

Supporting Information

Photoredox Alkylarylation of Styrenes with Alkyl N-Hydroxyphth- alimide Esters and Arenes involving C-H Functionalization

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(A) Typical experimental procedure

(a) Typical Experimental Procedure for the Photoredox Alkylarylation of Styrenes with Alkyl *N*-Hydroxyphthalimide Esters and Arenes involving C-H functionalization:

To a Schlenk tube were added alkenes **1** (0.2 mmol), alkyl *N*-Hydroxyphthalimide esters **2** (0.3 mol), arenes **3** (0.3 mmol), Ir(ppy)₃ (1 mol %; 0.002 mmol), In(OTf)₃ (20 mol %) and DMA (2 mL). Then the tube was charged with argon, and was stirred at 30 °C under 10 W blue LED light for 24 h until complete consumption of starting material as monitored by TLC and/or GC-MS analysis. After the reaction was finished, the reaction mixture was diluted in EtOAc, and washed with brine three times. The combined organic extracts were dried over Na₂SO₄ and concentrated in vacuum, and the resulting residue was purified by silica gel column chromatography (PE/EA = 100:1) to afford the desired products **4**.

(B) Cyclic voltammetry experiments

A solution of Adamant NHP ester in MeCN (0.003 M) was tested with 0.1 M Bu_4NPF_6 as the supporting electrolyte, using a glassy carbon as the working electrode, a Pt as the counter electrode, and a saturated calomel electrode reference electrode. Scan rate = 0.05 V/s, a sample interval of 0.001 V.

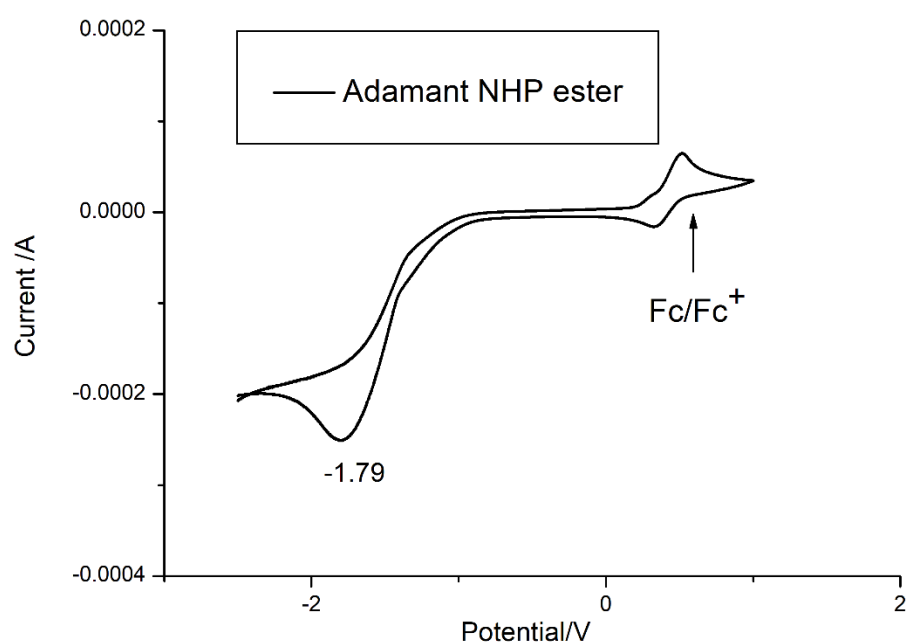


Figure S1: Cyclic voltammogram of Adamant NHP ester in MeCN and ferrocene as internal standard (0.002 M).

$$E^{\text{red}} = -1.79 \text{ V vs SCE}$$

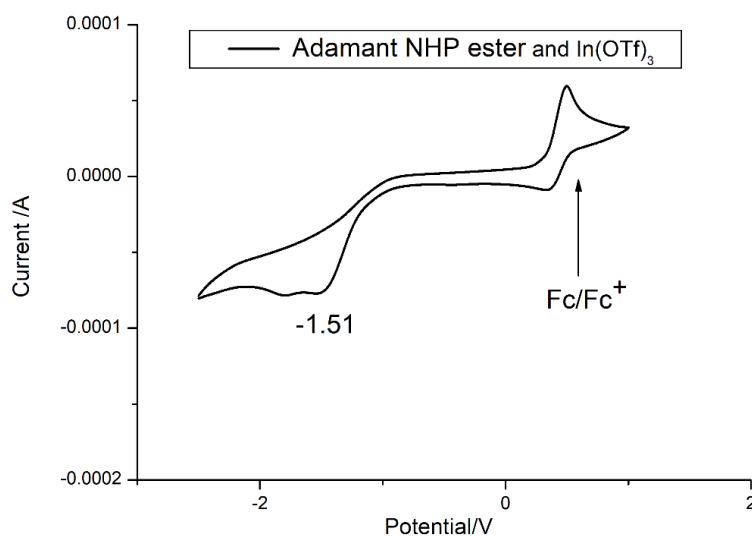


Figure S2: Cyclic voltammogram of Adamant NHP ester in MeCN and 20% In(OTf)₃ and ferrocene as internal standard (0.002 M).

$$E_{\text{red}} = -1.51 \text{ V vs SCE}$$

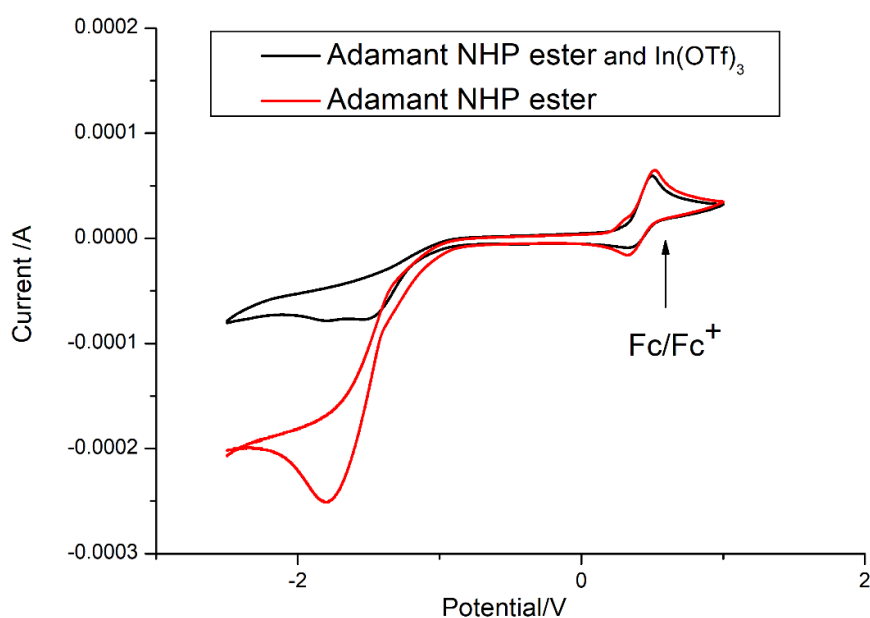
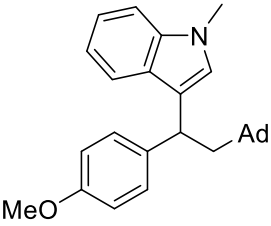


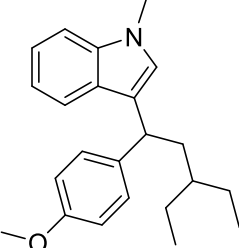
Figure S3: Cyclic voltammogram of Adamant NHP ester vs Adamant NHP ester an In(OTf)₃ in MeCN and ferrocene as internal standard.

(C) Analytical data of products

3-(2-(Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-methyl-1H-indole (4aaa):

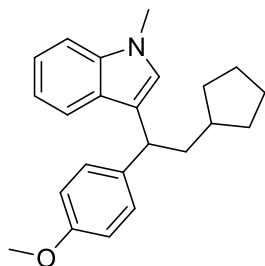
 71.8 mg, 90% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.59 (d, J = 7.5 Hz, 1H), 7.25-7.23 (m, 3H), 7.17 (t, J = 8.0 Hz, 1H), 7.05 (t, J = 8.0 Hz, 1H), 6.80 (d, J = 8.5 Hz, 2H), 6.68 (s, 1H), 4.37-4.34 (m, 1H), 3.76 (s, 3H), 3.69 (s, 3H), 2.02-1.98 (m, 1H), 1.91-1.88 (m, 4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.50-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.4, 139.3, 137.2, 128.8, 126.9, 126.0, 121.4, 119.4, 118.5, 113.5, 109.1, 55.2, 51.0, 43.1, 37.1, 36.5, 33.5, 32.6, 28.7; IR(KBr, cm^{-1}) 2906, 1509, 1242, 742; LRMS (EI, 70eV) m/z (%): 399 (M^+ , 8), 251 (20), 250 (100), 206 (15); HRMS (ESI) for $\text{C}_{28}\text{H}_{34}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 400.2635, found. 400.2644.

3-(3-Ethyl-1-(4-methoxyphenyl)pentyl)-1-methyl-1H-indole (4aba):

 35.5 mg, 53% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.48 (d, J = 8.0 Hz, 1H), 7.24-7.21 (m, 3H), 7.16 (t, J = 7.0 Hz, 1H), 7.01 (t, J = 7.0 Hz, 1H), 6.82-6.81 (m, 2H), 6.80 (s, 1H), 4.25-4.22 (m, 1H), 3.76 (s, 3H), 3.72 (s, 3H), 2.07-2.01 (m, 1H), 1.92-1.86 (m, 1H), 1.47-1.43 (m, 1H), 1.40-1.33 (m, 2H), 1.27-1.21 (m, 2H), 0.86 (t, J = 7.5 Hz, 3H), 0.79 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.6, 137.9, 137.2, 128.7, 127.4, 125.7, 121.4, 119.6, 118.5, 113.6, 109.1, 55.1, 40.0, 39.2, 37.3, 32.6, 25.4, 24.9, 10.6, 10.4; IR(KBr, cm^{-1}) 2959,

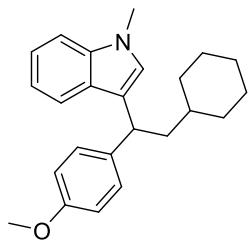
1509, 1245, 738; LRMS (EI, 70eV) m/z (%): 335(M^+ , 75), 251 (82), 250 (100), 206 (80); HRMS (ESI) for $C_{23}H_{30}NO$ [$M+H$] $^+$ calcd. 336.2322, found. 336.2335.

3-(2-Cyclopentyl-1-(4-methoxyphenyl)ethyl)-1-methyl-1H-indole (4aca):



40.0mg, 60% yield; R_f = 0.8 (PE:EA = 20:1); Yellow oil; 1H NMR (500 MHz, $CDCl_3$) δ : 1H NMR (500 MHz, $CDCl_3$) δ 7.46 (d, J = 8.0 Hz, 1H), 7.24-7.21(m, 3H), 7.16 (t, J = 8.0 Hz, 1H), 7.00 (t, J = 7.5 Hz 1H), 6.83 (s, 1H), 4.18-4.15 (m, 1H), 6.81 (d, J = 6.5 Hz, 2H), 3.76 (s, 3H), 3.73 (s, 3H), 2.12-2.08 (m, 1H), 2.05-2.00 (m, 1H), 1.85-1.82(m, 1H), 1.72-1.70 (m, 2H), 1.61-1.59 (m, 2H), 1.47-1.44 (m, 2H), 1.23-1.20 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 157.6, 137.9, 137.2, 128.7, 127.4, 125.6, 121.4, 119.6, 118.52 (s), 113.6, 109.0, 55.2, 43.1, 40.9, 37.8, 33.1, 32.6, 32.4, 25.2; IR(KBr, cm^{-1}) 2947, 1509, 1246, 738; LRMS (EI, 70eV) m/z (%): 333 (M^+ , 11), 251 (21), 250 (100), 206 (16); HRMS (ESI) for $C_{23}H_{28}NO$ [$M+H$] $^+$ calcd. 334.2165, found. 334.2174.

