Supporting Information

New Multifunctional Benzophenone-based Photoinitiators with High Migration Stability and their Application in 3D Printing

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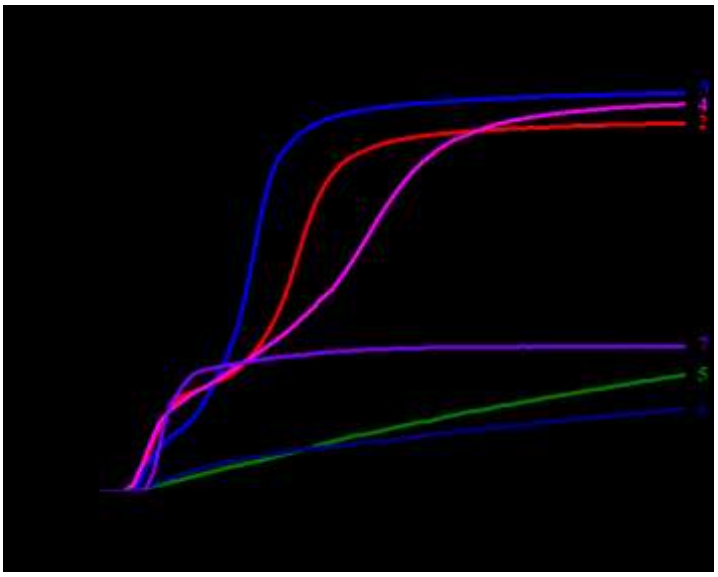


Fig. S1 Photopolymerization profiles of HDDA (acrylate function conversion vs. irradiation time) in laminate (~ 25 μm) under LED@405 nm irradiation in the presence of PI alone (0.3%, mol); curve 1: PI = BT1; curve 2: PI = BT2; curve 3: PI = BT3; curve 4: PI = BT4; curve 5: PI = BC1; curve 6: PI = BC2; curve 7: PI = BC3. The irradiation starts from t = 10 s.

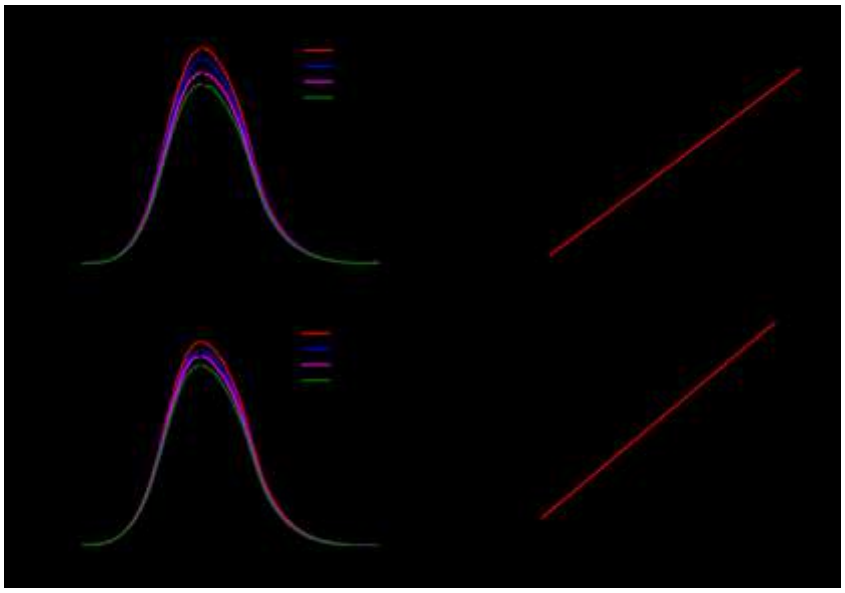


Fig. S2 (a) Fluorescence quenching of BT1 by Iod in acetonitrile; (b) Stern–Volmer treatment for BT1/Iod fluorescence quenching; (c) Fluorescence quenching of BT1 by EDB in acetonitrile; (d) Stern–Volmer treatment for BT1/EDB fluorescence quenching.

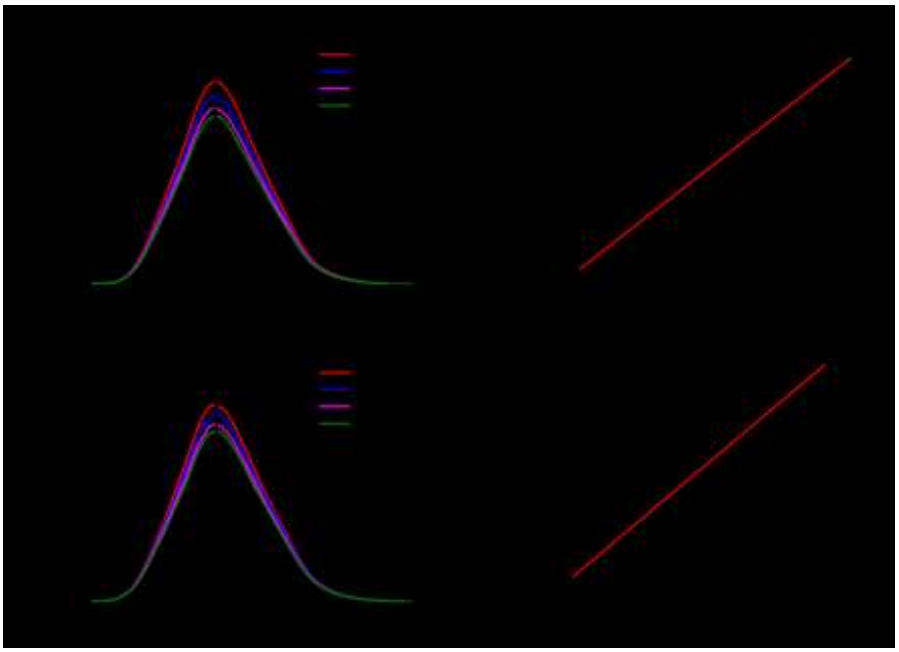


Fig. S3 (a) Fluorescence quenching of BT2 by Iod in acetonitrile; (b) Stern–Volmer treatment for BT2/Iod fluorescence quenching; (c) Fluorescence quenching of BT2 by EDB in acetonitrile; (d) Stern–Volmer treatment for BT2/EDB fluorescence quenching.

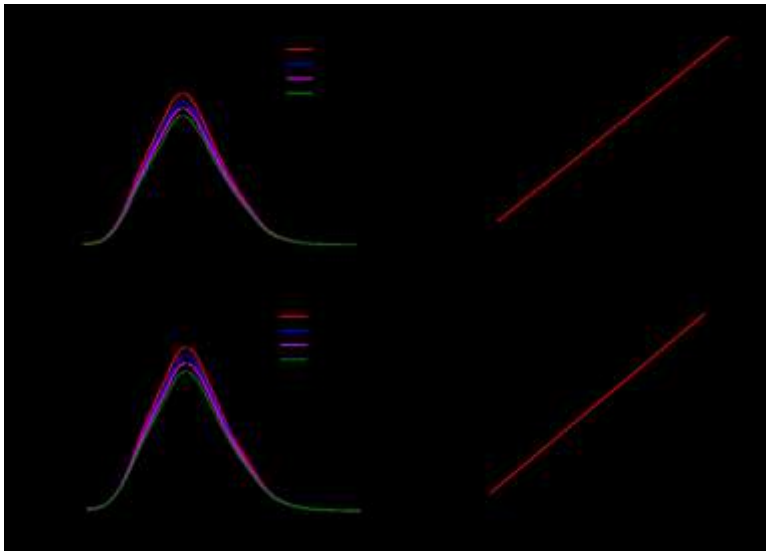


Fig. S4 (a) Fluorescence quenching of BT4 by Iod in acetonitrile; (b) Stern–Volmer treatment for BT4/Iod fluorescence quenching; (c) Fluorescence quenching of BT4 by EDB in acetonitrile; (d) Stern–Volmer treatment for BT4/EDB fluorescence quenching.

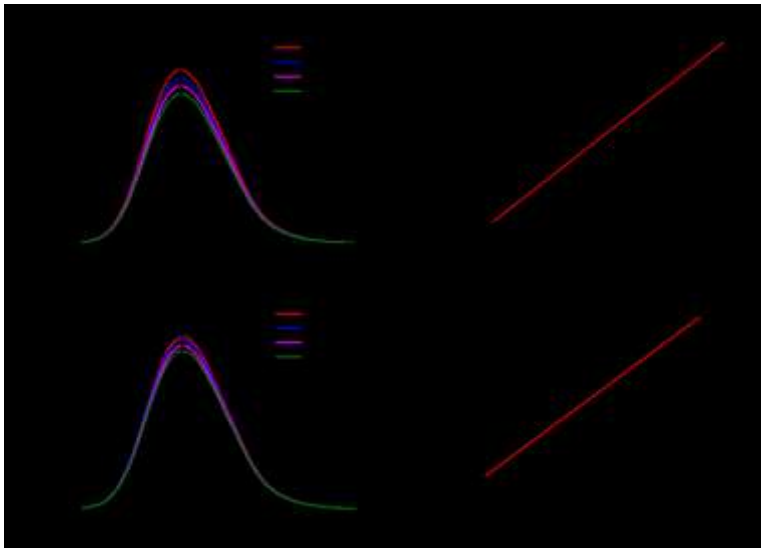


Fig. S5 (a) Fluorescence quenching of BC3 by Iod in acetonitrile; (b) Stern–Volmer treatment for BC3/Iod fluorescence quenching; (c) Fluorescence quenching of BC3 by EDB in acetonitrile; (d) Stern–Volmer treatment for BC3/EDB fluorescence quenching.

Fig. S6 Cyclic voltammograms of electrochemical reactions of PIs in acetonitrile solvent against saturated calomel electrode (SCE) under nitrogen saturated solution: (a) BT1, (b) BT2, (c) BT4, (d) BC3.

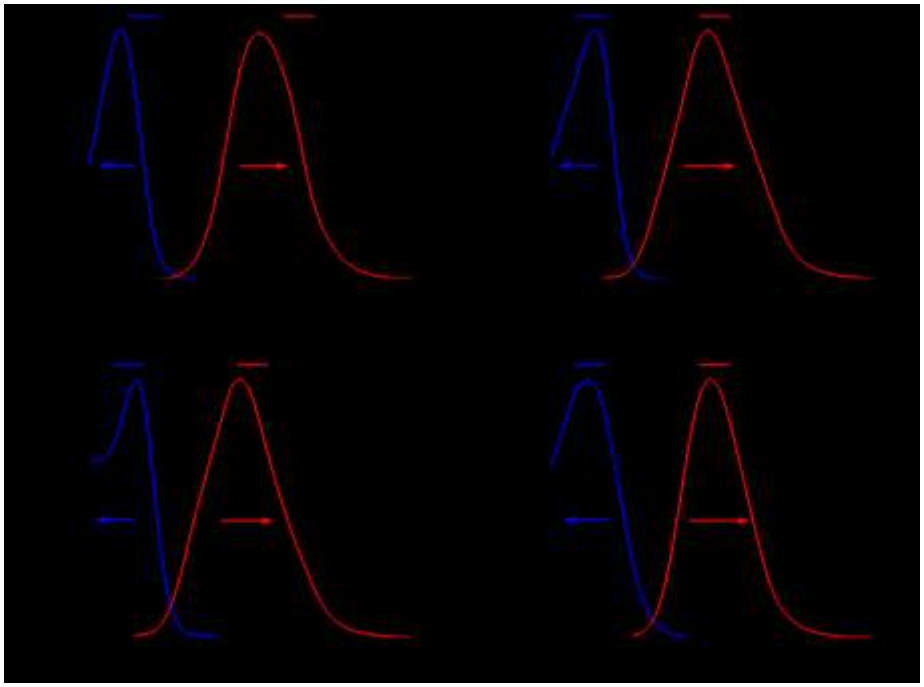


Fig. S7 Singlet state energy determination in acetonitrile for: (a) BT1, (b) BT2, (c) BT4, (d) BC3.

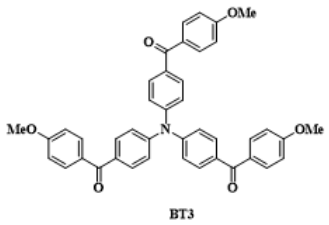
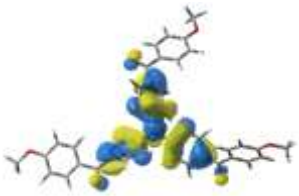
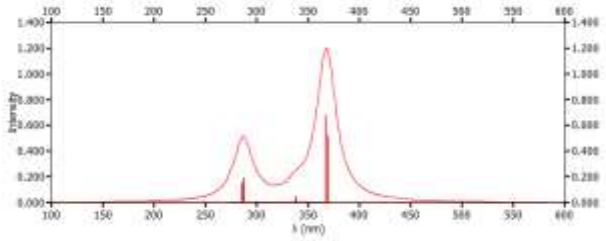
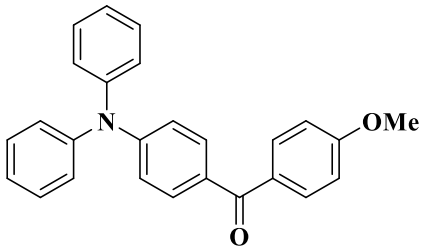
STRUCTURE	 BT3	
HOMO/LUMO (Isoval = 0.02)	 Lumo	 Homo
Triplet State Energy E_{T1} *(kcal mol^{-1})*	60.83	
Calculated UV-Visible absorption spectra	 λ_{max}= 367 nm F= 0.681	

Table S1. Frontier Molecular Orbital Properties, E_{T1} and calculated UV−Vis absoption spectra of BT3 (Calculated at the uB3LYP/6-31G* Level).

