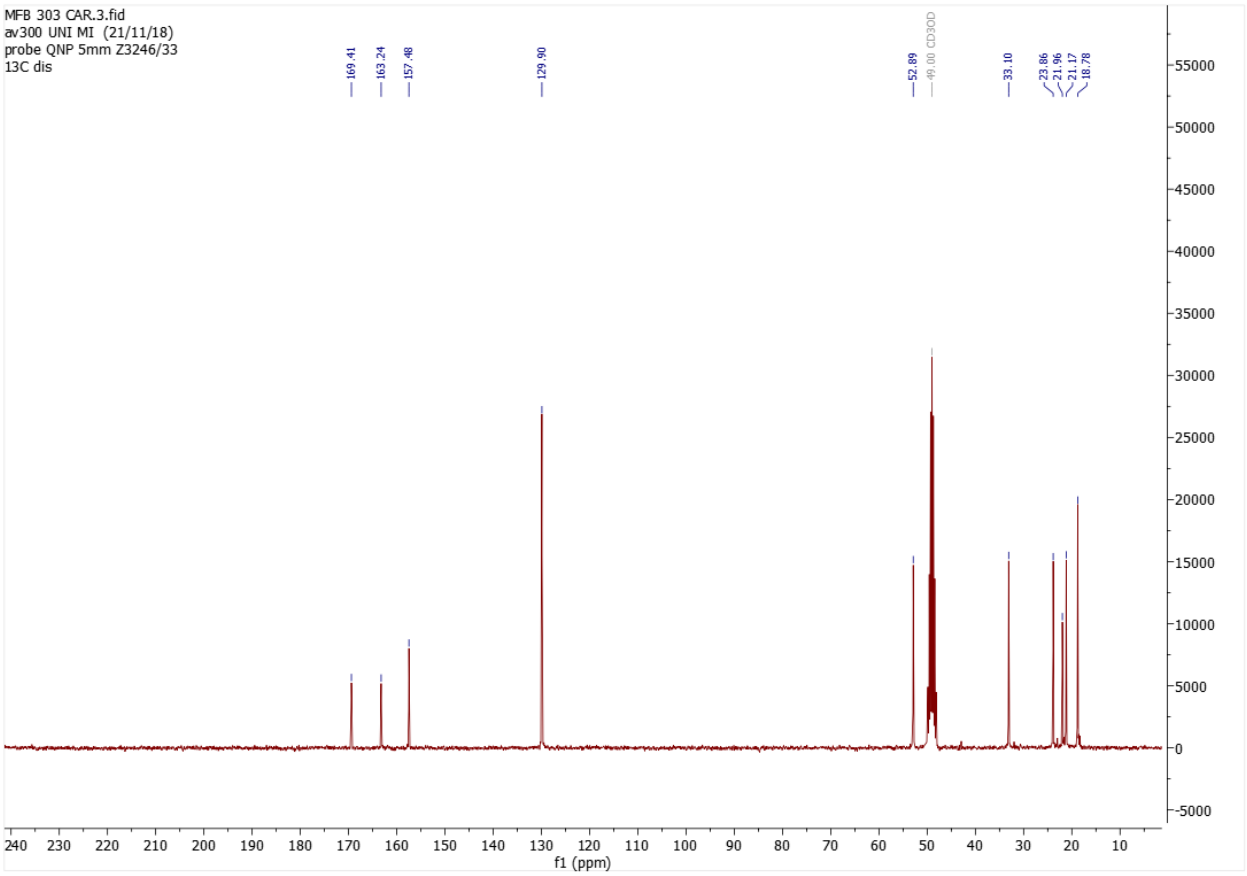




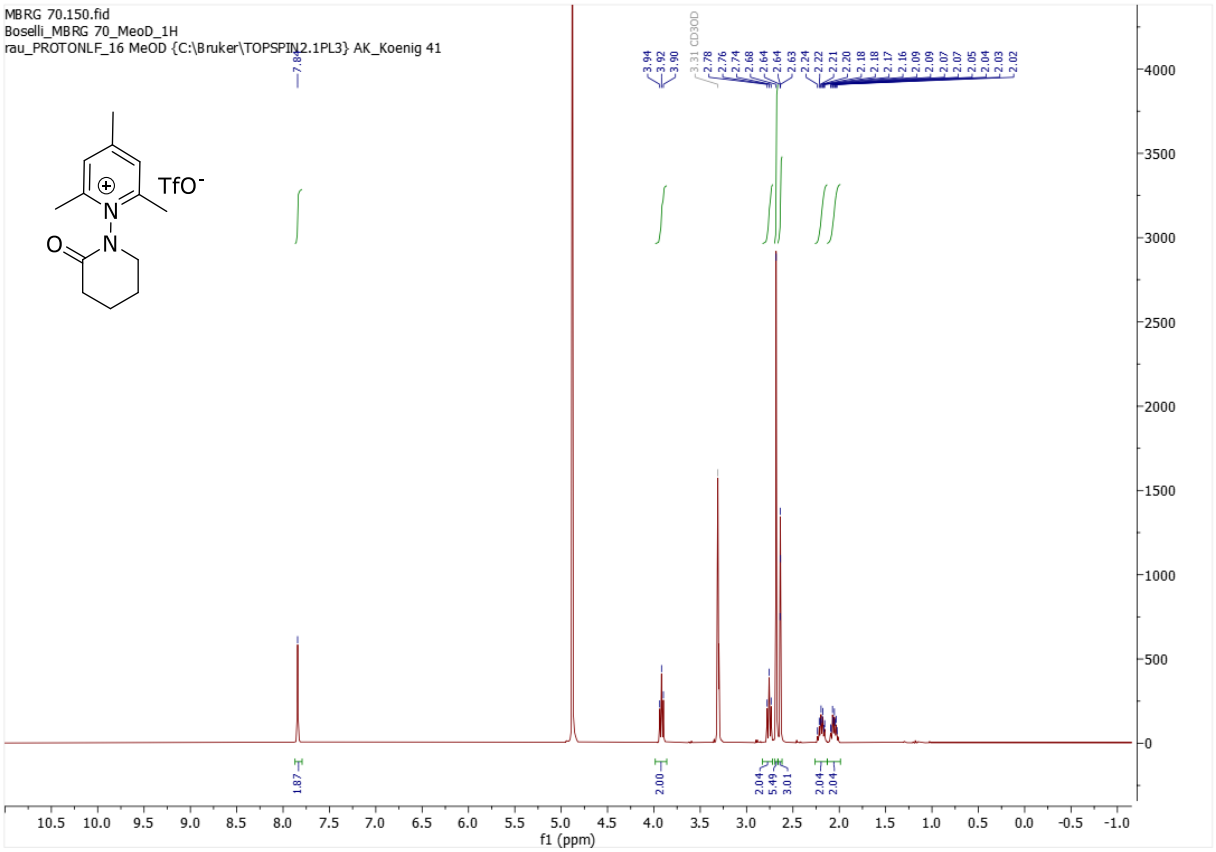
2,4,6-trimethyl-1-(2-oxopiperidin-1-yl)pyridinium tetrafluoroborate (4a)

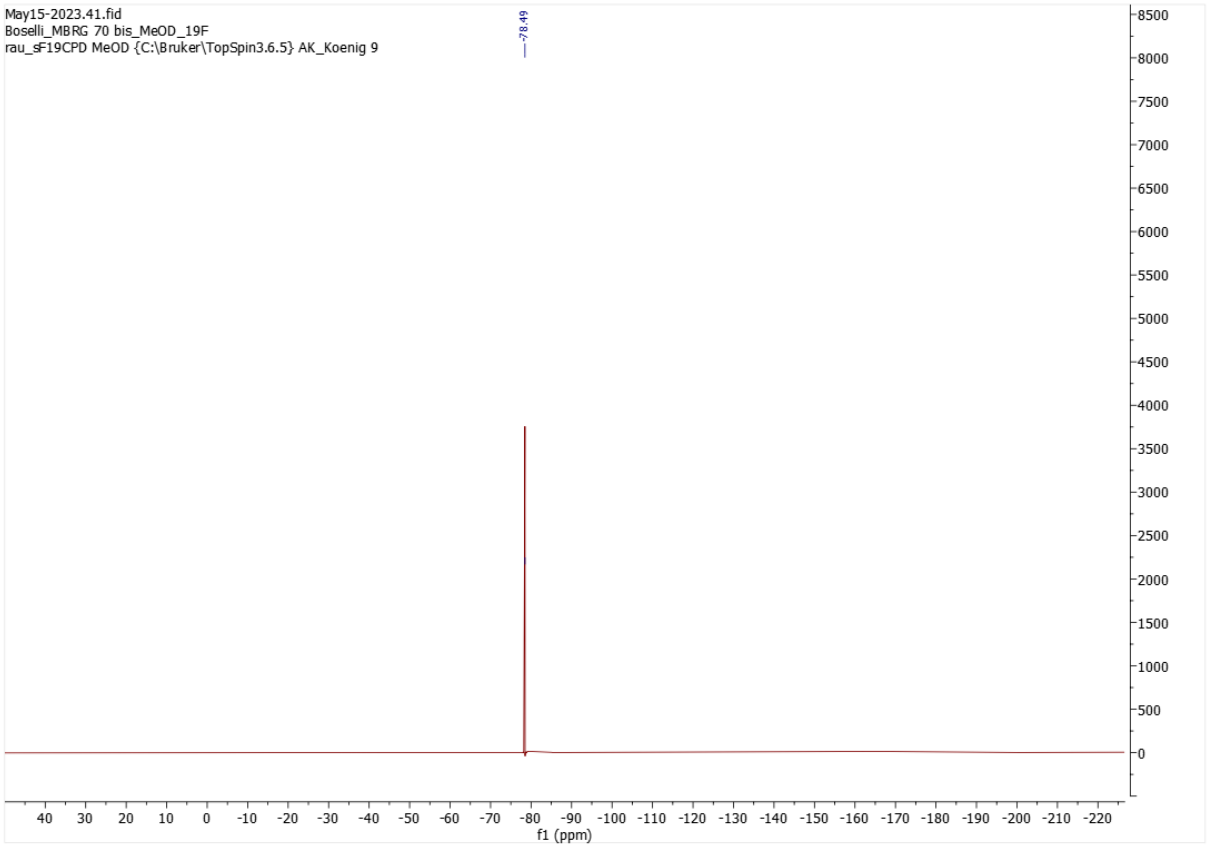


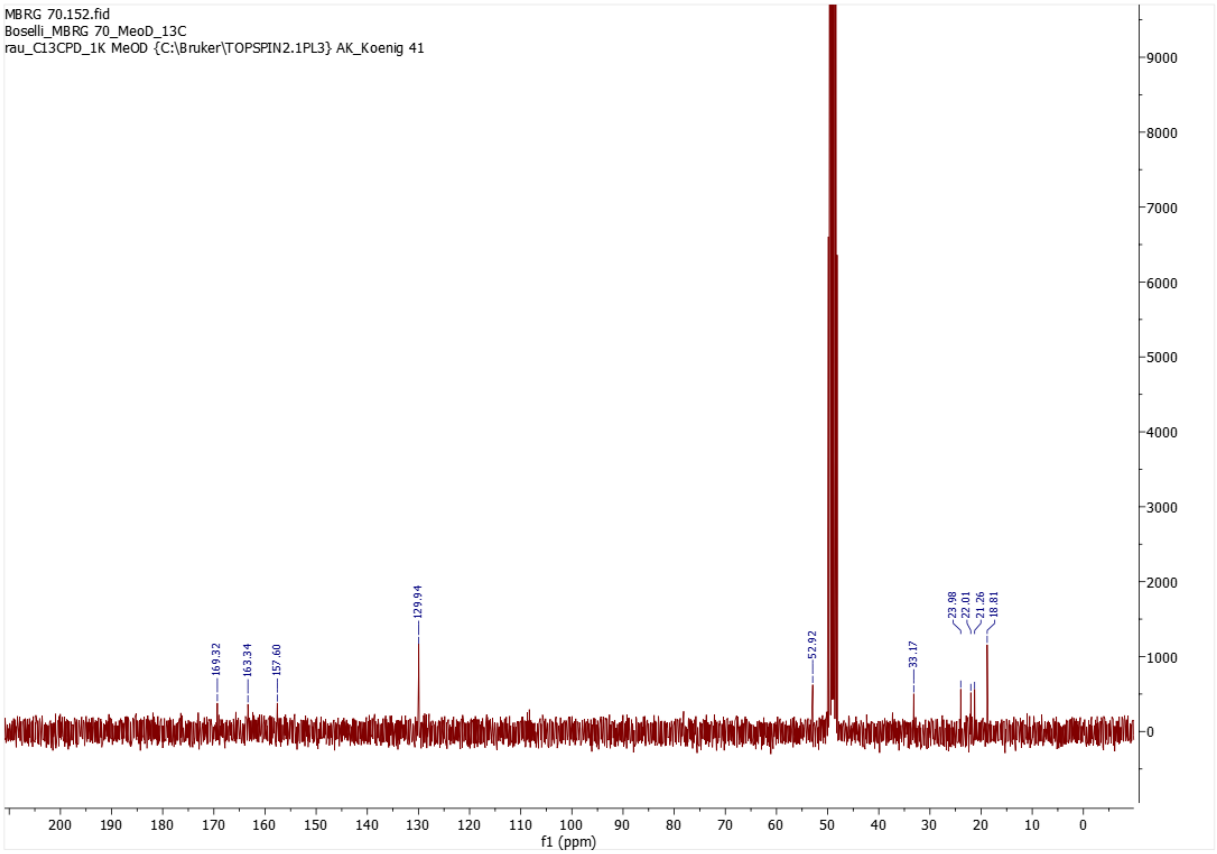



MFB 303 CAR.3.fid
av300 UNI MI (21/11/18)
probe QNP 5mm Z3246/33
13C dis
169.41
163.24
157.48
129.90
52.89
49.00 CD3OD
33.10
23.86
21.96
21.17
18.78
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

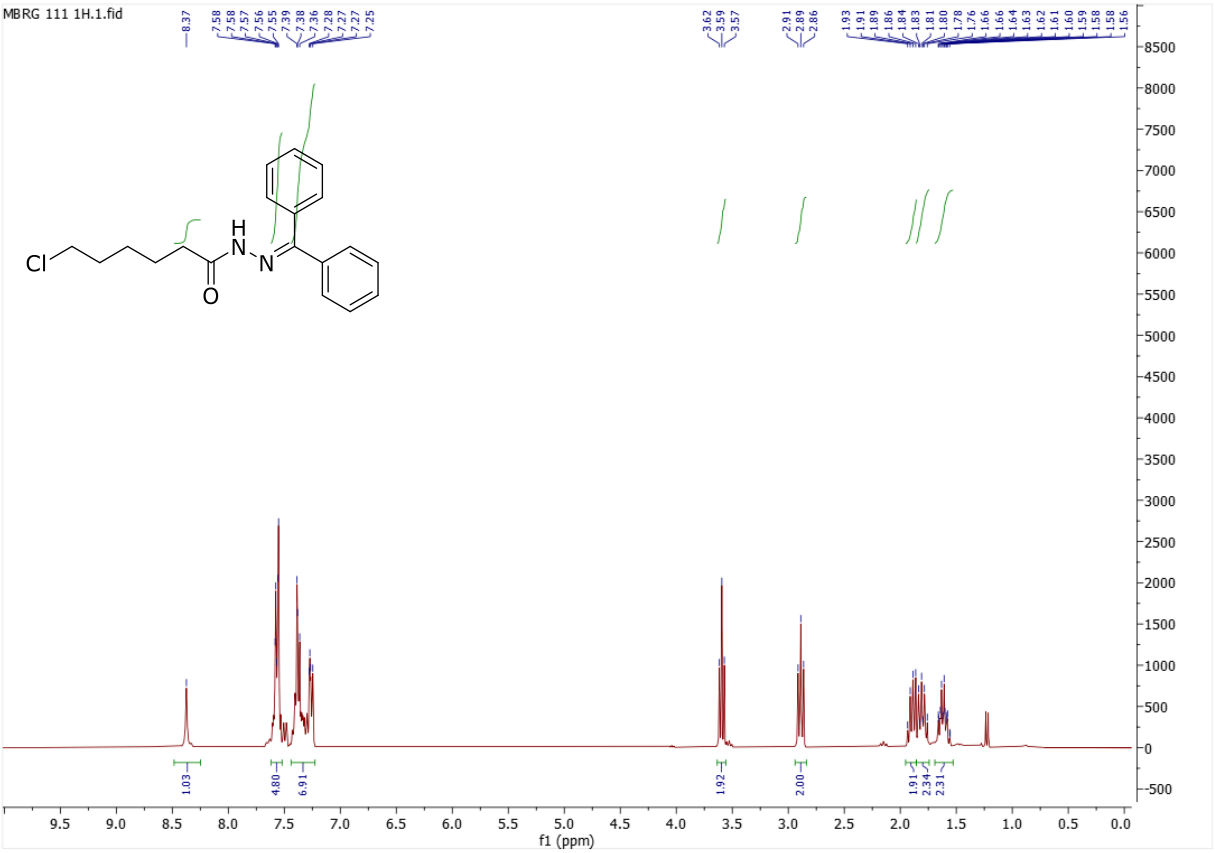
2,4,6-trimethyl-1-(2-oxopiperidin-1-yl)pyridinium triflate (4d)

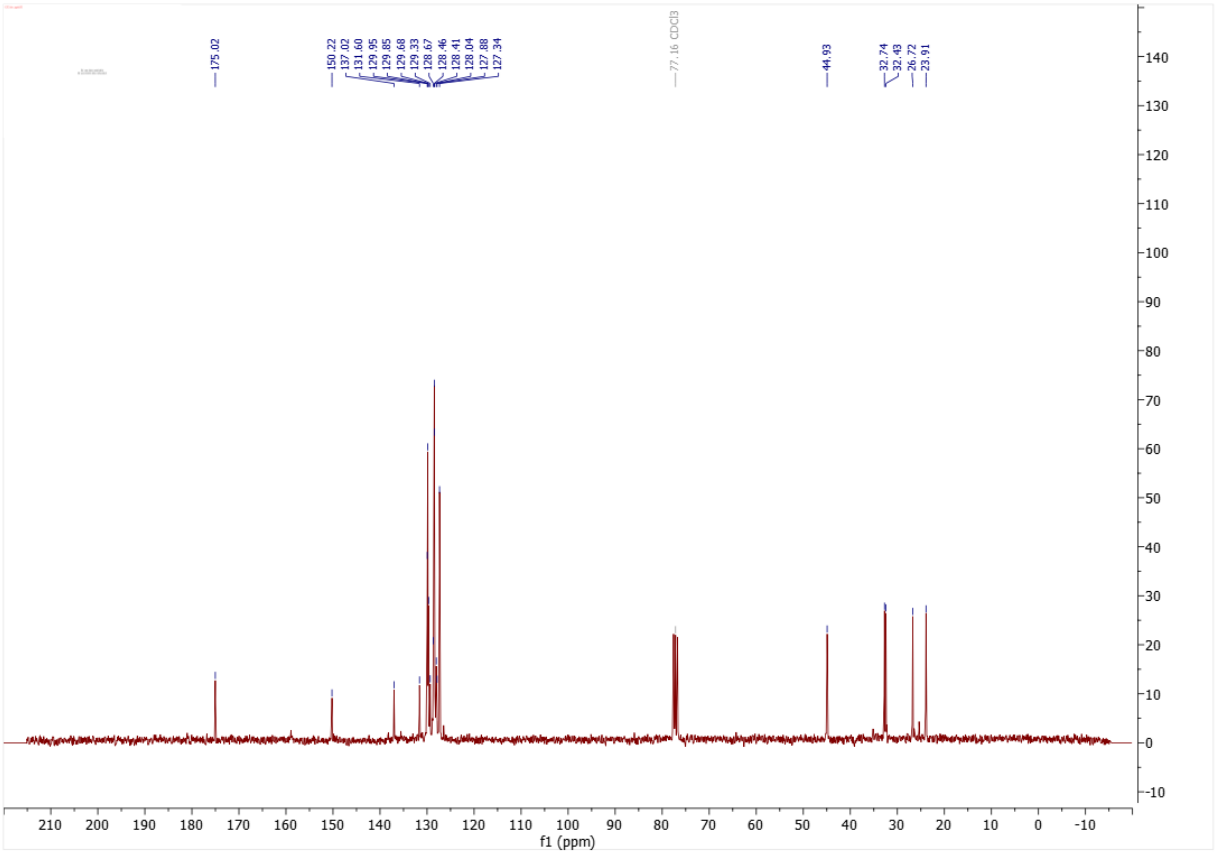




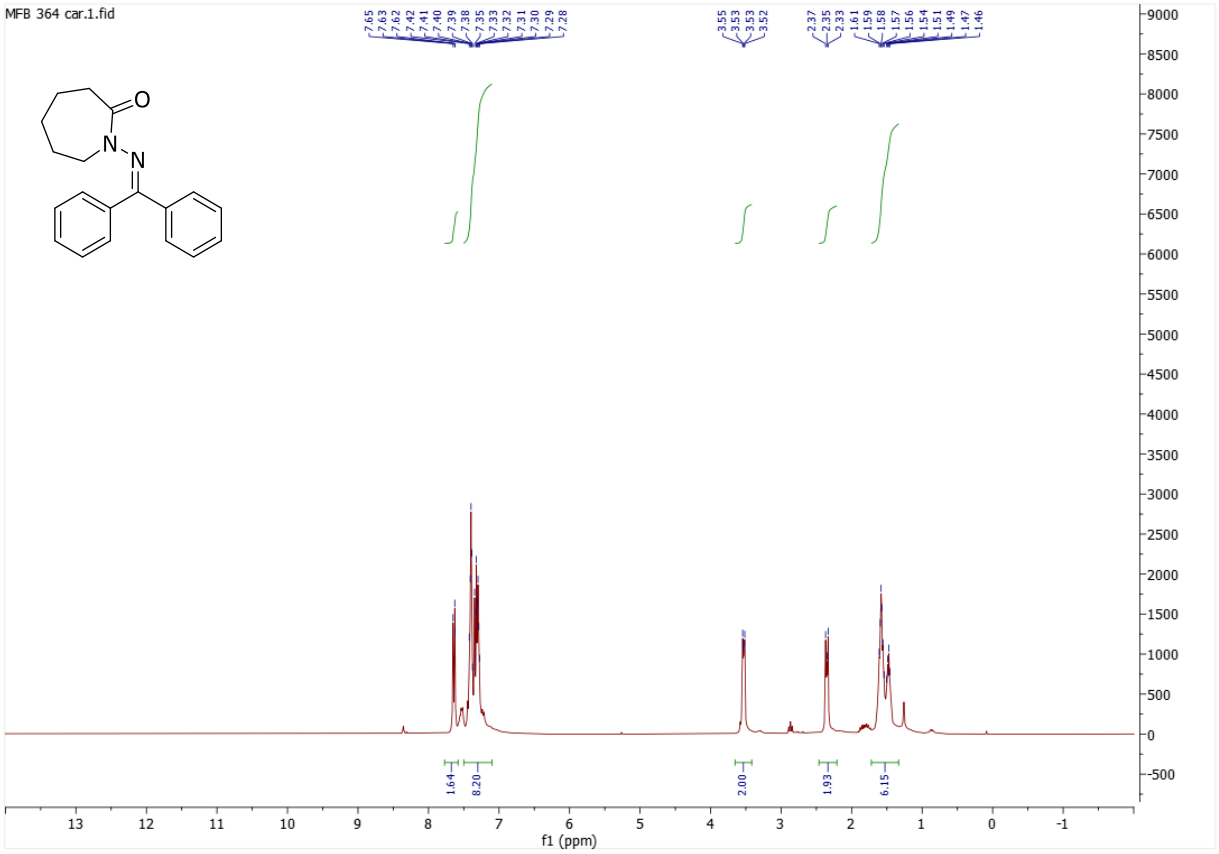

MBRG 70.152.fid
Boselli_MBRG 70_MeoD_13C
rau_C13CPD_1K MeOD {C:\Bruker\TOPSPIN2.1PL3} AK_Koenig 41
169.32
163.34
157.60
129.94
52.92
33.17
23.98
22.01
21.26
18.81
f1 (ppm)

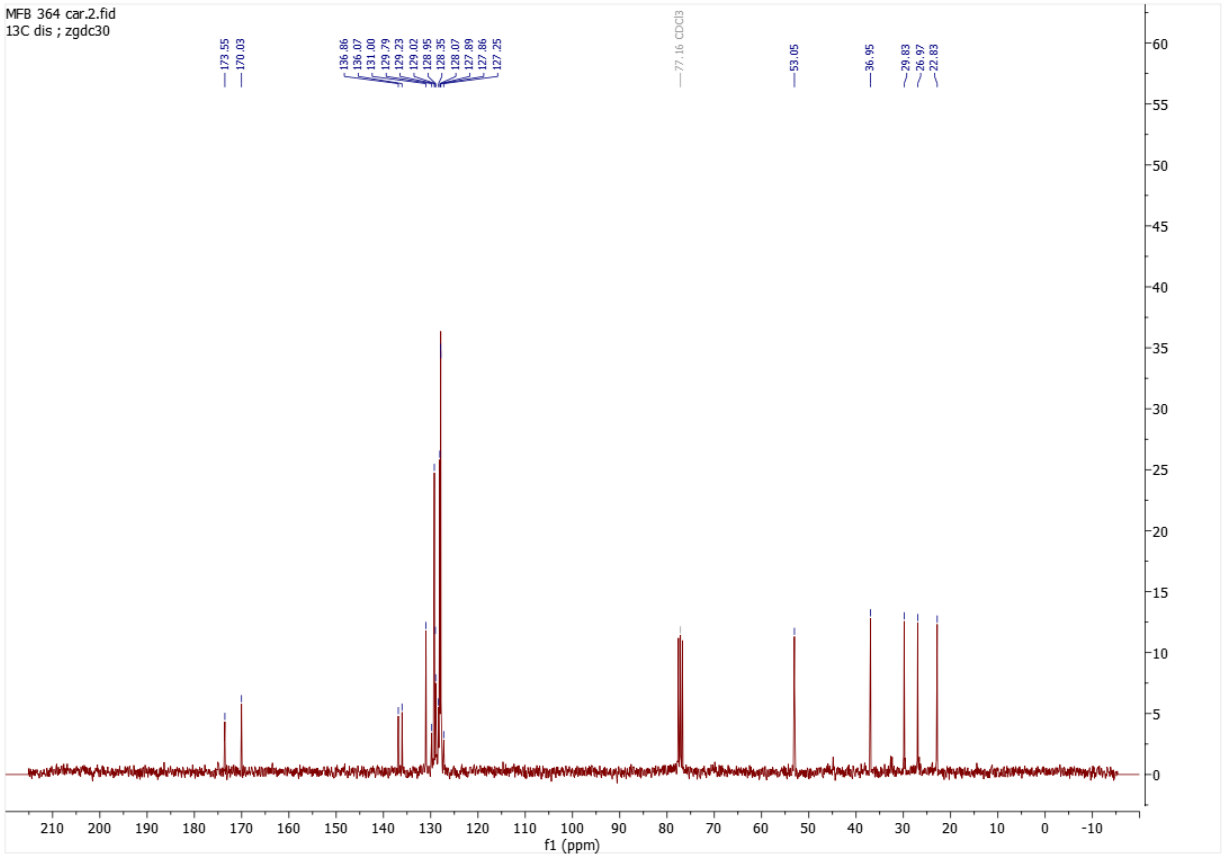
4-chloro-*N'*-(diphenylmethylene)esanehydrazide