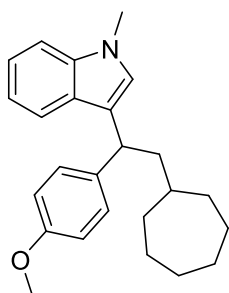
3-(2-Cyclohexyl-1-(4-methoxyphenyl)ethyl)-1-methyl-1H-indole (4ada):



54.8 mg, 79% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; 1H NMR (500 MHz, $CDCl_3$) δ : 7.46 (d, J = 8.0 Hz, 1H), 7.23-7.20 (m, 3H), 7.14 (t, J = 8.0 Hz, 1H), 7.00 (t, J = 7.5 Hz, 1H), 6.81-6.80 (m, 3H), 4.29-4.26 (m, 1H), 3.76 (s, 3H), 3.72 (s, 3H), 2.03-1.97 (m, 1H), 1.94-1.82 (m, 1H), 1.70-1.68 (m, 2H), 1.64-1.59 (m, 2H), 1.27-1.24 (s, 1H), 1.17-1.10 (m, 3H), 0.99-0.94 (m, 2H), 0.89-0.86 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 157.6, 138.0, 137.2, 128.7, 127.4, 125.7, 121.4, 119.7, 119.5, 118.5, 113.6, 109.0, 55.1, 44.4,

38.6, 34.9, 33.9, 33.1, 32.6, 26.7, 26.2; IR(KBr, cm^{-1}) 2921, 1509, 1246, 738; LRMS (EI, 70eV) m/z (%): 347 (M^+ , 11), 251 (21), 250 (100), 206 (16); HRMS (ESI) for $\text{C}_{24}\text{H}_{30}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 348.2422, found. 348.2435.

3-(2-Cycloheptyl-1-(4-methoxyphenyl)ethyl)-1-methylindoline (4aea):

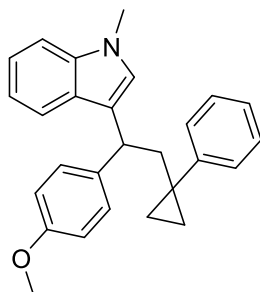


36.1 mg, 50% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil;

^1H NMR (500 MHz, CDCl_3) δ 7.45 (d, J = 8.0 Hz, 1H), 7.23 (d, J = 8.0 Hz, 1H), 7.20 (d, J = 9.0 Hz, 2H), 7.16 (t, J = 7.5 Hz, 1H), 7.00 (t, J = 8.0 Hz, 1H), 6.80-6.79 (m, 3H), 4.22 (t,

J = 8.5 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.06-2.00 (m, 1H), 1.87-1.83 (m, 2H), 1.68-1.57 (m, 3H), 1.50-1.42 (m, 6H), 1.29-1.25 (m, 3H); ^{13}C NMR (125MHz, CDCl_3) δ : 157.6, 137.9, 137.2, 128.7, 127.4, 125.7, 121.4, 119.6, 118.5, 113.6, 109.0, 55.2, 44.7, 39.3, 36.3, 35.2, 34.0, 32.6, 28.7, 26.1; IR(KBr, cm^{-1}) 2920, 1509, 1246, 756; LRMS (EI, 70eV) m/z (%): 361 (M^+ , 17), 251 (37), 250 (100), 206 (31); HRMS (ESI) for $\text{C}_{25}\text{H}_{32}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 362.2478, found. 362.2488.

3-(1-(4-Methoxyphenyl)-2-(1-phenylcyclopropyl)ethyl)-1-methyl-1H-indole (4afa):

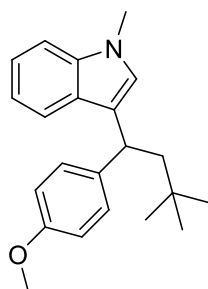


38.9 mg, 51% yield; R_f = 0.6 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.31-7.29 (m, 4H), 7.24-7.21 (m, 2H), 7.20-7.18 (m, 1H), 7.14-7.11 (m, 3H), 6.94 (t, J = 8.0 Hz, 1H), 6.79 (d, J = 9 Hz, 2H), 6.71 (s, 1H), 4.06-4.03 (m, 1H),

3.77 (s, 3H), 3.67 (s, 3H), 2.89-2.85 (m, 1H), 2.01-1.96 (m, 1H), 0.88-0.87 (m, 1H), 0.72-0.69 (m, 1H), 0.56-0.51 (m, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.7, 145.1,

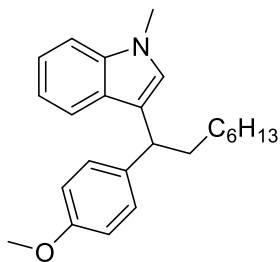
137.5, 137.1, 129.2, 128.1, 127.1, 125.8, 121.4, 119.6, 118.4, 113.4, 109, 55.2, 46.5, 39.8, 32.6, 24.3, 13.2, 12.2; IR(KBr, cm^{-1}) 2924, 1509, 1246, 739; LRMS (EI, 70eV) m/z (%): 381 (M^+ , 13), 251 (37), 250 (100), 206 (38); HRMS (ESI) for $\text{C}_{27}\text{H}_{28}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 382.2165, found. 382.2178.

3-(1-(4-Methoxyphenyl)-3,3-dimethylbutyl)-1-methyl-1H-indole (4aga):



33.4 mg, 52% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.59 (d, J = 8.0 Hz, 1H), 7.27 (d, J = 8.5 Hz, 2H), 7.24-7.23 (m, 1H), 7.19-7.16 (m, 1H), 7.07-7.03 (m, 1H), 6.80 (d, J = 9.0 Hz, 2H), 6.72 (s, 1H), 4.30-4.28 (m, 1H), 3.76 (s, 3H), 3.69 (s, 3H), 2.17-2.13 (m, 1H), 2.05-2.01 (m, 1H), 0.86 (s, 9H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.5, 139.0, 137.2, 128.8, 126.9, 125.8, 121.4, 121.1, 119.3, 118.5, 113.6, 109.1, 55.1, 49.9, 38.5, 32.6, 31.5, 30.3; IR(KBr, cm^{-1}) 2951, 1422, 1245, 738; LRMS (EI, 70eV) m/z (%): 321 (M^+ , 12), 250 (100), 206 (19), 125 (8); HRMS (ESI) for $\text{C}_{22}\text{H}_{28}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 322.2165, found. 322.2154.

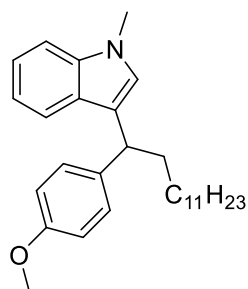
3-(1-(4-Methoxyphenyl)octyl)-1-methyl-1H-indole (4aha):



51.6 mg, 74% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.44 (d, J = 8.0 Hz, 1H), 7.23-7.20 (m, 3H), 7.16 (t, J = 7.5 Hz, 1H), 7.00 (t, J = 7.5 Hz, 1H), 6.82 (d, J = 7.0 Hz, 2H), 6.79 (s, 1H), 4.09 (t, J = 7.5 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.15-2.11 (m, 1H), 1.97-1.93 (m, 1H), 1.26-1.23 (m, 10H), 0.86 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.6, 137.9, 137.1, 128.7, 127.4, 125.7, 121.4, 119.5, 118.5, 113.5, 109.0, 55.1, 42.0, 36.4, 32.6, 31.9,

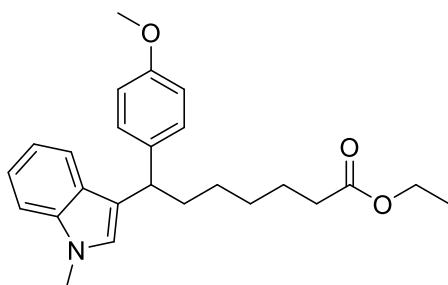
29.7, 29.2, 28.1, 22.7, 14.1; IR(KBr, cm^{-1}) 2947, 1509, 1246, 738; LRMS (EI, 70eV) m/z (%): 349 (M^+ , 9), 251 (20), 250 (100), 206 (16); HRMS (ESI) for $\text{C}_{24}\text{H}_{32}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 350.2478, found. 350.2489.

3-(1-(4-Methoxyphenyl)tridecyl)-1-methyl-1H-indole (4aia):



41.9 mg, 50% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.44 (d, J = 8.0 Hz, 1H), 7.23-7.19 (m, 3H), 7.16 (t, J = 8.0 Hz, 1H), 7.00 (t, J = 7.0 Hz, 1H), 6.82 (s, 1H), 6.80 (d, J = 8.5 Hz, 2H), 4.09 (t, J = 8.0 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.16-2.11 (m, 1H), 1.97-1.92 (m, 1H), 1.32-1.23 (m, 20H), 0.87 (t, J = 6.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.6, 137.9, 137.2, 128.7, 127.4, 125.7, 121.4, 119.6, 118.5, 113.6, 109.0, 55.2, 42.0, 36.4, 32.6, 31.9, 29.6, 29.3, 28.1, 22.7, 14.1; IR(KBr, cm^{-1}) 2924, 1509, 1246, 737; LRMS (EI, 70eV) m/z (%): 419 (M^+ , 7), 251 (20), 250 (100), 206 (10); HRMS (ESI) for $\text{C}_{29}\text{H}_{42}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 420.3261, found. 420.3273.

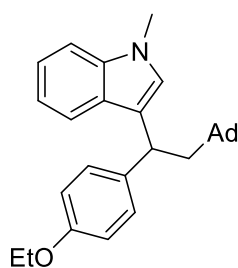
Ethyl 7-(4-methoxyphenyl)-7-(1-methyl-1H-indol-3-yl)heptanoate (4aja):



44.0 mg, 56% yield; R_f = 0.4 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.43 (d, J = 8.0 Hz, 1H), 7.24-7.19 (m, 3H), 7.16 (t, J = 8.0 Hz, 1H), 7.01-6.98 (m, 1H), 6.83 (s, 1H), 6.80 (d, J = 8.5 Hz, 2H), 4.11-4.08 (m, 3H), 3.75 (s, 3H), 3.73 (s, 3H), 2.25 (t, J = 7.5 Hz, 2H), 2.16-2.12 (m, 1H), 1.97-1.93 (m, 1H), 1.62-1.58 (m, 3H), 1.36-1.33 (m, 3H), 1.23 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125MHz, CDCl_3) δ : 173.8, 157.6, 137.7,

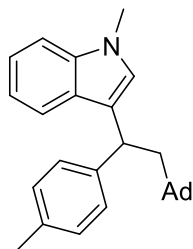
137.1, 128.7, 127.3, 125.6, 121.4, 119.5, 119.3, 118.5, 113.6, 109.0, 60.1, 55.1, 41.9, 36.2, 34.3, 32.6, 29.2, 27.7, 24.9, 14.2; IR(KBr, cm^{-1}) 2932, 1732, 1247, 740; LRMS (EI, 70eV) m/z (%): 393 (M^+ , 8), 251 (20), 250 (100), 206 (14); HRMS (ESI) for $\text{C}_{25}\text{H}_{32}\text{NO}_3$ $[\text{M}+\text{H}]^+$ calcd. 394.2377, found. 394.2386.

3-(2-(-Adamantan-1-yl)-1-(4-ethoxyphenyl)ethyl)-1-methyl-1H-indole (4baa):



75.2 mg, 91% yield; R_f = 0.6 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.59 (d, J = 8.0 Hz, 1H), 7.23 (d, J = 6.0 Hz, 3H), 7.17 (t, J = 7.5 Hz, 1H), 7.05 (t, J = 7.5 Hz, 1H), 6.79 (d, J = 8.5 Hz, 2H), 6.67 (s, 1H), 4.36-4.34 (m, 1H), 4.00-3.96 (m, 2H), 3.68 (s, 3H), 2.02-1.98 (m, 1H), 1.91-1.88 (m, 4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.50-1.45 (m, 6H); 1.38 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 156.8, 139.1, 137.16, 128.8, 126.9, 126.0, 121.3, 119.4, 118.5, 114.1, 109.1, 63.2, 51.0, 43.1, 37.1, 36.4, 33.5, 32.6, 28.7, 14.9; IR(KBr, cm^{-1}) 2896, 1609, 1240, 741; LRMS (EI, 70eV) m/z (%): 413 (M^+ , 9), 265 (20), 264 (100), 236 (15); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 414.2791, found. 414.2804.

3-(2-(-Adamantan-1-yl)-1-(p-tolyl)ethyl)-1-methyl-1H-indole (4caa):

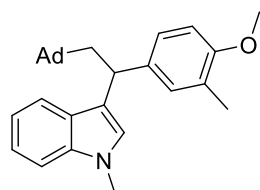


23.7 mg, 31% yield; R_f = 0.8 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.60 (d, J = 8.0 Hz, 1H), 7.24-7.22 (m, 3H), 7.17 (t, J = 8.0 Hz, 1H), 7.06-7.04 (m, 3H), 6.70 (s, 1H), 4.38-4.35 (m, 1H), 3.70 (s, 3H), 2.29 (s, 3H), 2.02-1.98 (m, 1H), 1.93-1.87 (m, 4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.50-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ : 144.2, 137.2, 134.9, 128.9, 127.8, 127.0, 126.0, 121.4, 121.2, 119.4, 118.5,

109.1, 51.0, 43.1, 37.1, 36.8, 33.6, 32.6, 28.7, 21.0; IR(KBr, cm^{-1}) 3048, 2901, 1469, 736; LRMS (EI, 70eV) m/z (%): 383 (M^+ , 11), 234 (100), 207 (18), 135 (5); HRMS (ESI) for $\text{C}_{28}\text{H}_{34}\text{N}$ [$\text{M}+\text{H}$] $^+$ calcd. 384.2686, found. 384.2699.