Syntheses of the photoinitiators

All reagents and solvents were purchased from Aldrich or Alfa Aesar and used as received without further purification. Mass spectroscopy was performed by the Spectropole of Aix-Marseille University. ESI mass spectral analyses were recorded with a 3200 QTRAP (Applied Biosystems SCIEX) mass spectrometer. The HRMS mass spectral analysis was performed with a QStar Elite (Applied Biosystems SCIEX) mass spectrometer. Elemental analyses were recorded with a Thermo Finnigan EA 1112 elemental analysis apparatus driven by the Eager 300 software. ^{1}H and ^{13}C NMR spectra were determined at room temperature in 5 mm o.d. tubes on a Bruker Avance 400 spectrometer of the Spectropole: ^{1}H (400 MHz) and ^{13}C (100 MHz). The ^{1}H chemical shifts were referenced to the solvent peaks DMSO (2.49 ppm), $CDCl_3$ (7.26 ppm) and the ^{13}C chemical shifts were referenced to the solvent peak DMSO (49.5 ppm), $CDCl_3$ (77.0 ppm). All photoinitiators were prepared with analytical purity up to accepted standards for new organic compounds (>98%) which was checked by high field NMR analysis.

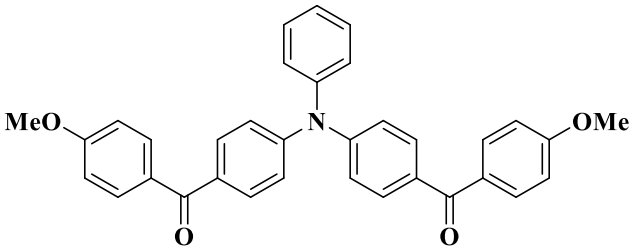
Synthesis of (4-(diphenylamino)phenyl)(4-methoxyphenyl)methanone BT1



In a 100 mL one-necked round bottom flask were added triphenylamine (1.5 g, 6.11 mmol, 1 equiv., M= 245.33 g/mol) and aluminium chloride (0.9 g, 6.73 mmol, 1.1 equiv., M= 133.33 g/mol) in CH_2Cl_2 (40 mL). The reaction mixture was cooled to 0 °C and 4-methoxybenzoyl chloride (1.04 g, 6.11 mmol, 1 equiv., M= 170.9 g/mol) was added. The reaction mixture was stirred overnight. A large amount of cold water was added to quench the reaction and the reaction mixture was then extracted with CH_2Cl_2. The organic layer was washed with water and dried over $MgSO_4$. After filtration and

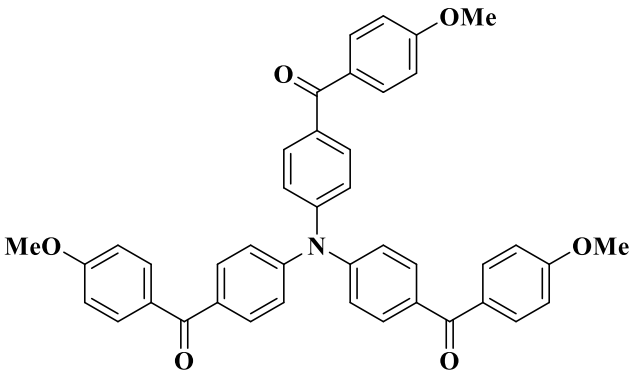
solvent evaporation, a mixture of THF and pentane caused the precipitation of the product. The product (0.72 g, 31% yield) was obtained as white yellowish solid. ^{1}H NMR ($CDCl_3$) δ : 7.89 – 7.81 (m, 2H), 7.77 – 7.66 (m, 2H), 7.43 – 7.32 (m, 4H), 7.22 – 7.13 (m, 6H), 7.07 – 7.02 (m, 2H), 7.02 – 6.94 (m, 2H), 3.90 (s, 3H); ^{13}C NMR ($CDCl_3$) δ : 194.26, 162.86, 151.67, 146.83, 132.27, 131.78, 131.07, 130.54, 129.71, 125.98, 124.58, 120.02, 113.56, 55.58; HRMS (ESI MS) m/z: theor: 380.1645 found: 380.1649 ($[M+H]^+$ detected).

Synthesis of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*((4-methoxyphenyl) methanone) BT2



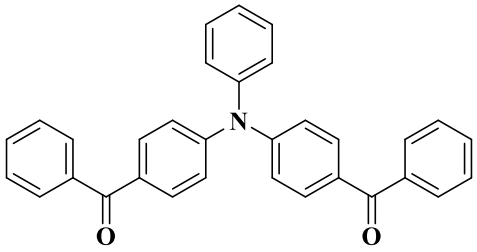
In a 100 mL one-necked round bottom flask were added triphenylamine (1.5 g, 6.11 mmol, 1 equiv., M= 245.33 g/mol) and aluminium chloride (1.79 g, 13.45 mmol, 2.2 equiv., M= 133.33 g/mol) in CH_2Cl_2 (40 mL). The reaction mixture was cooled to 0 °C and 4-methoxybenzoyl chloride (2.09 g, 12.23 mmol, 2 equiv., M= 170.59 g/mol) was added. The reaction mixture was stirred overnight. A large amount of cold water was added to quench the reaction and the reaction mixture was then extracted with CH_2Cl_2. The organic layer was washed with water and dried over magnesium sulfate. After filtration and solvent evaporation, THF and pentane allow formation of a solid. The product (1.14 g, 36% yield) was obtained as white yellowish solid. ^{1}H NMR ($CDCl_3$) δ : 8.09 (m, 4H), 7.98 – 7.92 (m, 4H), 7.60 – 7.58 (m, 2H), 7.46 – 7.44 (m, 3H), 7.33 – 7.28 (m, 4H), 7.25 – 7.21 (m, 4H), 4.16 (s, 6H); ^{13}C NMR ($CDCl_3$) δ : 194.18, 163.16, 150.46, 146.09, 133.62, 132.28, 131.65, 130.53, 130.27, 129.91, 129.59, 126.65, 125.85, 123.75, 122.31, 113.53, 55.52; HRMS (ESI MS) m/z: theor: 514.2013 found: 514.2013 ($[M+H]^+$ detected).

Synthesis of (nitrilotris(benzene-4,1-diyl))tris((4-methoxyphenyl)methanone) BT3



In a 100 mL one-necked round bottom flask were added triphenylamine (1.5 g, 6.11 mmol, 1 equiv., M= 245.32 g/mol) and aluminium chloride (2.69 g, 20.18 mmol, 3.3 equiv., M= 133.34 g/mol) in CH_2Cl_2 (40 mL). The reaction mixture was cooled to 0 °C and 4-methoxybenzoyl chloride (3.13 g, 18.34 mmol, 3 equiv., M= 170.59 g/mol) was added. The reaction mixture was stirred overnight. A large amount of cold water was added to quench the reaction and the reaction mixture was then extracted with CH_2Cl_2. The organic layer was washed with water and dried over magnesium sulfate. After filtration and solvent evaporation. After filtration and solvent evaporation, the product (1.4 g, 35% yield) was obtained as a yellowish solid. ^{1}H NMR ($CDCl_3$) δ : 8.19 – 8.07 (m, 6H), 8.07 – 7.98 (m, 6H), 7.58 – 7.46 (m, 6H), 7.31 – 7.19 (m, 6H), 4.16 (s, 9H); ^{13}C NMR ($CDCl_3$) δ: 194.21, 163.24, 149.85, 133.71, 132.44, 131.84, 130.36, 123.84, 113.71, 55.63; HRMS (ESI MS) m/z: theor: 648.2381 found: 648.2376 ($[M+H]^+$ detected).

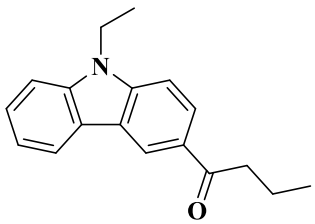
Synthesis of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*(phenylmethanone) BT4



Triphenylamine (4.96 g, 20 mmol, 1 equiv., M= 145.33 g/mol) was added in a predried 100 mL two-necked round-bottom flask with a magnetic stirrer bar. Then

aluminium chloride (3.8 g, 29 mmol, 1.4 equiv., M= 133.33 g/mol) was added to the round-bottom flask. The flask was evacuated under vacuum and flushed with nitrogen for three times. 25 mL of carbon disulfide was added to the flask as the solvent and the mixture was stirred on an ice bath for several minutes. Benzoyl chloride (2.56 mL, 22 mmol, 1.1 equiv., M= 140.57 g/mol) was added dropwise to the reaction mixture on an ice bath. The mixture was stirred at 0°C for 5 hours. After solvent removal, 25 mL of deionized water was added to the reaction mixture. Suction filtration was applied to get crude product from reaction mixture and the crude product was washed with deionized water and absolute ethanol. The crude product was then redissolved in dichloromethane and was condensed. A column chromatography (SiO_2, hexane/chloroform/THF 30/8/1 as eluent) was used in order to obtain the product (2.79 g, 30% yield) as a yellowish solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 – 8.14 (m, 4H), 7.85 – 7.77 (m, 4H), 7.67 – 7.57 (m, 4H), 7.54 – 7.48 (m, 6H), 7.44 – 7.39 (m, 1H), 7.28 – 7.22 (m, 2H), 7.22 – 7.17 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 195.35, 172.20, 150.79, 145.91, 138.04, 133.81, 132.08, 131.99, 131.68, 130.23, 129.99, 129.78, 129.36, 128.50, 128.25, 126.83, 125.74, 122.27; HRMS (ESI MS) m/z: theor: 454.1802 found: 454.1805 ($[M+H]^+$ detected). Analyses were consistent with those reported in the literature [Y. Liu, X. Chen, Y. Lv, S.W.Y. Chen, J. Lam, F. Mahtab, H.S. Kwok, X. Tao, B.Z. Tang, Systemic Studies of Tetraphenylethene–Triphenylamine Oligomers and a Polymer: Achieving Both Efficient Solid-State Emissions and Hole-Transporting Capability. Chemistry – A European Journal 2012, 18, 9929–9938]

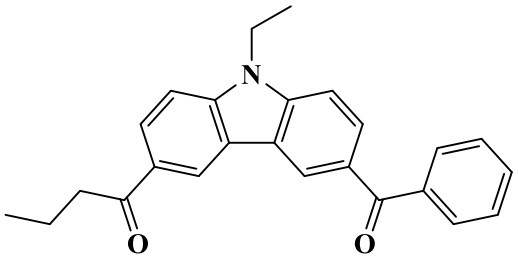
Synthesis of 1-(9-ethyl-9*H*-carbazol-3-yl)butan-1-one



9-Ethyl-9*H*-carbazole (0.33 g, 1.71 mmol, M = 195.26 g/mol) and butyryl chloride (0.18 g, 0.18 mL, 1.71 mmol, d = 1.026, M = 106.55 g/mol) were dissolved in 10 mL DCM (stabilized with amylene) and the solution was cooled to 0°C. Then, $AlCl_3$ (0.23

g, 1.71 mmol, M = 133.33 g/mol) were added in one portion and the solution was stirred overnight. The reaction mixture was poured on ice-water. The solution was extracted several times with DCM. The organic phases were combined, dried over magnesium sulfate and the solvent removed under reduced pressure. The residue was filtered on a plug of silicagel using DCM as the eluent (0.39 g, 86% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.76 (d, *J* = 1.4 Hz, 1H), 8.16 (td, *J* = 8.8, 1.3 Hz, 2H), 7.52 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H), 7.42 (dd, *J* = 14.1, 8.4 Hz, 2H), 7.30 (td, *J* = 7.6, 1.0 Hz, 1H), 4.39 (q, *J* = 7.2 Hz, 2H), 3.09 (d, *J* = 14.7 Hz, 2H), 1.91 – 1.81 (m, 2H), 1.46 (t, *J* = 7.2 Hz, 3H), 1.07 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 199.94, 142.62, 140.66, 128.72, 126.39, 126.25, 123.34, 122.73, 121.56, 120.67, 119.91, 108.97, 108.04, 40.47, 37.82, 18.35, 14.06, 13.80; HRMS (ESI MS) m/z: theor: 265.1467 found: 265.1471 ($M^{+\cdot}$ detected).