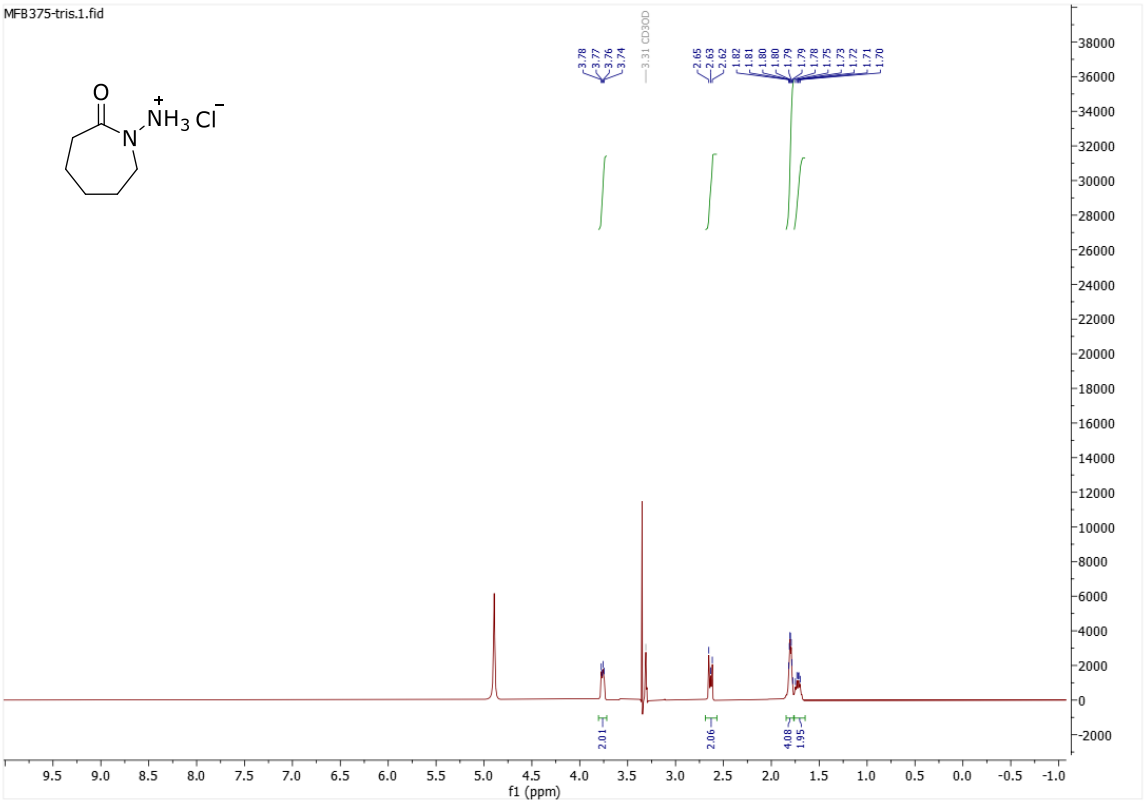


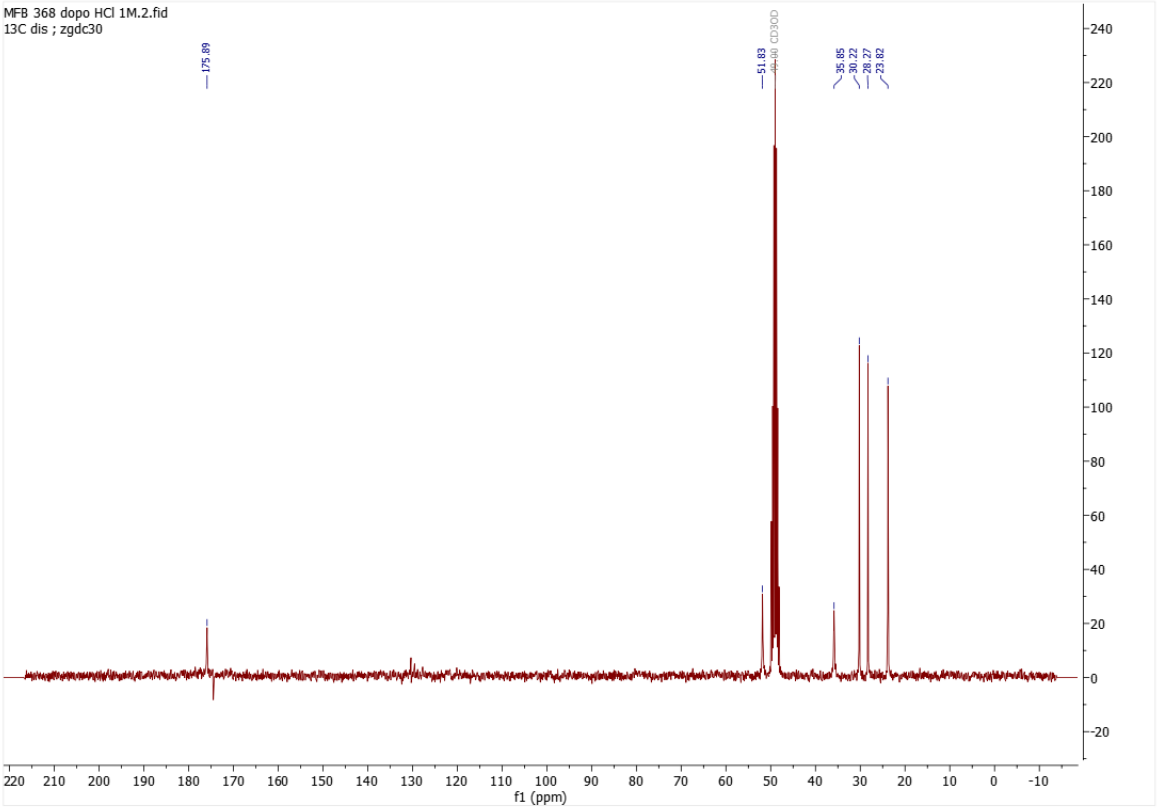
1-((diphenylmethylene)amino)-2-azepan2-one



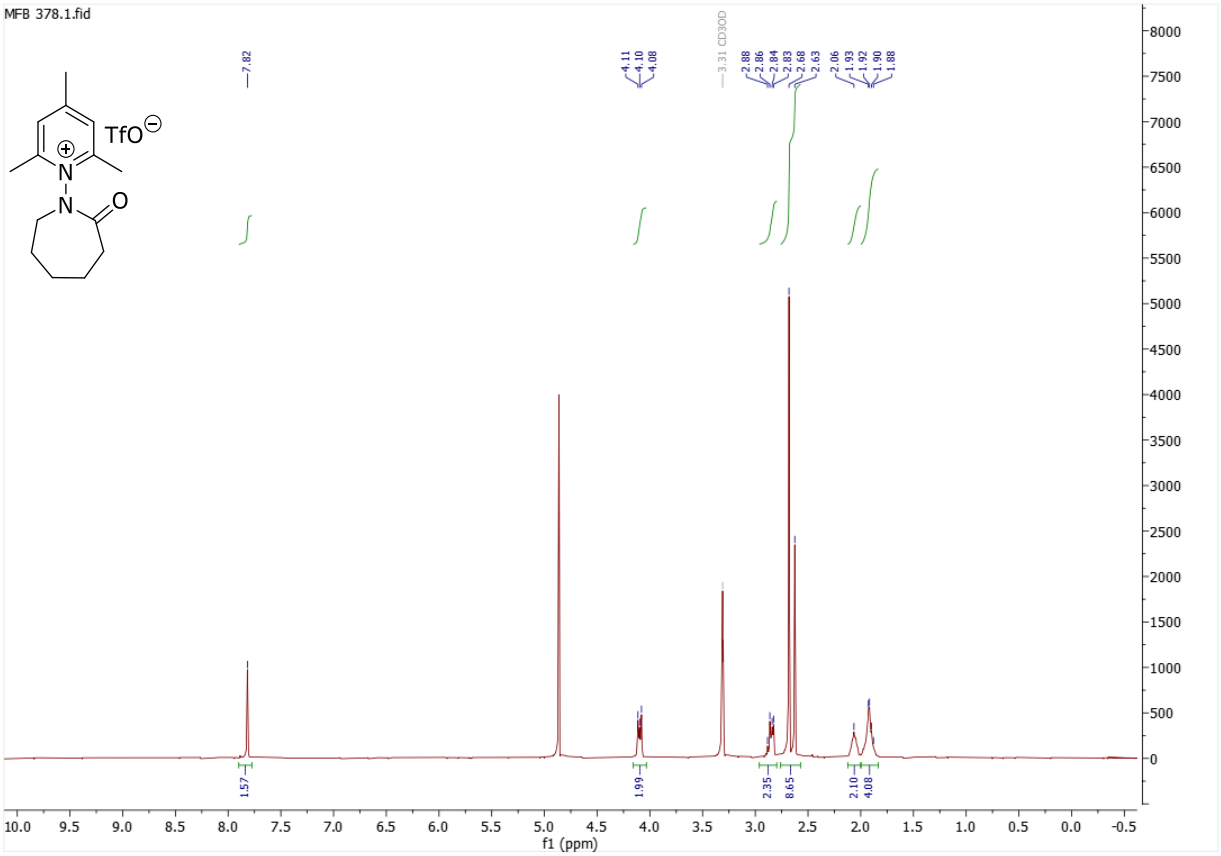


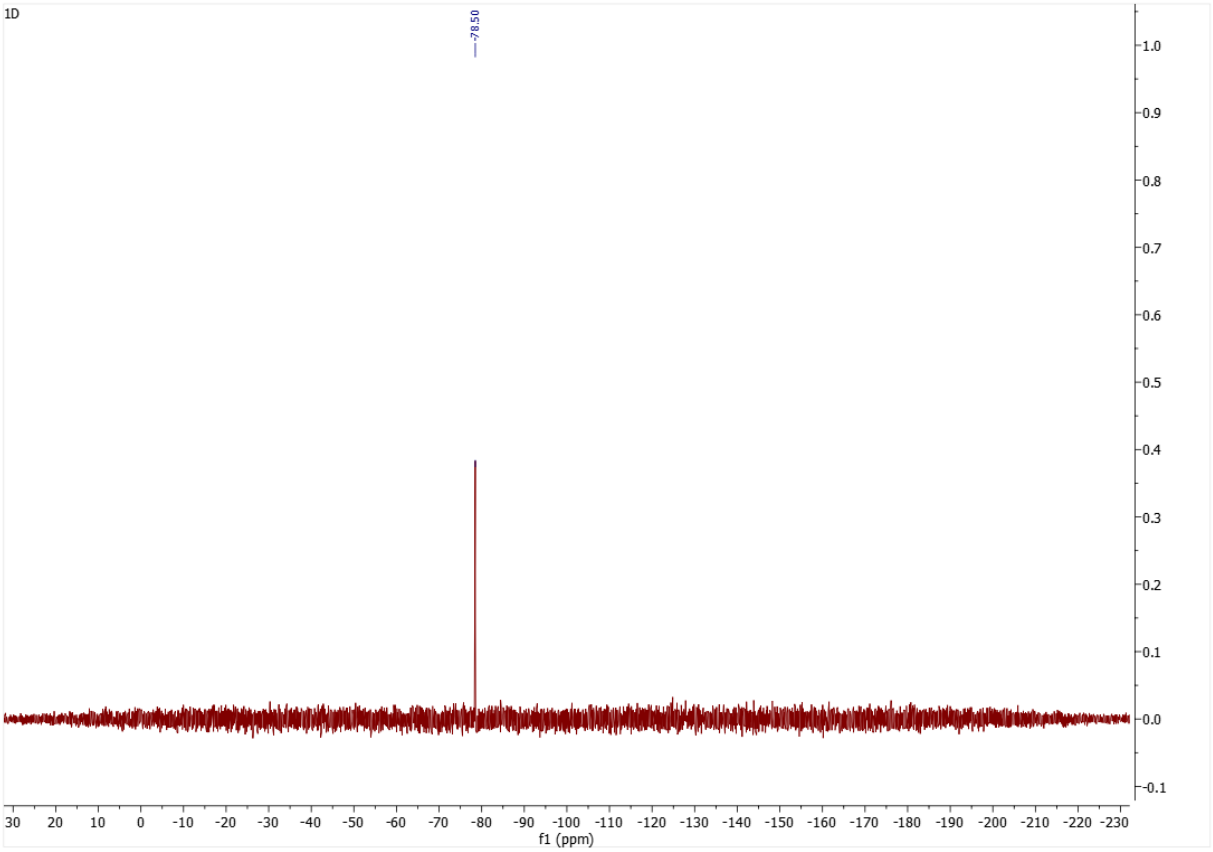
Amino-azepan-2-one hydrochloride

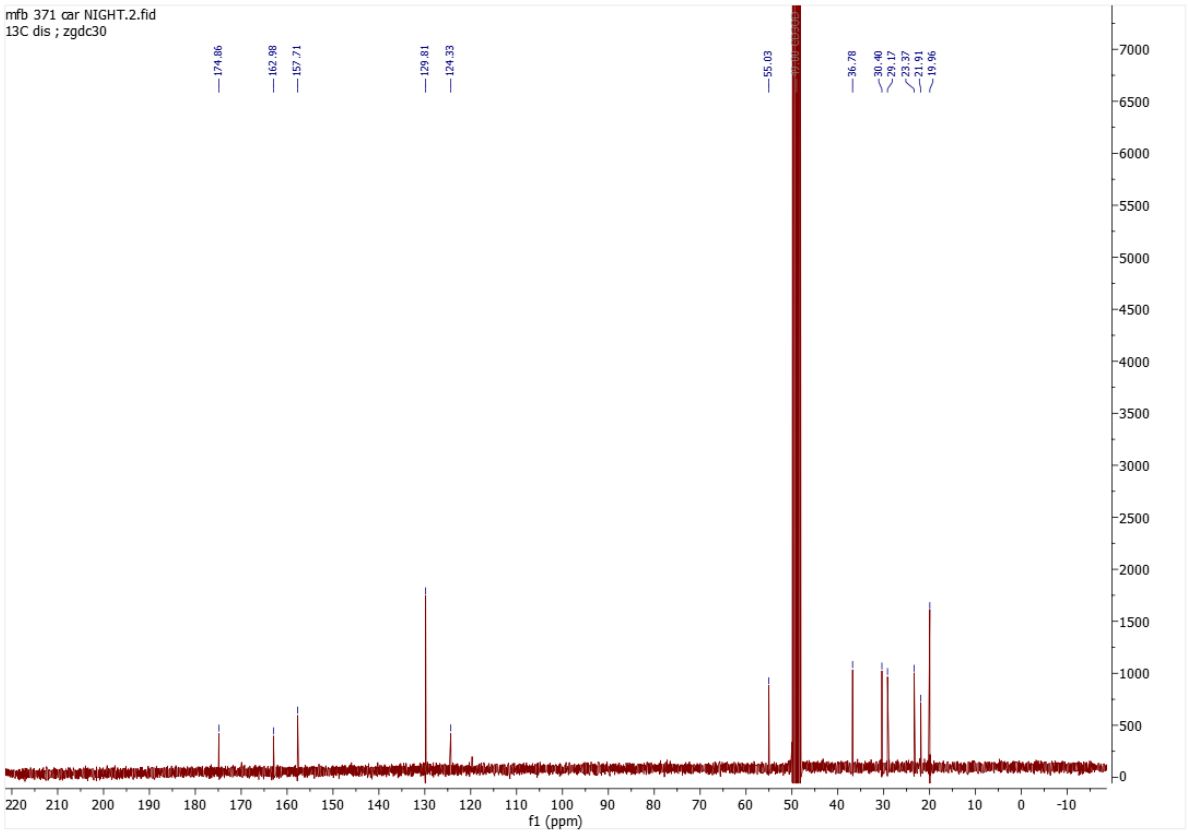




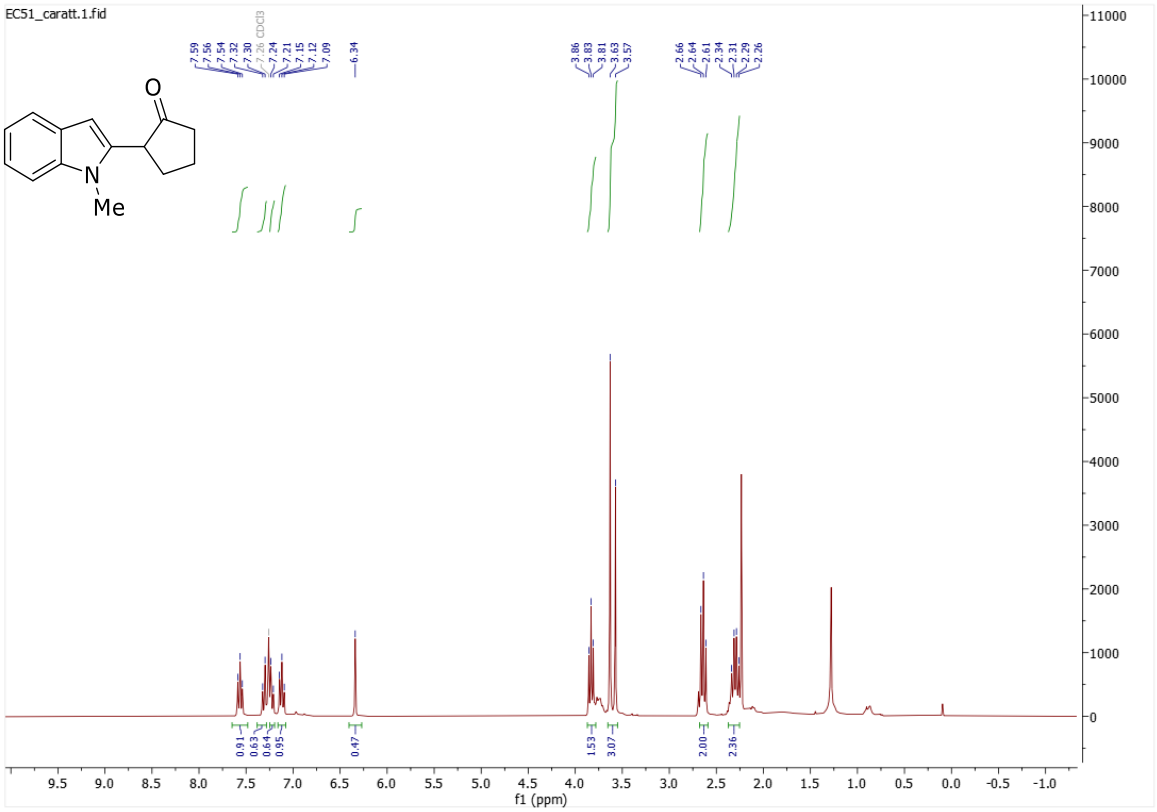
2,4,6-trimethyl-1-(2-oxoazepan-1-yl)pyridinium triflate (5d)

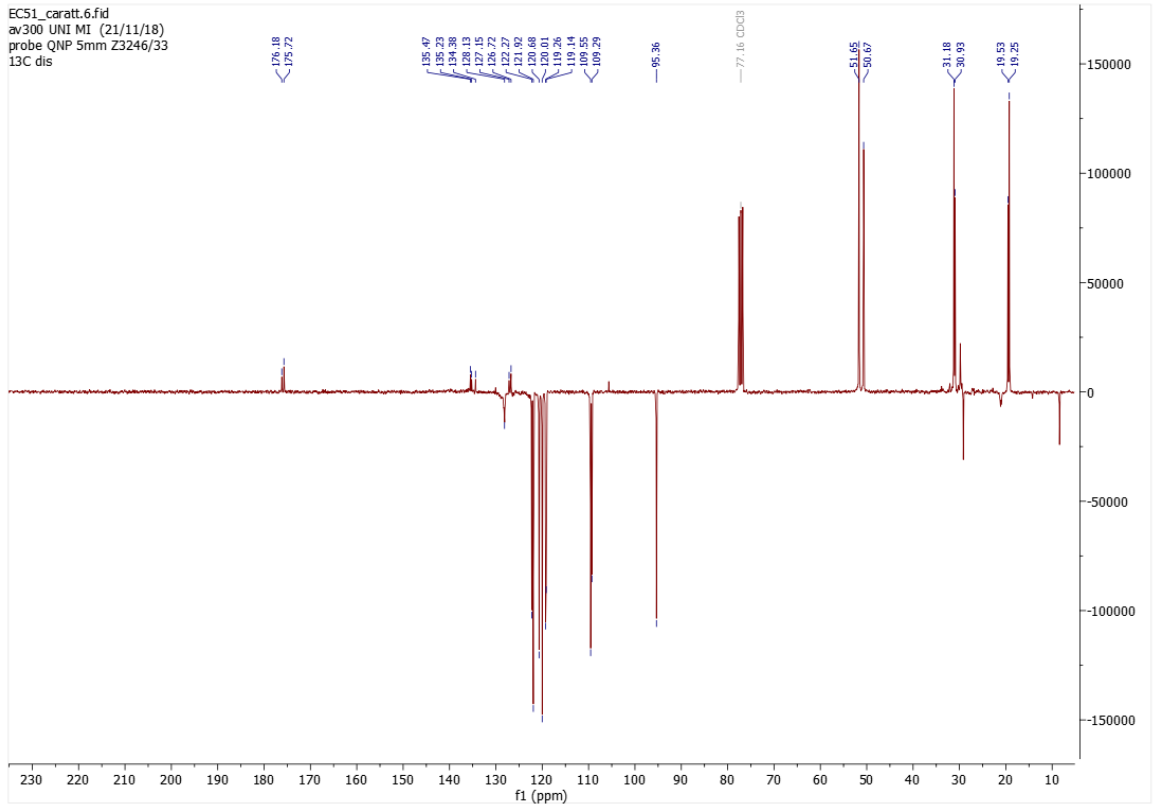




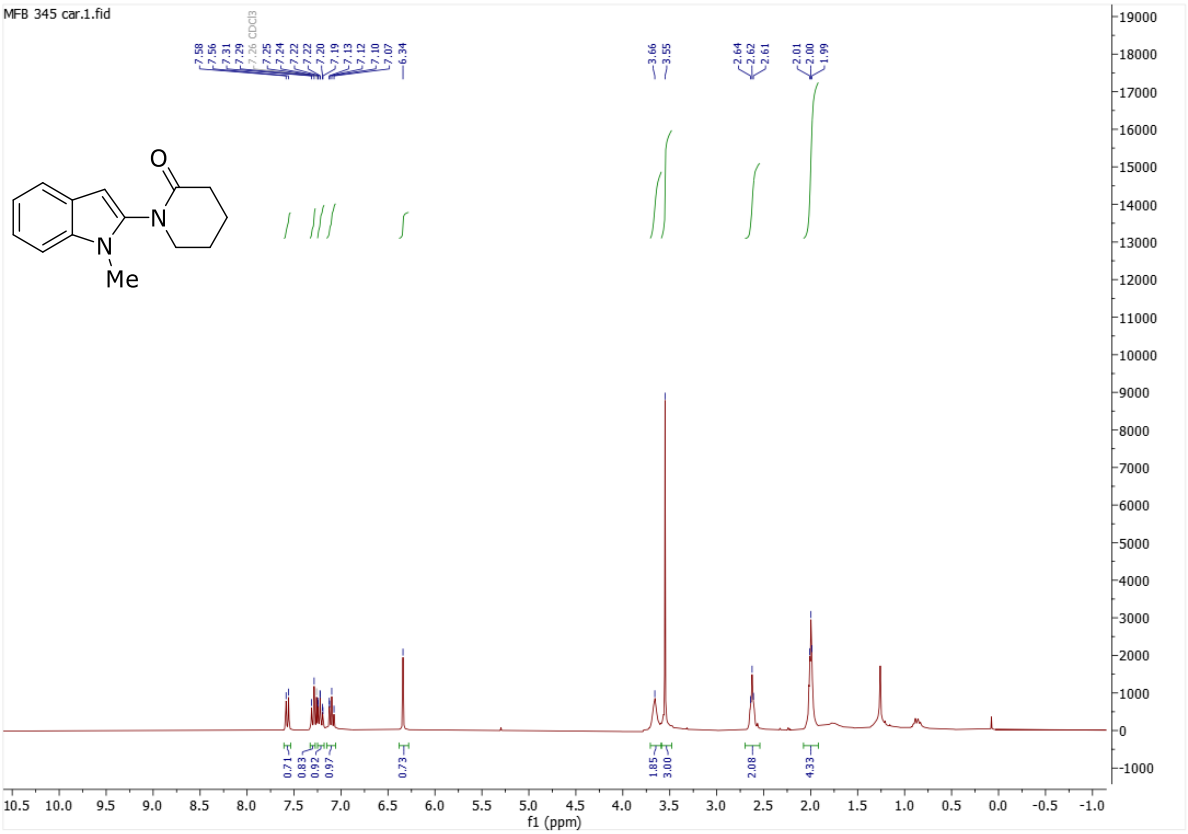

mfb 371 car NIGHT.2.fid
13C dis ; zgdc30
174.86
162.98
157.71
129.81
124.33
55.03
36.78
30.40
29.17
23.37
21.91
19.96
f1 (ppm)

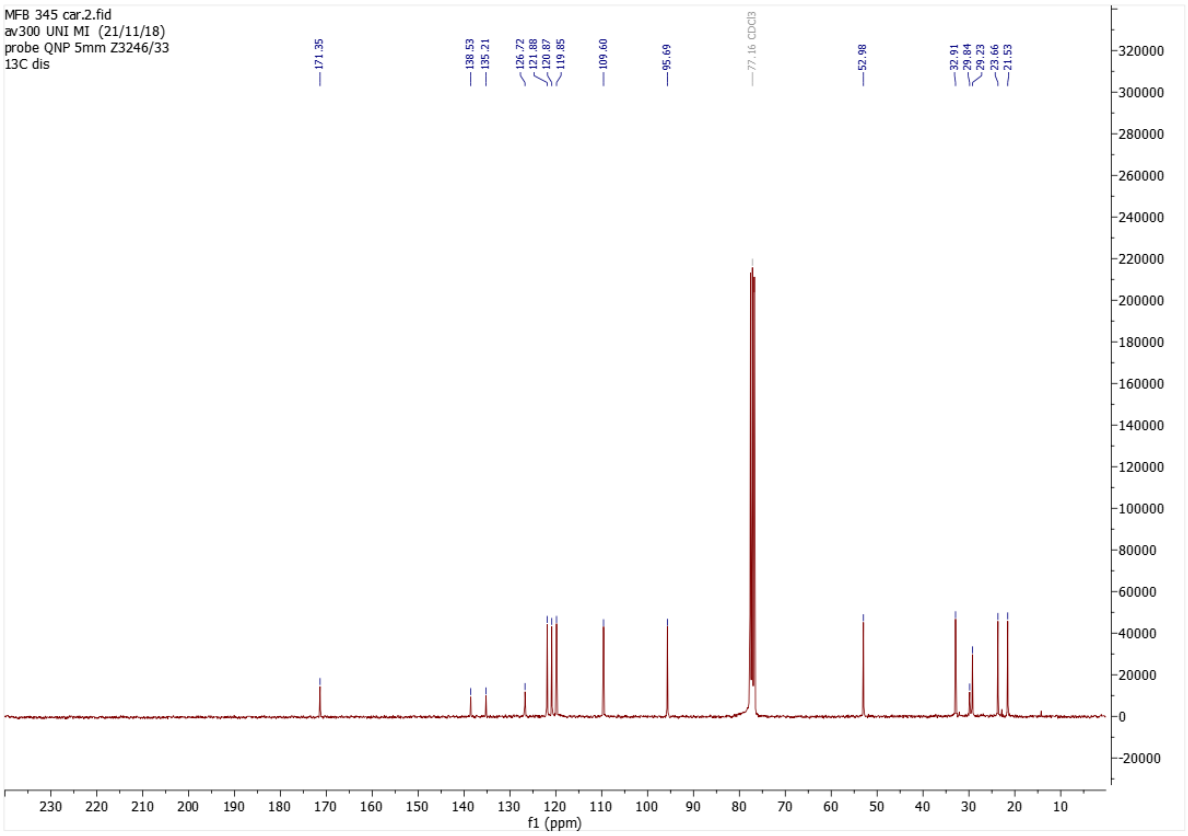
1-(1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7a)