3-(2-(-Adamantan-1-yl)-1-(4-methoxy-3-methylphenyl)ethyl)-1-methyl-1H-indole

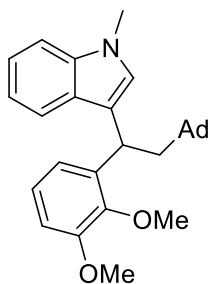
(4eaa):



67.7 mg, 82% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.61 (d, J = 8.0 Hz, 1H), 7.22 (s, 1H), 7.17 (t, J = 7.0 Hz, 1H), 7.12-7.09 (m, 2H), 7.05 (t, J = 7.0 Hz, 1H), 6.71-6.70 (m, 2H), 4.32 (t, J = 6.0 Hz, 1H), 3.77 (s, 3H), 3.68 (s, 3H), 2.18 (s, 3H), 2.01-1.97 (m, 1H), 1.93-1.87 (m, 4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.50-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 155.6, 138.9, 137.2, 130.2, 127.0, 126.0, 125.7, 121.4, 119.4, 118.4, 109.5, 109.0, 55.2, 51.1, 43.1, 37.1, 36.3, 33.5, 32.6, 28.7, 16.4; IR(KBr, cm^{-1}) 2901, 1502, 1249, 737; LRMS (EI, 70eV) m/z (%): 413 (M^+ , 9), 265 (21), 264 (100), 249 (9); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 414.2791, found. 414.2809.

3-(2-(-Adamantan-1-yl)-1-(2,3-dimethoxyphenyl)ethyl)-1-methyl-1H-indole

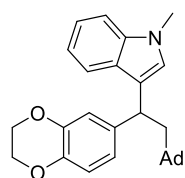
(4faa):



30.0 mg, 35% yield; R_f = 0.5 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.72 (d, J = 8.0 Hz, 1H), 7.24-7.22 (m, 1H), 7.18 (t, J = 7.5 Hz, 1H), 7.08 (t, J = 8.0 Hz, 1H), 7.01-6.97 (m, 2H), 6.74-6.73 (m, 1H), 6.71 (s, 1H), 4.96 (t, J = 7.0 Hz, 1H), 3.84 (s, 3H), 3.76 (s, 3H), 3.69 (s, 3H), 2.00-1.96 (m, 1H), 1.88-1.83 (m,

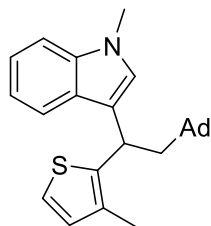
4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.50-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 152.7, 145.8, 140.9, 137.1, 127.1, 126.5, 123.4, 121.3, 120.7, 120.5, 119.5, 118.4, 109.3, 108.9, 60.7, 55.6, 50.9, 43.0, 37.1, 33.7, 32.6, 28.8; IR(KBr, cm^{-1}) 2902, 1476, 1068, 734; LRMS (EI, 70eV) m/z (%): 429 (M^+ , 18), 281 (21), 280 (100), 144 (36); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}_2$ [$\text{M}+\text{H}$] $^+$ calcd. 430.2741, found. 430.2751.

3-(2-(-Adamantan-1-yl)-1-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)ethyl)-1-methyl-1*H*-indole (4gaa):



41.0 mg, 48% yeild; R_f = 0.7 (PE:EA = 10:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.59 (d, J = 8.0 Hz, 1H), 7.22 (s, 1H), 7.17 (t, J = 8.0 Hz, 1H), 7.05 (t, J = 7.5 Hz, 1H), 6.83-6.80 (m, 2H), 6.74 (d, J = 6.5 Hz, 2H), 4.30-4.28 (m, 1H), 4.20 (s, 4H), 3.69 (s, 3H), 2.00-1.96 (m, 1H), 1.87-1.84 (m, 4H), 1.64 (d, J = 12.0 Hz, 3H), 1.57 (d, J = 11.5 Hz, 3H), 1.48 (s, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 143.1, 141.3, 140.8, 137.2, 127.0, 125.9, 121.4, 120.9, 119.4, 118.5, 116.8, 116.4, 109.1, 64.3, 51.1, 43.1, 37.1, 36.5, 33.5, 32.6, 28.7; LRMS (EI, 70eV) m/z (%): 427 (M^+ , 9), 278 (100), 279 (21), 222 (6); IR(KBr, cm^{-1}) 2900, 1504, 1253, 739; HRMS (ESI) for $\text{C}_{27}\text{H}_{31}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 428.2584, found 428.2594.

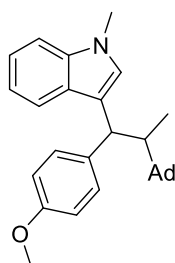
3-(2-(-Adamantan-1-yl)-1-(3-methylthiophen-2-yl)ethyl)-1-methyl-1*H*-indole (4haa):



58.4 mg, 75% yield; R_f = 0.3 (PE); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.65 (d, J = 8.0 Hz, 1H), 7.24-7.22 (m, 1H), 7.18 (t, J = 7.0 Hz, 1H), 7.09 (t, J = 7.0 Hz, 1H), 7.01 (d, J = 5.0 Hz, 1H),

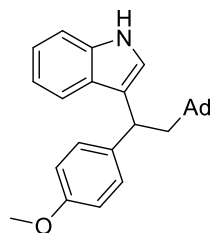
6.75-6.73 (m, 2H), 4.71-4.69 (m, 1H), 3.68 (s, 3H), 2.23 (s, 3H), 2.06-2.02 (m, 1H), 1.91-1.89 (m, 4H), 1.67-1.65 (m, 3H), 1.59-1.55 (m, 3H), 1.53-1.50 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 145.5, 137.0, 130.8, 129.8, 126.7, 126.3, 121.4, 120.7, 120.5, 119.1, 118.6, 109.2, 53.1, 42.9, 37.1, 33.6, 30.1, 28.7, 14.1; IR(KBr, cm^{-1}) 3053, 2899, 1469, 736; LRMS (EI, 70eV) m/z (%): 389 (M^+ , 12), 241 (23), 240 (100), 224 (10); HRMS (ESI) for $\text{C}_{26}\text{H}_{32}\text{NS}$ [$\text{M}+\text{H}$] $^+$ calcd. 390.2250, found. 390.2261.

3-(2-(Adamantan-1-yl)-1-(4-methoxyphenyl)propyl)-1-methyl-1H-indole (4iaa):



33.9 mg, 41% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.55 (d, J = 8.0 Hz, 1H), 7.25-7.24 (m, 1H), 7.21 (d, J = 8.5 Hz, 2H), 7.16 (t, J = 7.0 Hz, 1H), 7.04 (t, J = 8.0 Hz, 1H), 6.97 (s, 1H), 6.76 (d, J = 8.5 Hz, 2H), 4.69 (d, J = 4.0 Hz, 1H), 3.77 (s, 3H), 3.74 (s, 3H), 1.87-1.84 (m, 4H), 1.66-1.60 (m, 3H), 1.59-1.58(m, 3H), 1.53-1.50 (m, 6H), 0.98 (d, J = 7.5 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.1, 139.7, 136.2, 129.2, 128.6, 127.6, 121.2, 119.4, 118.5, 116.5, 113.2, 108.8, 55.2, 50.5, 40.5, 40.1, 37.2, 36.2, 32.8, 28.8, 10.6; IR(KBr, cm^{-1}) 2904, 1537, 1034, 734; LRMS (EI, 70eV) m/z (%): 413(M^+ , 2), 281 (2), 250 (100), 206 (14); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 414.2791, found. 414.2801.

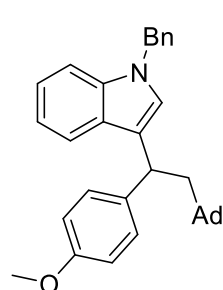
3-(2-(Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1H-indole (4aab):



49.3 mg, 64% yield; R_f = 0.4 (PE:EA = 10:1); Yellow oil; ^1H NMR(500 MHz, CDCl_3) δ 7.87 (s, 1H), 7.59 (d, J = 8.0 Hz, 1H), 7.31 (d, J = 8.5 Hz, 1H), 7.25-7.24 (m, 2H), 7.15 (t, J = 7.5 Hz, 1H), 7.06 (t, J = 8.0 Hz, 1H), 6.87 (s, 1H), 6.81-6.78 (m, 2H), 4.37(t, J = 7.5 Hz, 1H), 3.76

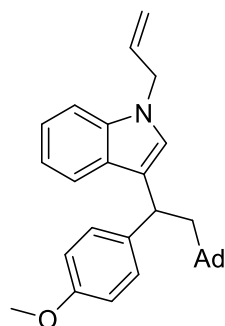
(s, 3H), 2.05-2.02 (m, 1H), 1.90-1.85 (m, 4H), 1.65-1.63(m, 3H), 1.58-1.55 (m, 3H), 1.49-1.48 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.4, 139.2, 136.5, 128.8, 126.6, 122.7, 121.8, 121.1, 119.4, 119.1, 113.5, 111.0, 55.2, 50.9, 43.1, 38.6, 37.1, 36.4, 33.5, 28.7, 27.8; IR(KBr, cm^{-1}) 3413, 2899, 1512, 746; LRMS (EI, 70eV) m/z (%): 385 (M^+ , 7), 237 (19), 236 (100), 192 (12); HRMS (ESI) for $\text{C}_{27}\text{H}_{32}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 386.2478, found. 386.2488.

3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-benzyl-1H-indole (4aac):



38 mg, 40% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.59 (d, J = 7.5 Hz, 1H), 7.27-7.24 (m, 5H), 7.17 (d, J = 8.5 Hz, 1H), 7.11 (t, J = 7.5 Hz, 1H), 7.06-7.02 (m, 3H), 6.85 (s, 1H), 6.79 (d, J = 8.0 Hz, 2H), 5.29- 5.21 (m, 2H), 4.38 (t, J = 6.5 Hz, 1H), 3.75 (s, 3H), 2.06-2.02 (m, 1H), 1.87-1.82 (m, 4H), 1.65-1.63 (m, 3H), 1.57-1.55(m, 3H), 1.49-1.47 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.4, 139.4, 137.9, 136.9, 128.7, 127.3, 126.4, 125.5, 121.6, 119.6, 118.8, 113.5, 109.6, 55.2, 51.0, 49.8, 43.1, 37.1, 36.5, 33.5, 28.0; IR(KBr, cm^{-1}) 2898, 1608, 1508, 764; LRMS (EI, 70eV) m/z (%): 475 (M^+ , 10), 327 (28), 326 (100), 91 (96); HRMS (ESI) for $\text{C}_{34}\text{H}_{38}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 476.2948, found. 476.2961.

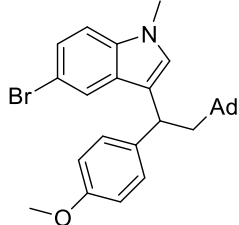
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-allyl-1H-indole (4aad):



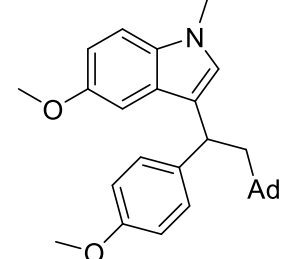
49.3 mg, 58% yield; R_f = 0.7 (PE:EA = 20:1); Colorless oil; ^1H NMR (500 MHz, CDCl_3) δ 7.58 (d, J = 8.0 Hz, 1H), 7.25-7.21 (m, 3H), 7.14 (t, J = 7.5 Hz, 1H), 7.04 (t, J = 7.5 Hz, 1H), 6.79 (d, J = 8.6 Hz, 2H), 6.75 (s, 1H), 5.98-5.90 (m, 1H), 5.14 (d, J = 9.0

Hz, 1H), 5.01 (d, $J = 17.5$ Hz, 1H), 4.64-4.62 (m, 2H), 4.37-4.35 (m, 1H), 3.75 (s, 3H), 2.04-2.00 (m, 1H), 1.88-1.87 (m, 4H), 1.65-1.62 (m, 3H), 1.57-1.54 (s, 3H), 1.49-1.47 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.4, 139.3, 136.6, 133.7, 128.8, 127.2, 125.0, 121.4, 119.5, 118.6, 116.8, 113.5, 109.4, 55.1, 51.0, 48.6, 43.1, 37.1, 36.4, 33.5, 28.7; IR(KBr, cm^{-1}) 3053, 2900, 1509, 737; LRMS (EI, 70eV) m/z (%): 425 (M^+ , 8), 277 (21), 276 (100), 235 (6); HRMS (ESI) for $\text{C}_{30}\text{H}_{36}\text{NO}$ [$\text{M}+\text{H}$] $^+$ calcd. 426.2791, found. 426.2804.