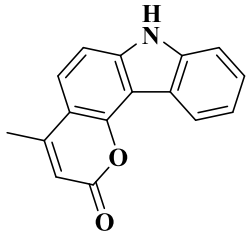
Synthesis of 1-(6-benzoyl-9-ethyl-9*H*-carbazol-3-yl)butan-1-one BC1



1-(9-Ethyl-9*H*-carbazol-3-yl)butan-1-one (0.45 g, 1.71 mmol, M = 265.36 g/mol) and benzoyl chloride (0.24 g, 0.20 mL, 1.71 mmol, d = 1.211, M = 140.57 g/mol) were dissolved in 10 mL DCM (stabilized with amylene) and the solution was cooled to 0°C. Then, $AlCl_3$ (0.43 g, 3.22 mmol, M = 133.33 g/mol) were added in one portion and the solution was stirred overnight. The reaction mixture was poured onto ice-water. The solution was extracted several times with DCM. The organic phases were combined, dried over magnesium sulfate and the solvent removed under reduced pressure. The residue was filtered on a plug of silicagel using DCM as the eluent (0.51 g, 81% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, *J* = 1.3 Hz, 1H), 8.64 (d, *J* = 1.2 Hz, 1H), 8.20 (dd, *J* = 8.7, 1.7 Hz, 1H), 8.10 (dd, *J* = 8.6, 1.7 Hz, 1H), 7.88 – 7.81 (m, 2H), 7.66 – 7.58 (m, 1H), 7.57 – 7.46 (m, 4H), 4.45 (q, *J* = 7.3 Hz, 2H), 3.08 (t, *J* = 7.3 Hz, 2H),

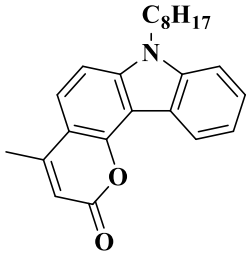
1.89 – 1.79 (m, 2H), 1.51 (t, *J* = 7.3 Hz, 3H), 1.05 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 199.78, 196.41, 143.32, 143.22, 138.73, 131.89, 129.89, 129.69, 129.56, 128.99, 128.31, 126.90, 124.07, 122.96, 122.86, 121.74, 108.73, 108.70, 40.50, 38.18, 18.22, 14.01, 13.85; HRMS (ESI MS) m/z: theor: 370.1802 found: 370.1798 ($[M+H]^+$ detected).

Synthesis of 4-methylpyrano[3,2-*c*]carbazol-2(7*H*)-one



This molecule was synthesized according to a procedure previously reported in the literature, without modification and in similar yield [R. Zhou, X. Sun, R. Mhanna, J.-P. Malval, M. Jin, H. Pan, D. Wan, F. Morlet-Savary, H. Chaumeil, C. Joyeux, Wavelength-Dependent, Large-Amplitude Photoinitiating Reactivity within a Carbazole-Coumarin Fused Oxime Esters Series, ACS Appl. Polym. Mater. 2020, 2, 5, 2077–2085]. ^{1}H NMR (300 MHz, DMSO) δ 11.90 (s, 1H), 8.31 (t, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.6 Hz, 1H), 7.61 (d, *J* = 8.1 Hz, 1H), 7.53 – 7.46 (m, 1H), 7.36 – 7.27 (m, 1H), 6.28 (d, *J* = 1.2 Hz, 1H), 2.53 (d, *J* = 1.1 Hz, 1H).

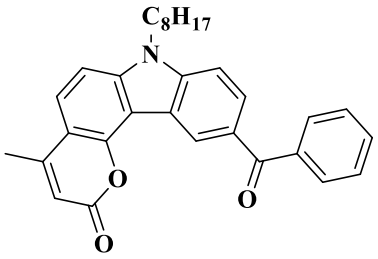
Synthesis of 4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one



4-Methylpyrano[3,2-*c*]carbazol-2(7*H*)-one (3.54 g, 14.20 mmol, M = 249.27 g/mol) was dissolved in dry DMF (100 mL) in a flask fitted with a magnetic stirrer and condenser. Then, bromooctane (2.74 g, 14.20 mmol, M = 193.13 g/mol) and potassium carbonate (3.92 g, 28.40 mmol) were added. Then a small amount of potassium iodide

and 18-crown-6 were added as catalyst. The reaction was heated at 100°C for 24h under N_2. The mixture was cooled to room temperature, the inorganic salt was filtered off and the precipitate was washed with DMF (2 × 40 mL). Then the filtrate was poured into sodium chloride aqueous solution (5 wt%, 1000 mL). The gained precipitation was filtered off and then dissolved in dichloromethane, dried with Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by column chromatography (SiO_2, DCM) to obtain a yellow product (4.88 g, 95% yield). ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.63 (d, *J* = 7.8 Hz, 1H), 7.62 (d, *J* = 8.7 Hz, 1H), 7.53 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H), 7.44 (d, *J* = 8.2 Hz, 1H), 7.39 – 7.32 (m, 1H), 7.29 (d, *J* = 8.7 Hz, 1H), 6.20 (d, *J* = 1.1 Hz, 1H), 4.33 (t, *J* = 7.2 Hz, 2H), 2.51 (d, *J* = 1.1 Hz, 3H), 1.96 – 1.78 (m, 2H), 1.44 – 1.15 (m, 10H), 0.86 (t, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.44, 153.83, 150.42, 142.81, 140.10, 126.08, 123.87, 121.60, 121.11, 120.46, 111.55, 110.70, 110.31, 108.87, 105.48, 43.45, 31.74, 29.30, 29.11, 29.04, 27.21, 22.57, 19.31, 14.02; HRMS (ESI MS) m/z: theor: 361.2042 found: 361.2040 ($M^{+\cdot}$ detected).

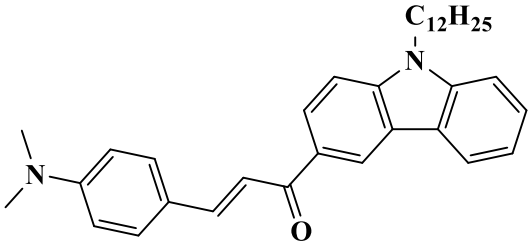
Synthesis of 10-benzoyl-4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one BC2



4-Methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one (0.62 g, 1.71 mmol, M = 361.48 g/mol) and benzoyl chloride (0.42 g, 0.35 mL, 3.00 mmol, d = 1.211, M = 140.57 g/mol) were dissolved in 10 mL DCM (stabilized with amylene) and the solution was cooled to 0°C. Then, $AlCl_3$ (0.43 g, 3.22 mmol, M = 133.33 g/mol) were added in one portion and the solution was stirred overnight. The reaction mixture was poured on ice-water. The solution was extracted several times with DCM. The organic phases were combined, dried over magnesium sulfate and the solvent removed under reduced pressure. The residue was filtered on a plug of silicagel using DCM as the eluent (0.65 g, 82% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.97 (d, *J* = 1.3 Hz, 1H), 8.04 (dd, *J* = 8.5,

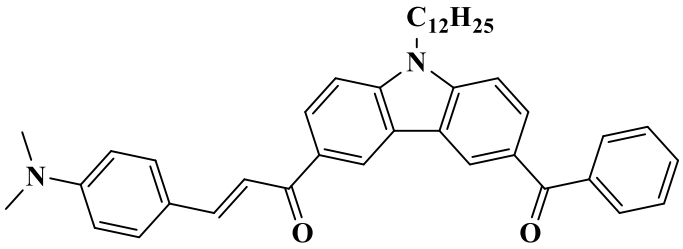
1.3 Hz, 1H), 7.89 (d, *J* = 7.1 Hz, 2H), 7.62 (dd, *J* = 16.5, 8.0 Hz, 2H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.47 (d, *J* = 8.6 Hz, 1H), 7.31 (d, *J* = 8.5 Hz, 1H), 6.16 (s, 1H), 4.35 (t, *J* = 7.0 Hz, 2H), 2.48 (s, 3H), 1.95 – 1.83 (m, 2H), 1.44 – 1.16 (m, 10H), 0.86 (t, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.24, 160.65, 153.48, 150.14, 143.35, 142.38, 138.38, 132.15, 130.15, 130.11, 130.08, 128.39, 128.26, 126.56, 122.51, 120.50, 112.22, 111.29, 110.42, 108.57, 105.90, 43.73, 31.73, 29.27, 29.11, 29.02, 27.18, 22.57, 19.31, 14.04; HRMS (ESI MS) m/z: theor: 465.2304 found: 465.2307 ($M^{+\cdot}$ detected).

Synthesis of 3-(4-(dimethylamino)phenyl)-1-(9-dodecyl-9*H*-carbazol-3-yl) prop-2-en-1-one



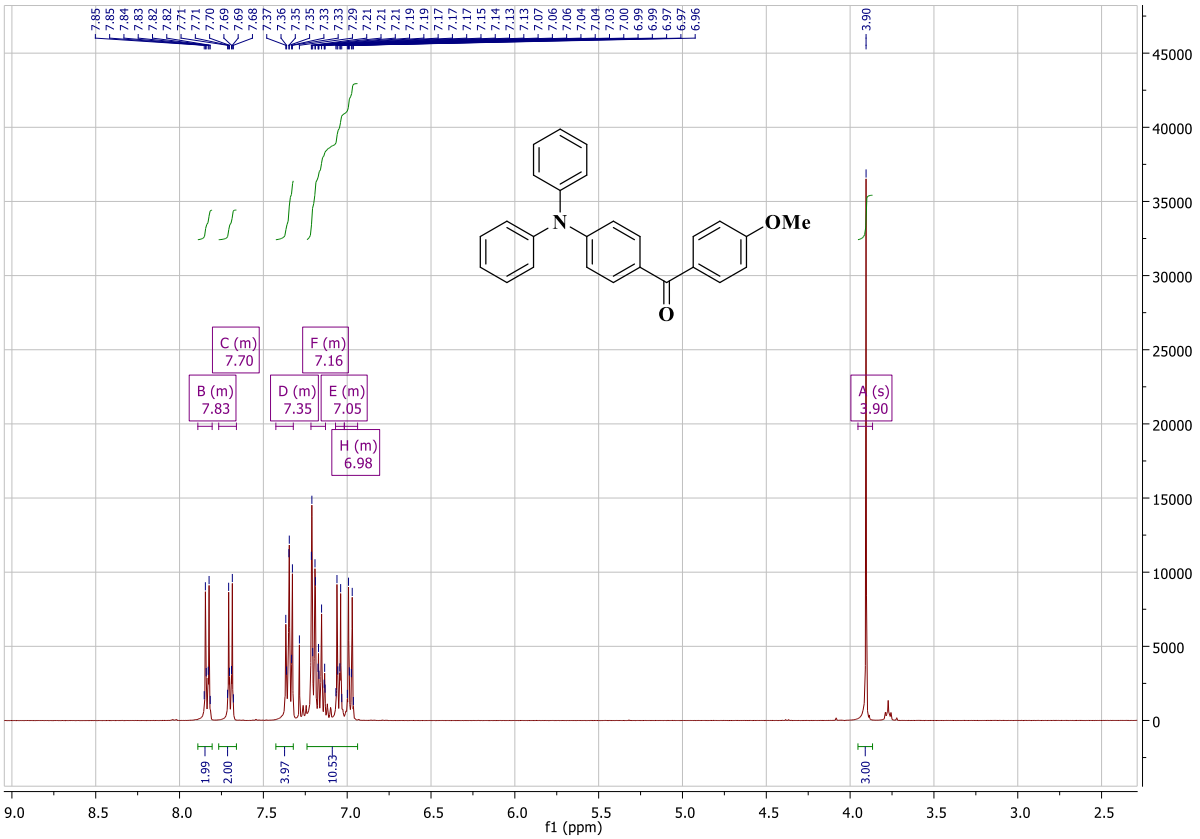
This compound was synthetized according the literature (Chen et al., « Novel D–π-A and A–π-D–π-A Three-Component Photoinitiating Systems Based on Carbazole/Triphenylamino Based Chalcones and Application in 3D and 4D Printing ». Polym. Chem., 2020, 11, 6512, DOI: 10.1039/d0py01197e) ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (d, *J* = 1.5 Hz, 1H), 8.25 – 8.17 (m, 2H), 7.88 (d, *J* = 15.4 Hz, 1H), 7.60 (dd, *J* = 12.1, 10.6 Hz, 3H), 7.55 – 7.48 (m, 1H), 7.44 (d, *J* = 8.5 Hz, 2H), 7.34 – 7.27 (m, 1H), 6.73 (d, *J* = 8.8 Hz, 2H), 4.32 (t, *J* = 7.2 Hz, 2H), 3.04 (s, 6H), 1.88 (dd, *J* = 14.4, 7.0 Hz, 2H), 1.44 – 1.18 (m, 18H), 0.89 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.70, 151.79, 144.49, 142.98, 141.14, 130.32, 130.23, 126.64, 126.25, 123.32, 122.69, 121.74, 120.69, 119.79, 117.48, 112.01, 109.18, 108.37, 43.35, 40.21, 31.91, 29.60, 29.56, 29.49, 29.39, 29.33, 28.96, 27.28, 22.69, 14.12