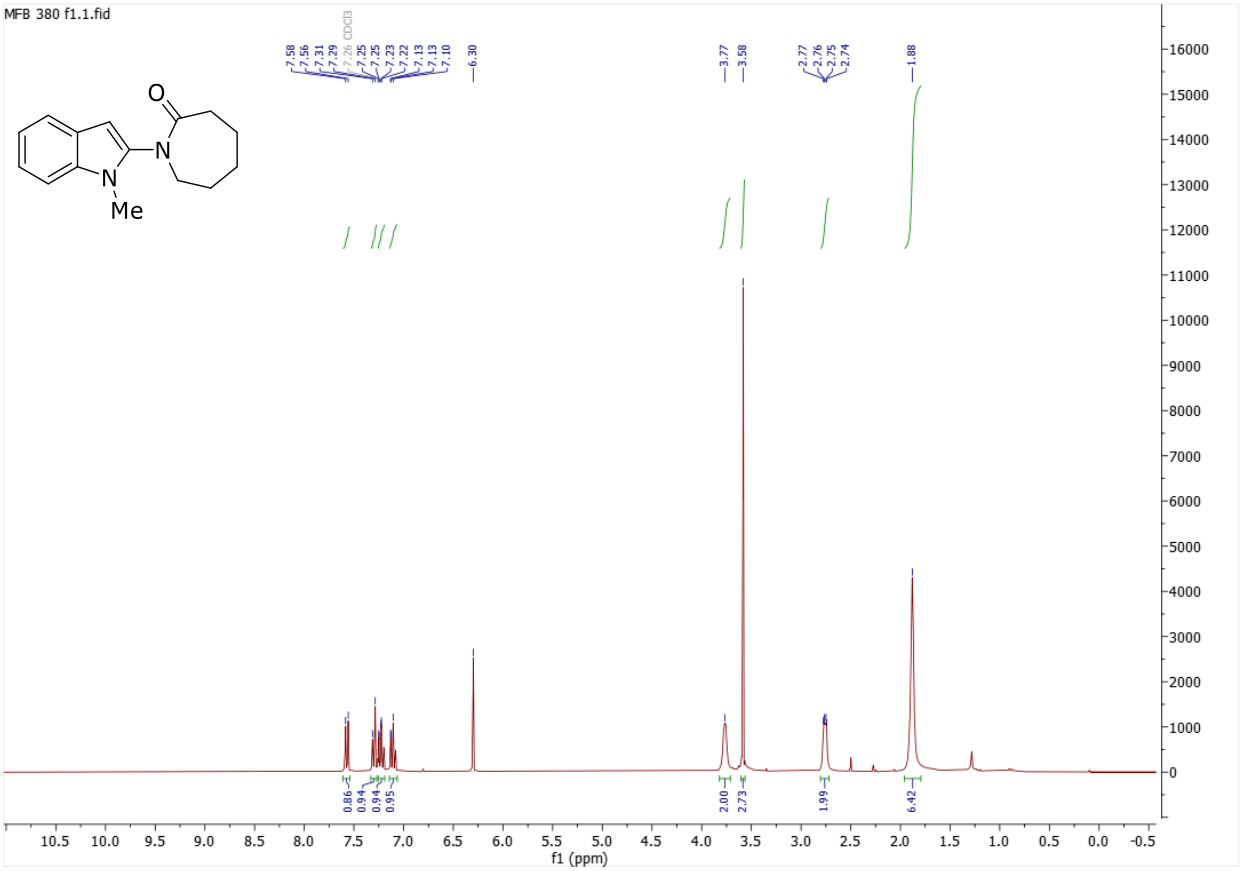


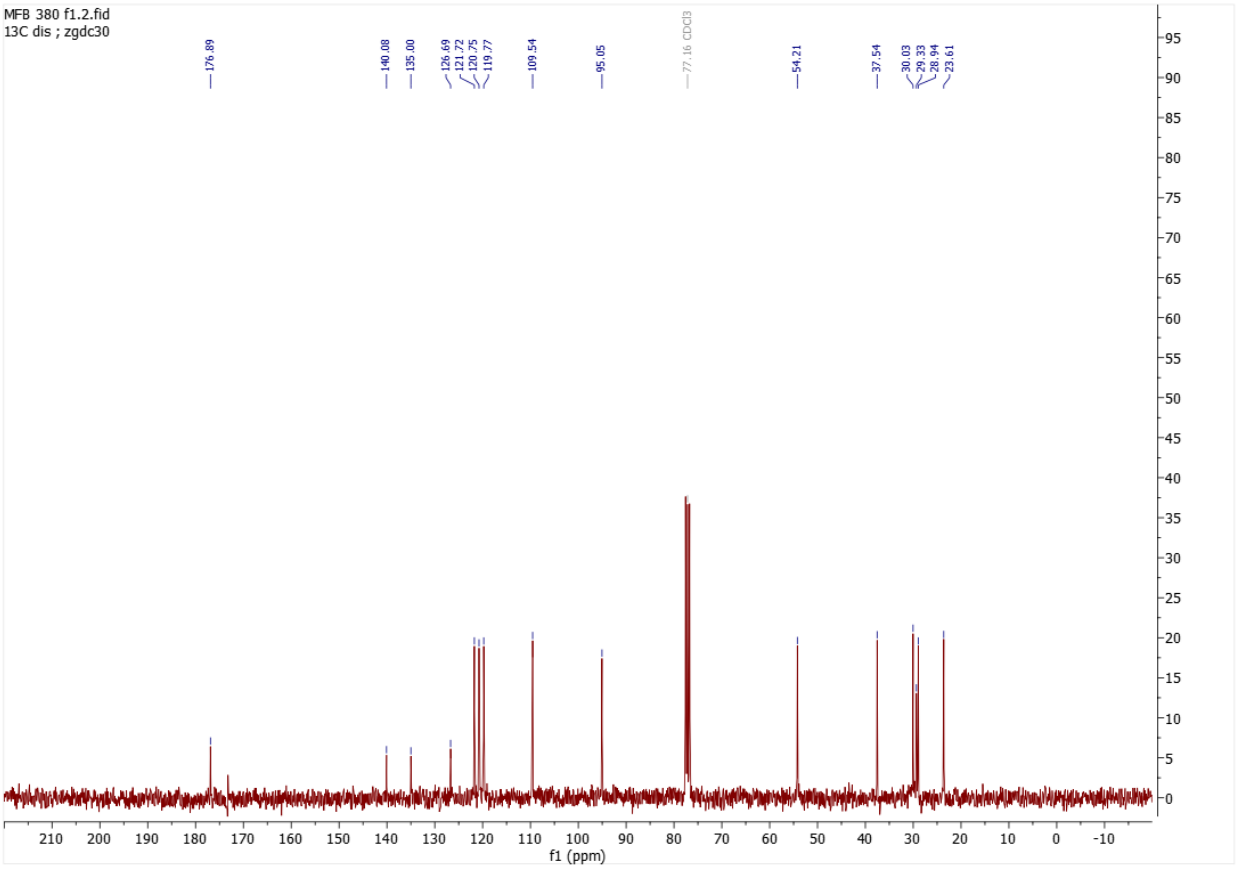
1-(1-methyl-1H-indol-2-yl)piperidin-2-one (7b)



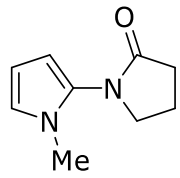


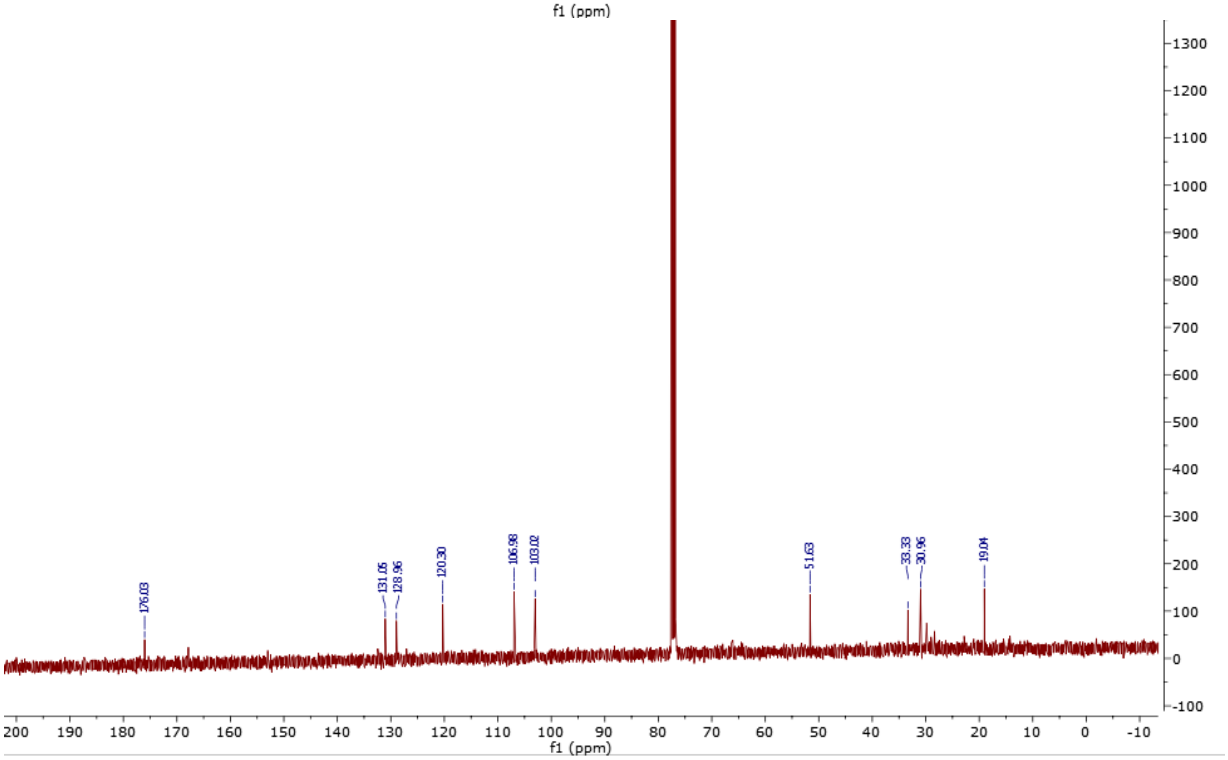
1-(1-methyl-1H-indol-2-yl)azepan-2-one (7c)



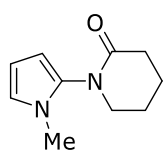


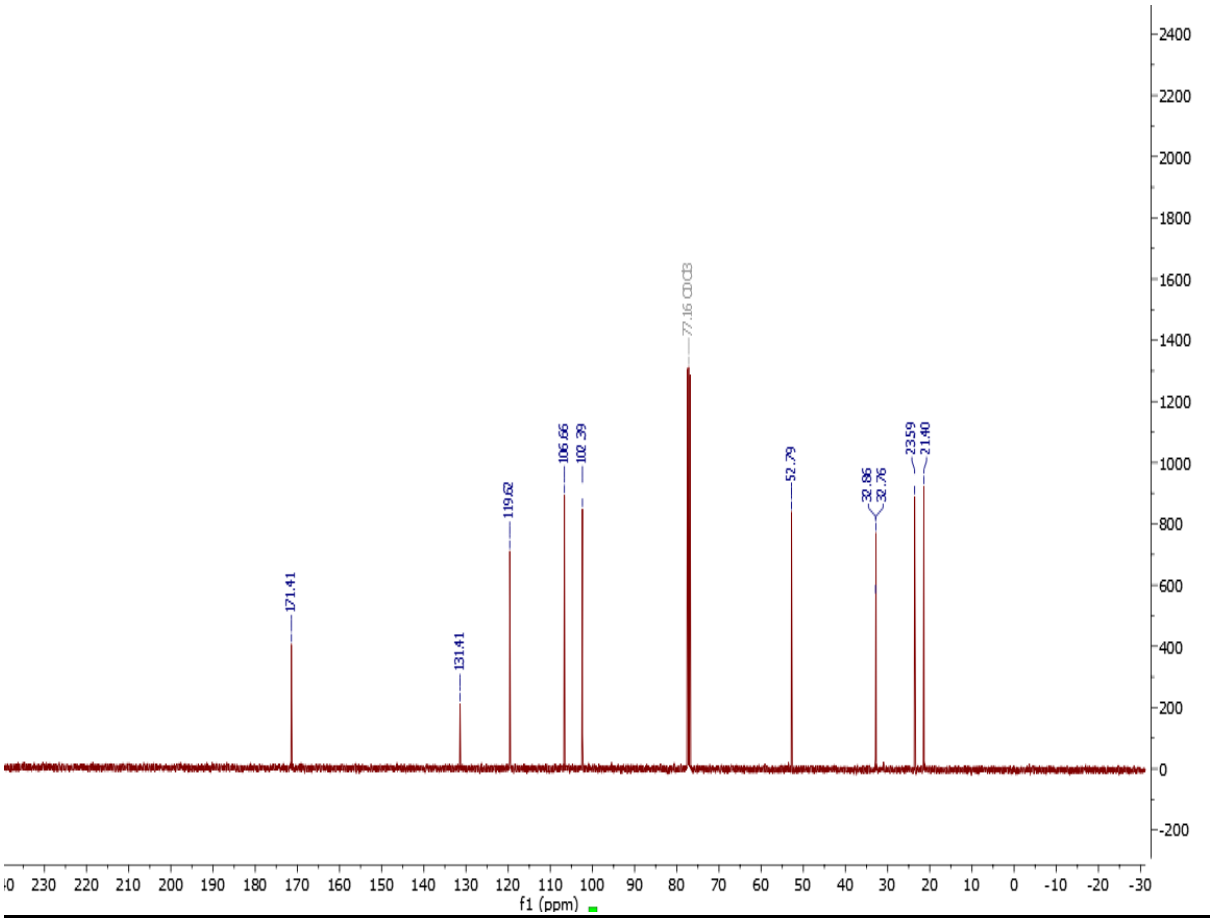
1-(1-methyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7d)



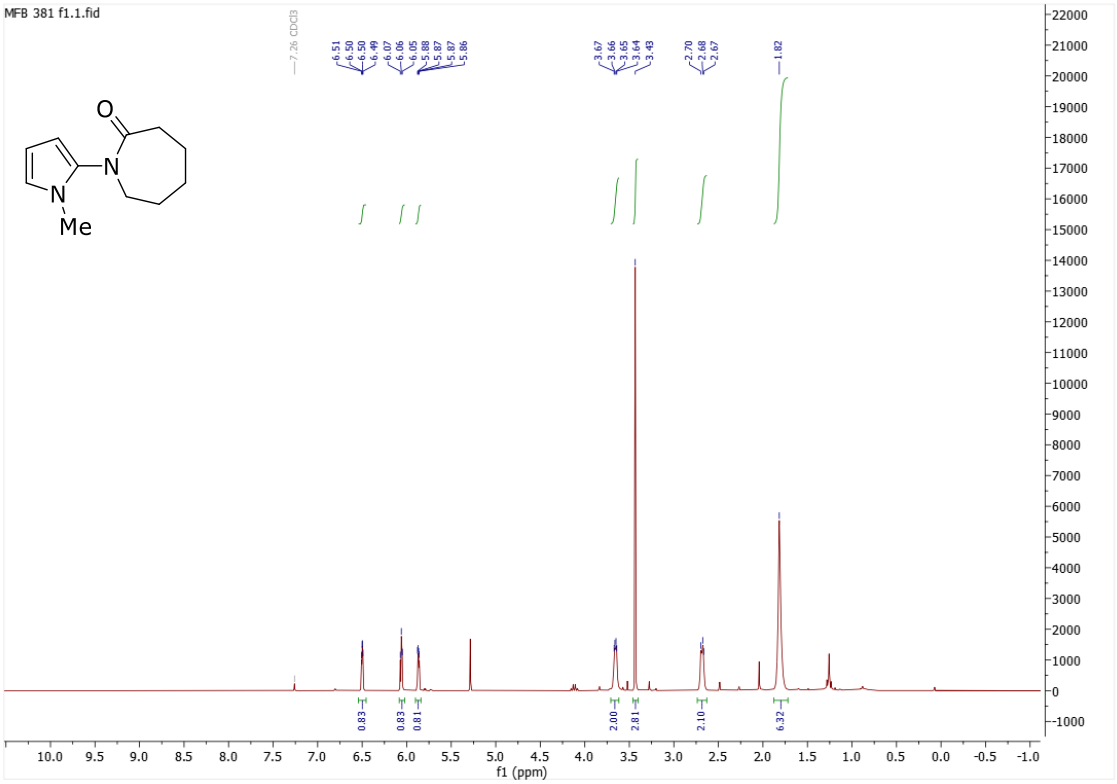


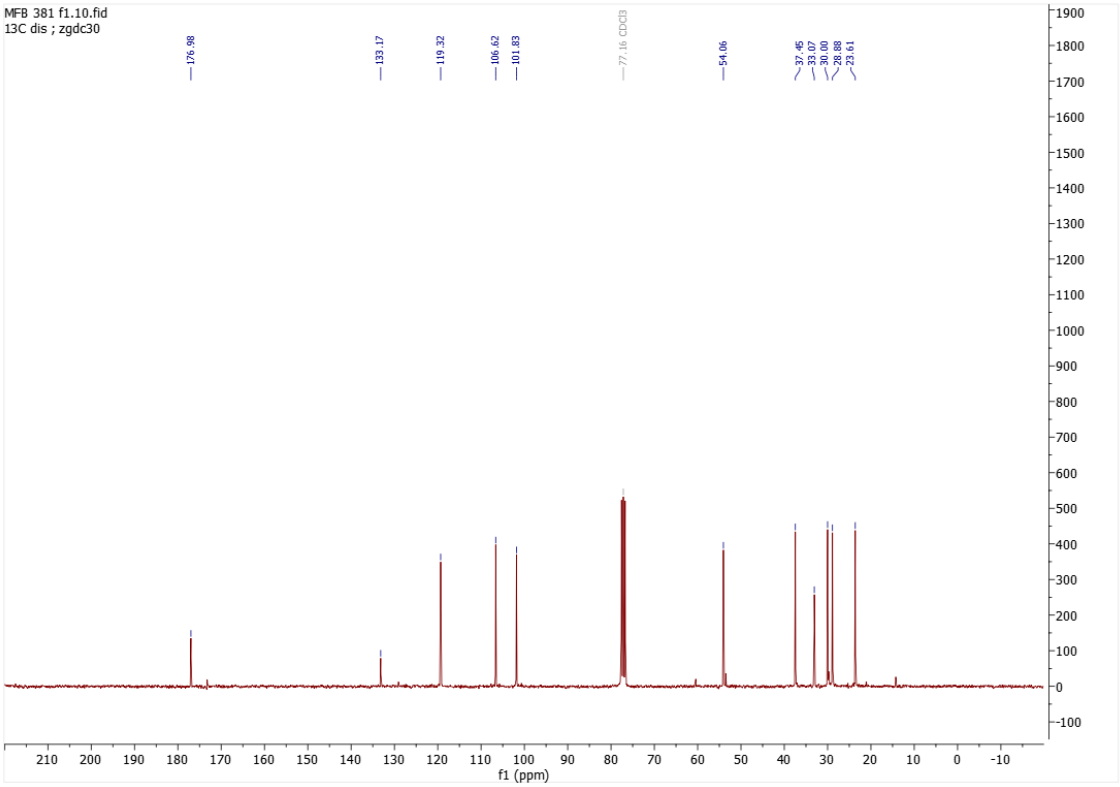
1-(1-methyl-1H-pyrrol-2-yl)piperidin-2-one (7e)



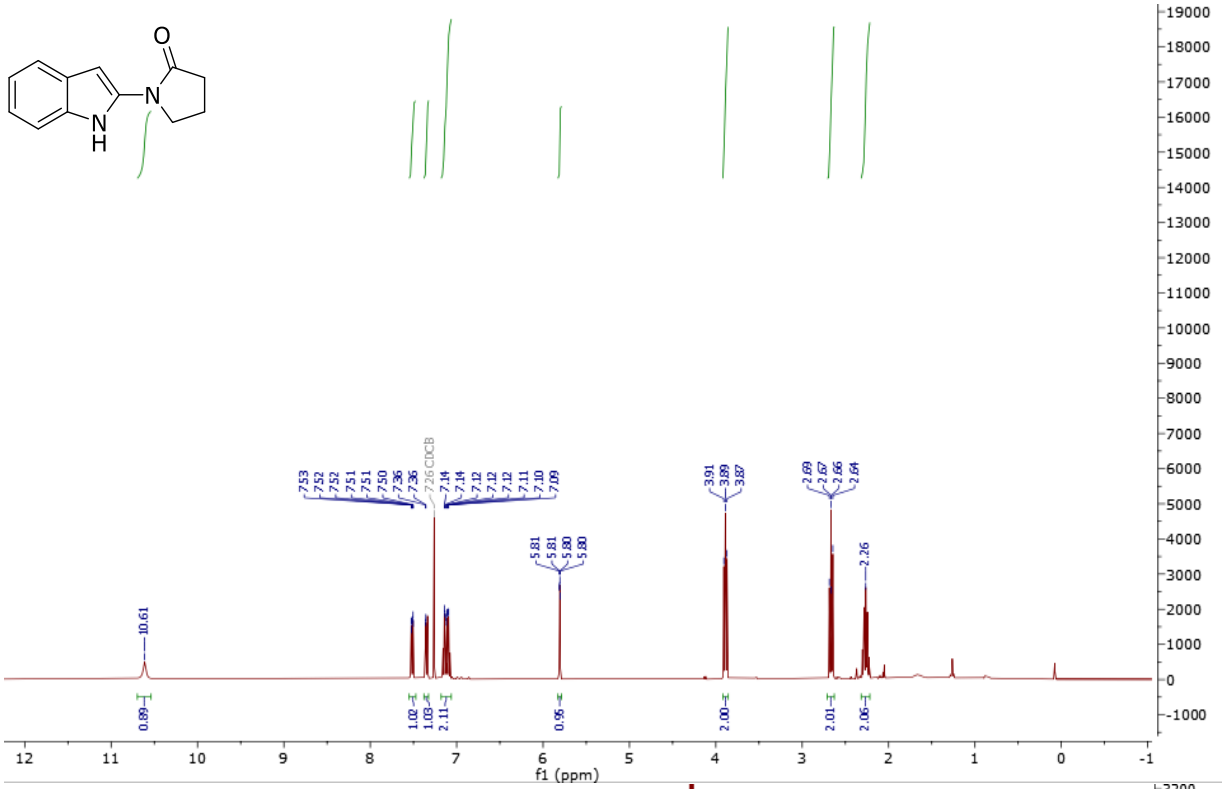


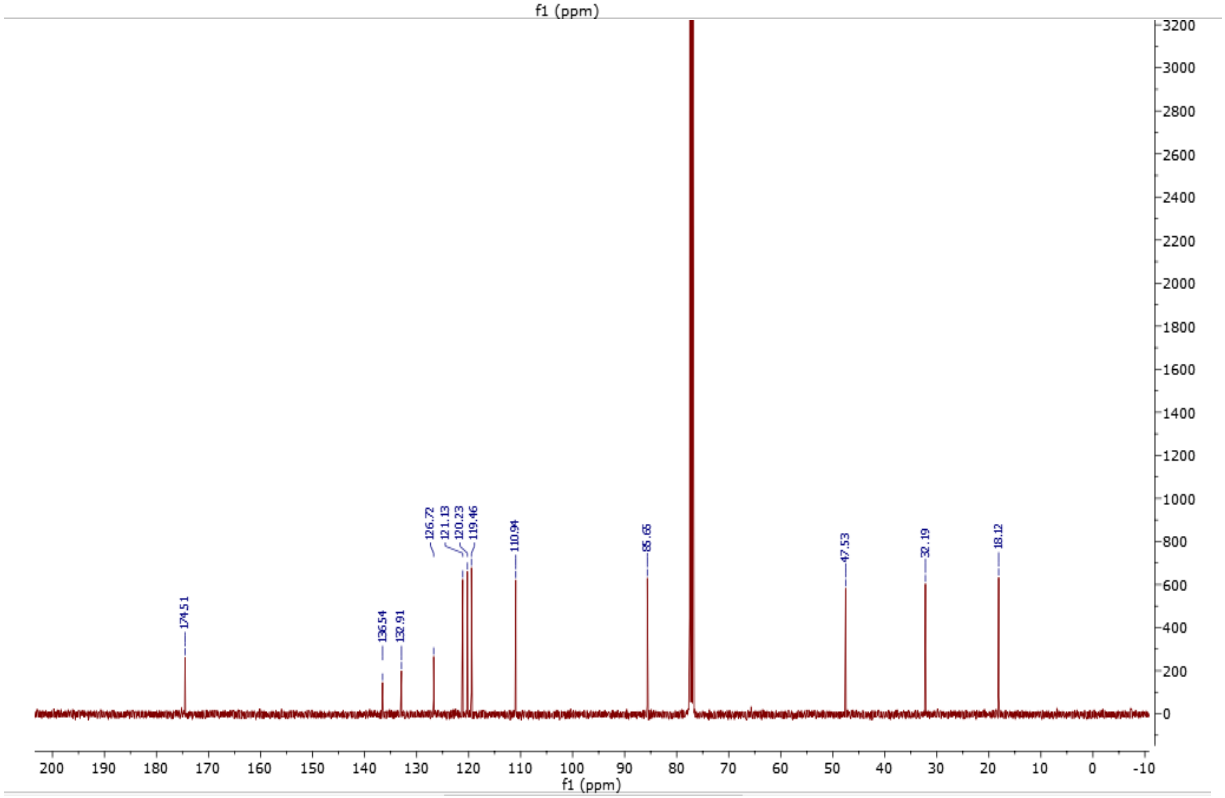
1-(1-methyl-1H-indol-2-yl)azepan-2-one (7f)



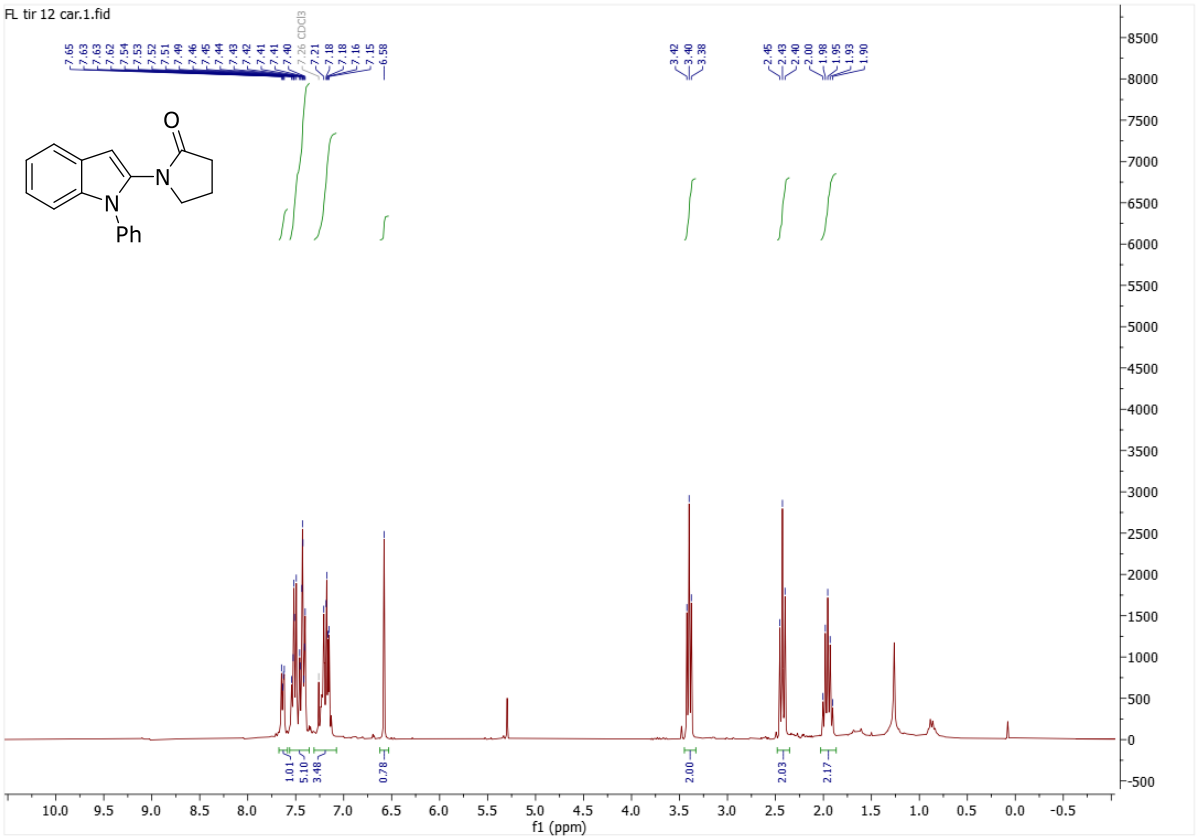


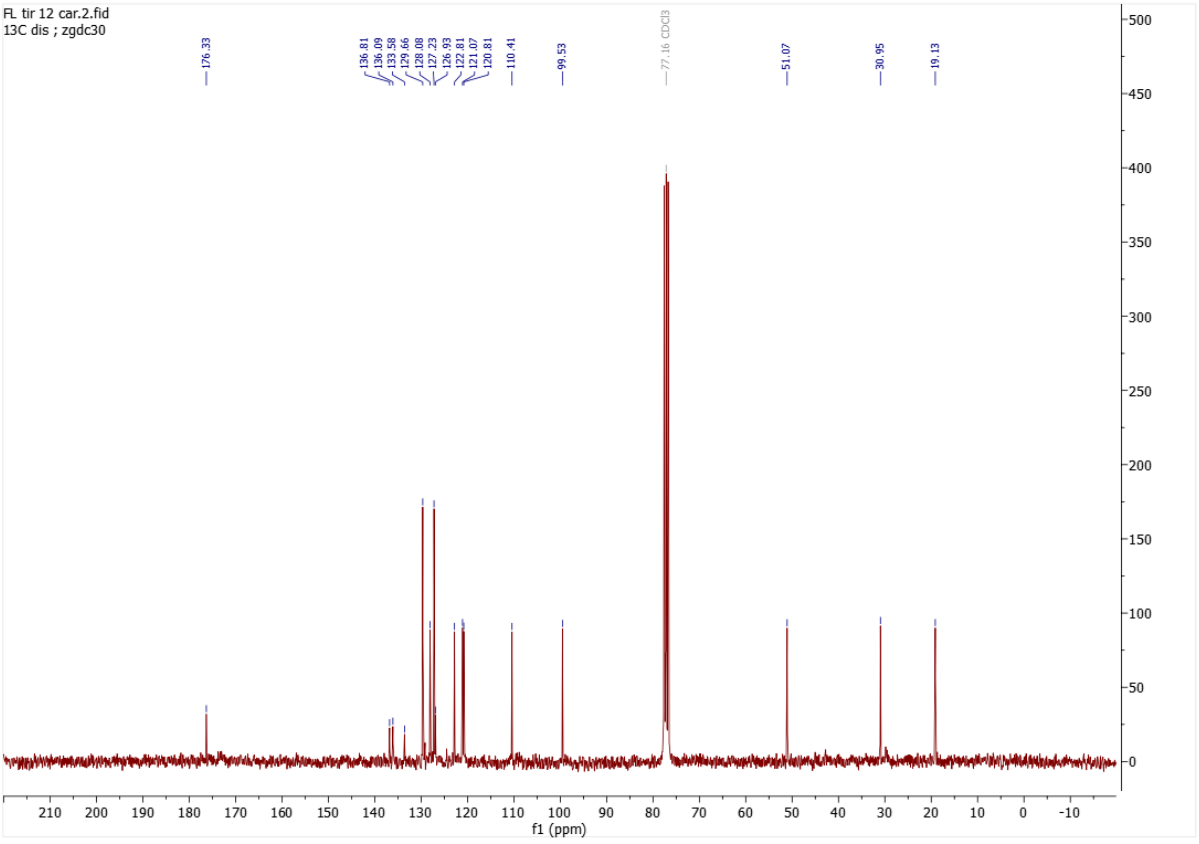
1-(1H-indol-2-yl)pyrrolidin-2-one (7g)