3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-5-bromo-1-methyl-1H-indole

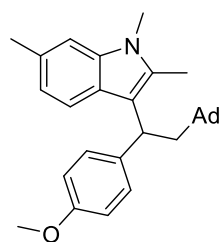
(4aae):
 63.9 mg, 67% yield; $R_f = 0.6$ (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.67 (s, 1H), 7.25-7.21 (m, 3H), 7.09 (d, $J = 8.5$ Hz, 1H), 6.81 (d, $J = 8.5$ Hz, 2H), 6.73 (s, 1H), 4.29-4.26 (m, 1H), 3.77 (s, 3H), 3.68 (s, 3H), 1.96-1.92 (m, 1H), 1.88-1.84 (m, 4H), 1.66-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.49-1.47 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.5, 138.9, 135.8, 128.6, 127.1, 124.2, 121.8, 120.9, 113.6, 112.0, 110.6, 55.2, 51.1, 43.1, 37.0, 36.2, 33.5, 32.8, 28.7; IR(KBr, cm^{-1}) 2896, 1510, 1247, 797; LRMS (EI, 70eV) m/z (%): 479 (M^{++2} , 6), 477 (M^+ , 7), 330 (93), 328 (100), 206 (17); HRMS (ESI) for $\text{C}_{28}\text{H}_{33}^{79}\text{BrNO}$ [$\text{M}+\text{H}$] $^+$ calcd. 478.1740, found. 478.1749.

3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-5-methoxy-1-methyl-1H-indole (4aaf):

 66.1 mg, 77% yield; $R_f = 0.4$ (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.26-7.24 (m, 2H), 7.12 (d, $J = 9.0$

Hz, 1H), 7.02 (s, 1H), 6.85-6.83 (m, 1H), 6.81 (d, $J = 8.5$ Hz, 2H), 6.66 (s, 1H), 4.29 (t, $J = 8.0$ Hz, 1H), 3.83 (s, 3H), 3.77 (s, 3H), 3.66 (s, 3H), 2.00-1.96 (m, 1H), 1.90-1.86 (m, 4H), 1.66-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.51-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.4, 153.3, 139.2, 132.7, 128.8, 127.1, 126.7, 120.7, 113.5, 111.1, 109.8, 101.7, 56.0, 55.2, 50.9, 43.1, 37.1, 36.5, 33.5, 32.8, 28.7; IR(KBr, cm^{-1}) 2900, 1509, 1246, 792; LRMS (EI, 70eV) m/z (%): 429 (M^+ , 6), 281 (20), 280 (100), 96 (13); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}_2$ $[\text{M}+\text{H}]^+$ calcd. 430.2741, found. 430.2753.

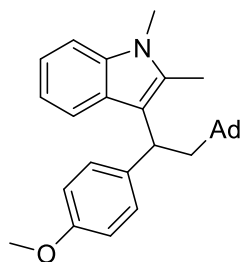
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2,6-trimethyl-1H-indole



(4aag):

79.4 mg, 93% yield; $R_f = 0.6$ (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ : 7.46 (s, 1H), 7.27 (d, $J = 9.0$ Hz, 2H), 7.09 (d, $J = 8.0$ Hz, 1H), 6.92 (d, $J = 8.0$ Hz, 1H), 6.74 (d, $J = 8.5$ Hz, 2H), 4.32-4.30 (m, 1H), 3.71 (s, 3H), 3.57 (s, 3H), 2.44 (s, 3H), 2.38 (s, 3H), 2.25-2.21 (m, 1H), 2.08-2.05 (m, 1H), 1.90-1.85 (s, 3H), 1.65-1.62 (m, 3H), 1.54-1.52 (m, 3H), 1.46-1.45 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ : 157.1, 140.1, 135.3, 131.7, 128.5, 127.3, 127.0, 121.6, 119.7, 115.8, 113.4, 108.2, 55.1, 49.7, 42.7, 37.1, 35.9, 33.5, 29.5, 28.7, 21.7, 10.9; IR(KBr, cm^{-1}) 2906, 1508, 1237, 824; LRMS (EI, 70eV) m/z (%): 427 (M^+ , 11), 279 (23), 278 (100), 220 (9); HRMS (ESI) for $\text{C}_{30}\text{H}_{38}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 428.2948, found. 428.2958.

3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2-dimethyl-1*H*-indole

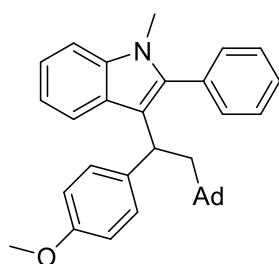


(4aah):

60.3 mg, 73% yield; $R_f = 0.8$ (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.70 (d, $J = 8.0$ Hz, 1H), 7.28 (d, $J = 8.5$ Hz, 2H), 7.22-7.20 (m, 1H), 7.11 (t, $J = 7.0$ Hz, 1H), 7.02 (t, $J = 8.0$ Hz, 1H), 6.76-6.73 (m, 2H), 4.35-4.33 (m, 1H), 3.71 (s, 3H), 3.61 (s, 3H), 2.41 (s, 3H), 2.26-2.22 (m, 1H), 2.10-2.06 (m, 1H), 1.90-1.85 (s, 3H), 1.64-1.62 (m, 3H), 1.55-1.53 (m, 3H), 1.45-1.44 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.1, 139.9, 136.8, 131.6, 128.5, 126.7, 112.0, 118.3, 116.3, 113.4, 108.5, 55.1, 49.5, 42.7, 37.1, 36.0, 33.5, 29.5, 28.7, 10.9; IR(KBr, cm^{-1}) 3053, 2909, 1243, 735; LRMS (EI, 70eV) m/z (%): 413 (M^+ , 12), 265 (21), 264 (100), 220 (8); HRMS (ESI) for $\text{C}_{29}\text{H}_{36}\text{NO}$ $[\text{M}+\text{H}]^+$ calcd. 414.2791, found. 414.2797.

3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-methyl-2-phenyl-1*H*-indole

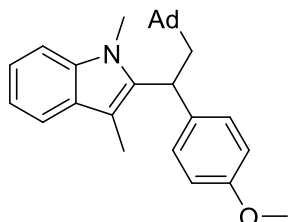
(4aai):



60.8 mg, 64% yield; $R_f = 0.6$ (PE:EA = 20:1); Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.81 (d, $J = 8.0$ Hz, 1H), 7.48-7.44 (m, 3H), 7.31 (t, $J = 8.5$ Hz, 2H), 7.29-7.21 (m, 4H), 7.11 (t, $J = 8.0$ Hz, 1H), 6.74 (d, $J = 9.0$ Hz, 2H), 4.19-4.16 (m, 1H), 3.74 (s, 3H), 3.54 (s, 3H), 2.28-2.23 (m, 1H), 1.92-1.89 (m, 1H), 1.74-1.73 (m, 3H), 1.56-1.53 (m, 3H), 1.43-1.41 (m, 3H), 1.27-1.19 (m, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.1, 140.2, 137.6, 137.3, 132.4, 130.9, 128.7, 128.2, 126.8, 121.5, 121.2, 118.8, 117.7, 113.3, 109.4, 55.1, 50.3, 42.4, 37.0, 36.5, 33.5, 30.8, 28.6; IR(KBr, cm^{-1})

3057, 2895, 1507, 761; LRMS (EI, 70eV) m/z (%): 475 (M^+ , 10), 327 (28), 326 (100), 282 (13); HRMS (ESI) for $C_{34}H_{38}NO$ $[M+H]^+$ calcd. 476.2948, found. 476.2958.

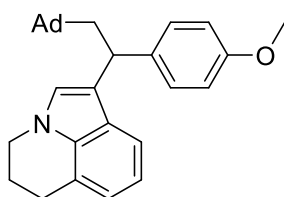
2-(2-(*-Adamantan-1-yl*)-1-(4-methoxyphenyl)ethyl)-1,3-dimethyl-1*H*-indole



(4aaj):

42.1 mg, 51% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; 1H NMR (500 MHz, $CDCl_3$) δ : 7.54 (d, J = 7.5 Hz, 1H), 7.20 (d, J = 8.0 Hz, 1H), 7.16 (d, J = 7.0 Hz, 1H), 7.12 (d, J = 9.0 Hz, 2H), 7.09 (t, J = 8.0 Hz, 1H), 6.77 (d, J = 8.5 Hz, 2H), 4.52 (t, J = 7.0 Hz, 1H), 3.75 (s, 3H), 3.50 (s, 3H), 2.41 (s, 3H), 2.13-2.05 (m, 2H), 1.90-1.89 (m, 3H), 1.67-1.65 (m, 3H), 1.58-1.55 (m, 3H), 1.52-1.45 (m, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 157.6, 139.9, 136.8, 135.9, 128.5, 120.6, 118.4, 118.1, 113.5, 108.5, 106.6, 55.2, 47.6, 42.6, 37.0, 34.3, 33.3, 30.9, 28.6, 10.0; IR(KBr, cm^{-1}) 2899, 1509, 1248, 737; LRMS (EI, 70eV) m/z (%): 413 (M^+ , 32), 414 (11), 265 (22), 264 (100); HRMS (ESI) for $C_{29}H_{36}NO$ $[M+H]^+$ calcd. 414.2791, found. 414.2895.

1-(2-(*-Adamantan-1-yl*)-1-(4-methoxyphenyl)ethyl)-5,6-dihydro-4*H*-pyrrolo[3,2,1

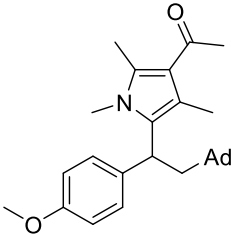


-i]quinoline (4aal):

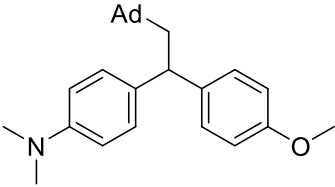
74.8 mg, 88% yield; R_f = 0.7 (PE:EA = 20:1); Yellow oil; 1H NMR (500 MHz, $CDCl_3$) δ 7.40 (d, J = 8.0 Hz, 1H), 7.26 (d, J = 9.0 Hz, 2H), 6.95 (t, J = 7.0 Hz, 1H), 6.85 (d, J = 6.5 Hz, 1H), 6.82-6.79 (m, 2H), 6.67 (s, 1H), 4.36-4.33 (m, 1H), 4.05-4.01 (m, 2H), 3.76 (s, 3H), 2.93 (t, J = 6.0 Hz, 2H), 2.17 (t, J = 6.0 Hz, 2H), 2.04-2.01 (m, 1H), 1.93-1.87 (m, 4H), 1.65-1.63 (m, 3H), 1.58-1.56 (m, 3H), 1.51-1.45 (m, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 157.4,

139.4, 134.7, 128.8, 124.3, 123.2, 121.6, 118.8, 118.3, 117.0, 113.5, 55.1, 51.0, 43.8, 43.1, 37.0, 33.5, 28.7, 24.7, 22.8; IR(KBr, cm⁻¹) 2897, 1509, 1247, 746; LRMS (EI, 70eV) *m/z* (%): 425 (M⁺, 10), 268 (100), 211 (42), 207 (40); HRMS (ESI) for C₃₀H₃₆NO [M+H]⁺ calcd. 426.2719, found. 426.2730.

1-(5-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2,4-trimethyl-1*H*-pyrrol-3-yl)ethan-1-one (4aam):

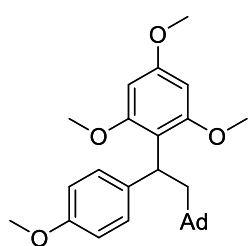
 38.4 mg, 46% yield; R_f = 0.6 (PE:EA = 20:1); Yellow oil; ¹H NMR (500 MHz, CDCl₃) δ 7.10 (d, *J* = 8.5 Hz, 2H), 6.80 (d, *J* = 9.0 Hz, 2H), 4.33 (t, *J* = 7.5, 5.2 Hz, 1H), 3.77 (s, 3H), 3.18 (s, 3H), 2.46 (s, 3H), 2.42 (s, 3H), 2.34 (s, 3H), 2.09-2.05 (m, 1H), 1.92-1.91 (s, 3H), 1.84-1.79 (m, 1H), 1.70-1.67 (m, 3H), 1.60-1.57 (m, 3H), 1.49-1.44 (m, 6H); ¹³C NMR (125 MHz, CDCl₃) δ 196.2, 157.6, 136.0, 132.9, 128.3, 121.3, 114.5, 113.5, 55.2, 42.5, 37.0, 33.3, 31.5, 28.6, 13.2, 12.4; IR(KBr, cm⁻¹) 2900, 1715, 1509, 1247; LRMS (EI, 70eV) *m/z* (%): 419 (M⁺, 14), 270 (100), 240 (6), 212 (8); HRMS (ESI) for C₂₈H₃₈NO₂ [M+H]⁺ calcd. 420.2897, found. 420.2889.