Synthesis of 1-(6-benzoyl-9-dodecyl-9*H*-carbazol-3-yl)-3-(4-(dimethylamino)-phenyl) prop-2-en-1-one BC3

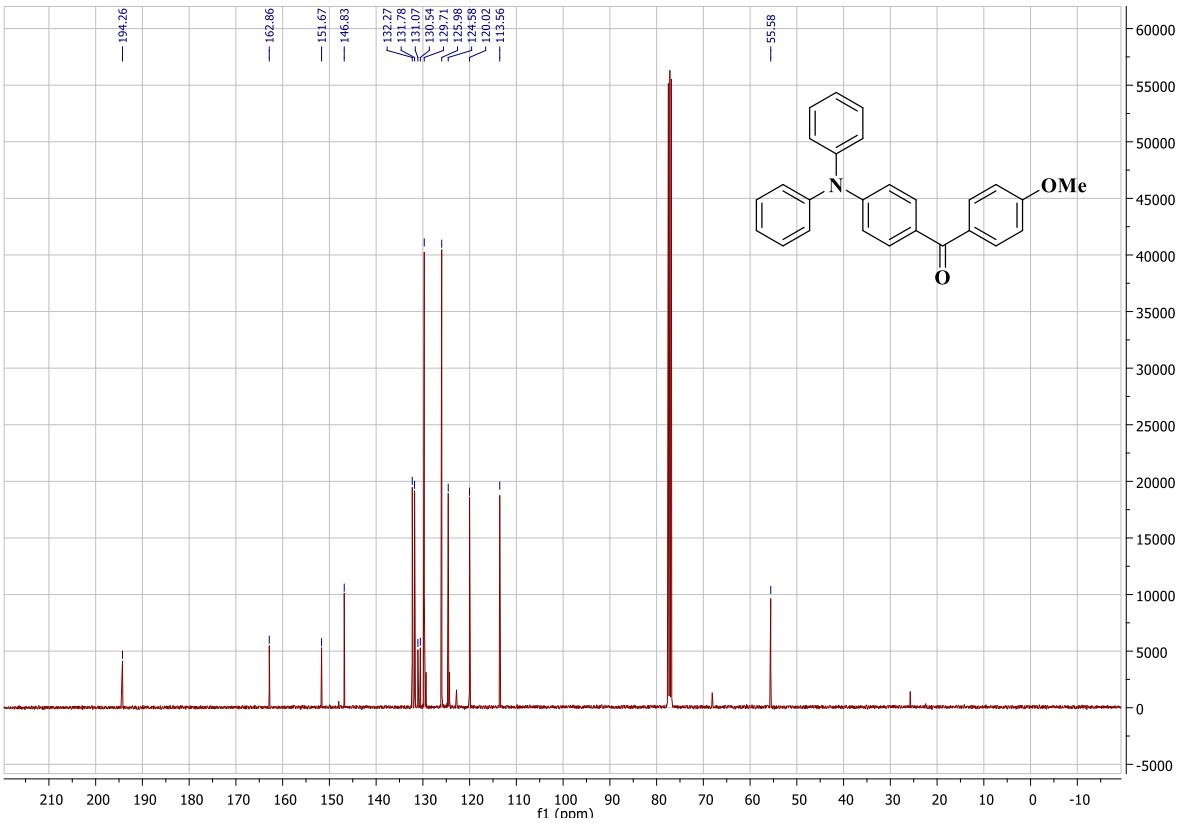


3-(4-(Dimethylamino)phenyl)-1-(9-dodecyl-9*H*-carbazol-3-yl)prop-2-en-1-one (4.35 g, 8.55 mmol, M = 508.75 g/mol) and benzoyl chloride (1.2 g, 1.0 mL, 8.55 mmol, d = 1.211, M = 140.57 g/mol) were dissolved in 50 mL DCM (stabilized with amylene) and the solution was cooled to 0°C. Then, $AlCl_3$ (2.15 g, 16.1 mmol, M = 133.33 g/mol) were added in one portion and the solution was stirred overnight. The reaction mixture was poured on ice-water. The solution was extracted several times with DCM. The organic phases were combined, dried over magnesium sulfate and the solvent removed under reduced pressure. The residue was filtered on a plug of silicagel using DCM as the eluent (4.14 g, 79% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 (d, *J* = 1.4 Hz, 1H), 8.58 (d, *J* = 1.3 Hz, 1H), 8.17 (dd, *J* = 8.7, 1.7 Hz, 1H), 7.99 (dd, *J* = 8.6, 1.7 Hz, 1H), 7.81 – 7.75 (m, 1H), 7.53 – 7.41 (m, 3H), 7.39 (d, *J* = 8.7 Hz, 1H), 4.26 (t, *J* = 7.2 Hz, 1H), 2.94 (s, 3H), 1.82 (dt, *J* = 14.9, 7.3 Hz, 1H), 1.36 – 1.08 (m, 10H), 0.78 (t, *J* = 6.9 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ : 196.60, 189.60, 152.06, 145.18, 143.82, 143.73, 138.90, 131.99, 131.50, 130.50, 130.04, 129.53, 128.99, 128.43, 127.45, 124.28, 123.10, 123.01, 122.93, 121.97, 117.03, 112.01, 109.17, 109.04, 43.76, 40.26, 32.01, 29.70, 29.65, 29.57, 29.46, 29.43, 29.09, 27.35, 22.79, 14.22; HRMS (ESI MS) m/z: theor: 613.3789 found: 613.3787 ($[M+H]^+$ detected).

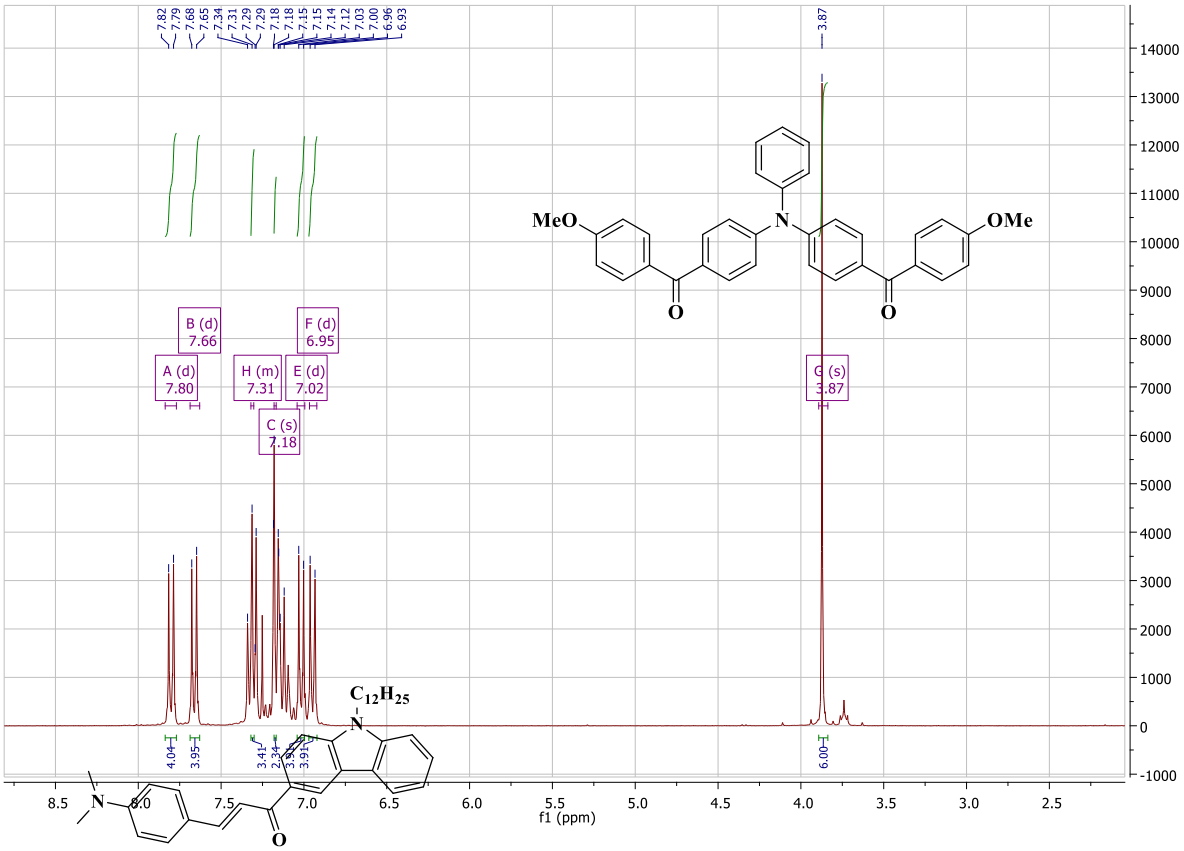
^{1}H NMR of (4-(diphenylamino)phenyl)(4-methoxyphenyl)methanone



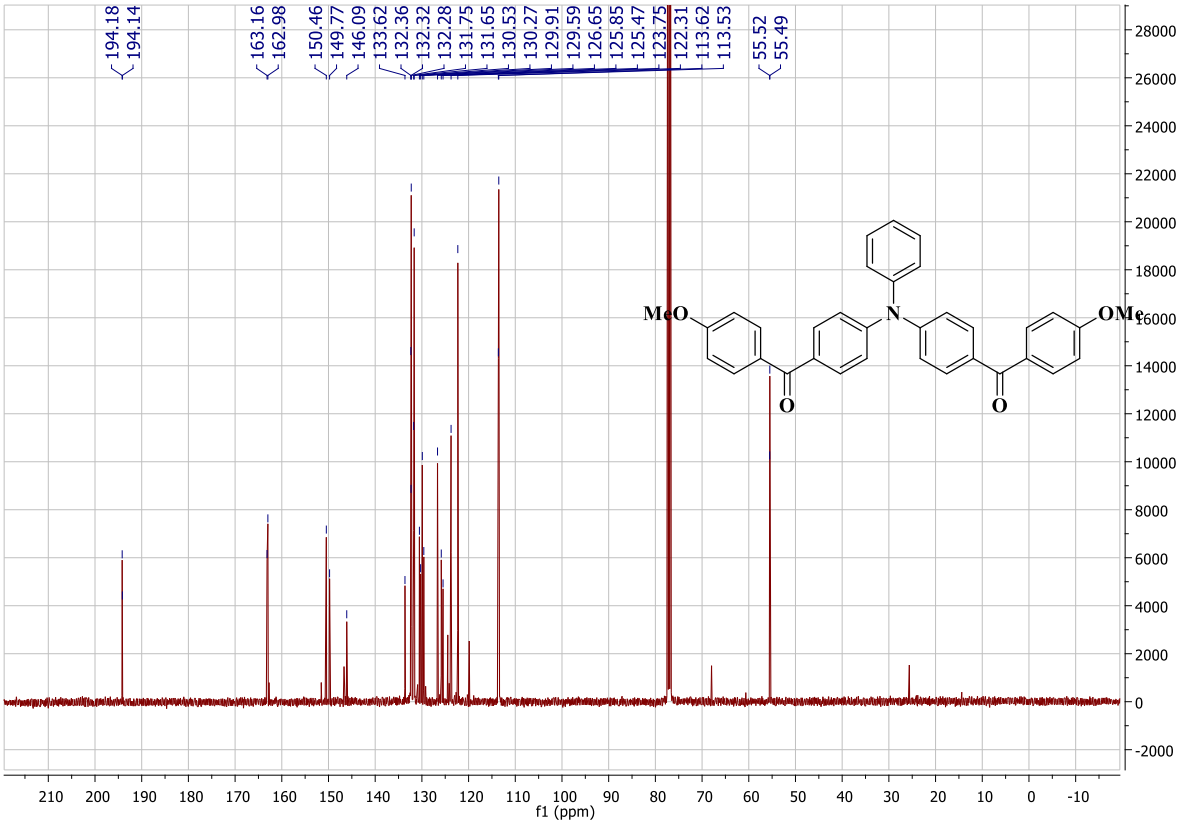
^{13}C NMR of (4-(diphenylamino)phenyl)(4-methoxyphenyl)methanone