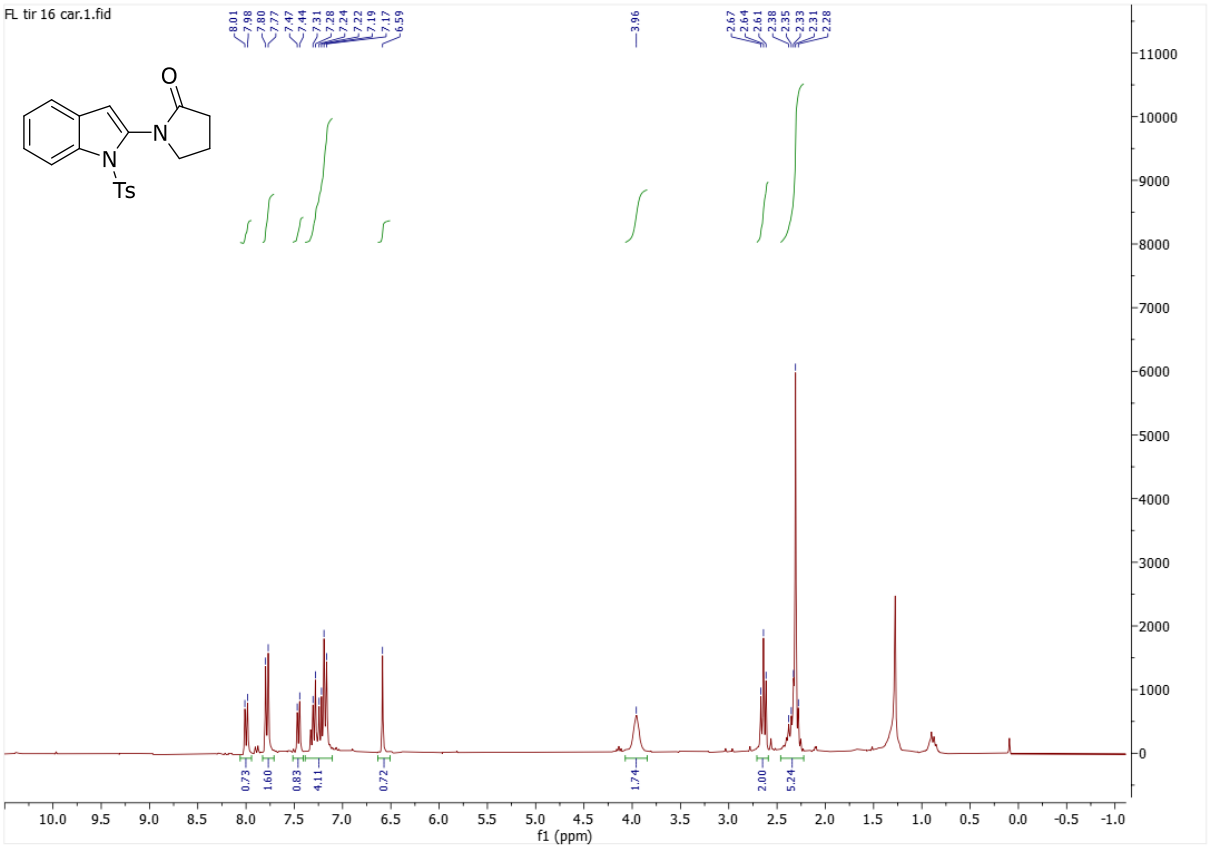


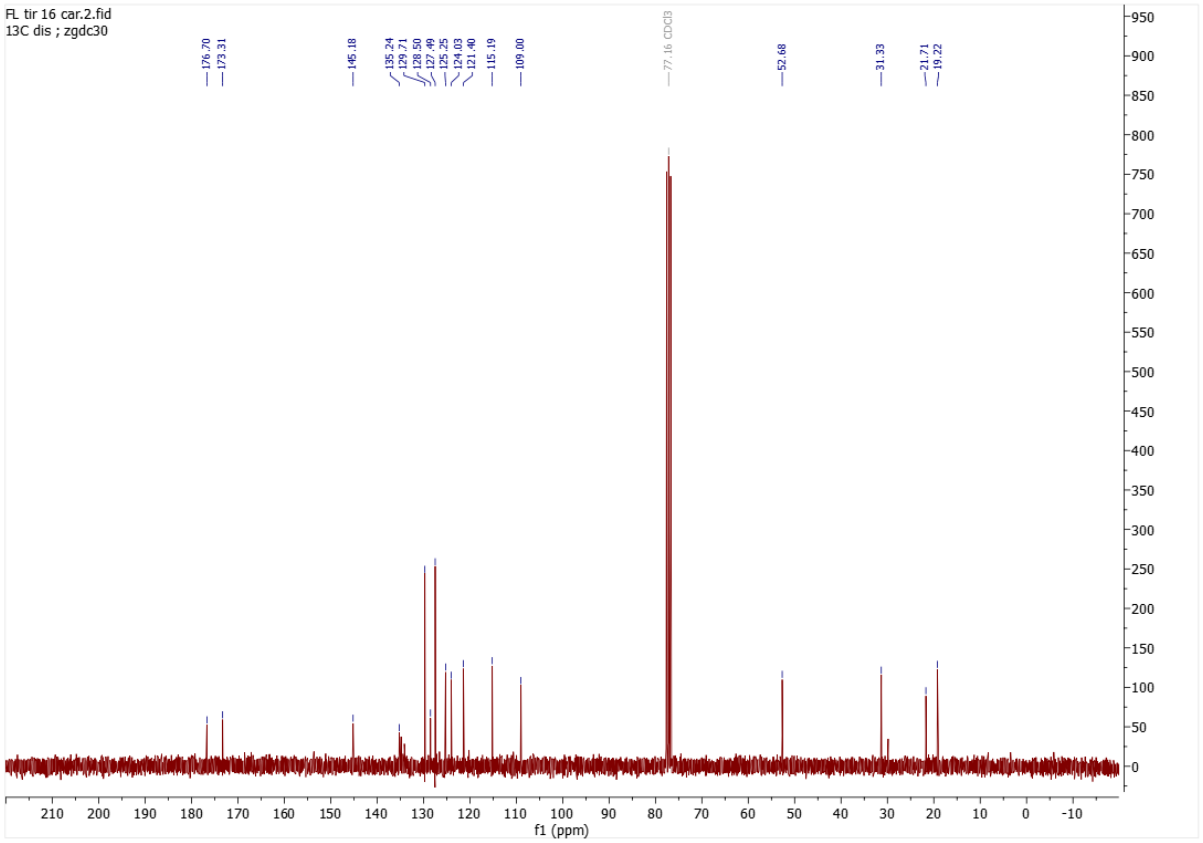
1-(1-phenyl-1H-indol-2-yl)pyrrolidin-2-one (7h)



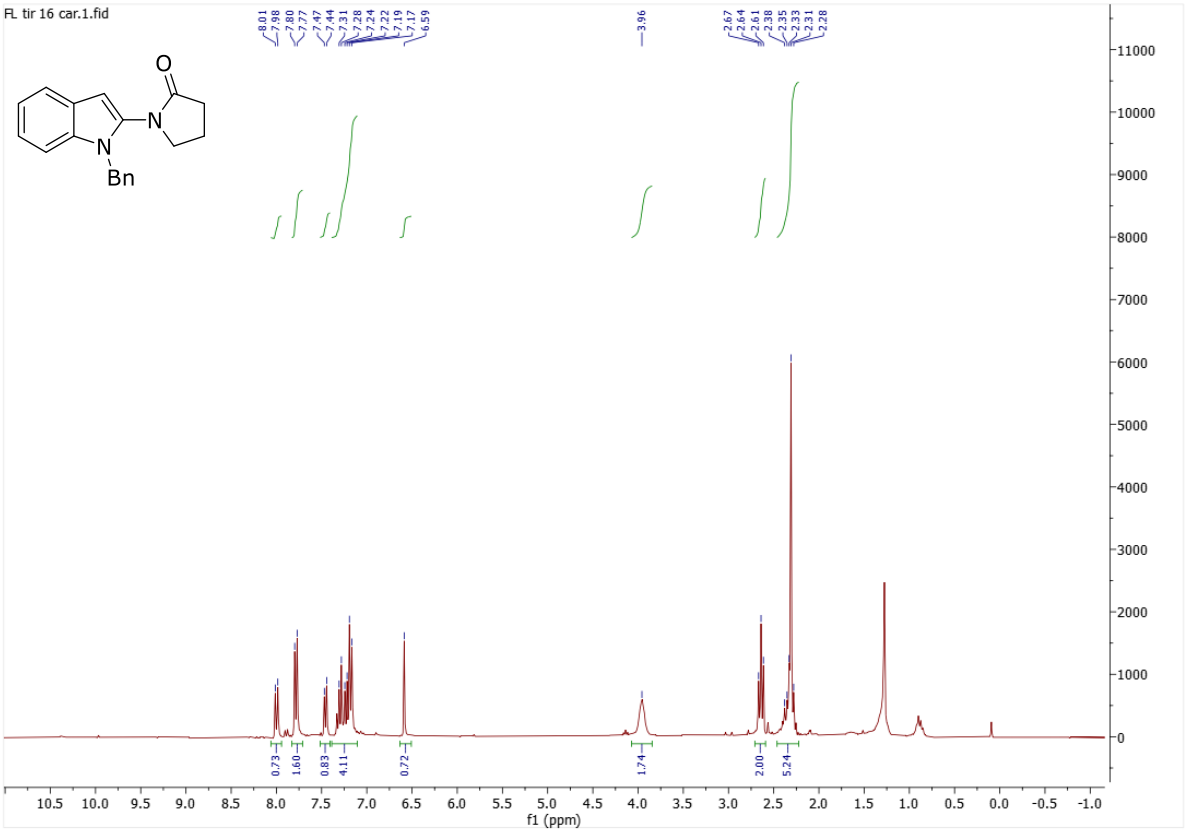


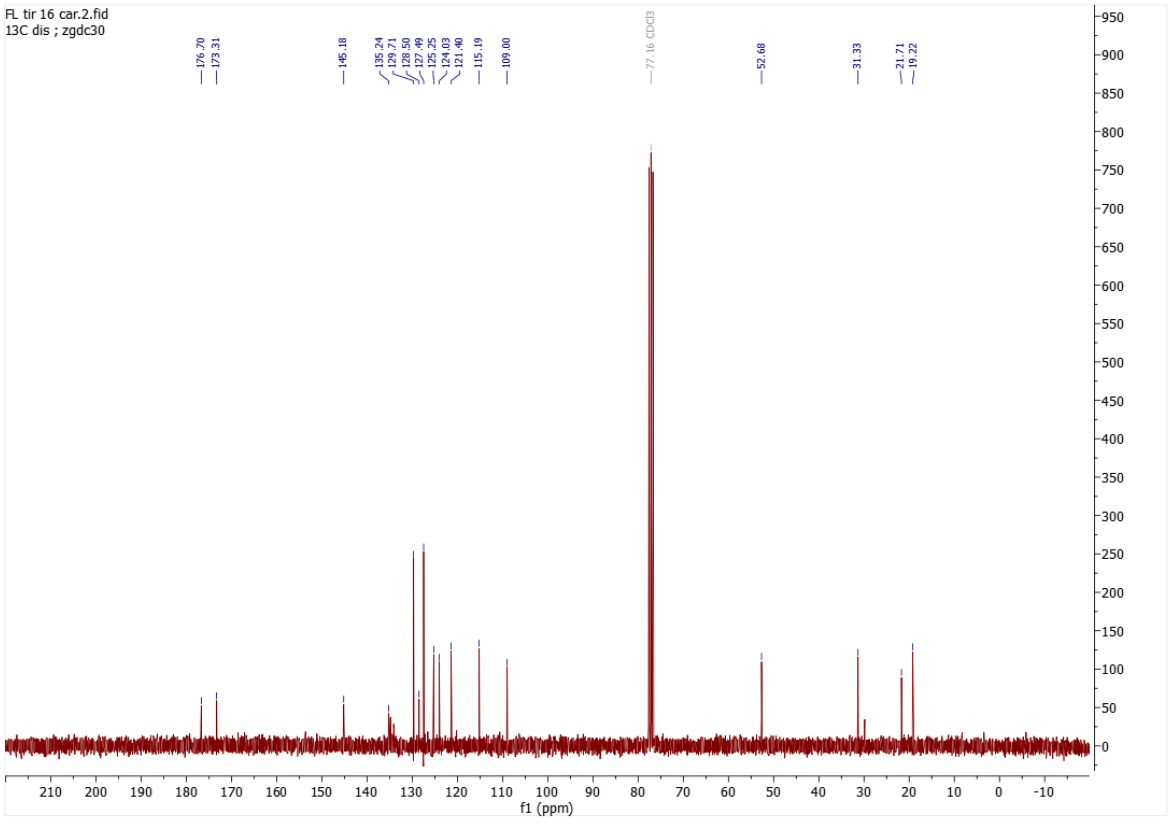
1-(1-tosyl-1H-indol-2-yl)pyrrolidin-2-one (7i)



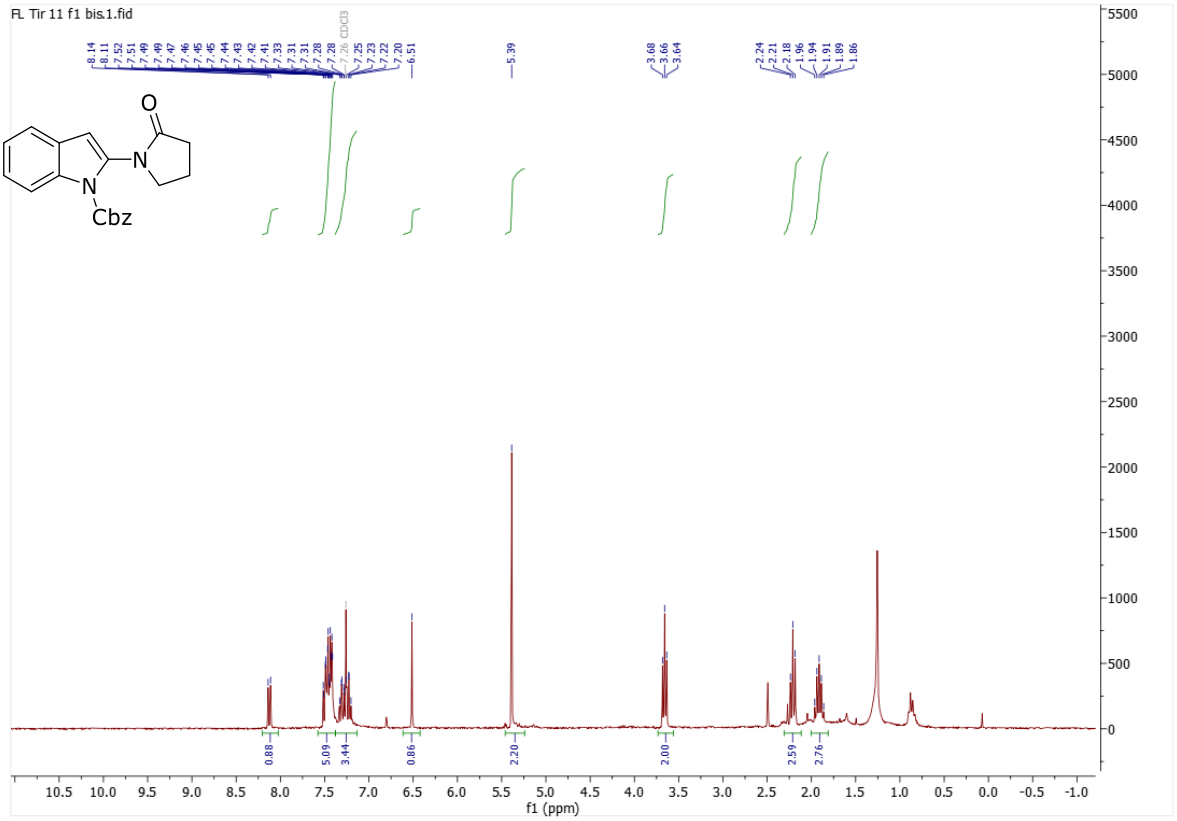


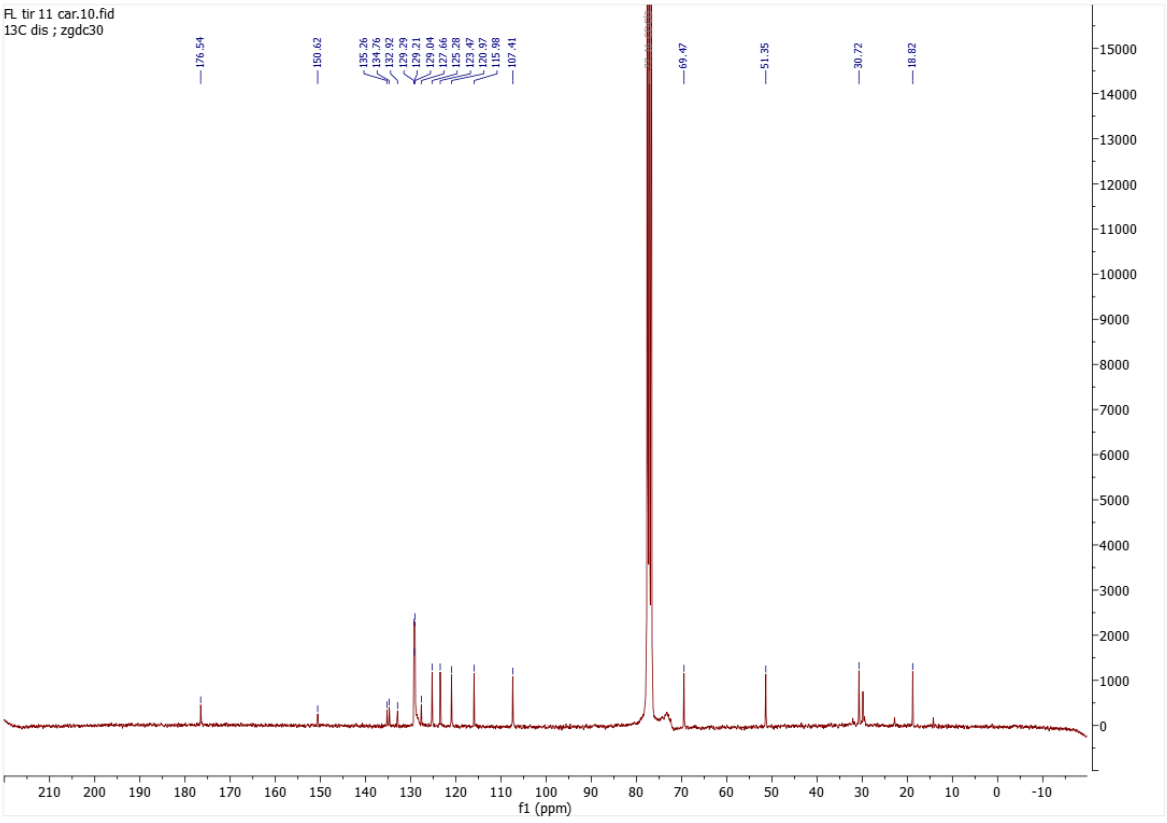
1-(1-benzyl-1H-indol-2-yl)pyrrolidin-2-one (7j)



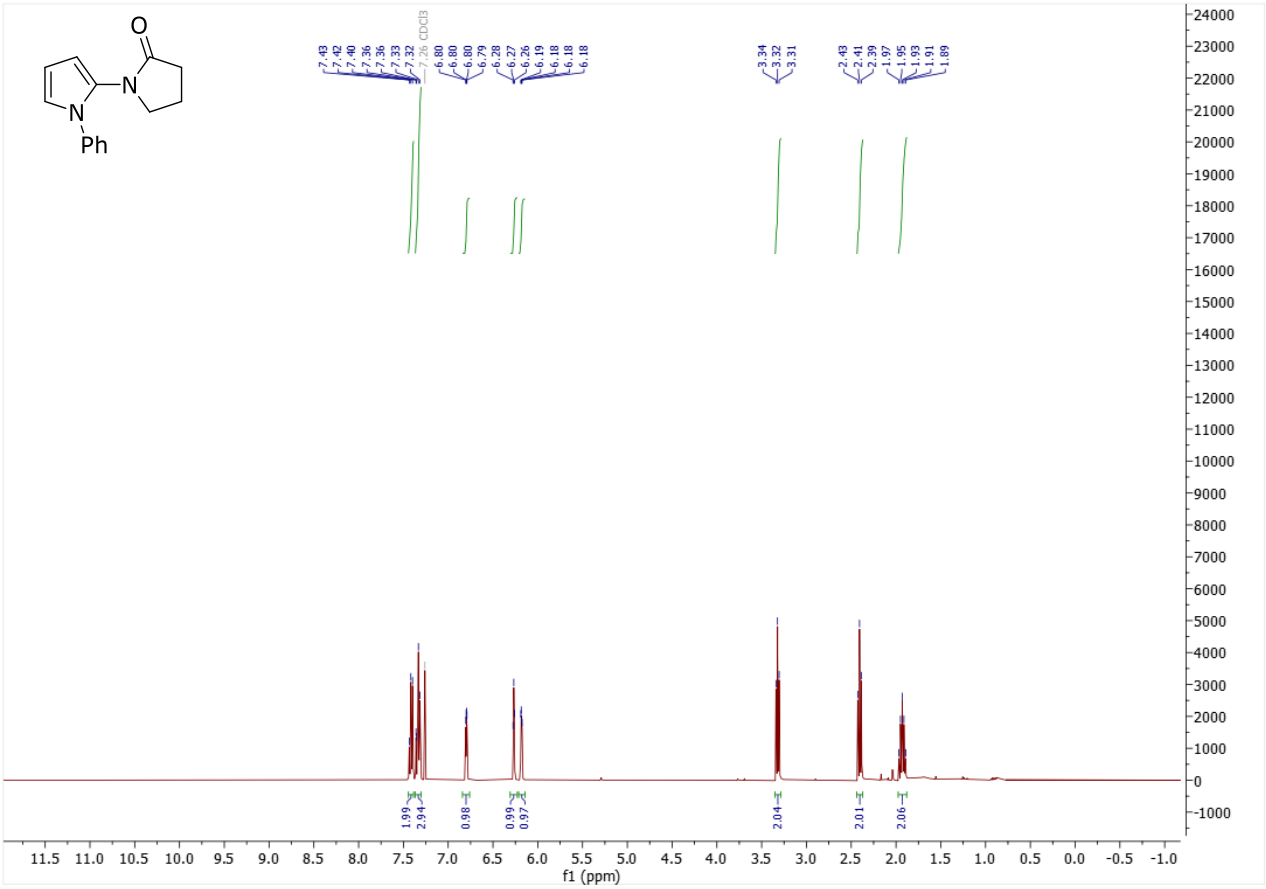


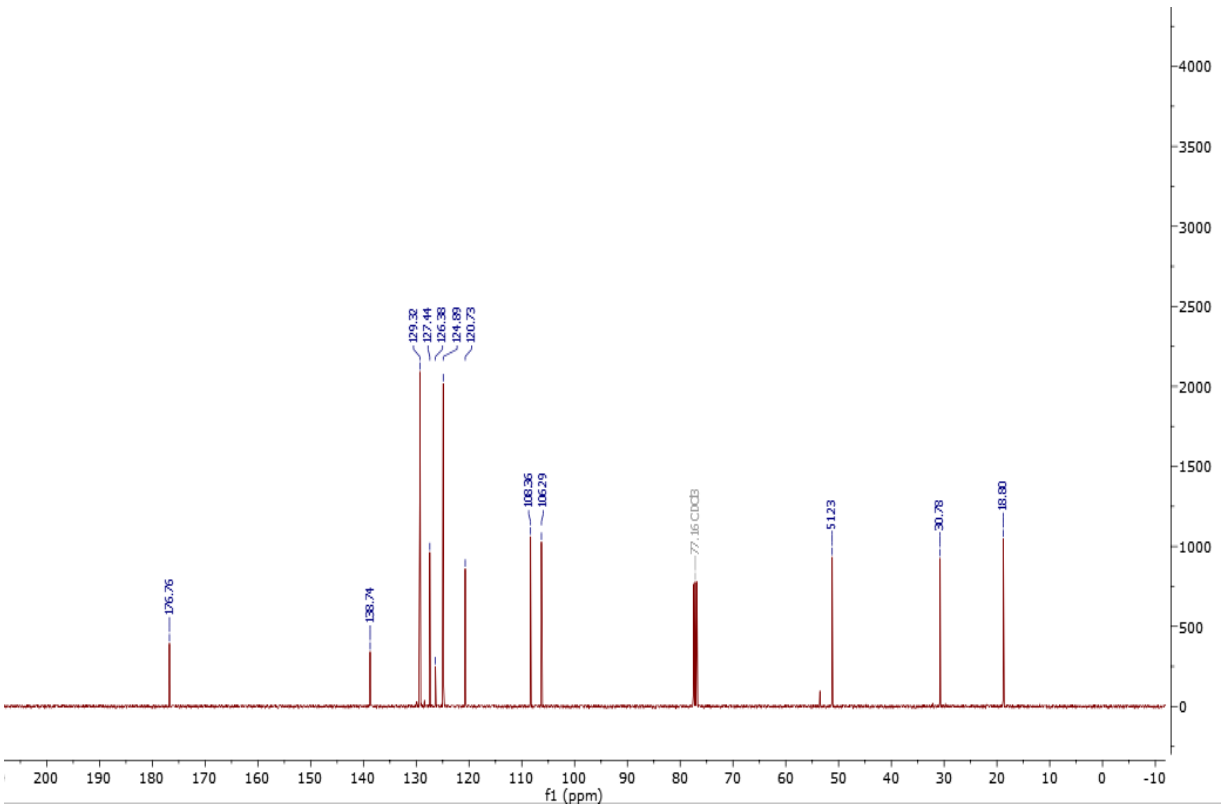
1-(1-benzyloxycarbonyl-1H-indol-2-yl)pyrrolidin-2-one (7k)



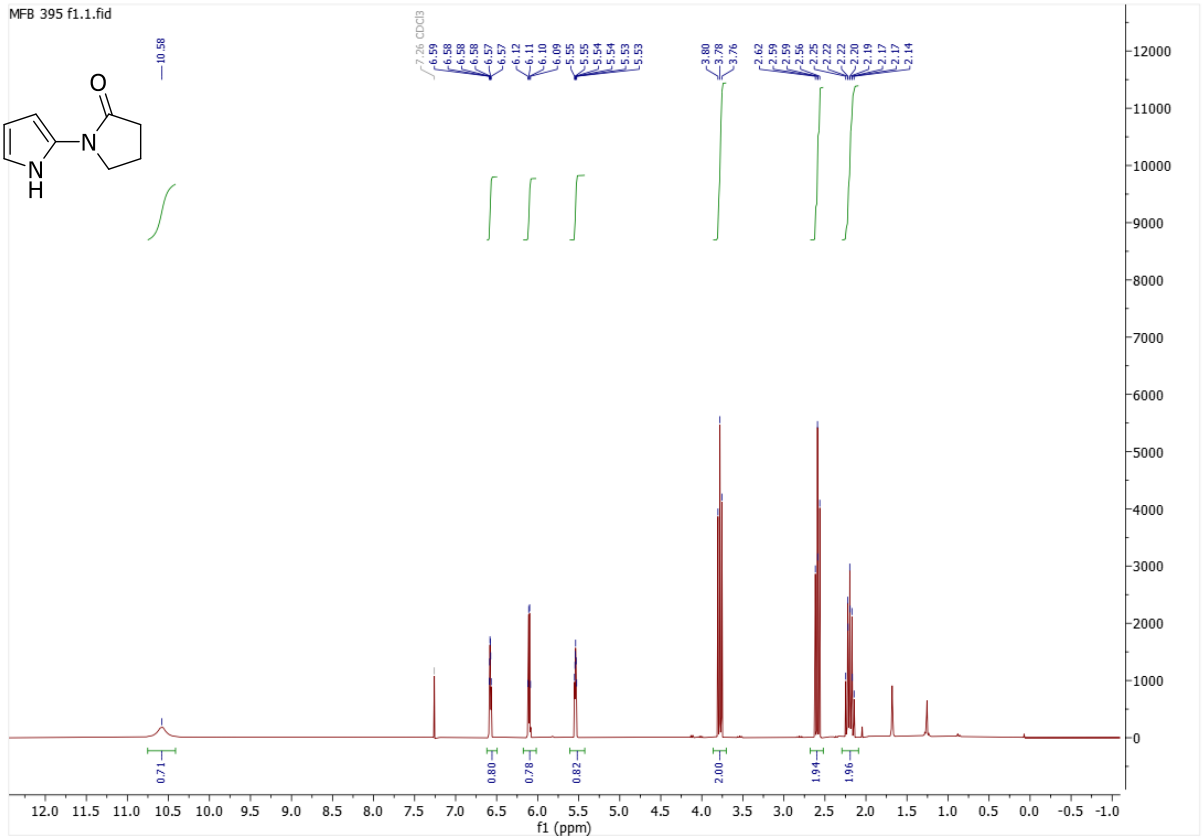


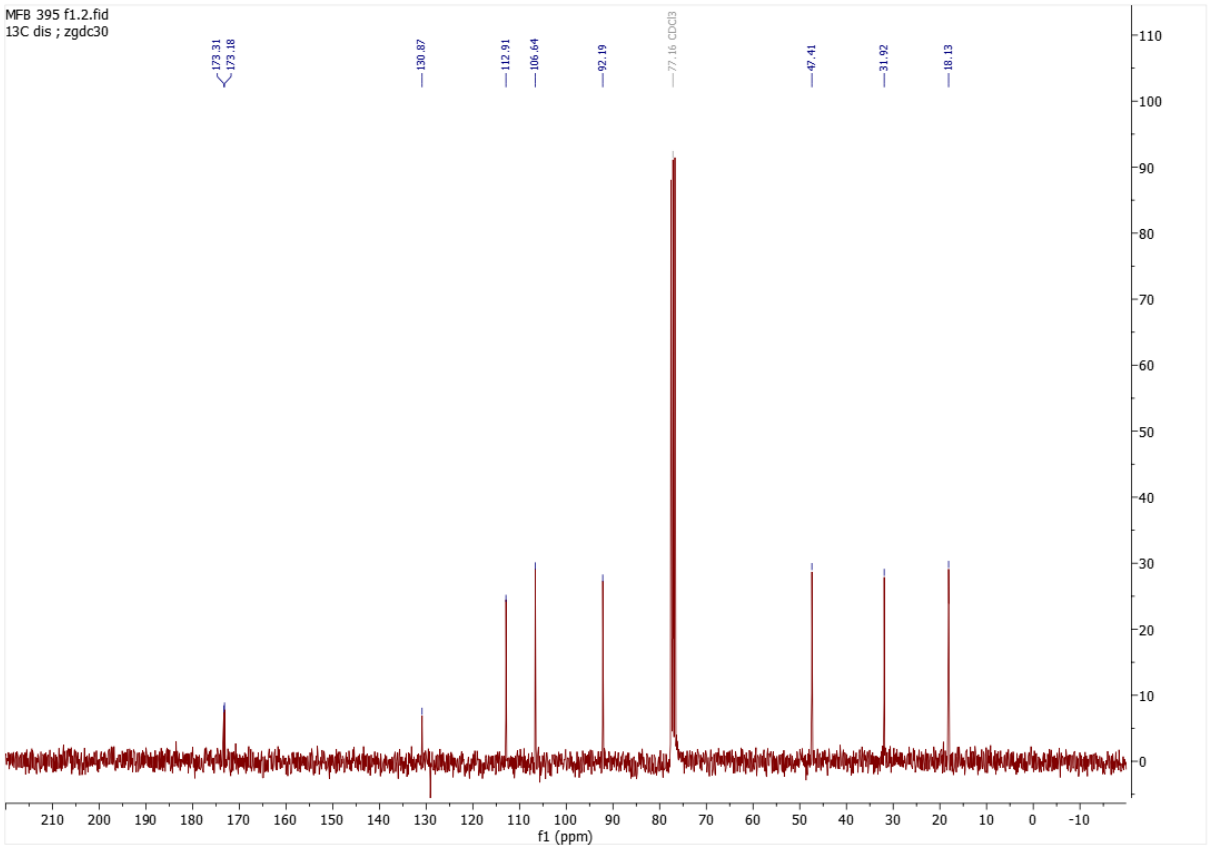
1-(1-phenyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7l)