4-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-*N,N*-dimethylaniline (4aan):

 39.8 mg, 51% yield; R_f = 0.6 (PE:EA = 20:1); Yellow oil; ¹H NMR (500 MHz, CDCl₃) δ 7.17 (d, *J* = 8.5 Hz, 2H), 7.11 (d, *J* = 8.5 Hz, 2H), 6.78 (d, *J* = 8.5 Hz, 2H), 6.65 (d, *J* = 9.0 Hz, 2H), 3.99 (t, *J* = 6.5 Hz, 1H), 3.75 (s, 3H), 2.88 (s, 6H), 1.89-1.86 (m, 5H), 1.64-1.62 (m, 3H), 1.56-1.54 (m, 3H), 1.42-1.41 (m, 6H); ¹³C NMR (125 MHz, CDCl₃) δ: 157.3, 148.7, 140.1, 135.7, 128.5, 128.1, 113.6, 112.8, 100.0, 55.2, 50.9,

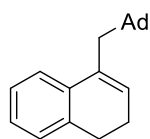
44.3, 43.1, 40.8, 37.1, 33.4, 28.7; IR(KBr,cm⁻¹) 2902, 1509, 1246, 808; LRMS (EI, 70eV) *m/z* (%): 389 (M⁺, 14), 241 (20), 240 (100), 224(10); HRMS (ESI) for C₂₇H₃₆NO [M+H]⁺ calcd. 390.2791, found. 390.2784.

1-(2-(4-Methoxyphenyl)-2-(2,4,6-trimethoxyphenyl)ethyl)adamantane (4aao):



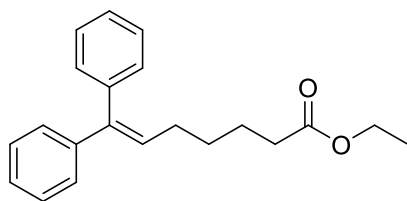
42.7 mg, 49% yield; R_f = 0.6 (PE:EA = 10:1); White solid; mp149.6-150.4 °C; ¹H NMR (500 MHz, CDCl₃) δ 7.29 (d, *J* = 8.5 Hz, 2H), 6.73 (d, *J* = 8.5 Hz, 2H), 6.08 (s, 2H), 4.72 (t, *J* = 7.5 Hz, 1H), 3.76 (s, 6H), 3.74 (s, 6H), 2.11- 2.08 (m, 1H), 1.94-1.90 (m, 1H), 1.85-1.82 (m, 3H), 1.64-1.62(m, 3H), 1.56-1.54 (m, 3H), 1.44-1.39 (m, 6H); ¹³C NMR (125 MHz, CDCl₃) δ 159.0, 156.9, 139.5, 128.9, 116.6, 112.8, 91.2, 55.1, 47.1, 42.7, 37.2, 33.4, 32.9, 28.8; IR(KBr,cm⁻¹) LRMS (EI, 70eV) *m/z* (%): 436 (M⁺, 9), 288 (21), 287 (100), 121 (60); HRMS (ESI) for C₂₈H₃₇NO₄[M+H]⁺ calcd. 437.2686, found. 437.2699.

1-((3,4-Dihydronaphthalen-1-yl)methyl)adamantane (5k):



17.2 mg, 31% yield; R_f = 0.8 (PE); Yellow oil; ¹H NMR (500 MHz, CDCl₃) δ 7.34 (d, *J* = 8.0 Hz, 1H), 7.16 (t, *J* = 8.5 Hz 1H), 7.13-7.09 (m, 2H), 5.77 (t, *J* = 4.5 Hz, 1H), 2.73 (t, *J* = 8.0Hz, 2H), 2.27 (s, 2H), 2.25-2.20 (m, 2H), 1.89-1.85 (m, 3H), 1.65-1.62 (m, 3H), 1.57-1.54 (m, 3H), 1.46-1.45 (m, 6H); ¹³C NMR (125 MHz, CDCl₃) δ 136.4, 133.1, 128.6, 127.3, 126.1, 125.8, 123.6, 46.1, 43.2, 37.0, 33.5, 29.0, 28.8, 23.3; IR(KBr,cm⁻¹) 2892, 1449, 1360, 767; LRMS (EI, 70eV) *m/z* (%): 278 (M⁺, 28), 135 (100), 128 (17), 93 (21); HRMS (ESI) for C₂₁H₂₇ [M+H]⁺ calcd. 279.2107, found. 279.2115.

Ethyl 7,7-diphenylhept-6-enoate (5l):



33.0mg, 54% yield; R_f = 0.6 (PE:EA = 10:1);

Yellow oil; ^1H NMR (500 MHz, CDCl_3) δ 7.36 (t, J = 7.0 Hz, 2H), 7.30 (t, J = 7.5Hz, 1H), 7.25-7.24 (m,

2H), 7.22-7.20 (m, 3H), 7.17-7.16 (m, 2H), 6.06 (t, J = 7.0Hz, 1H), 4.13-4.09 (m, 2H),

2.25 (t, J = 7.5 Hz, 2H), 2.15-2.11 (m, 2H), 1.64-1.61 (m, 2H), 1.50-1.44 (m, 2H),

1.24 (t, J = 7.5 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 173.7, 142.7, 141.9, 140.1,

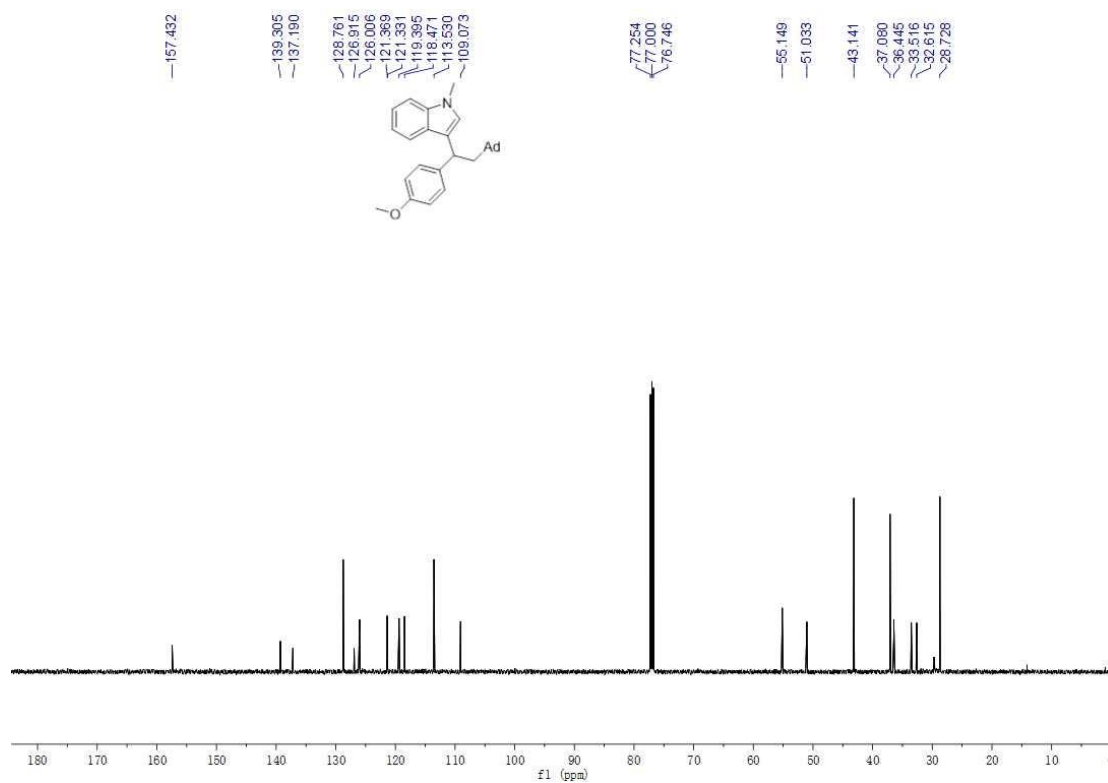
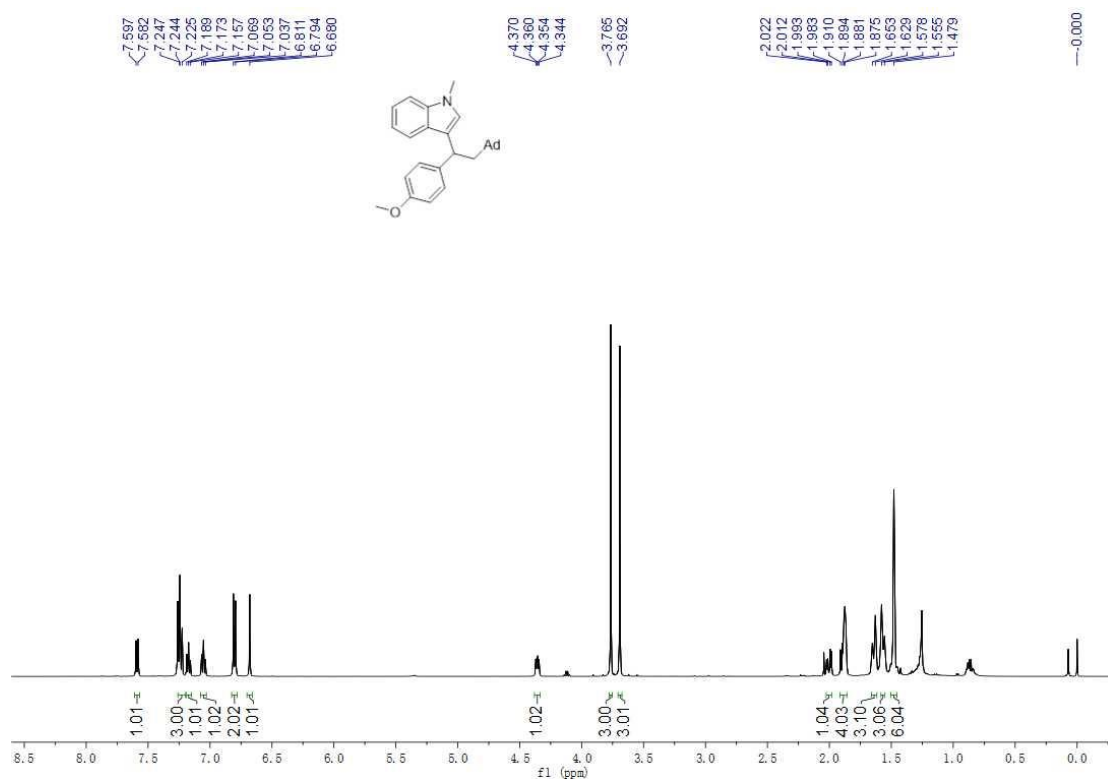
129.8, 129.4, 128.1, 127.2, 126.8, 60.2, 34.1, 29.3, 24.5, 14.2, LRMS (EI, 70eV) m/z

(%): 308 (M^+ , 30), 206 (100), 193 (85), 91 (70); HRMS (ESI) for $\text{C}_{21}\text{H}_{25}\text{O}_2$ [$\text{M}+\text{H}$] $^+$