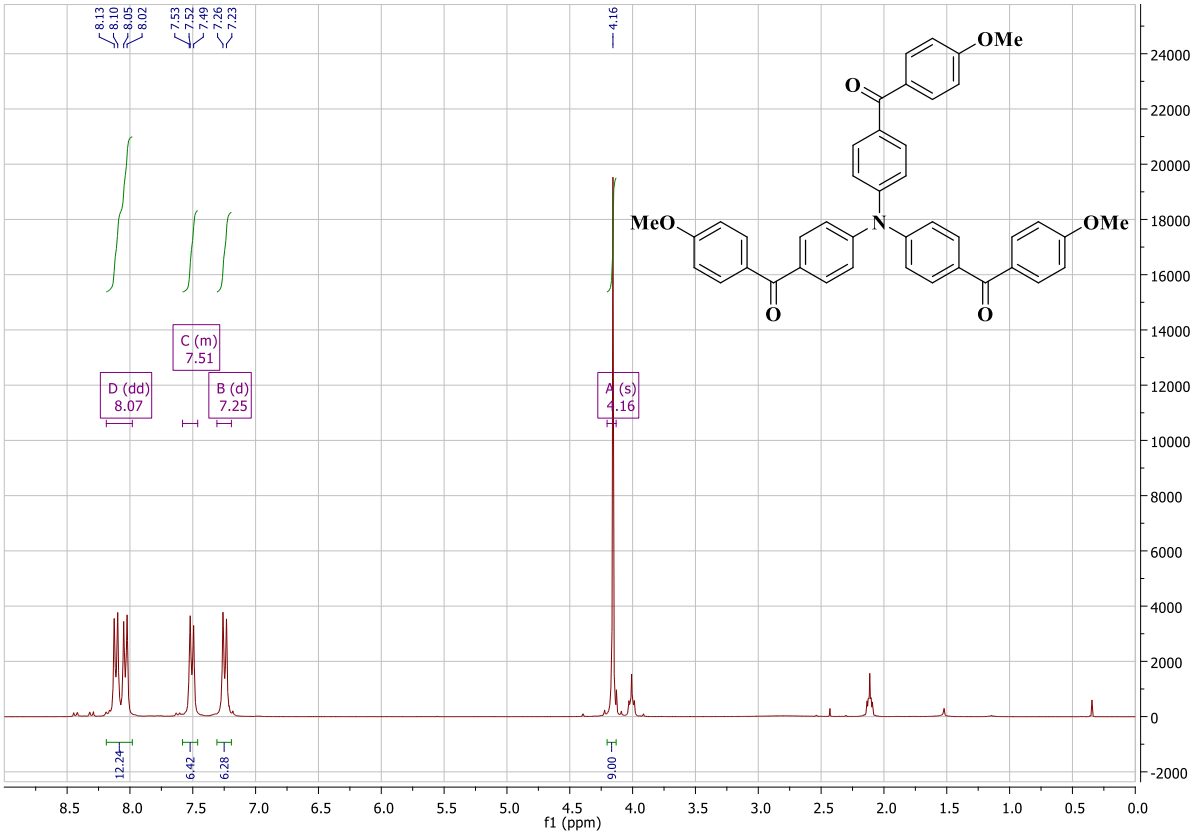
^{1}H NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*((4-methoxyphenyl) methanone)



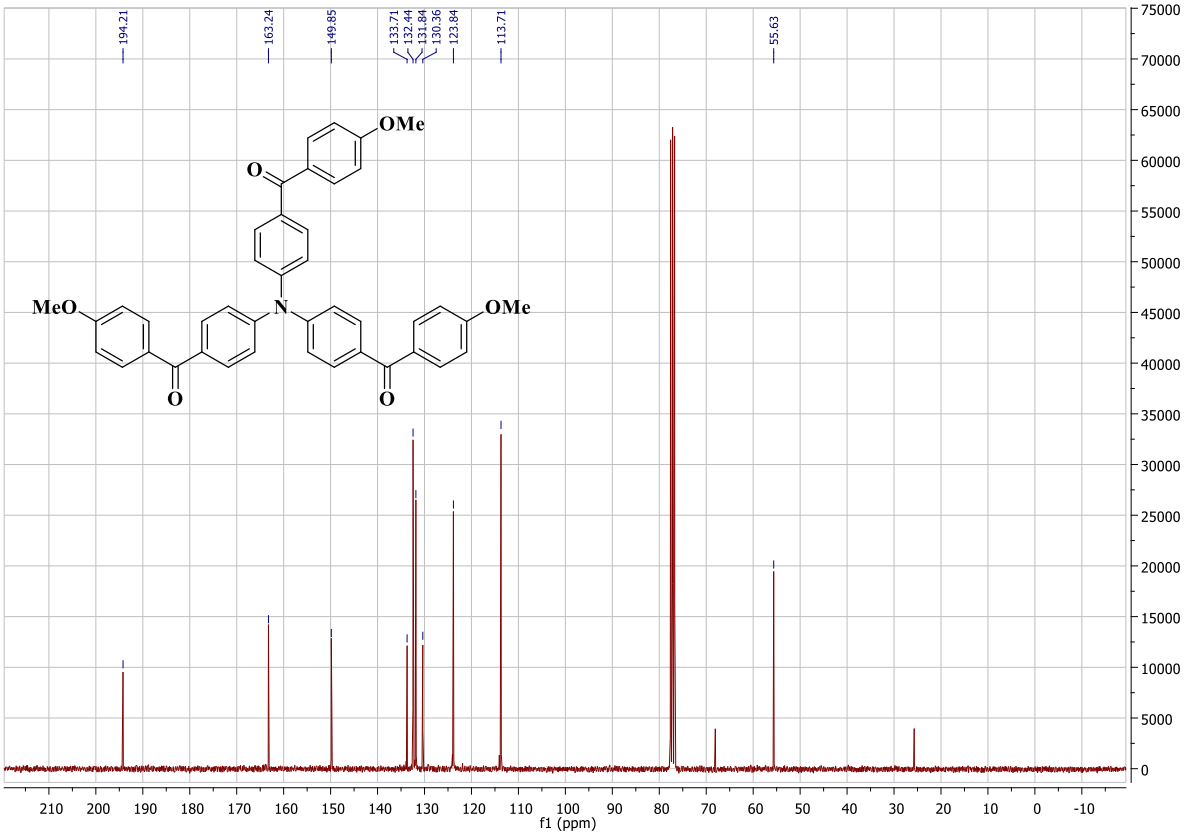
^{13}C NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*((4-methoxyphenyl) methanone)



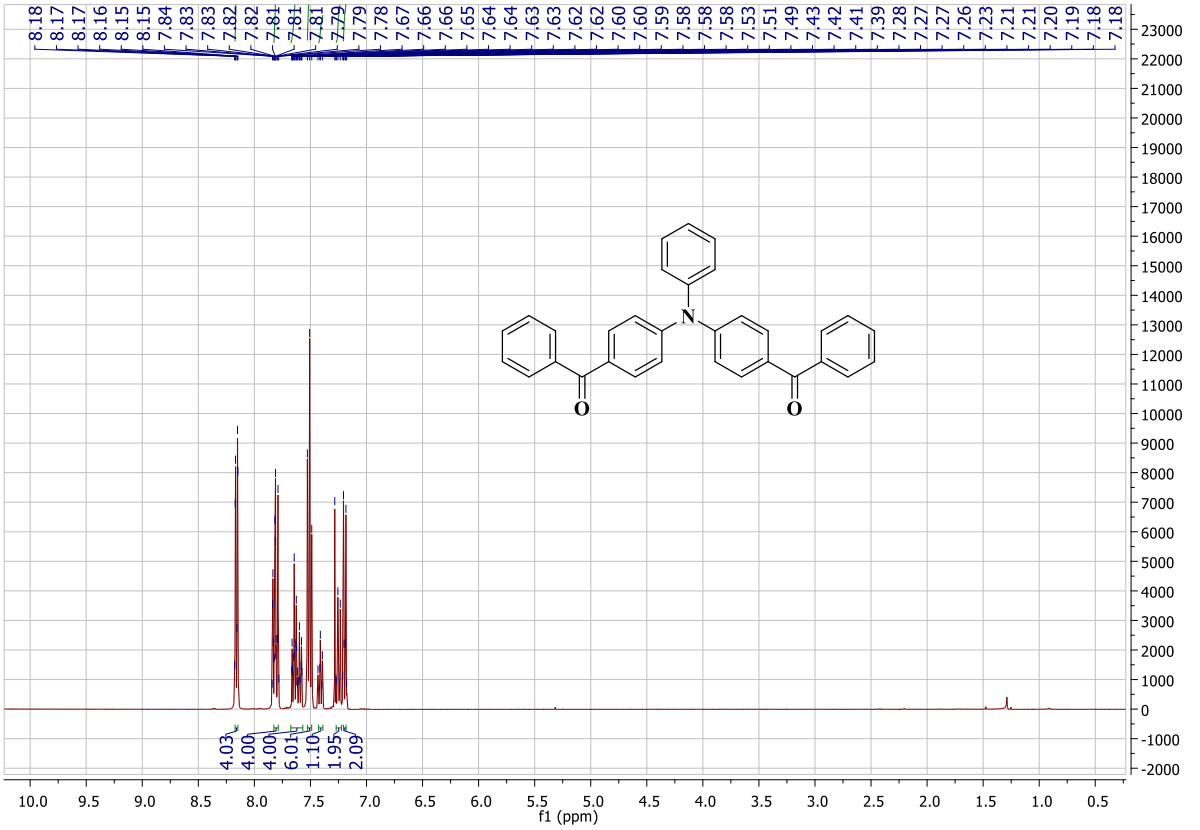
^{1}H NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*(phenylmethanone)



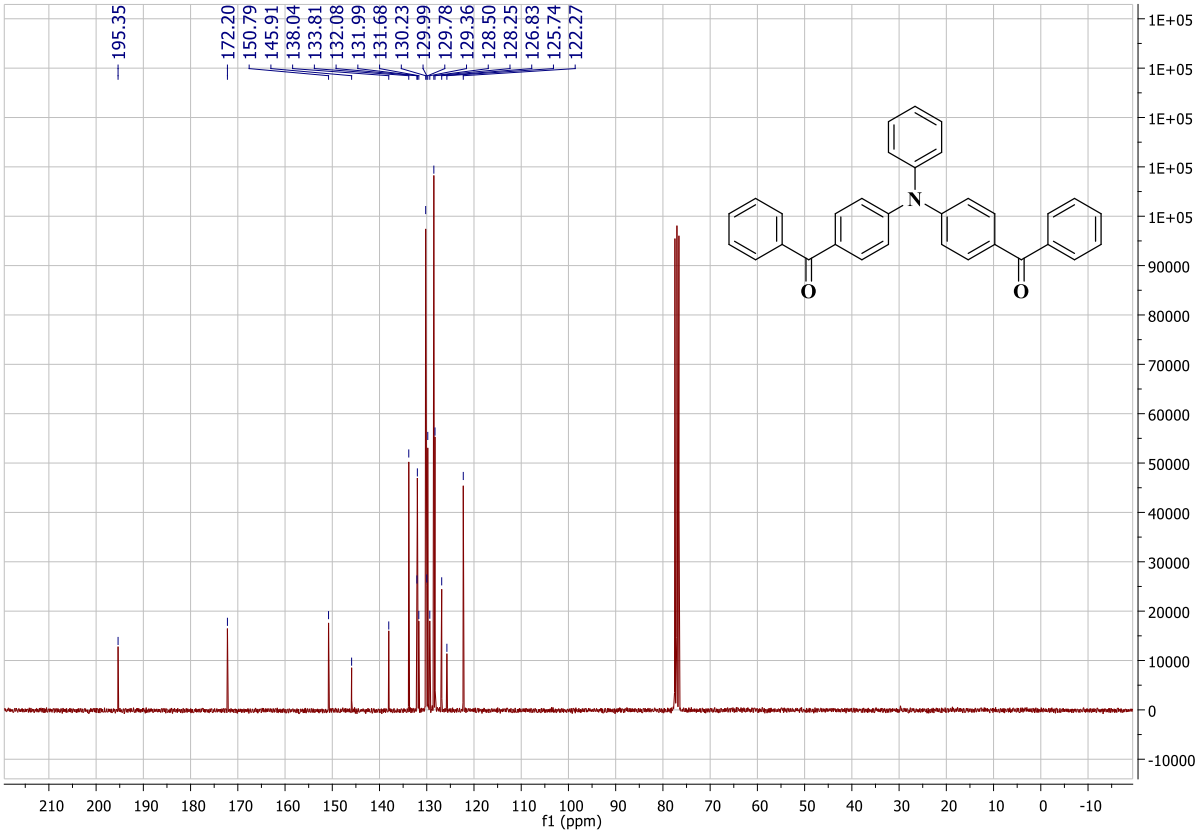
^{13}C NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*(phenylmethanone)