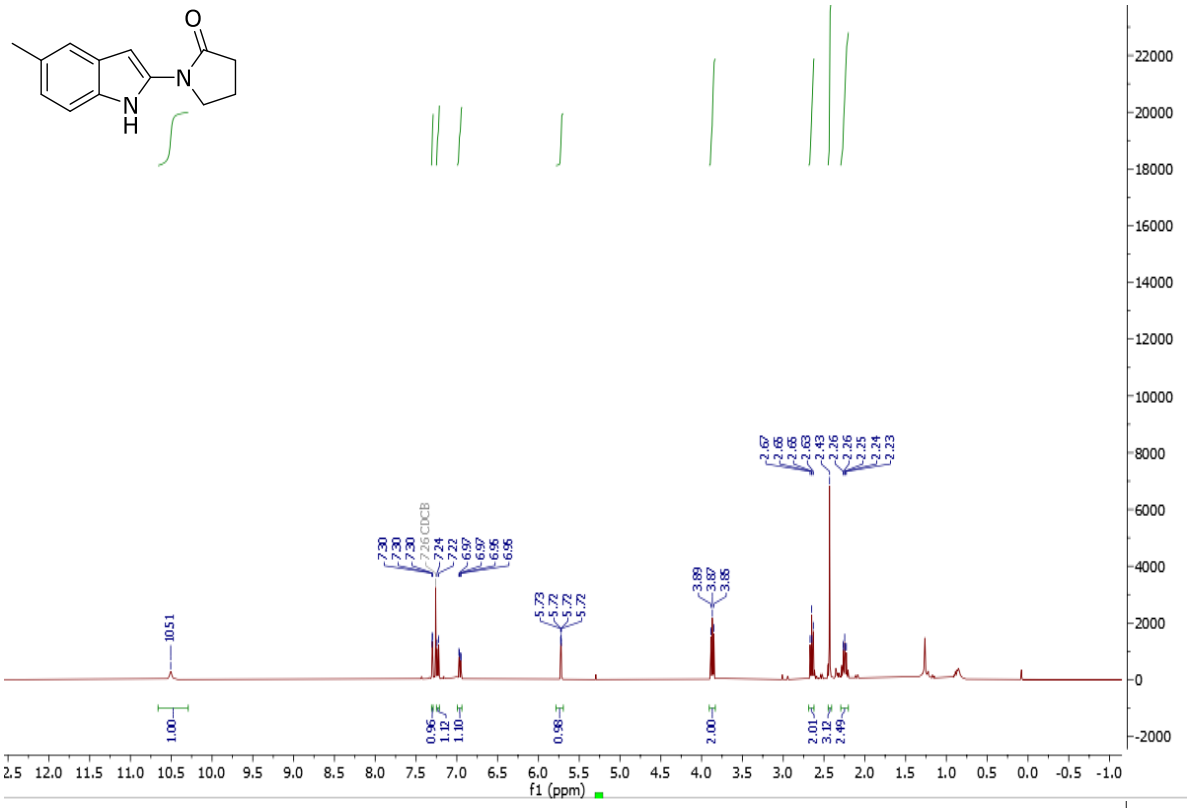


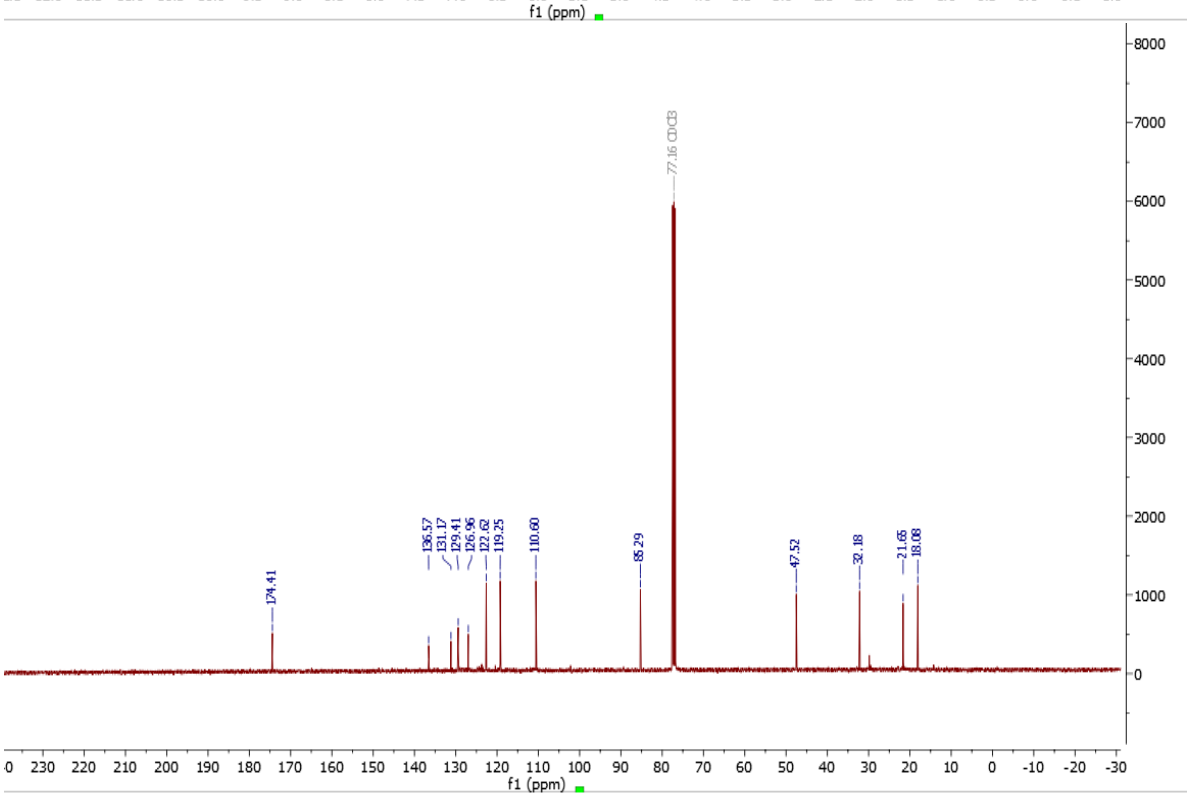
1-(1H-pyrrol-2-yl)pyrrolidin-2-one (7m)



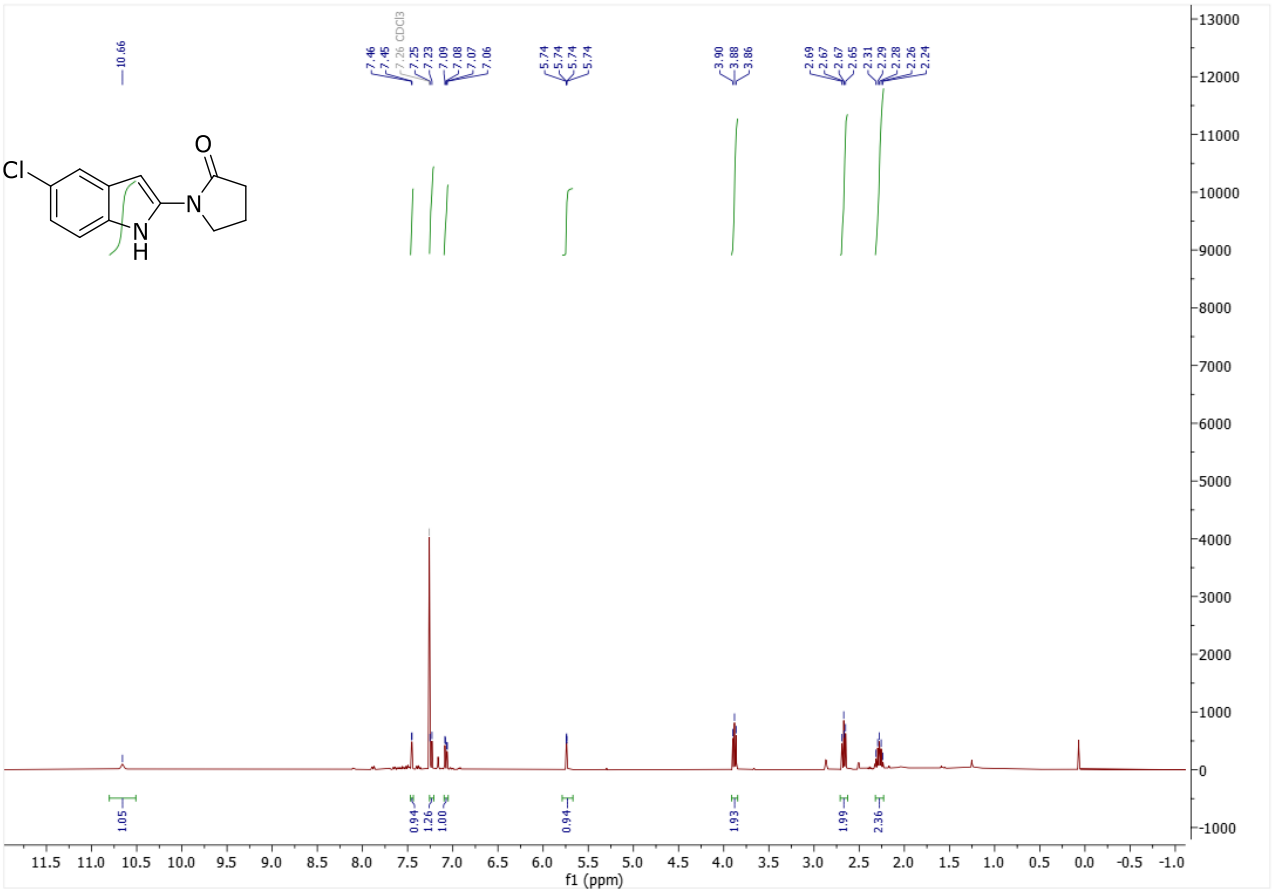


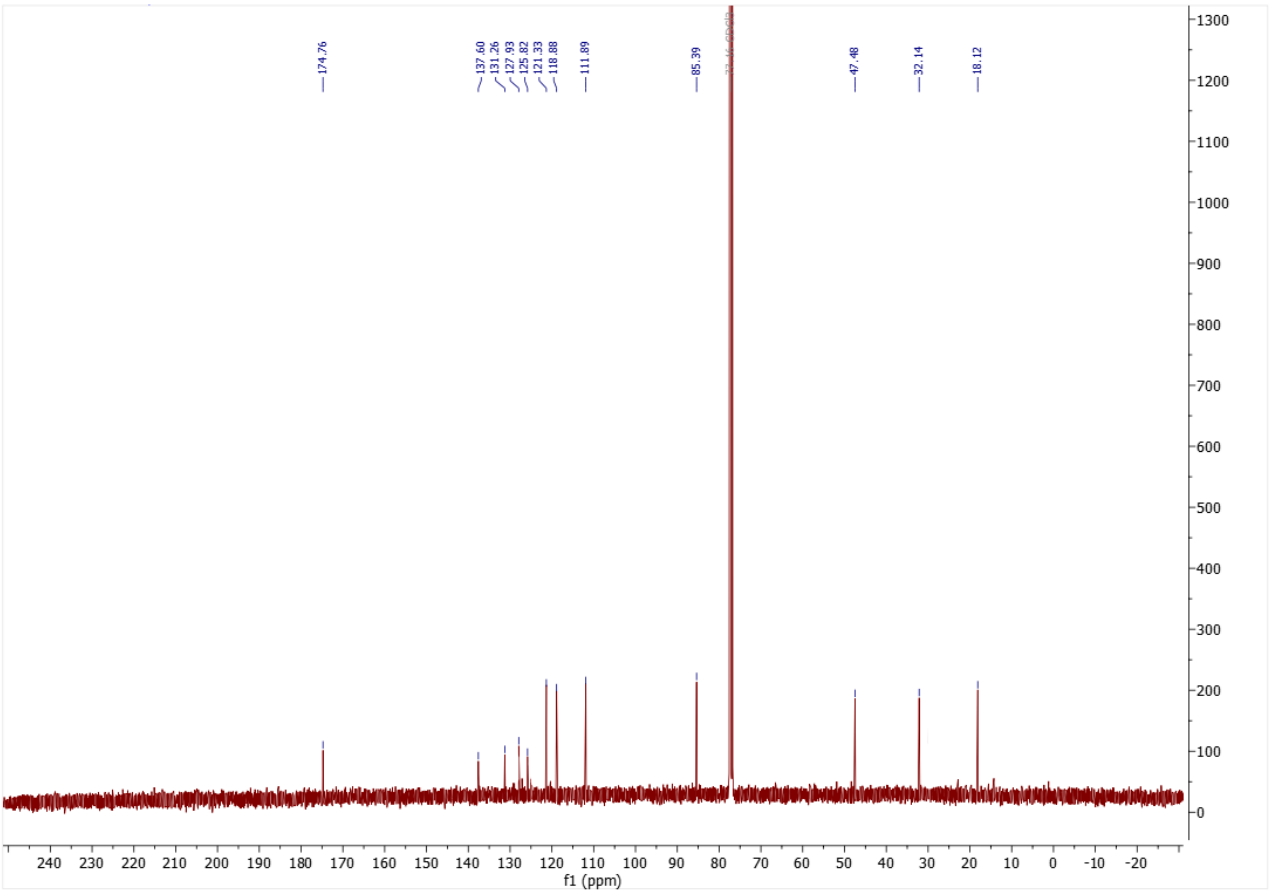
1-(5-methyl-1H-indol-2-yl)pyrrolidin-2-one (7n)



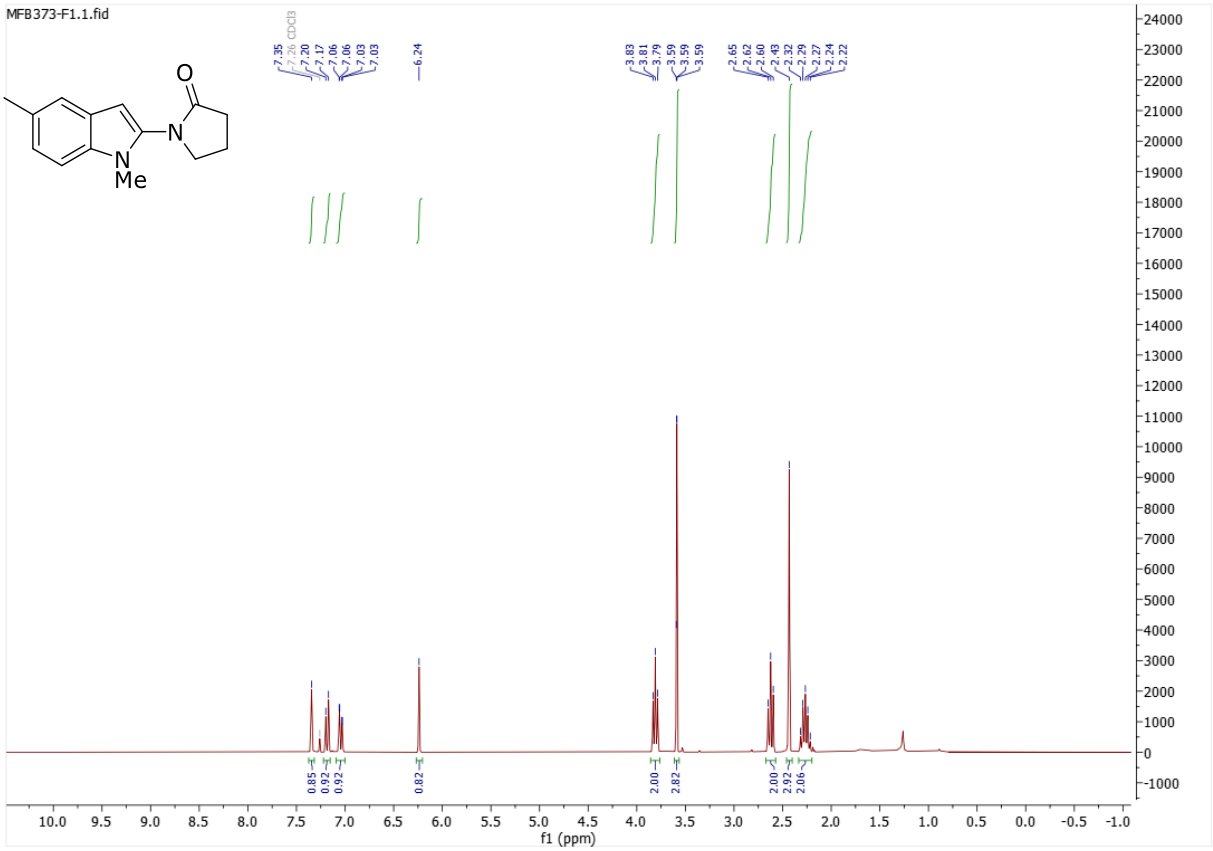


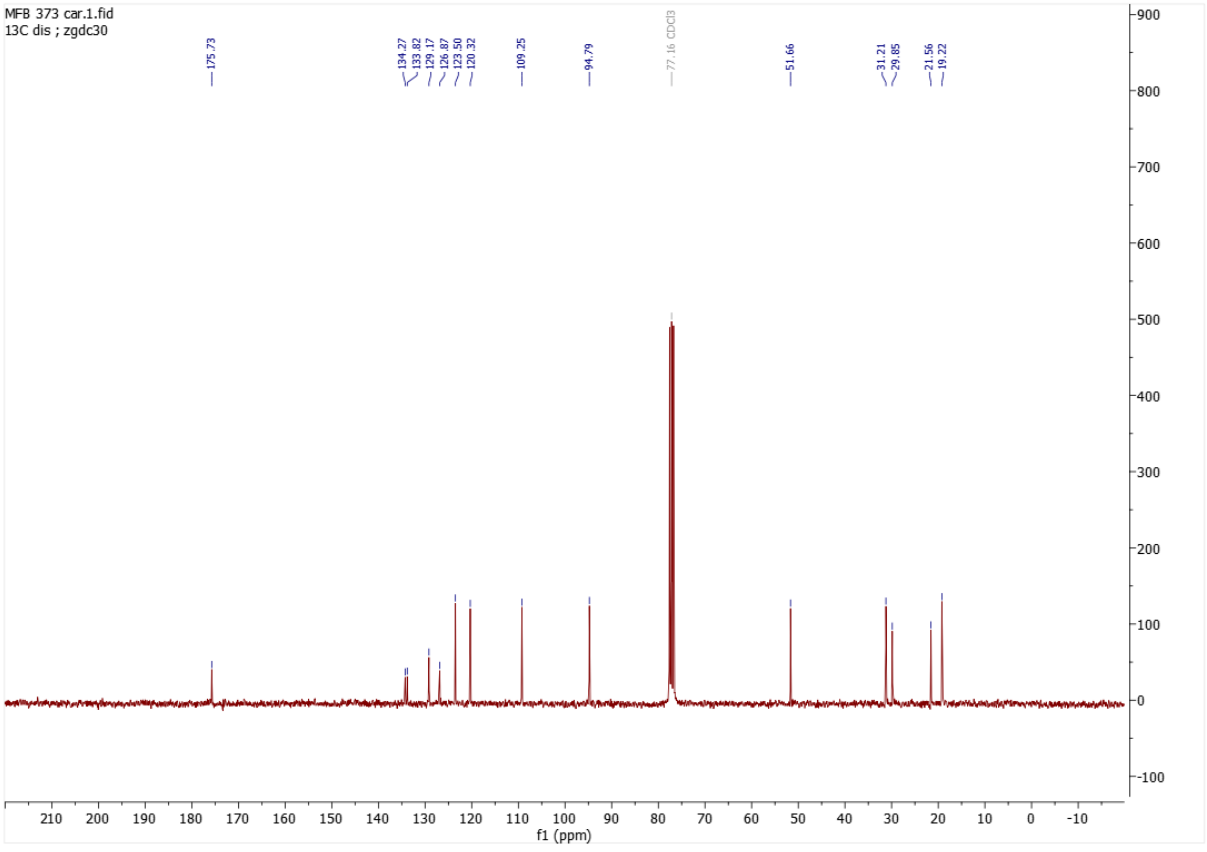
1-(5-chloro-1H-indol-2-yl)pyrrolidin-2-one (7o)



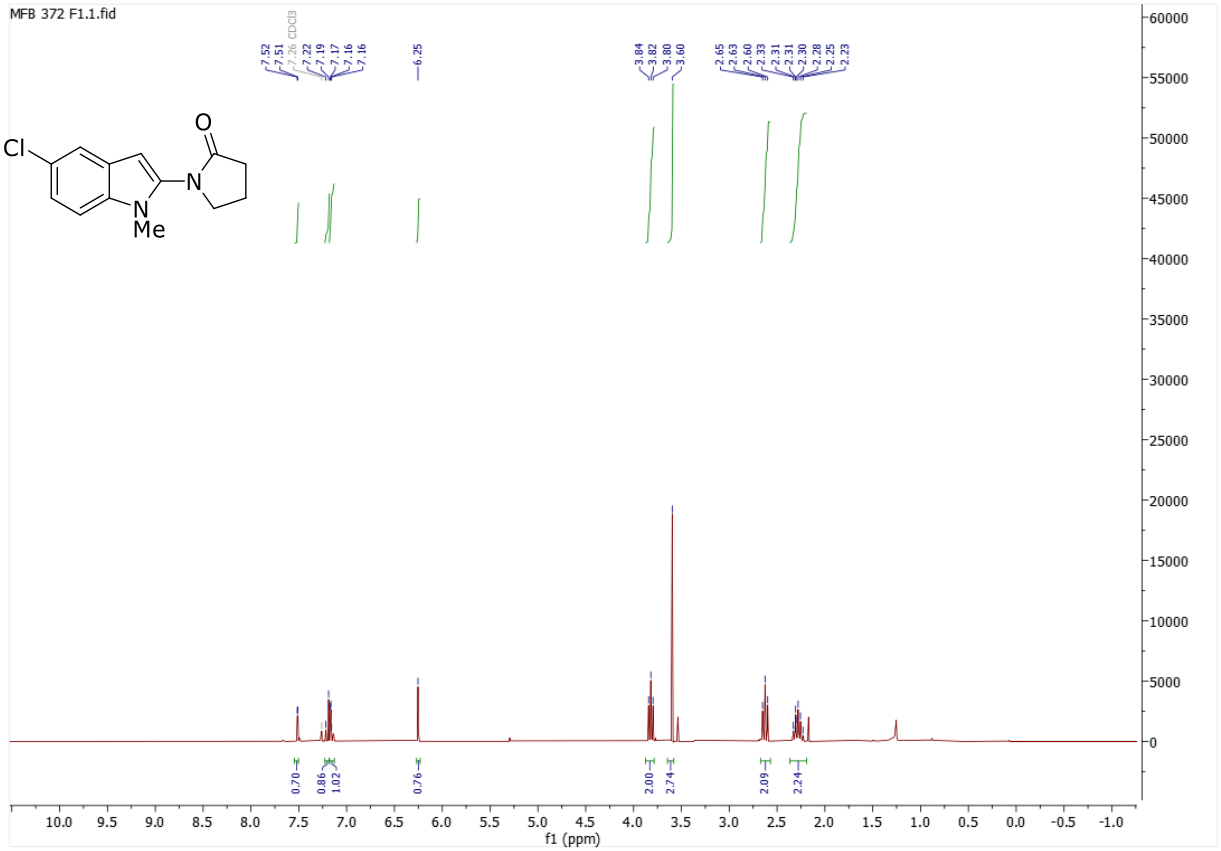


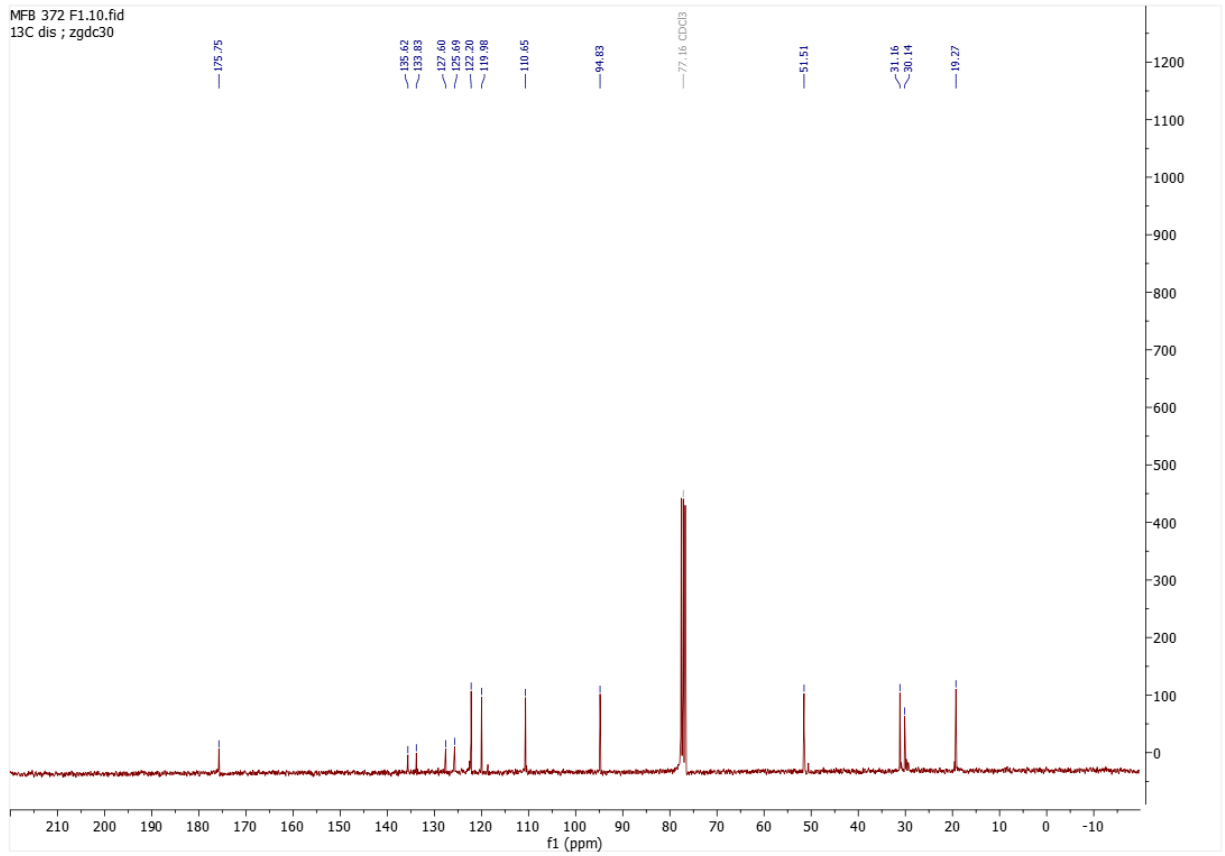
1-(1,5-dimethyl-1H-indol-2-yl)pyrrolidin-2-one (7p)