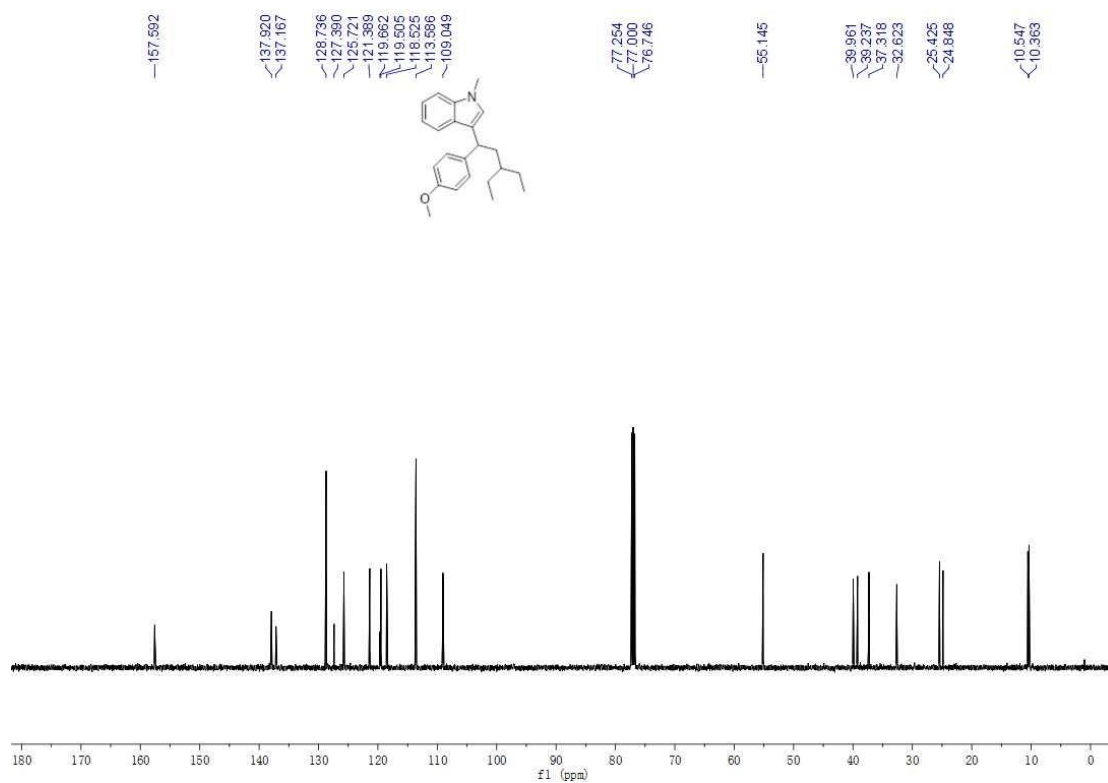
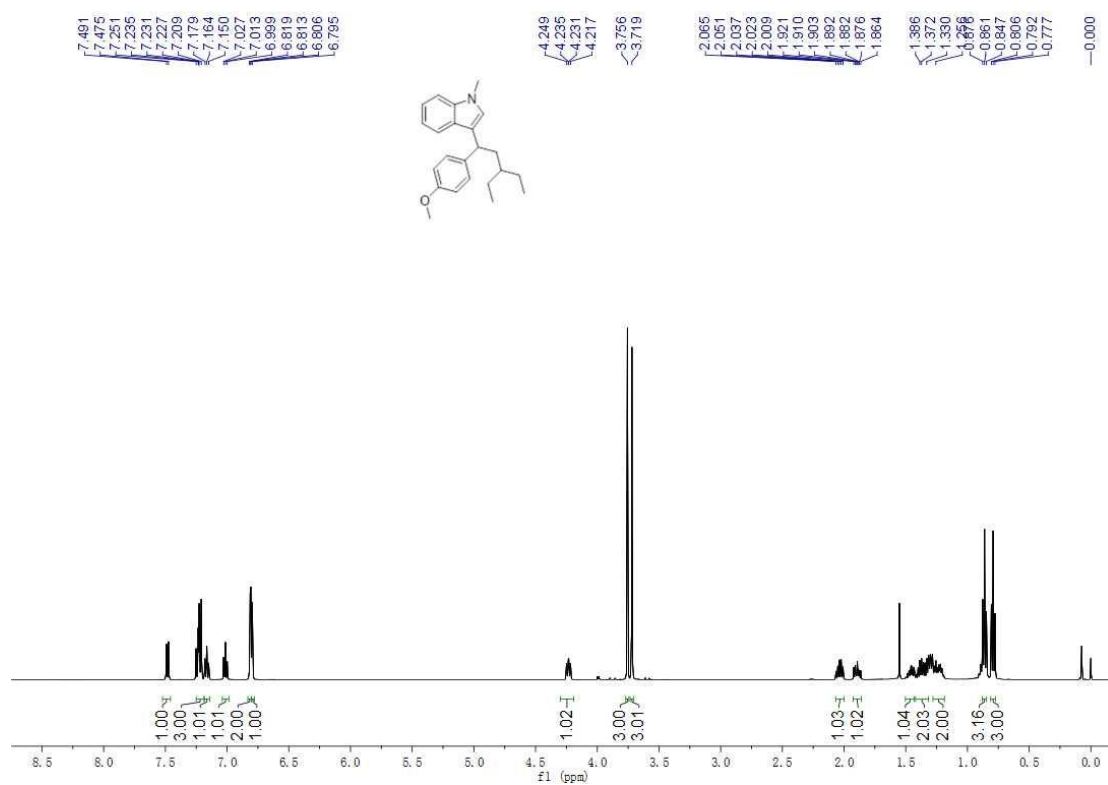
calcd. 309.1849, found. 309.1859.

(D) Spectra

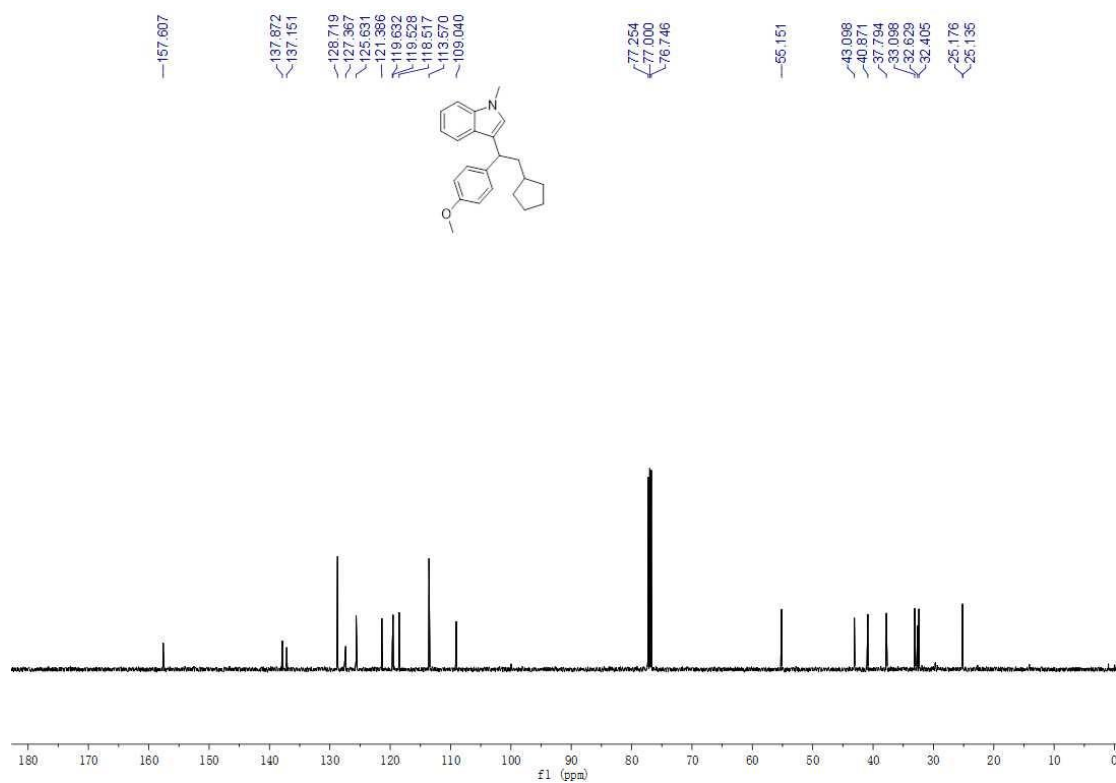
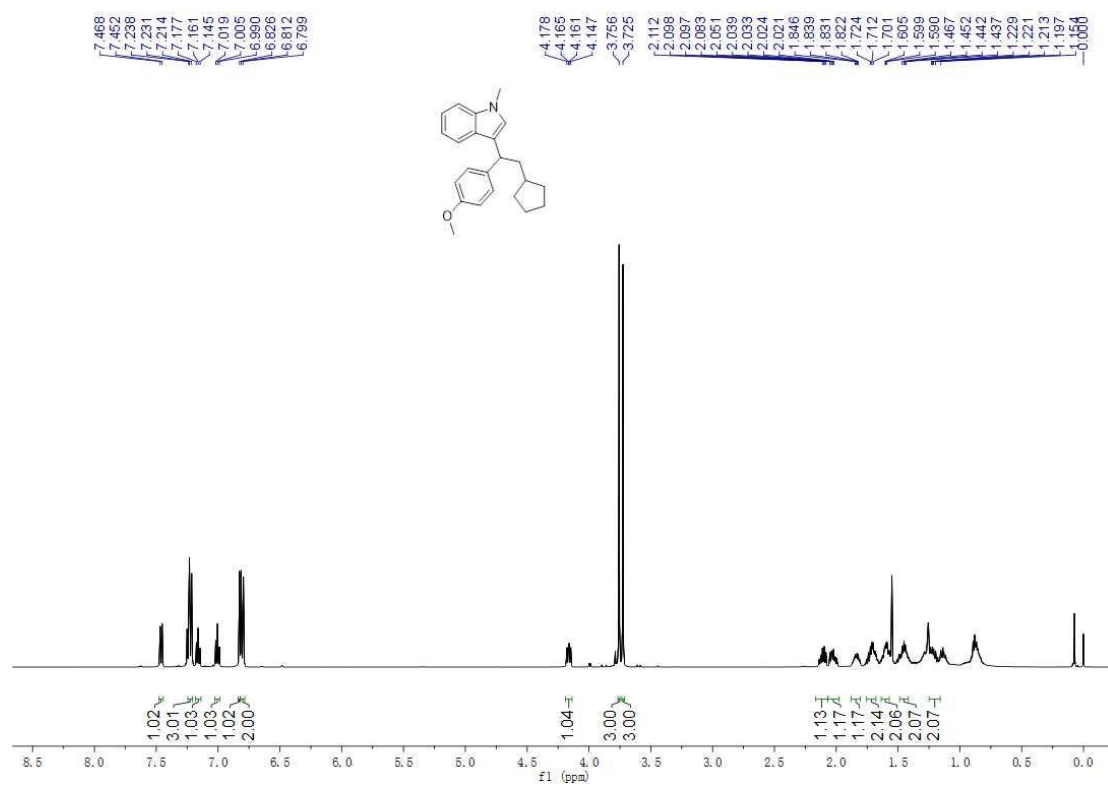
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-methyl-1*H*-indole(4aaa)