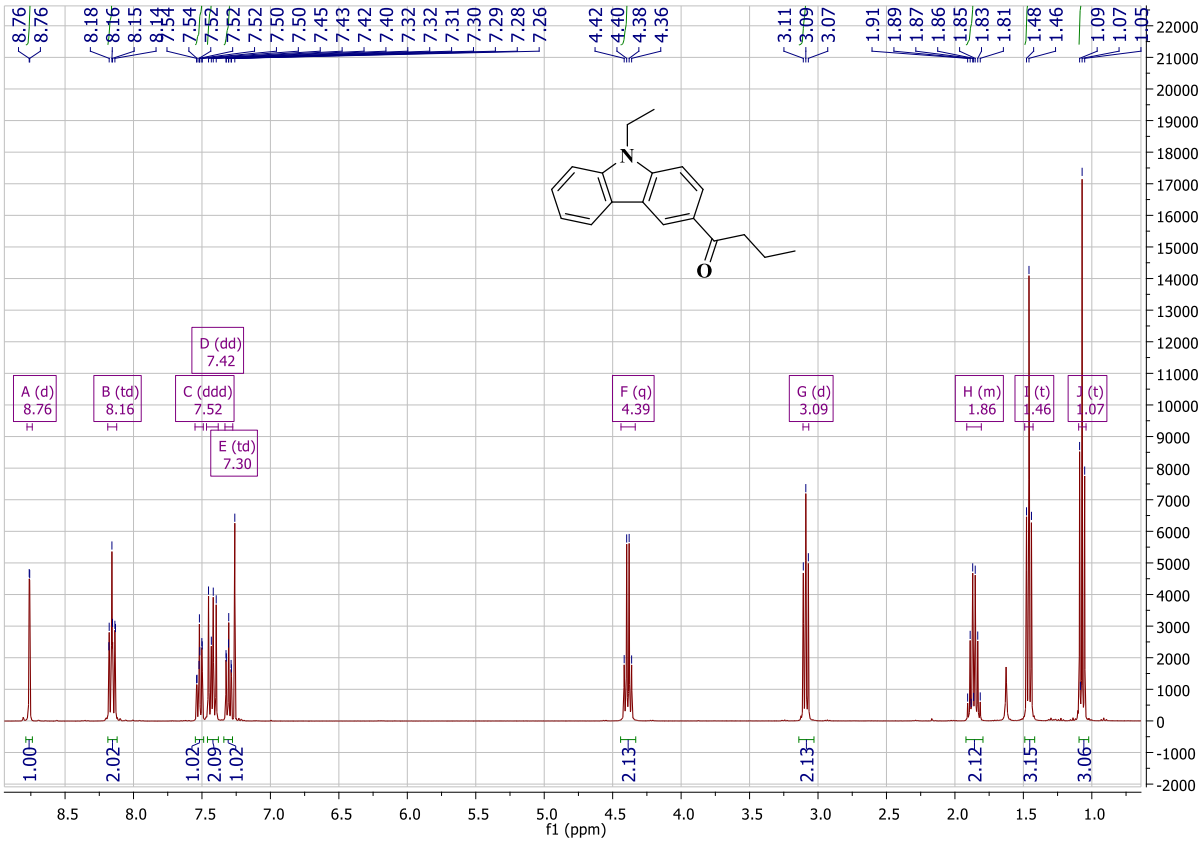
^{1}H NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*(phenylmethanone)



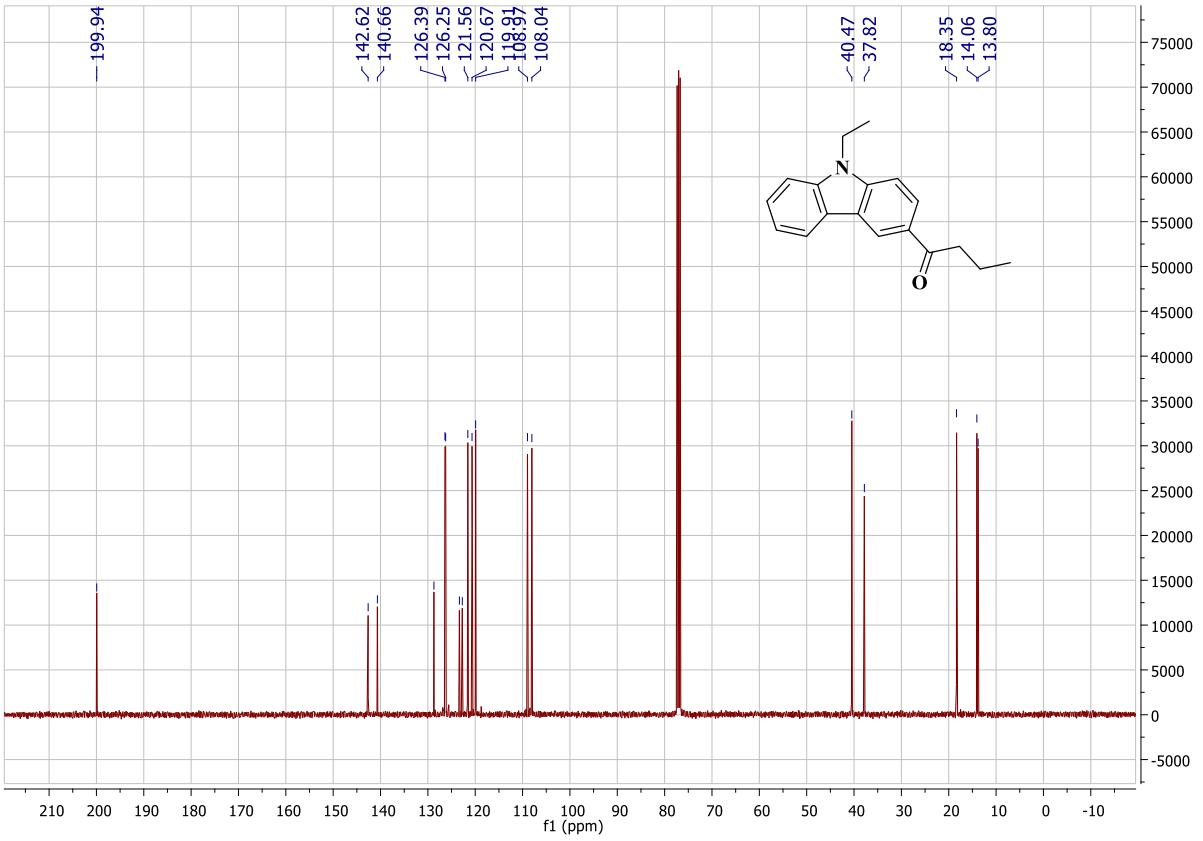
^{13}C NMR of ((phenylazanediyl)*bis*(4,1-phenylene))*bis*(phenylmethanone)



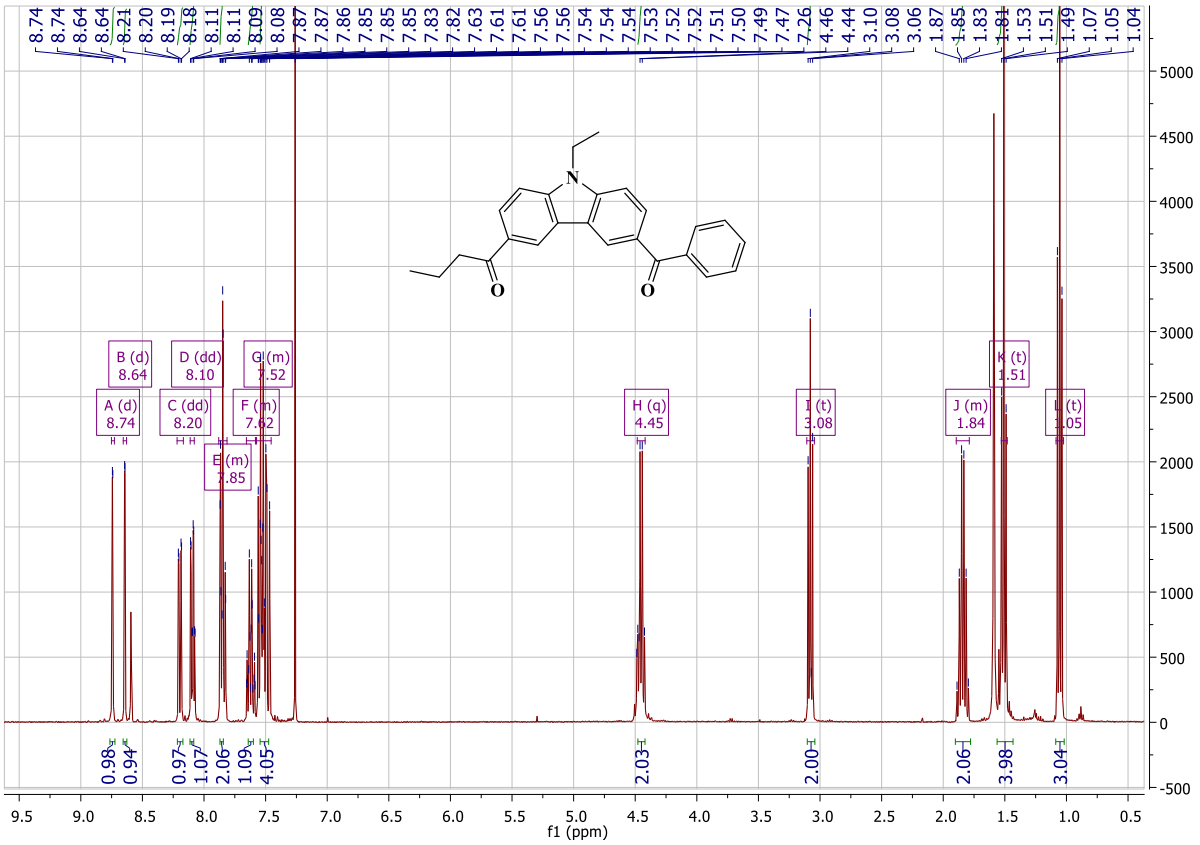
^{1}H NMR of 1-(9-ethyl-9*H*-carbazol-3-yl)butan-1-one



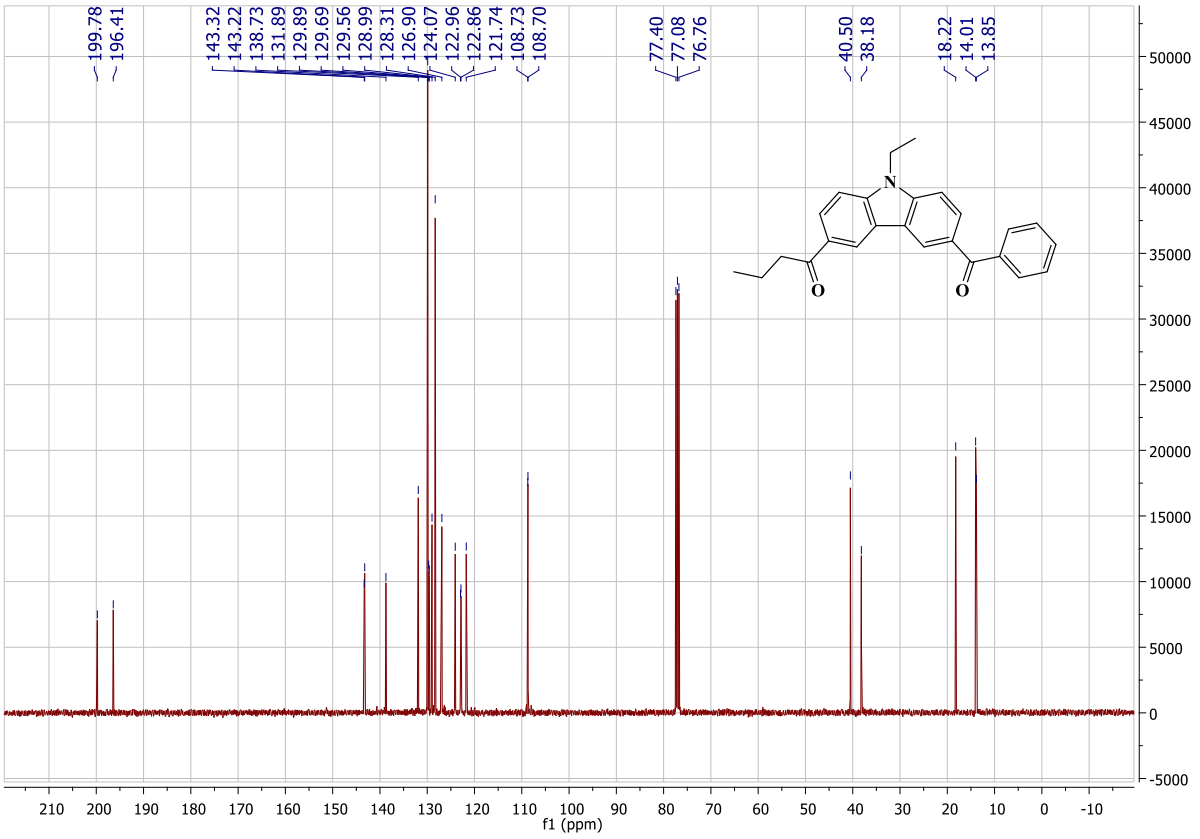
^{13}C NMR of 1-(9-ethyl-9*H*-carbazol-3-yl)butan-1-one