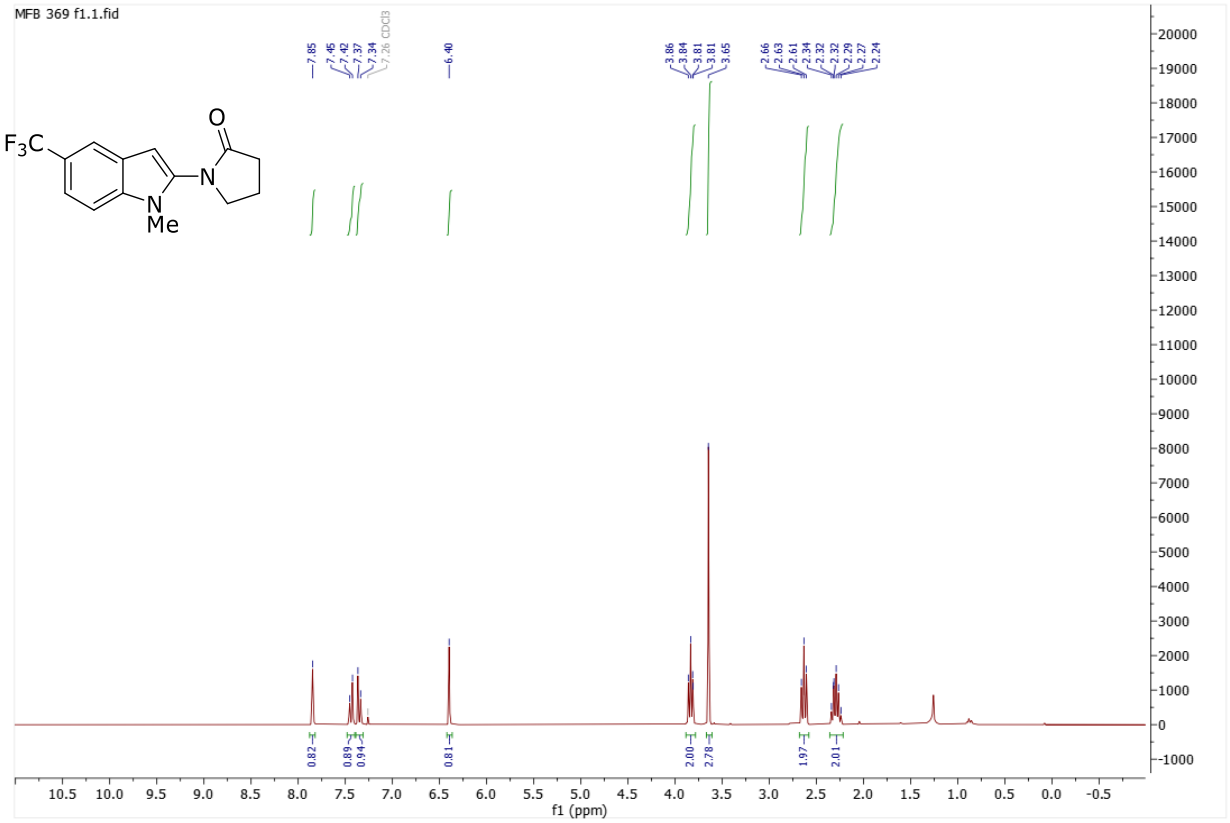


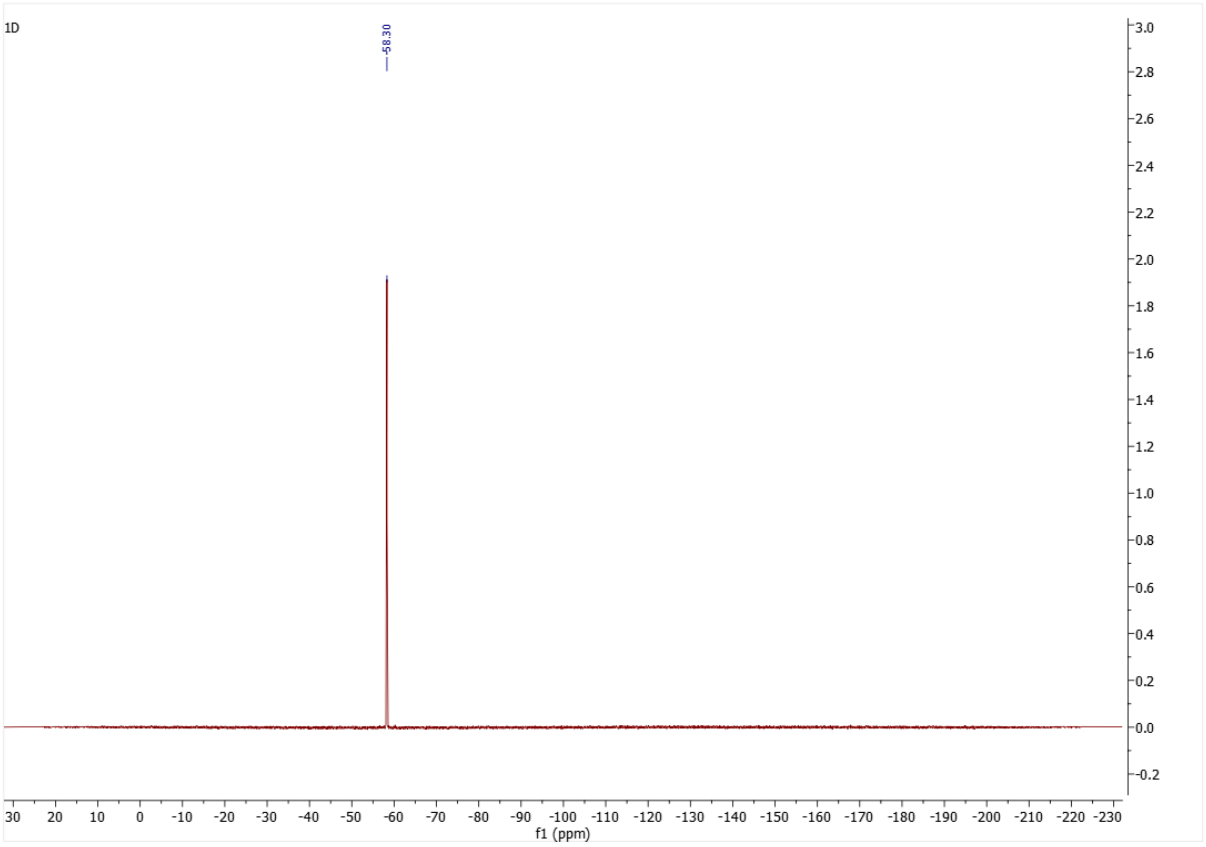
1-(5-chloro-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7q)

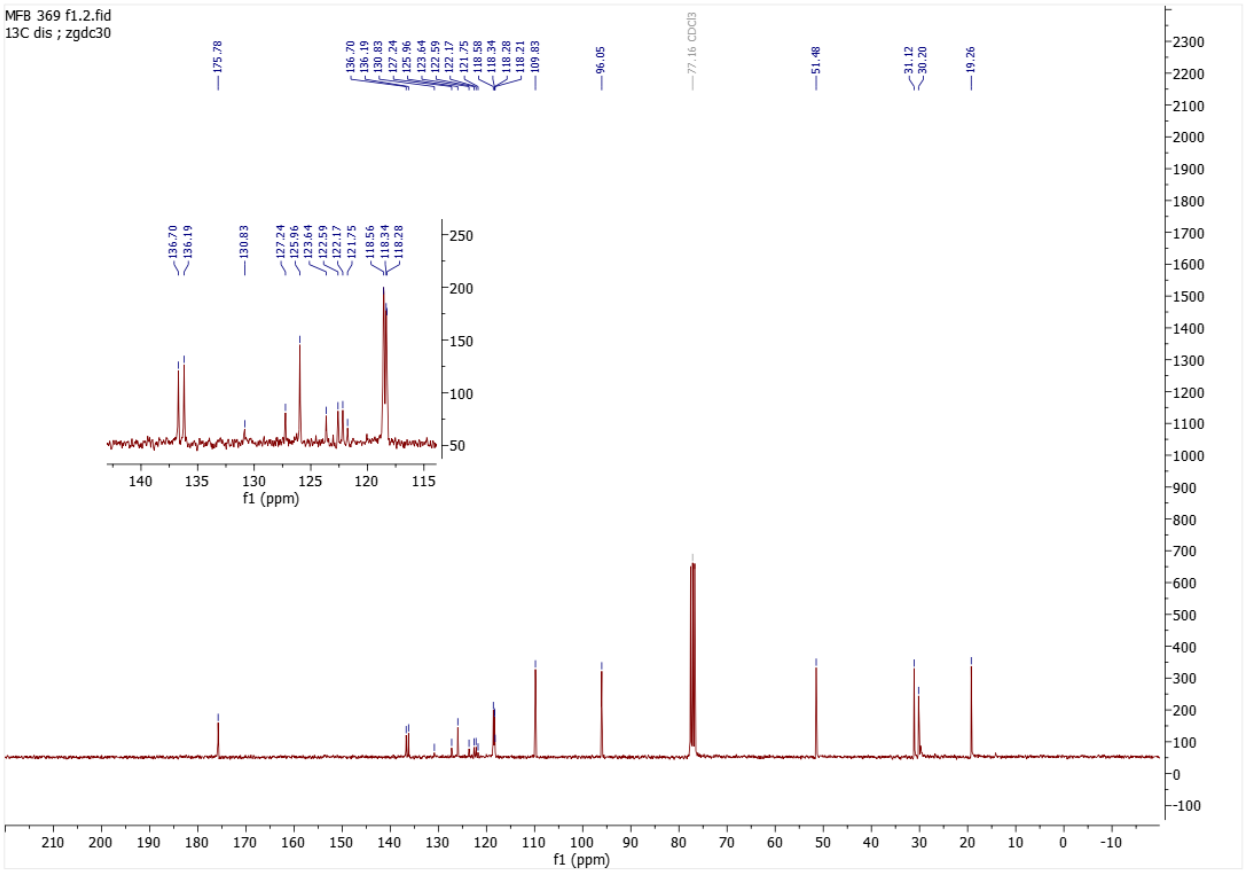




1-(1-methyl-5-trifluoromethyl-1H-indol-2-yl)pyrrolidin-2-one (7r)






MFB 369 f1.2.fid
13C dis ; zgdc30
175.78
136.70
136.19
130.83
127.24
125.96
123.64
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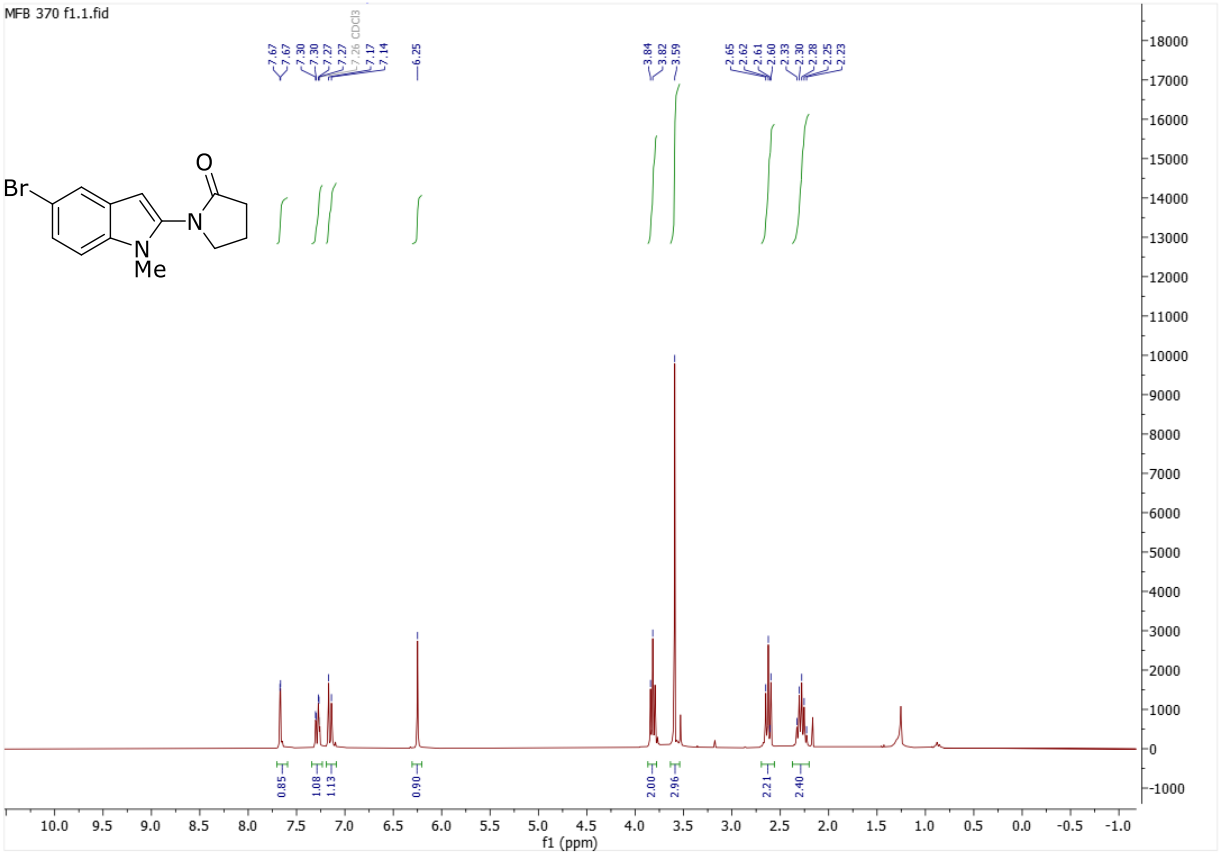
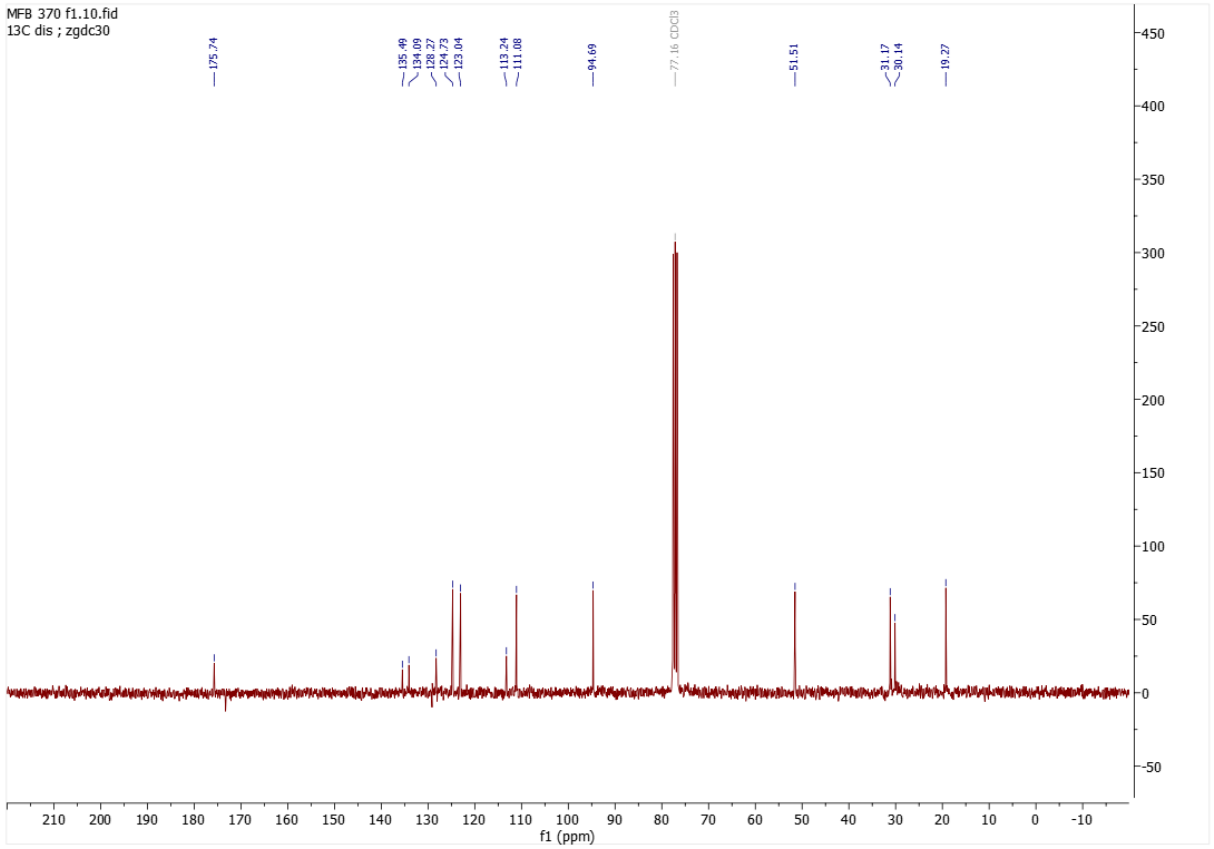
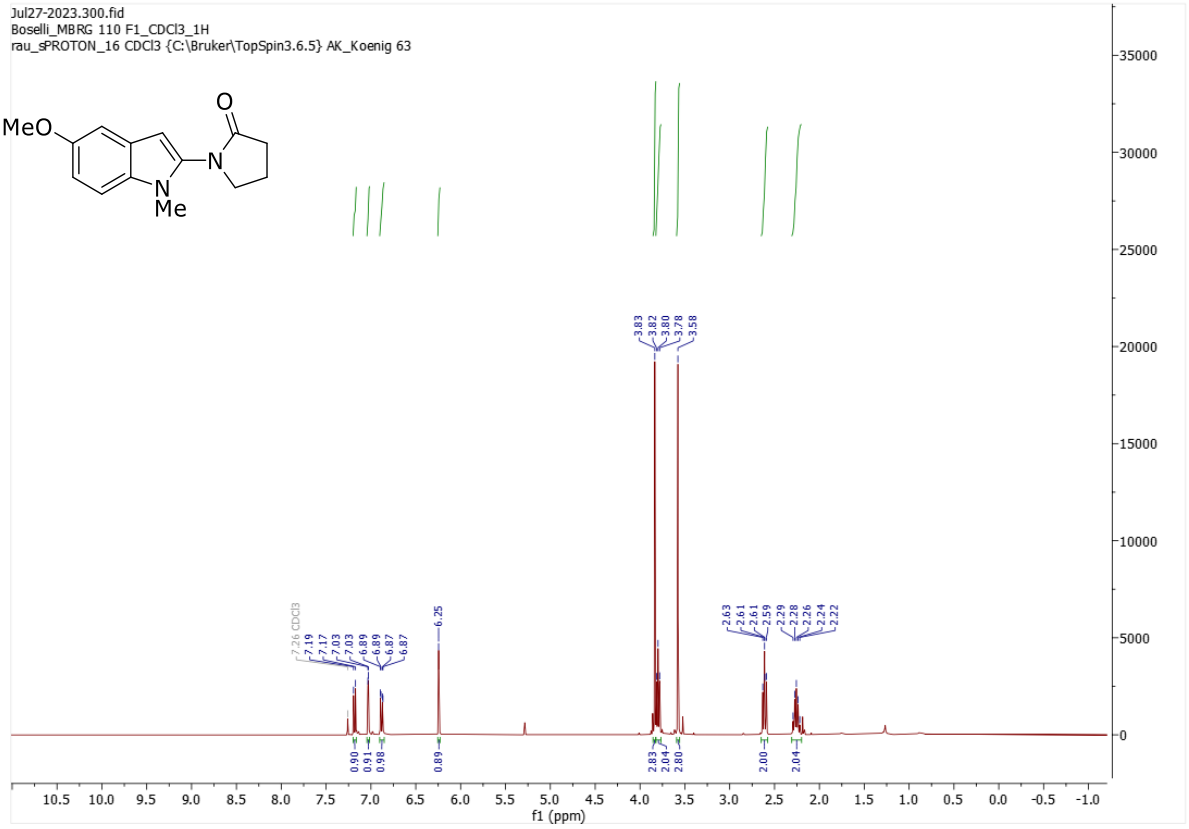
122.17
121.75
118.58
118.34
118.28
118.21
109.83
96.05
77.16 CDCl3
51.48
31.12
30.20
19.26
f1 (ppm)

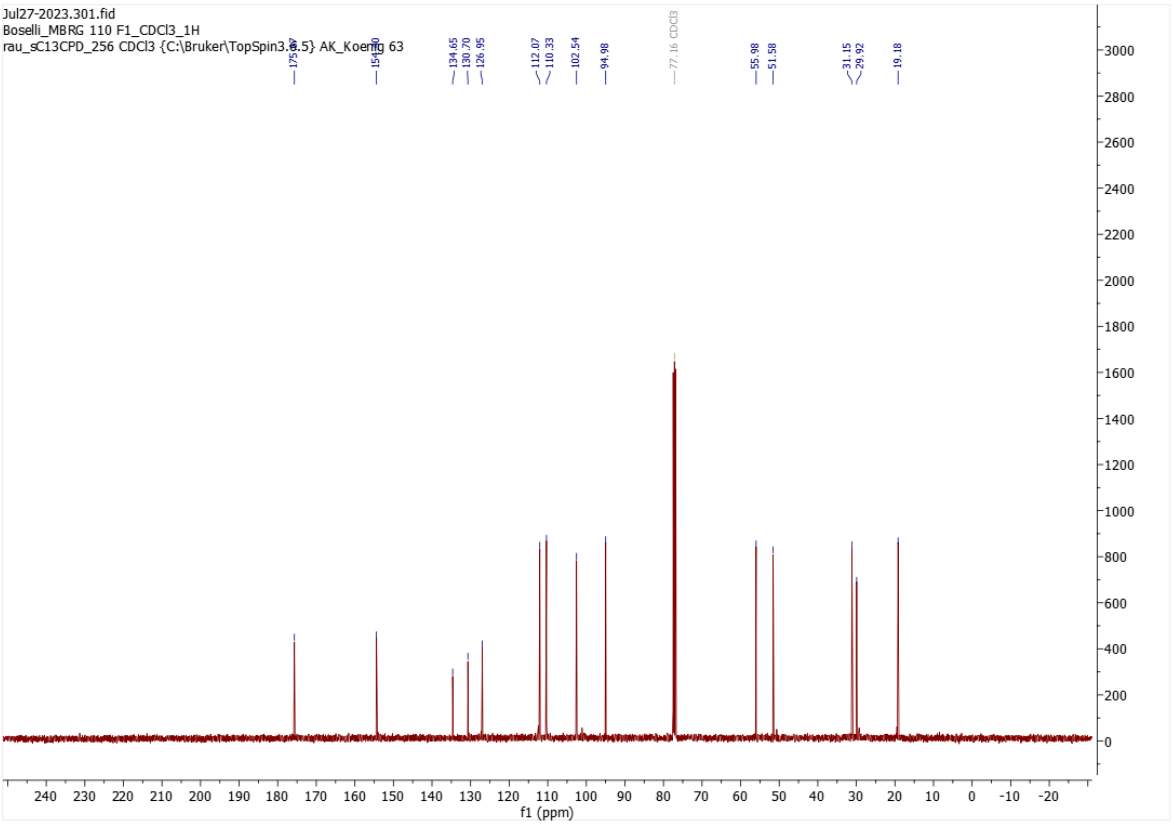
1-(5-bromo-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7s)



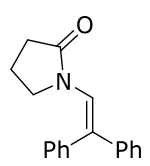


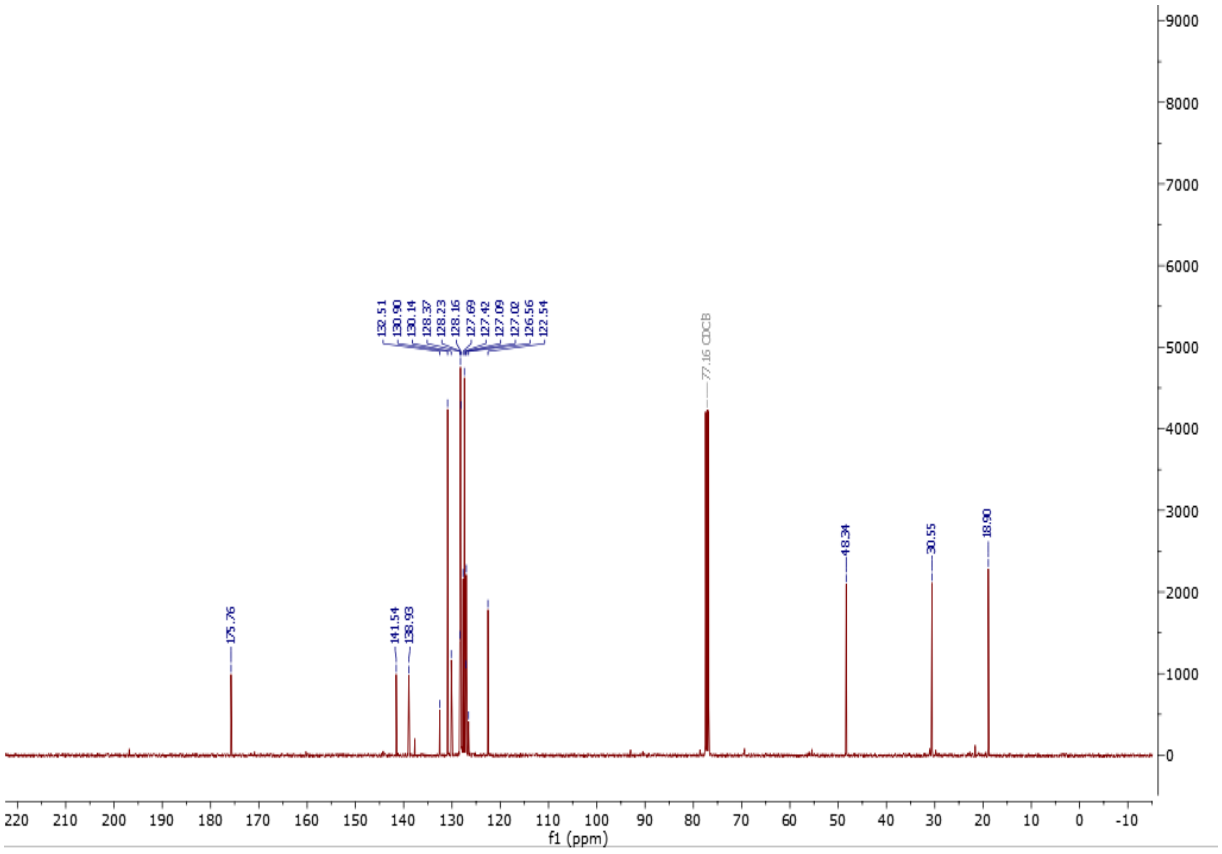
1-(5-methoxy-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7t)