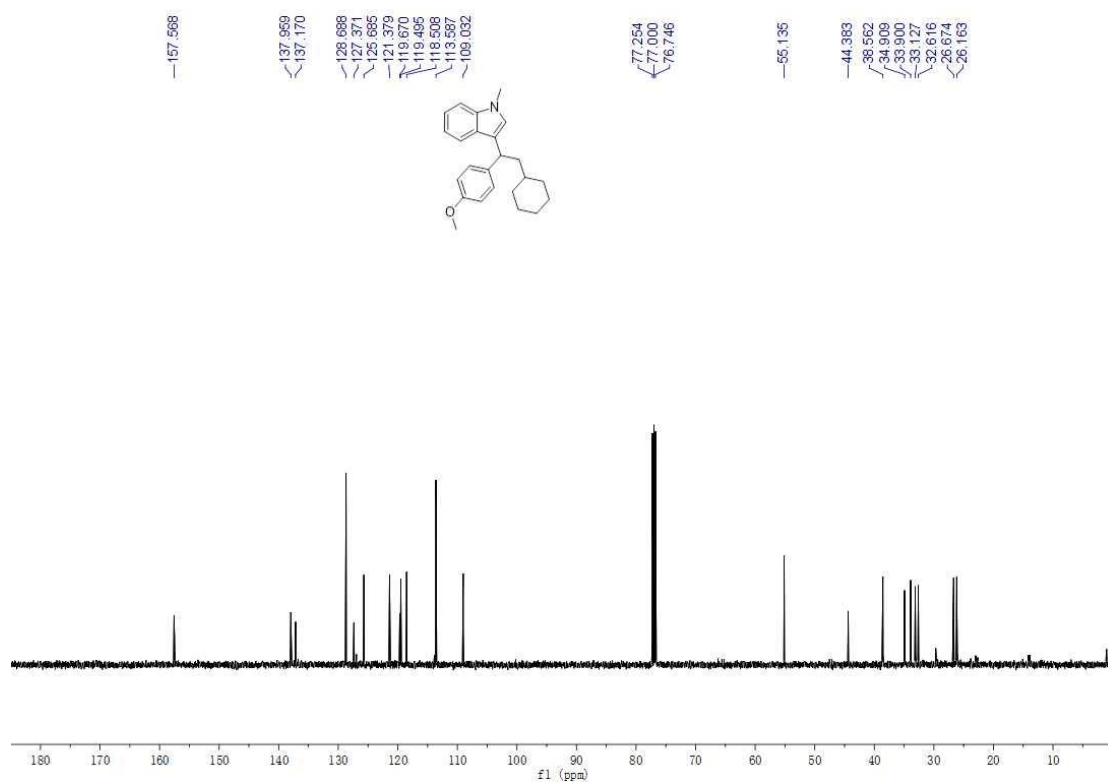
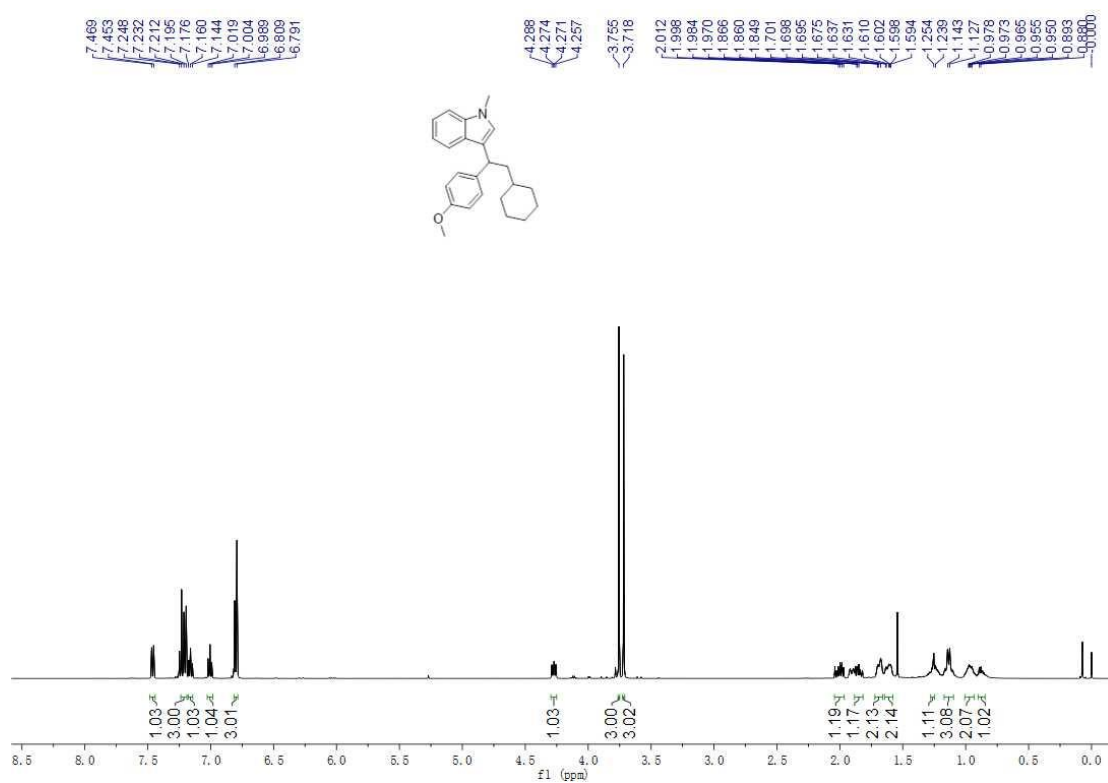
3-(3-Ethyl-1-(4-methoxyphenyl)pentyl)-1-methyl-1H-indole (4aba)



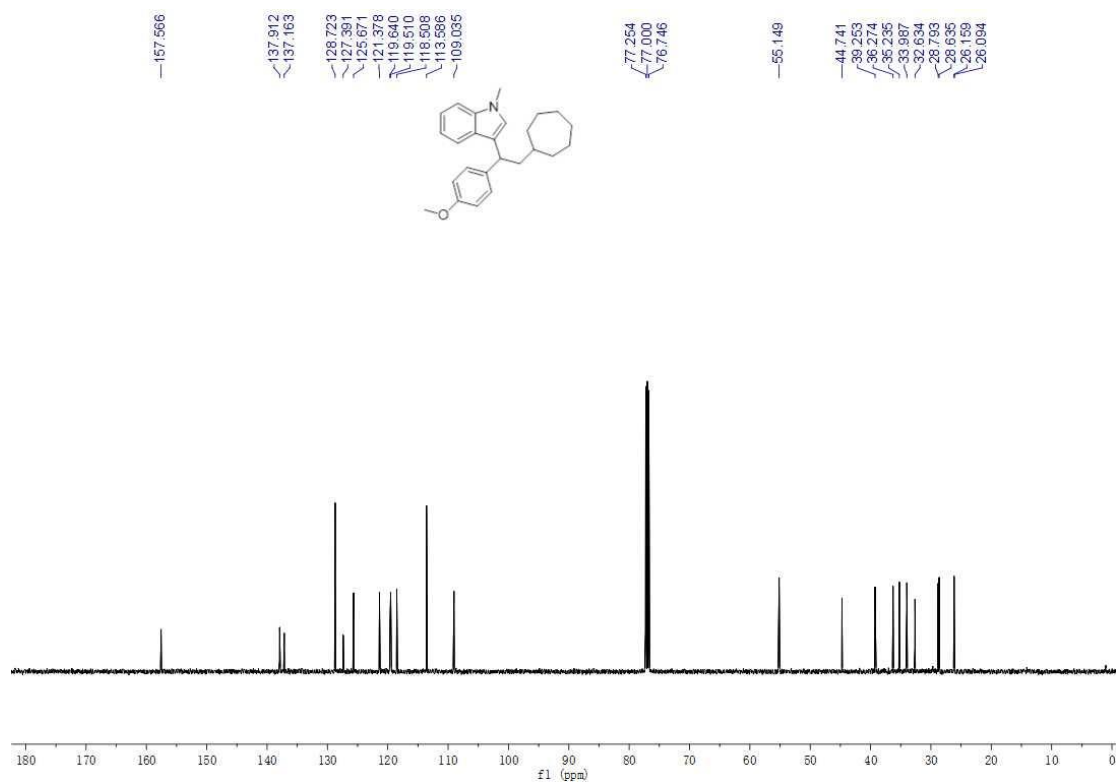
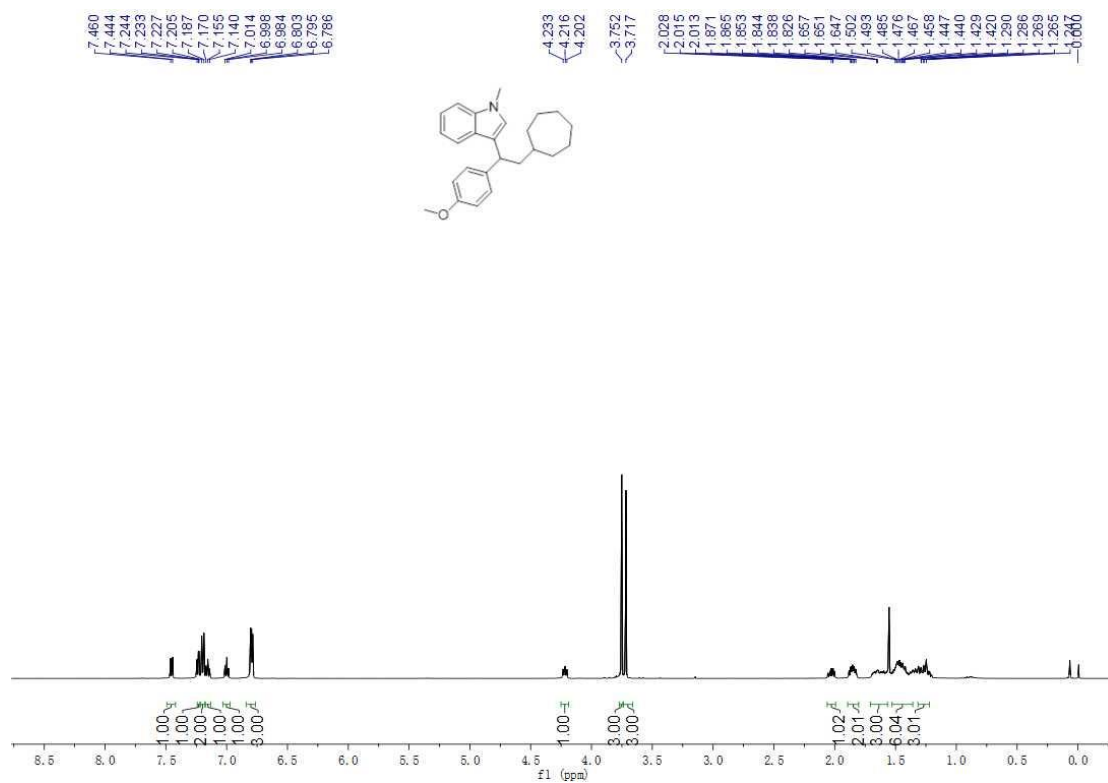
3-(2-Cyclopentyl-1-(4-methoxyphenyl)ethyl)-1-methyl-1H-indole (4aca)



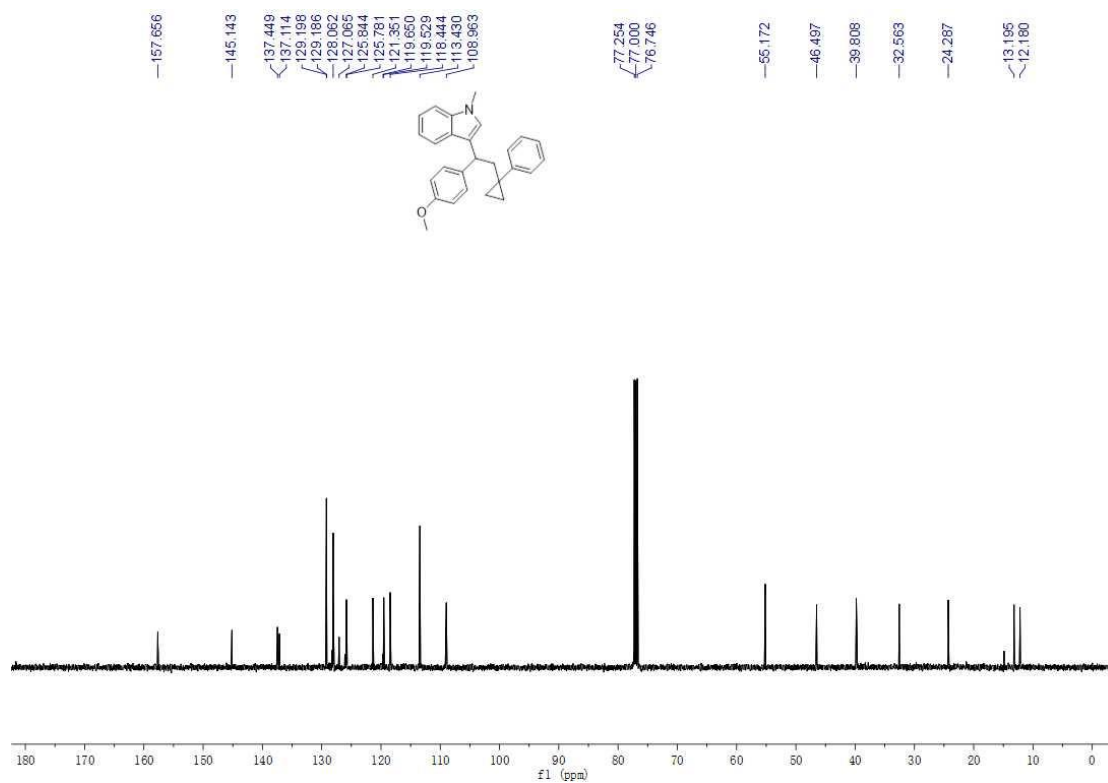
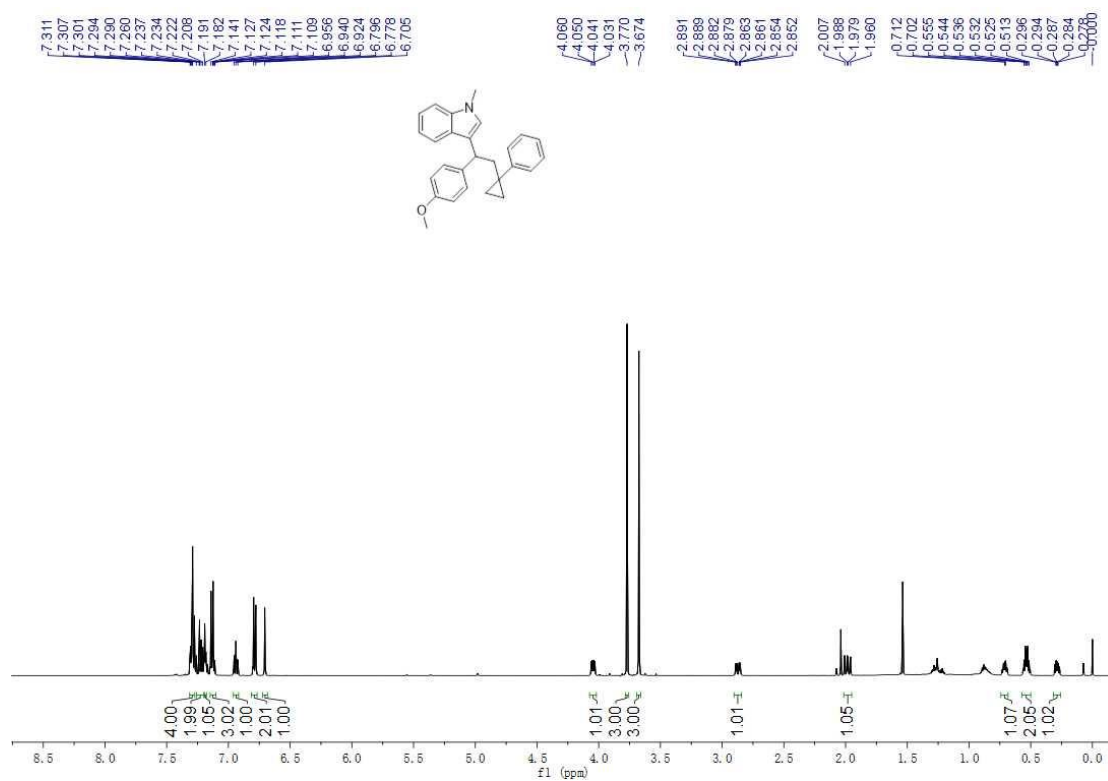
3-(2-Cyclohexyl-1-(4-methoxyphenyl)ethyl)-1-methyl-1H-indole (4ada)