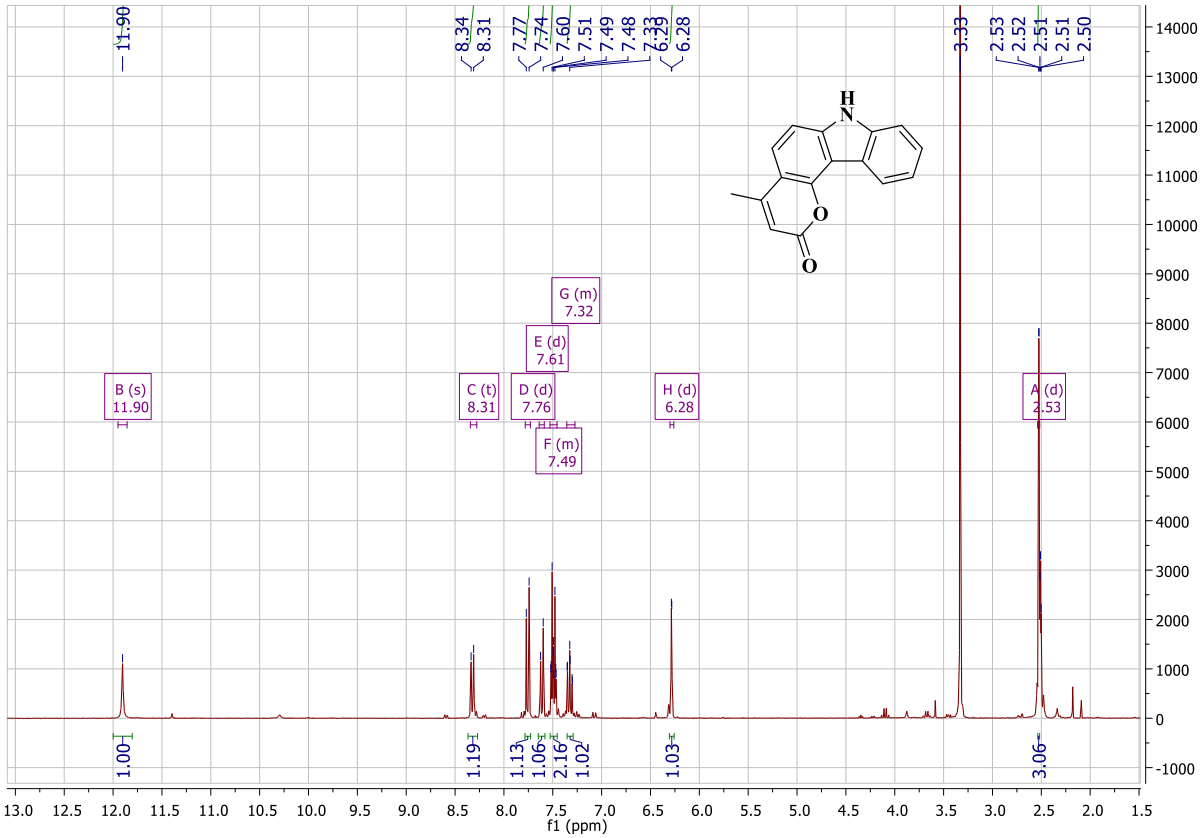
^{1}H NMR of 1-(6-benzoyl-9-ethyl-9*H*-carbazol-3-yl)butan-1-one BC1



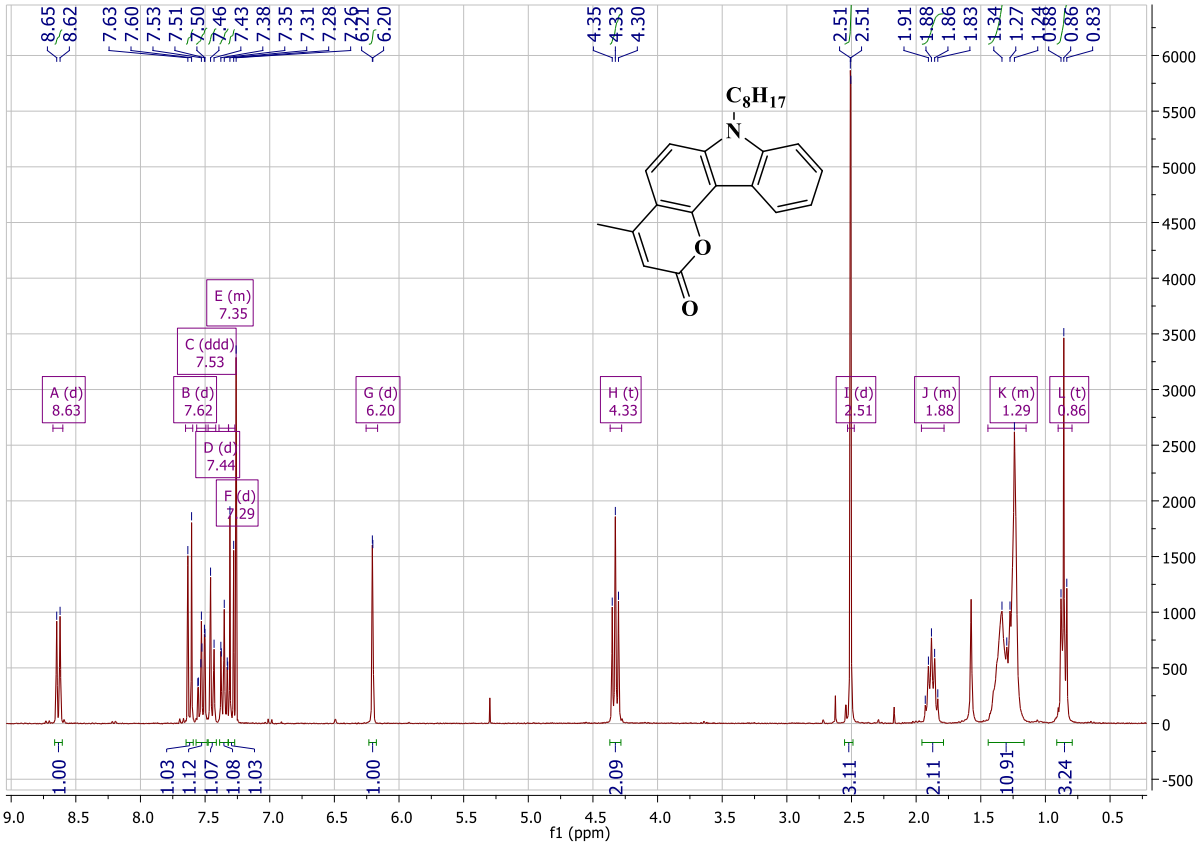
^{13}C NMR of 1-(6-benzoyl-9-ethyl-9*H*-carbazol-3-yl)butan-1-one BC1



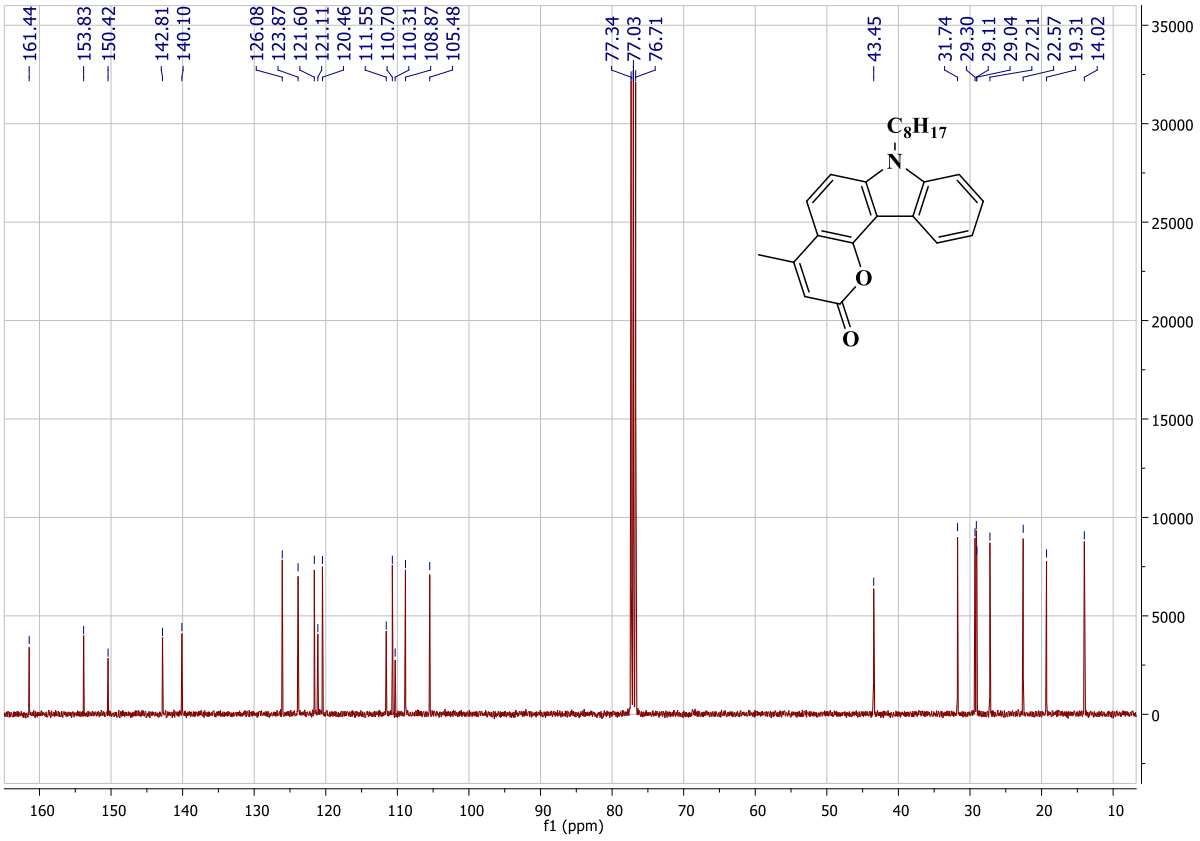
^{1}H NMR of 4-methylpyrano[3,2-*c*]carbazol-2(7*H*)-one



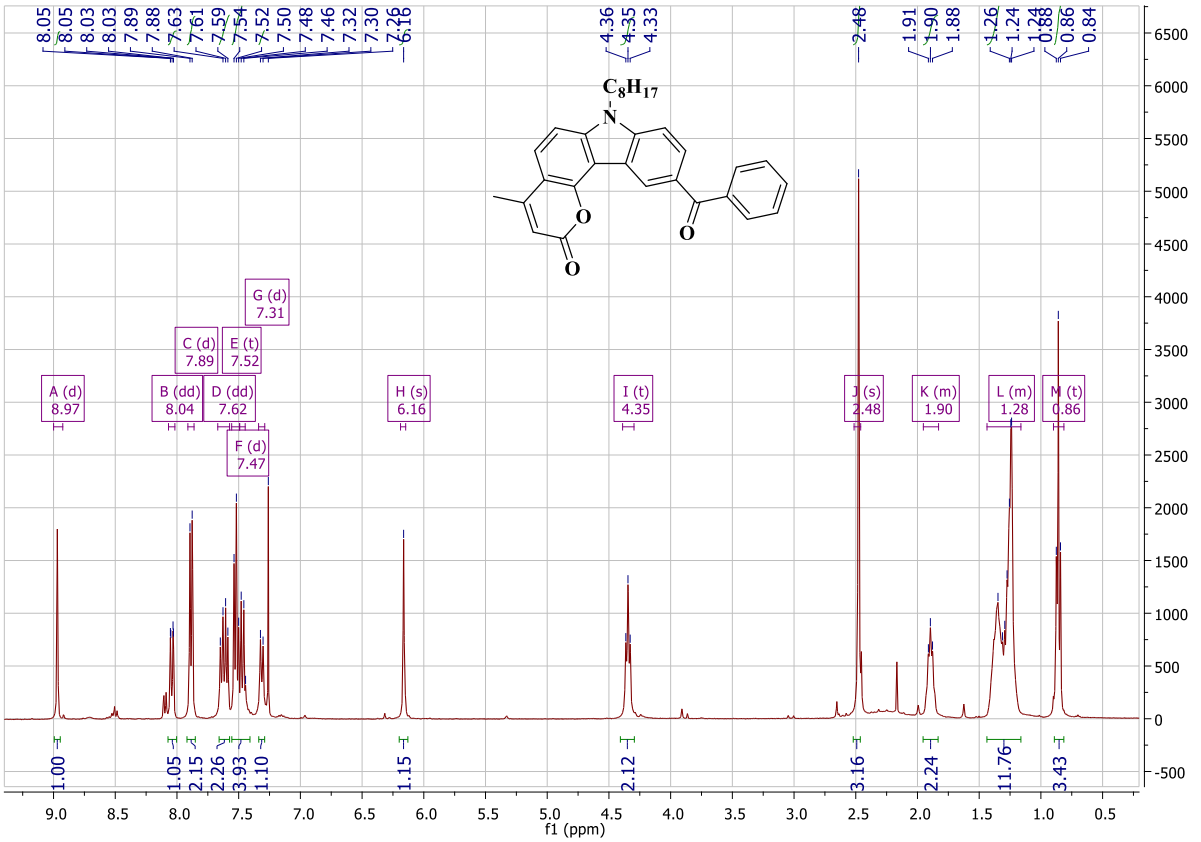
^{1}H NMR of 4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one