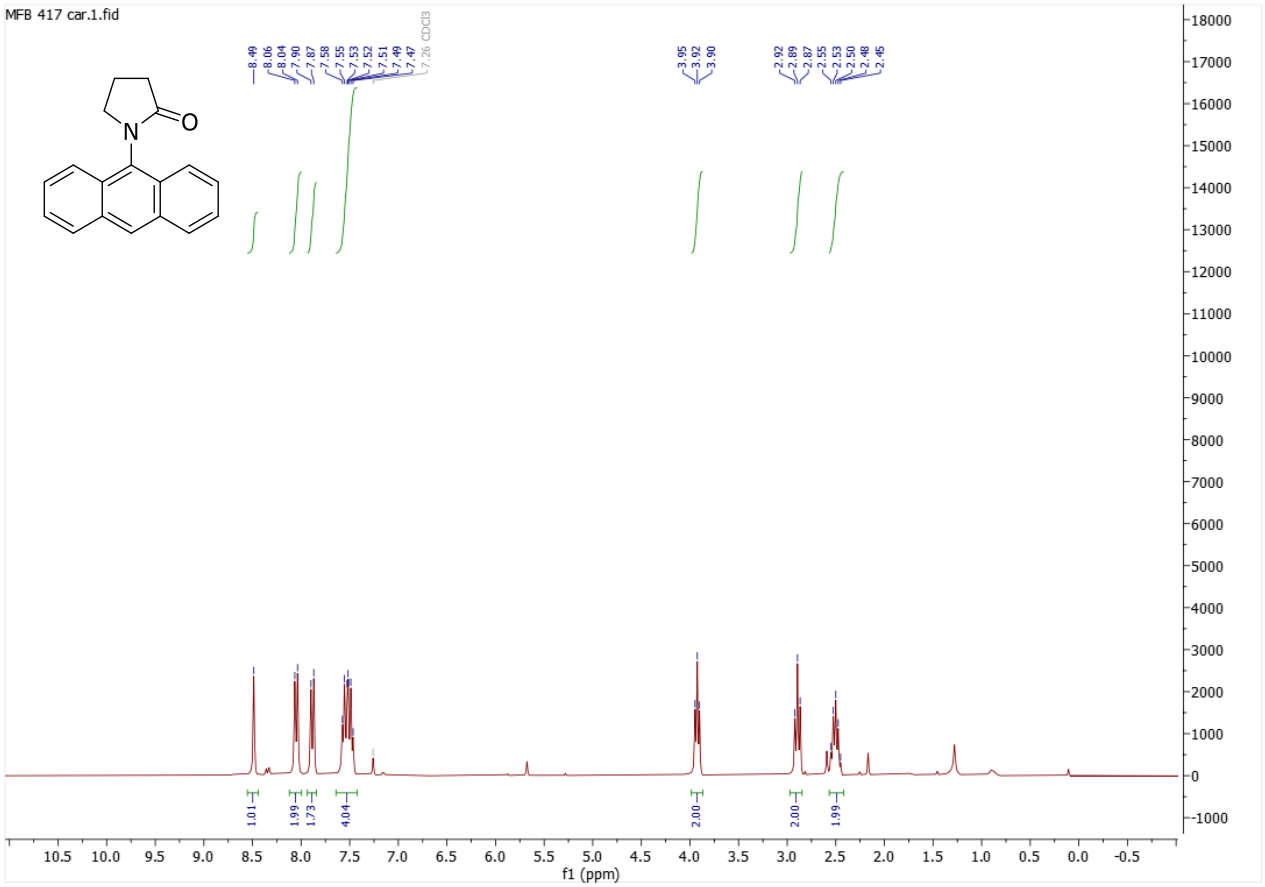


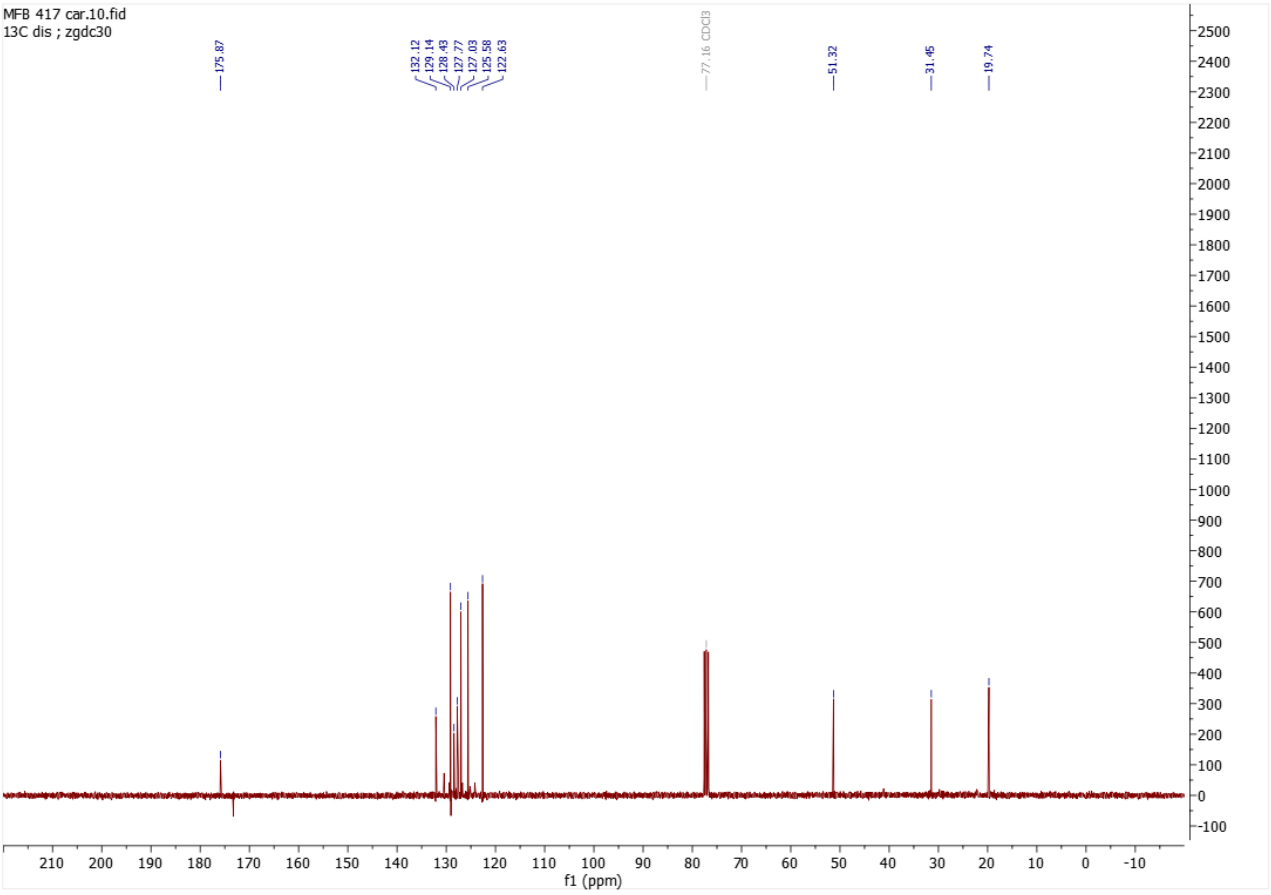
1-(1-phenyl-1H-pyrrol-2-yl)pyrrolidin-2-one (7u)



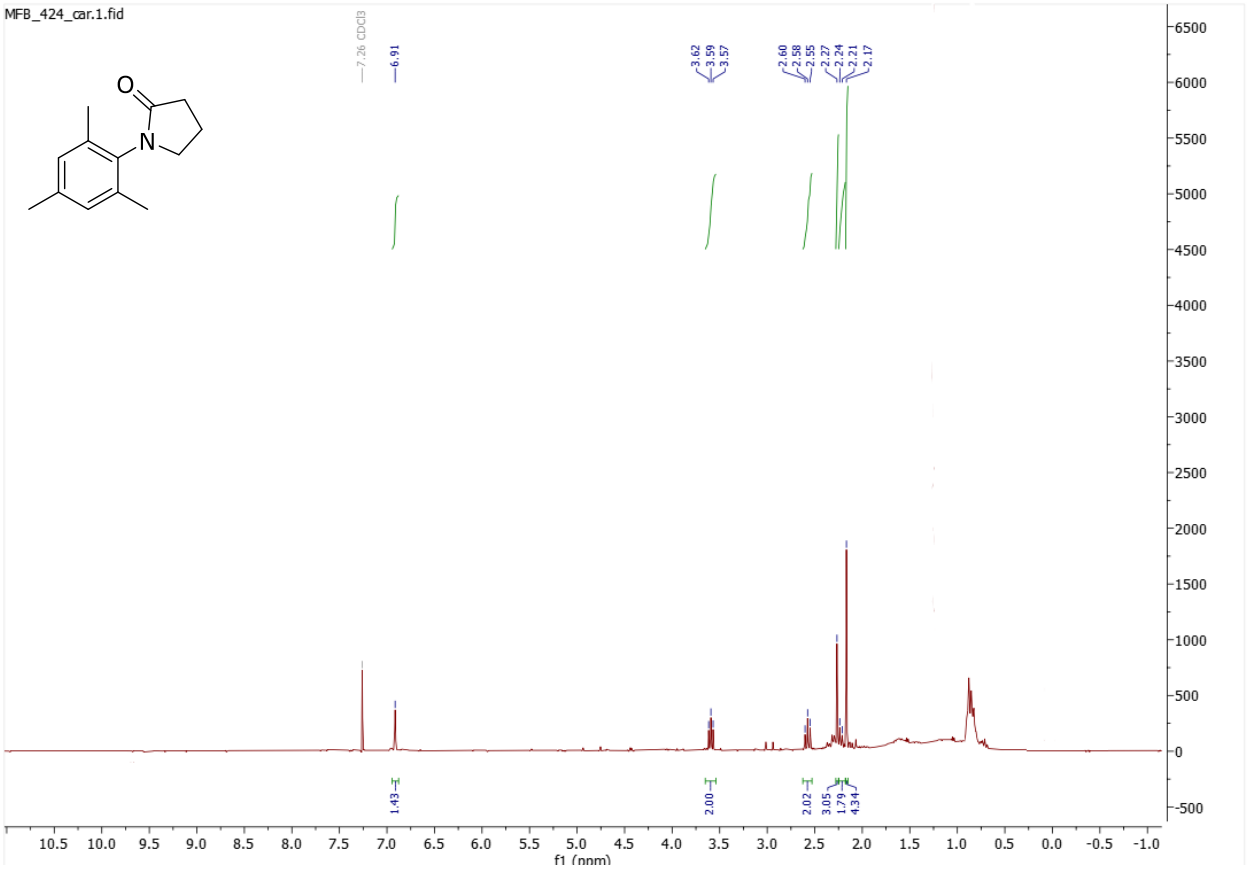


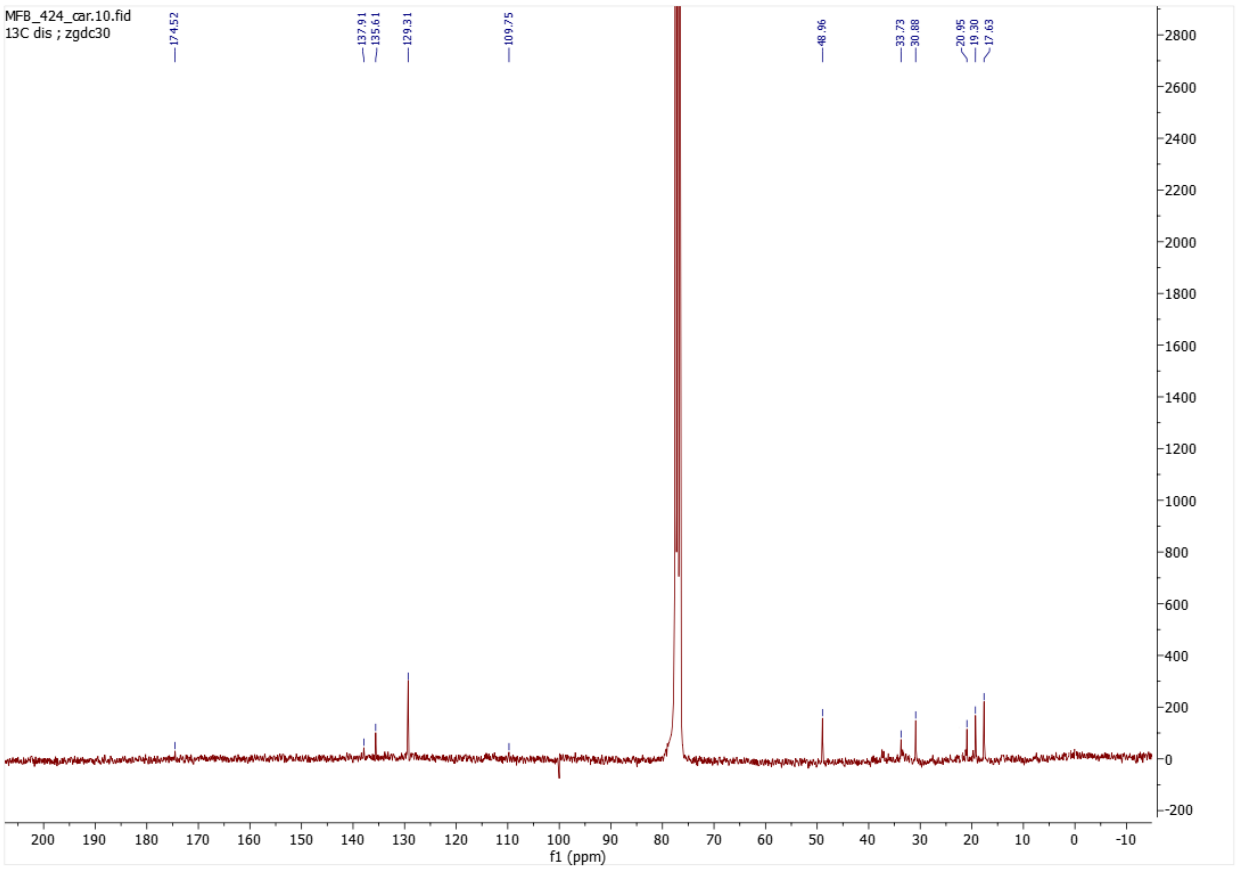
1-(anthracen-9-yl)pyrrolidin-2-one (7x)



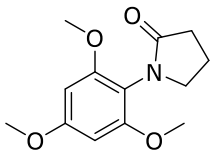


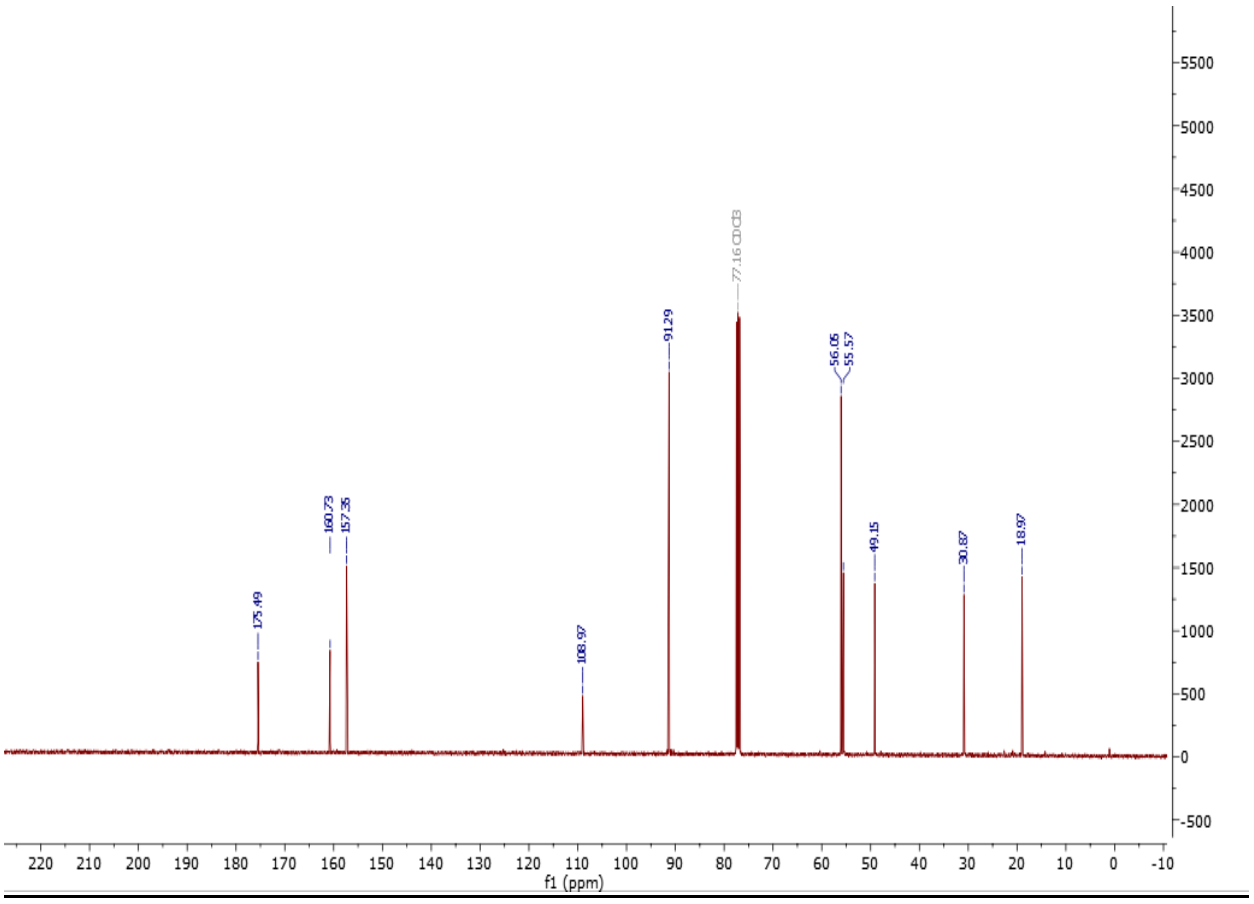
1-(2,4,6-trimethylphenyl)pyrrolidin-2-one (7y)



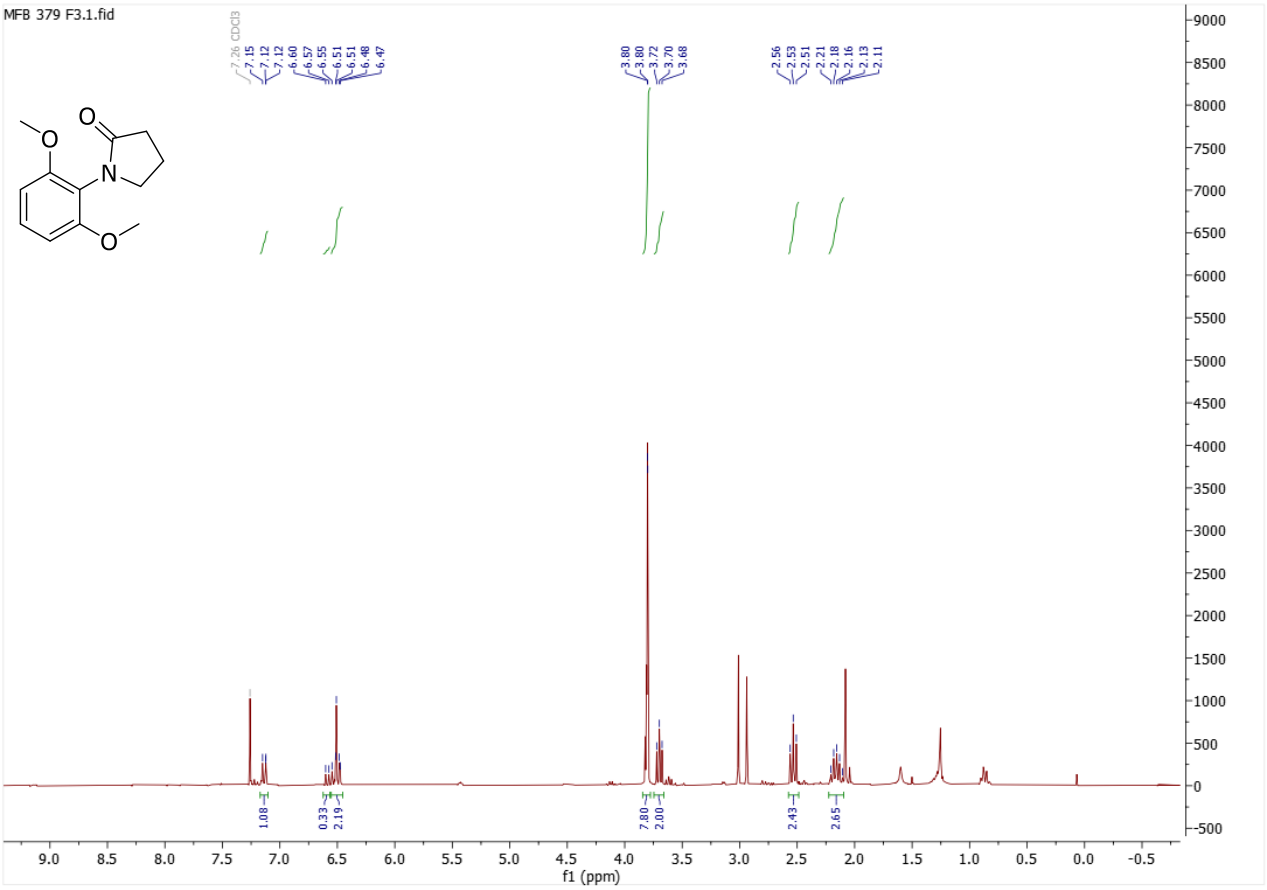


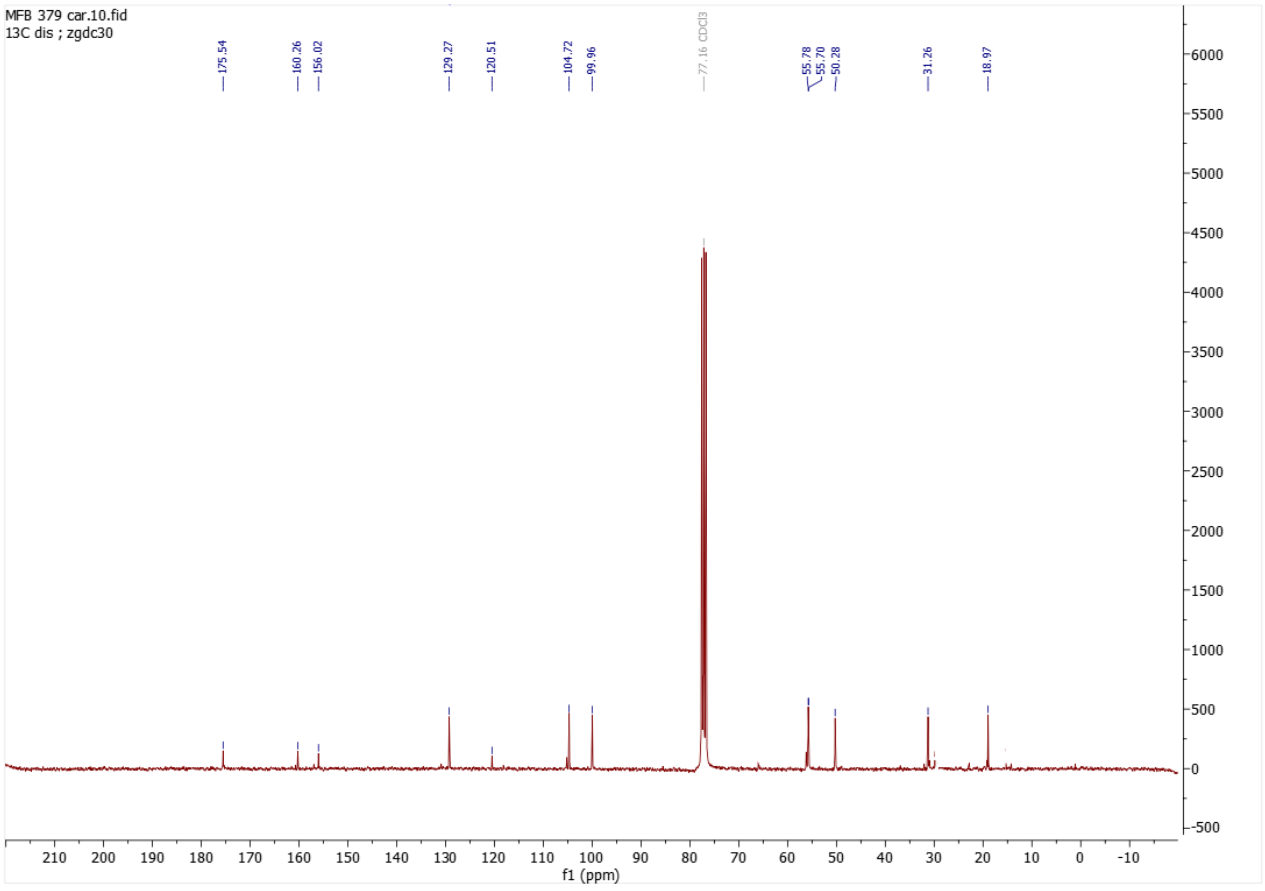
1-(2,4,6-trimethoxyphenyl)pyrrolidin-2-one (7z)



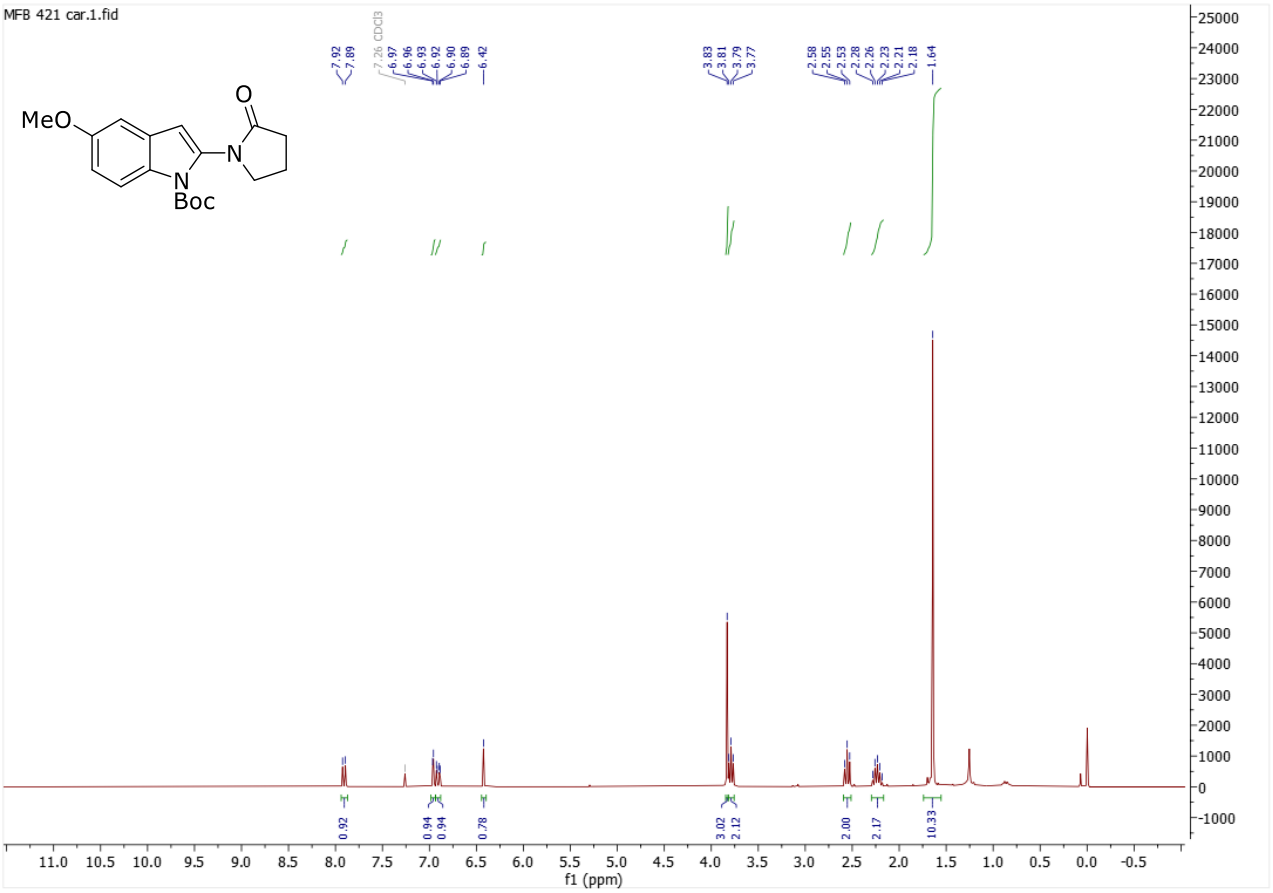


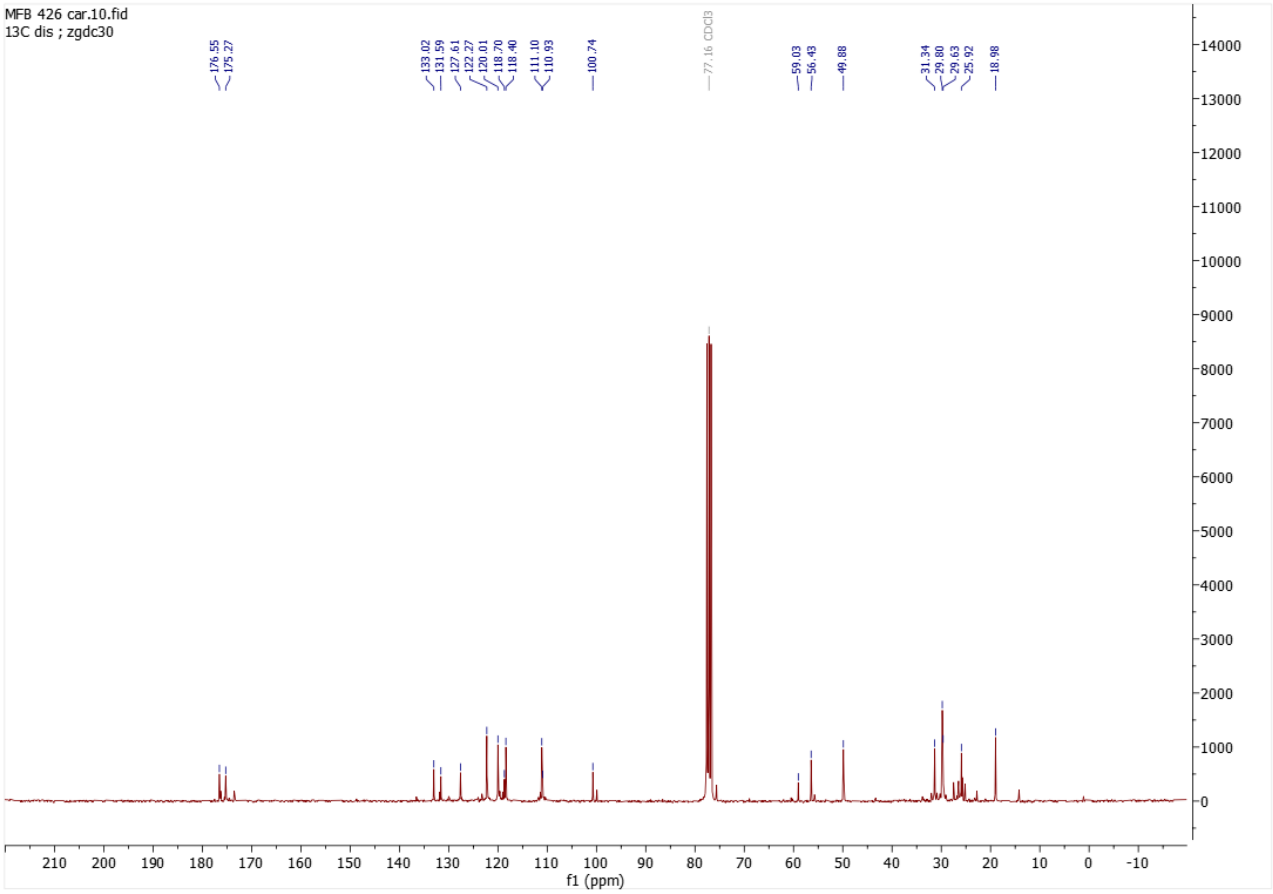
1-(2,6-dimethoxyphenyl)pyrrolidin-2-one (7aa)



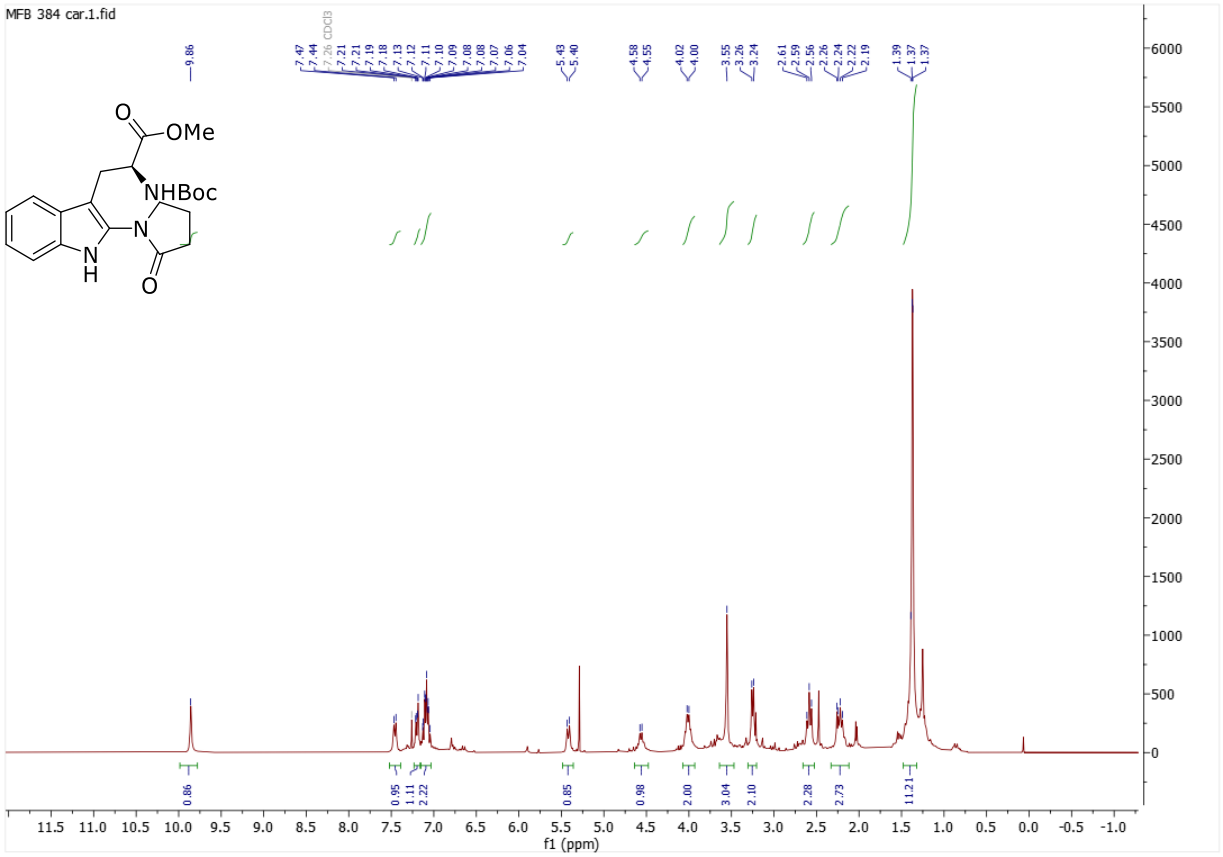


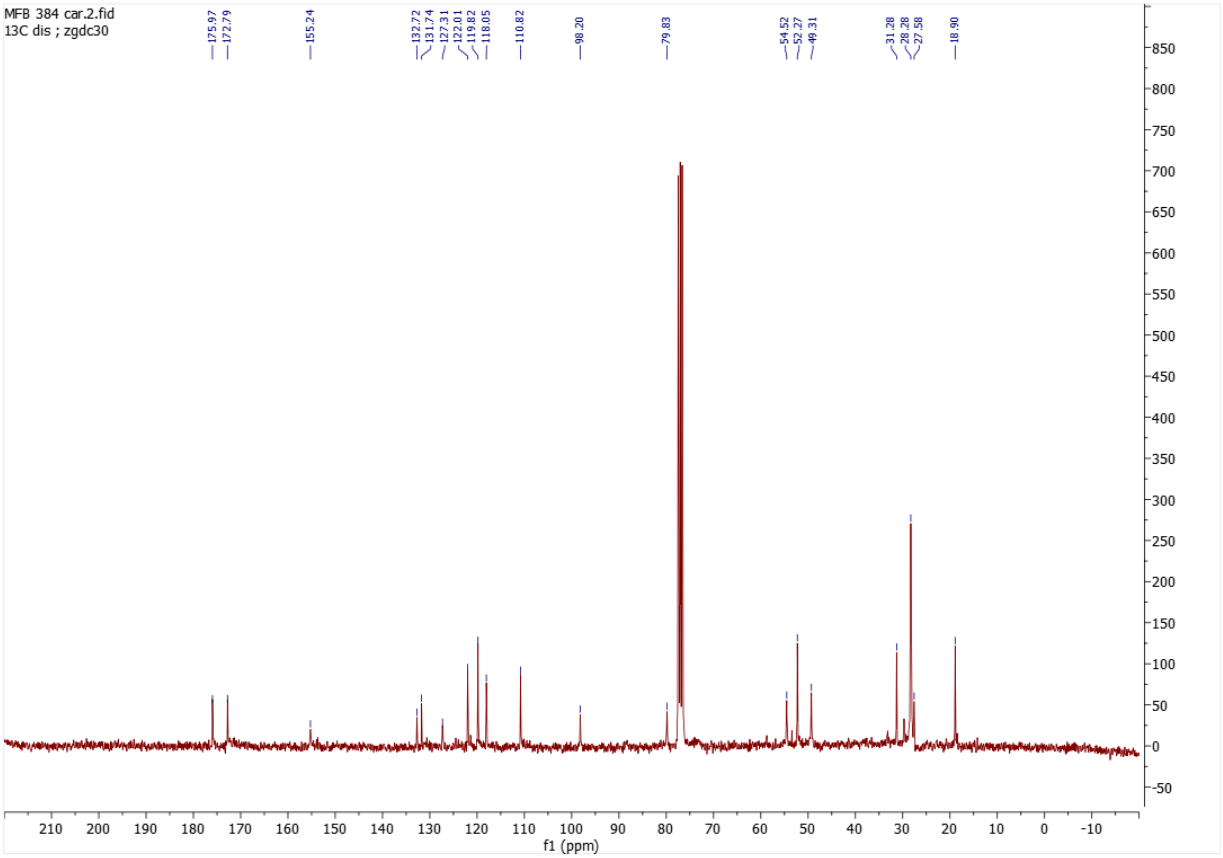
1-((tert-butyloxycarbonyl))-5-methoxy-1-methyl-1H-indol-2-yl)pyrrolidin-2-one (7ab)



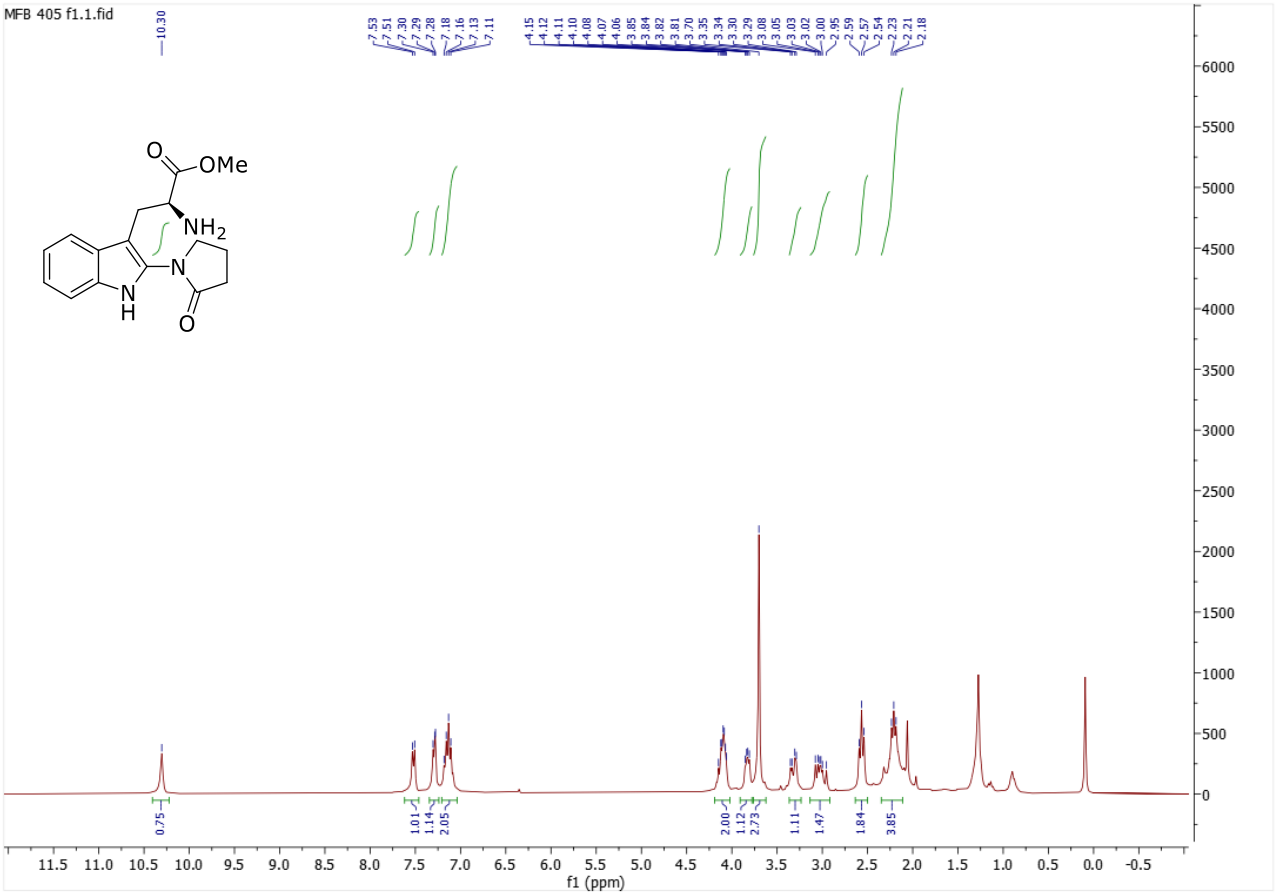


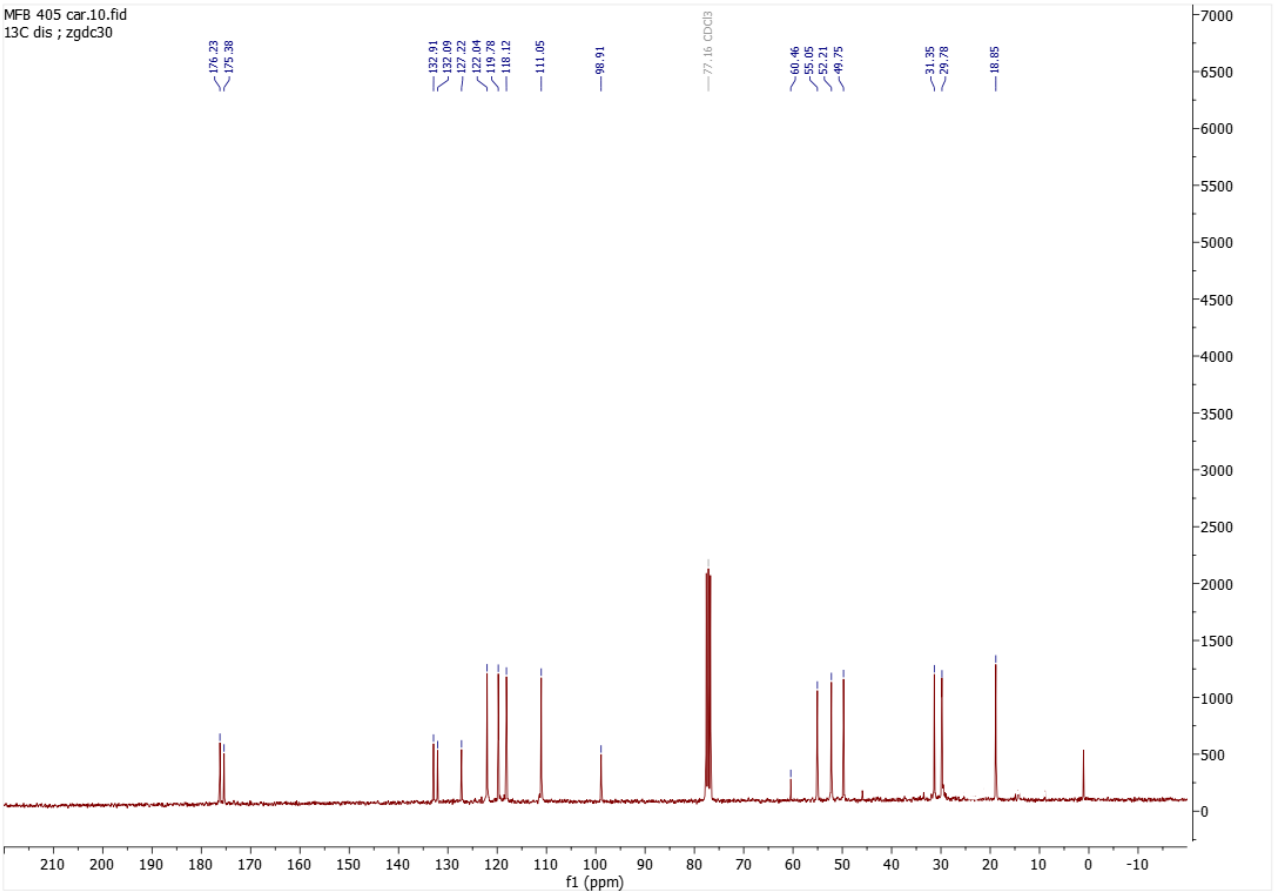
1-(*N*-Boc-OMe-L-tryptophan)pyrrolidin-2-one (7ac)





1-(*O*-Me-L-tryptophan)pyrrolidin-2-one (7ad)





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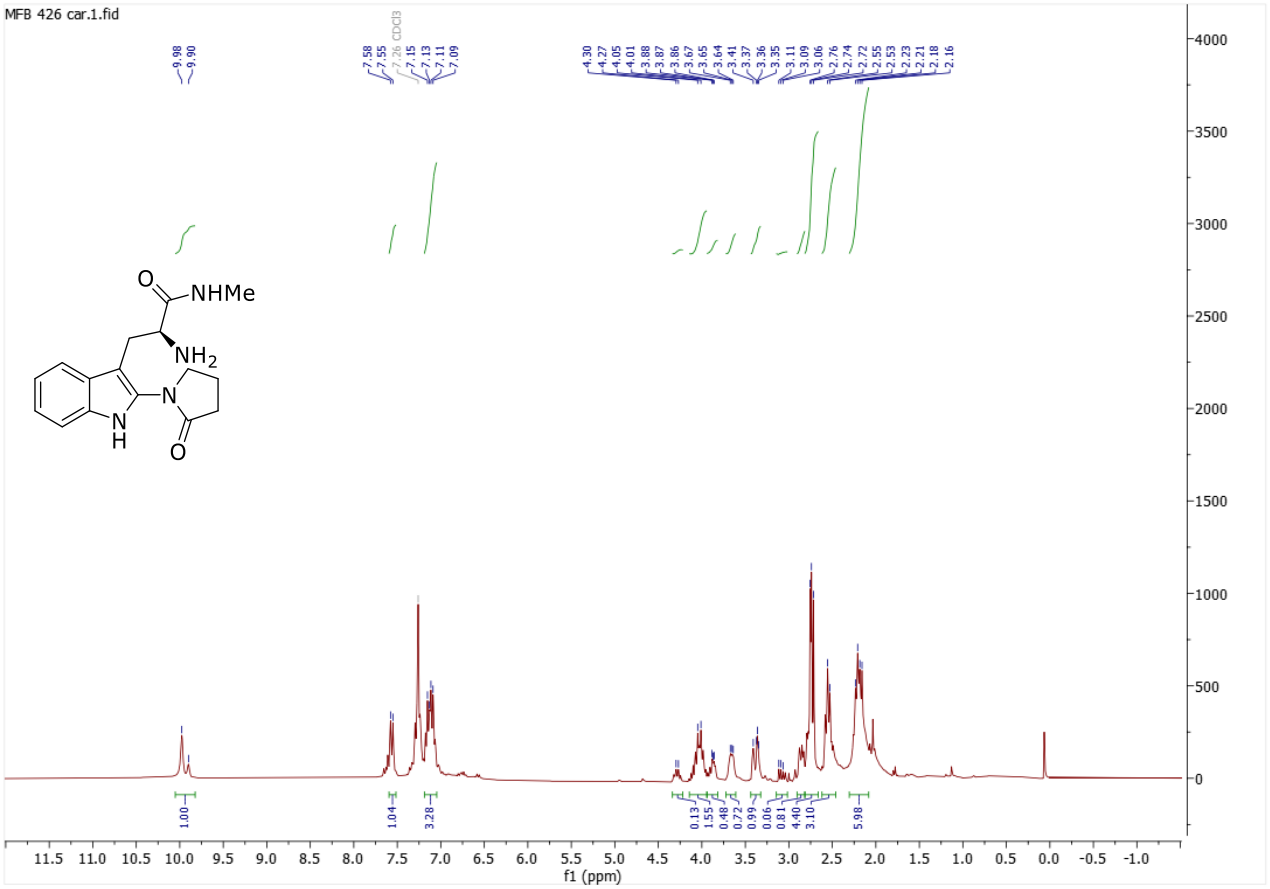
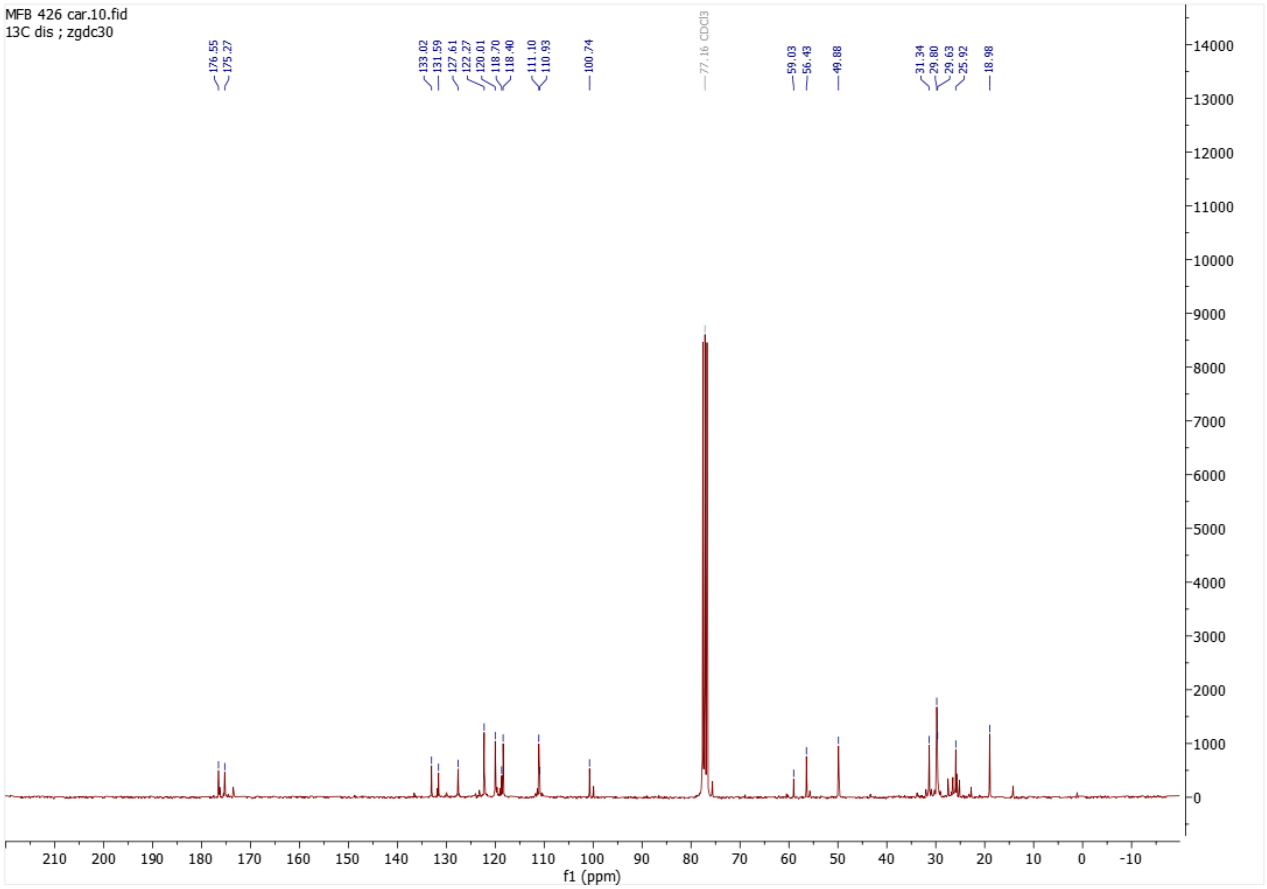
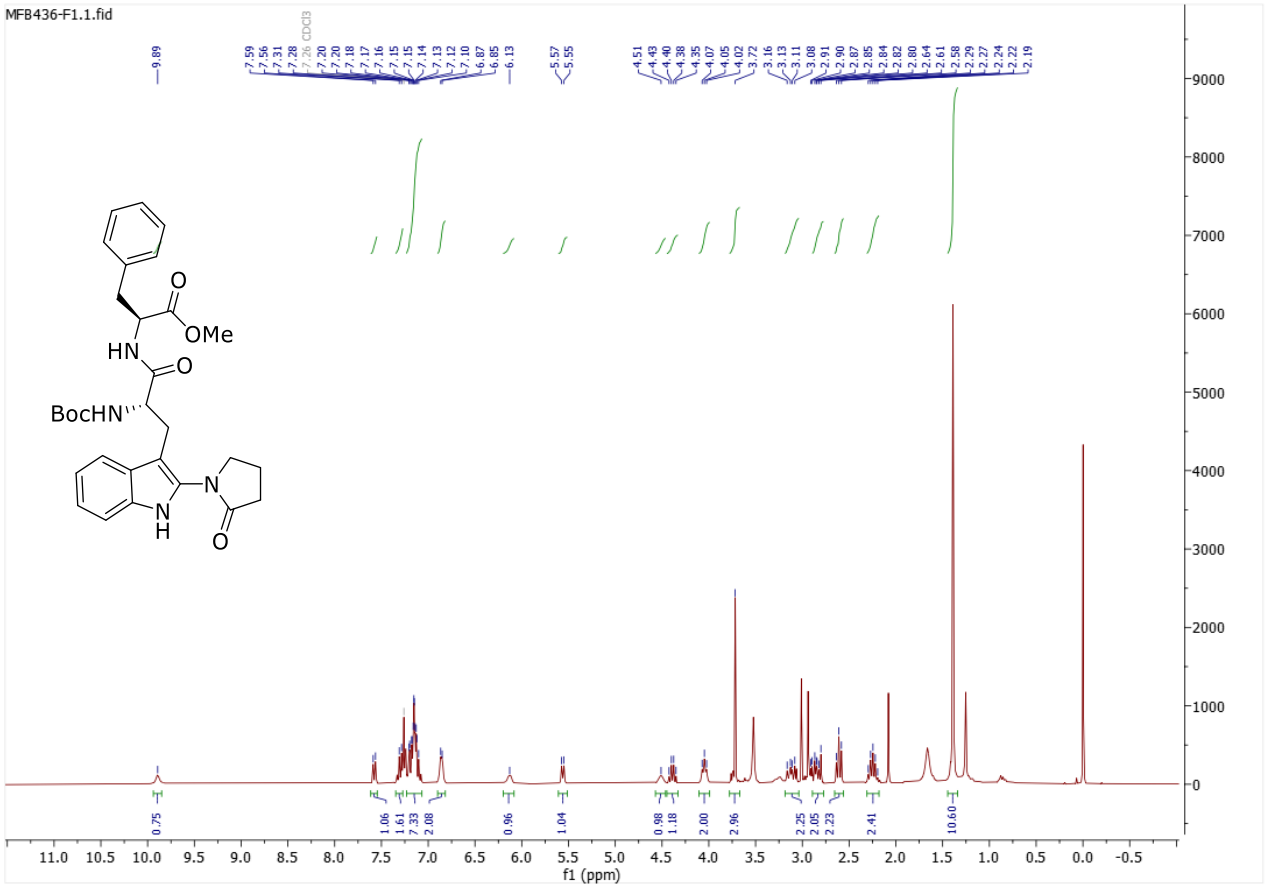
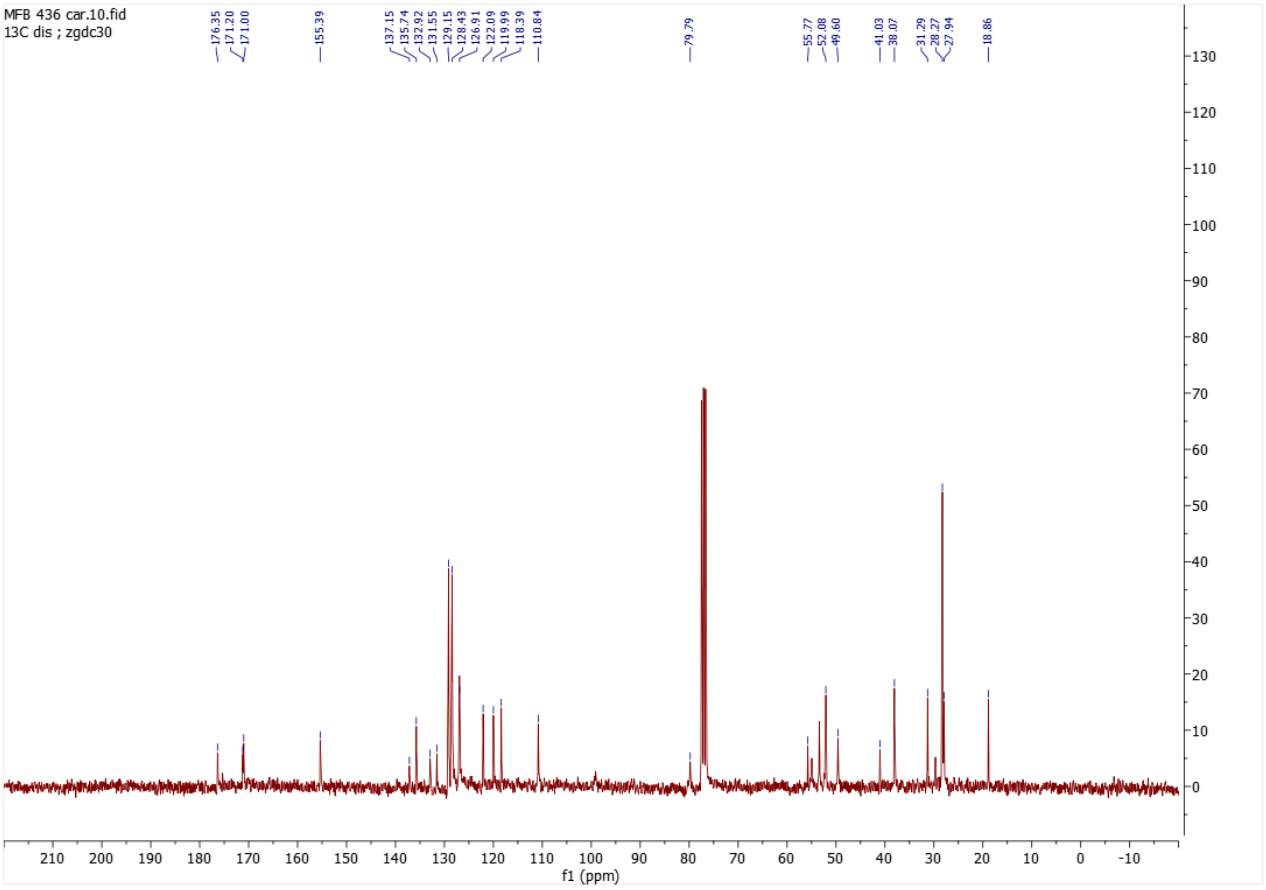




1-(*N*-Boc-Trp-Phe-OMe)pyrrolidin-2-one (7af)





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