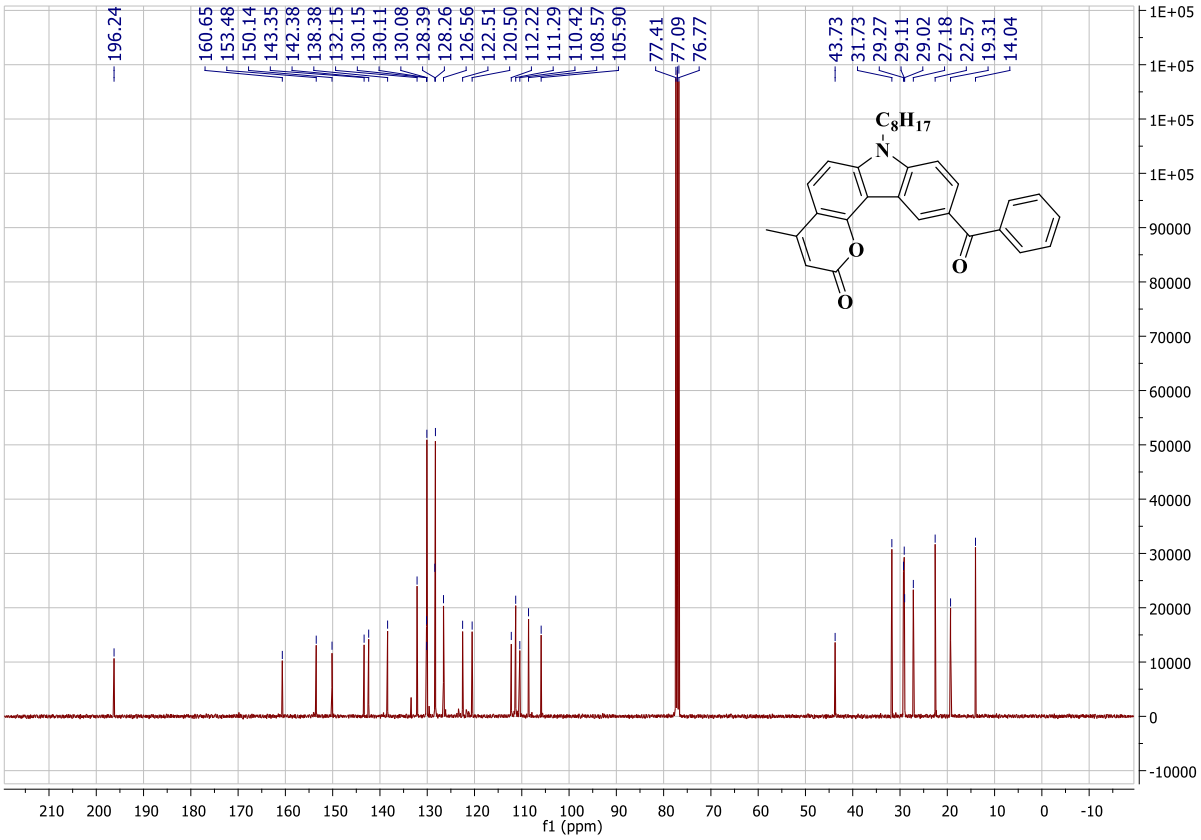
^{13}C NMR of 4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one



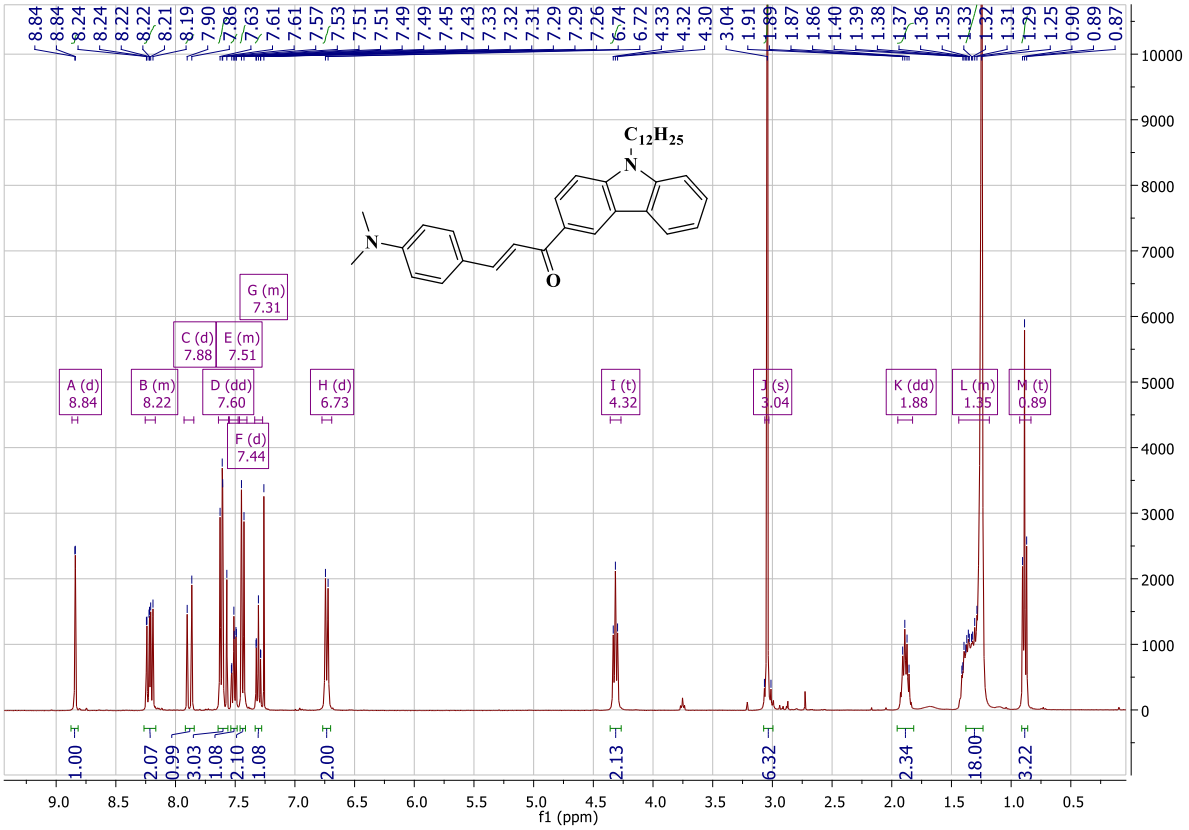
^{1}H NMR of 10-benzoyl-4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one BC2



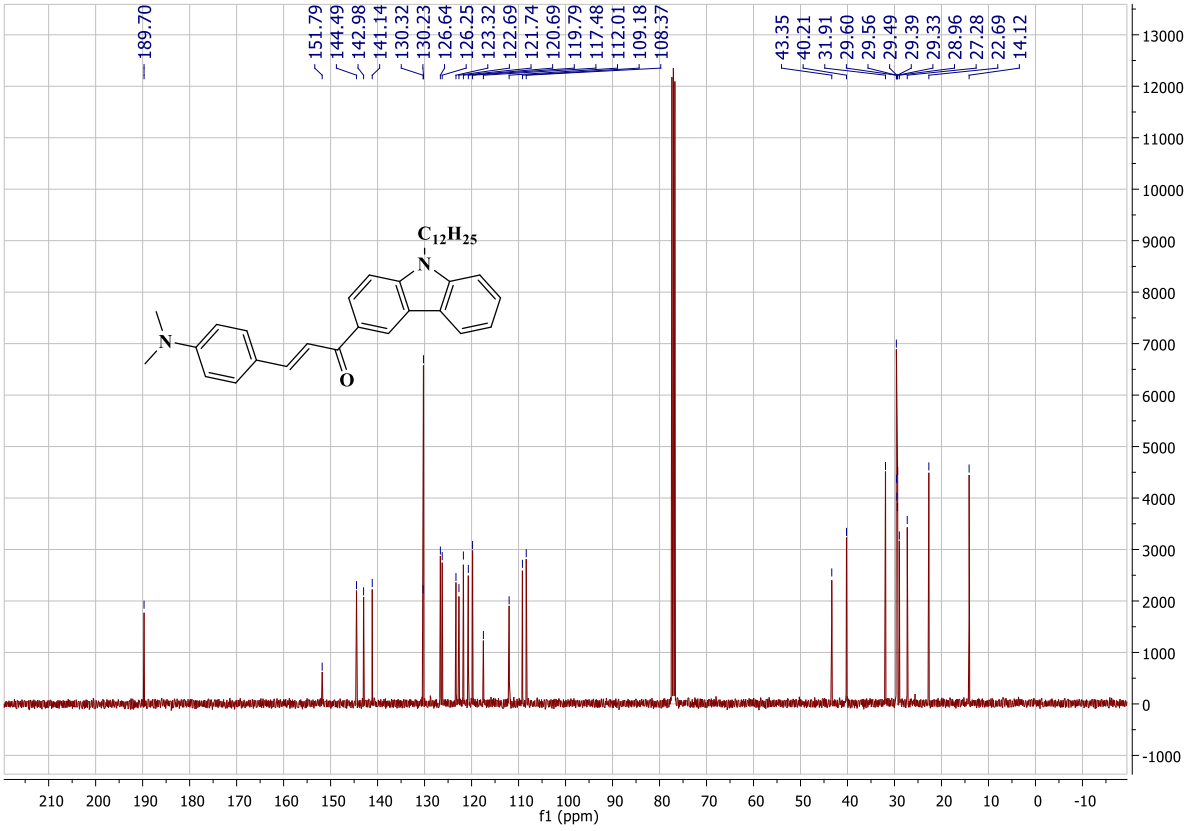
^{13}C NMR of 10-benzoyl-4-methyl-7-octylpyrano[3,2-*c*]carbazol-2(7*H*)-one BC2



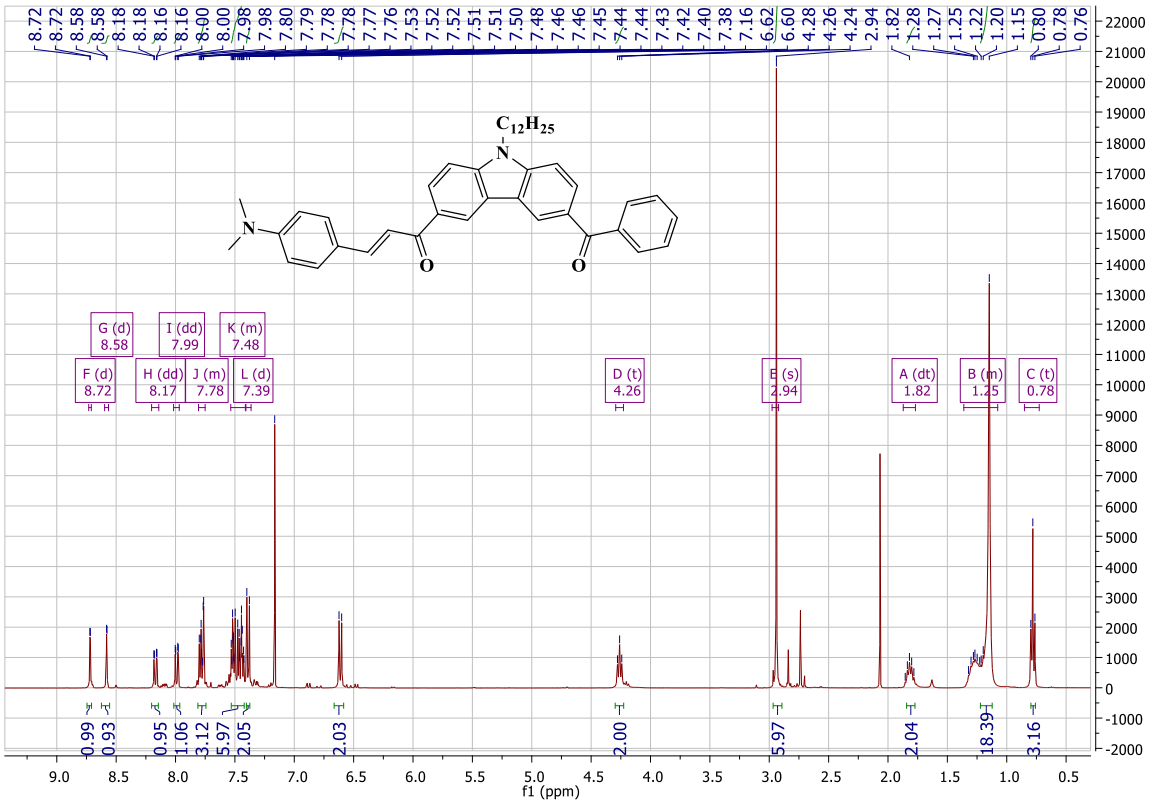
[1]H NMR of 3-(4-(dimethylamino)phenyl)-1-(9-dodecyl-9H-carbazol-3-yl) prop-2-en-1-one



[13]C NMR of 3-(4-(dimethylamino)phenyl)-1-(9-dodecyl-9*H*-carbazol-3-yl) prop-2-en-1-one



^{1}H NMR of 1-(6-benzoyl-9-dodecyl-9*H*-carbazol-3-yl)-3-(4-(dimethylamino)phenyl) prop-2-en-1-one



^{13}C NMR of 1-(6-benzoyl-9-dodecyl-9*H*-carbazol-3-yl)-3-(4-(dimethylamino)phenyl) prop-2-en-1-one