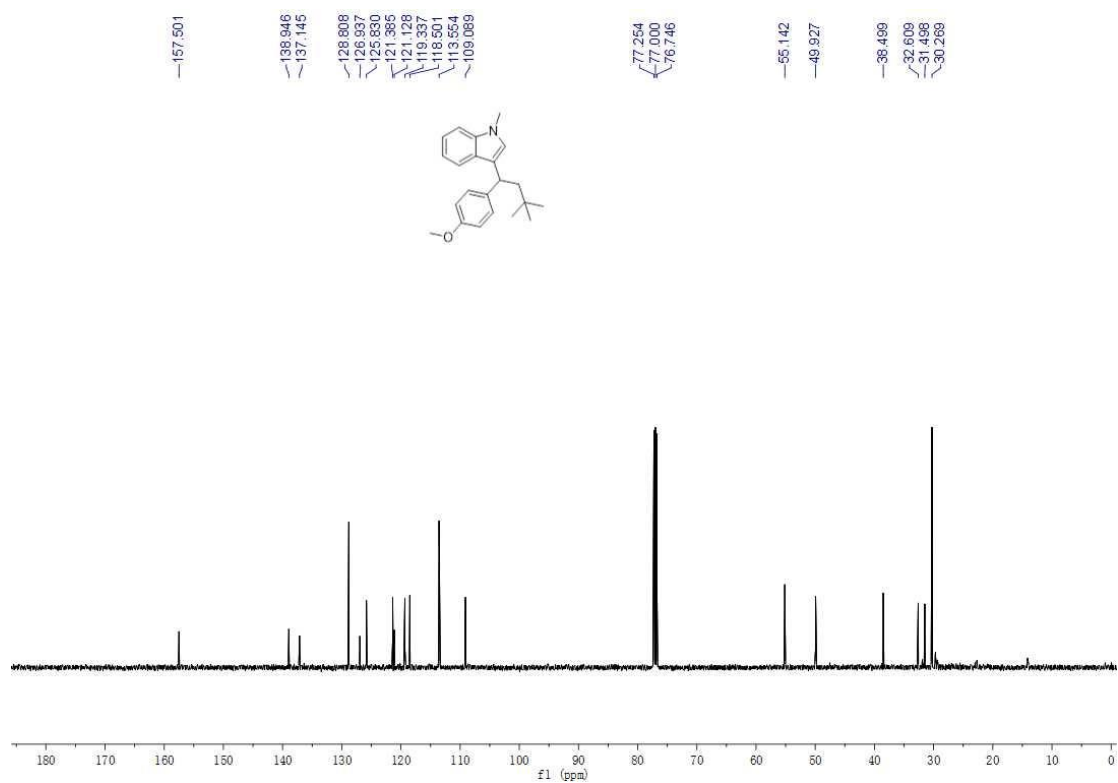
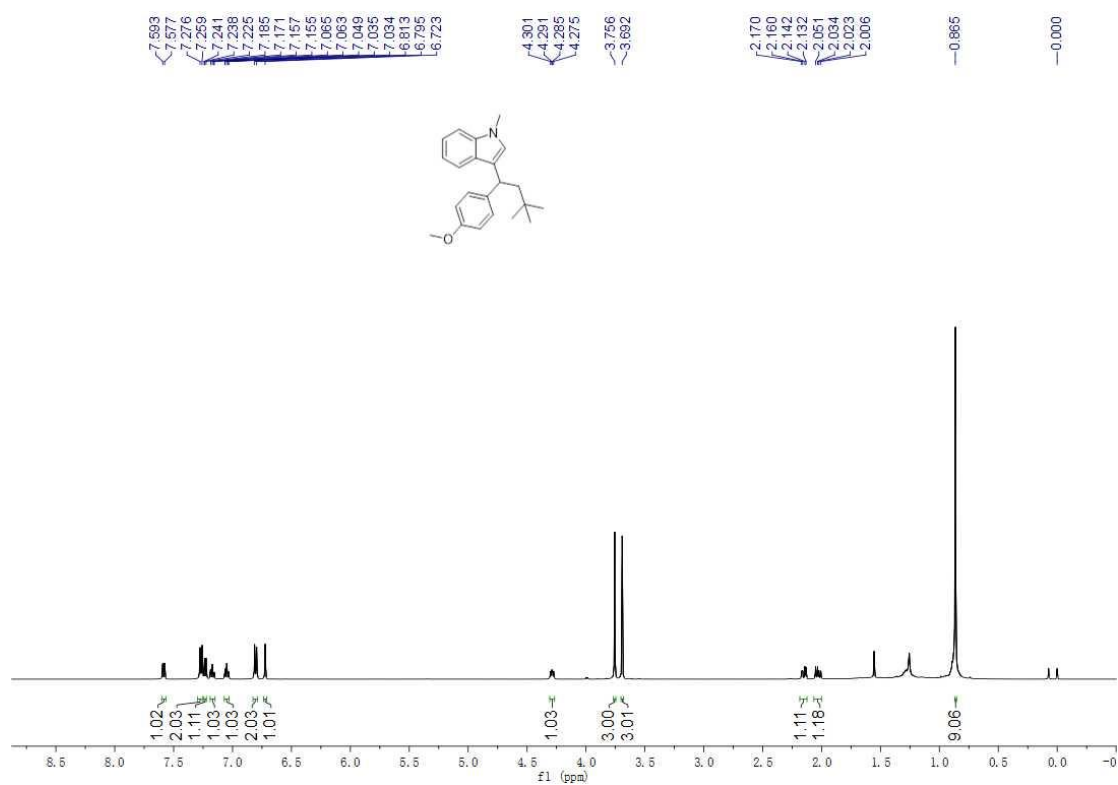
3-(2-Cycloheptyl-1-(4-methoxyphenyl)ethyl)-1-methylindoline(4aea)



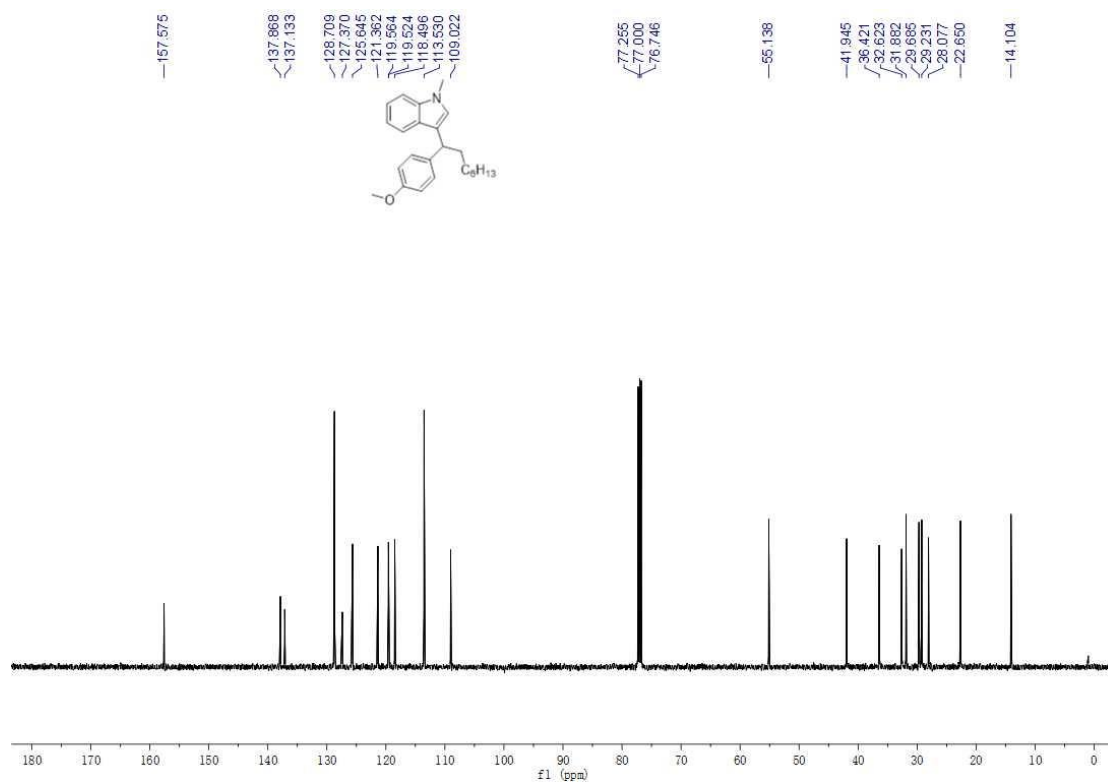
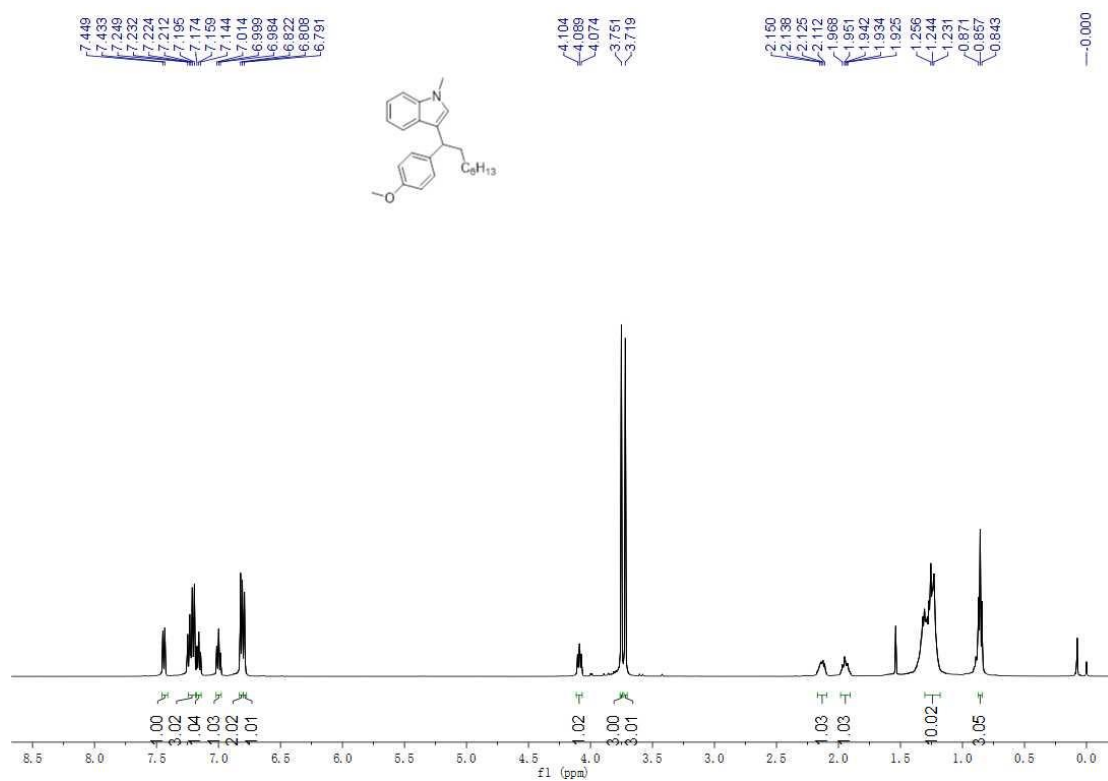
3-(1-(4-Methoxyphenyl)-2-(1-phenylcyclopropyl)ethyl)-1-methyl-1H-indole (4afa)



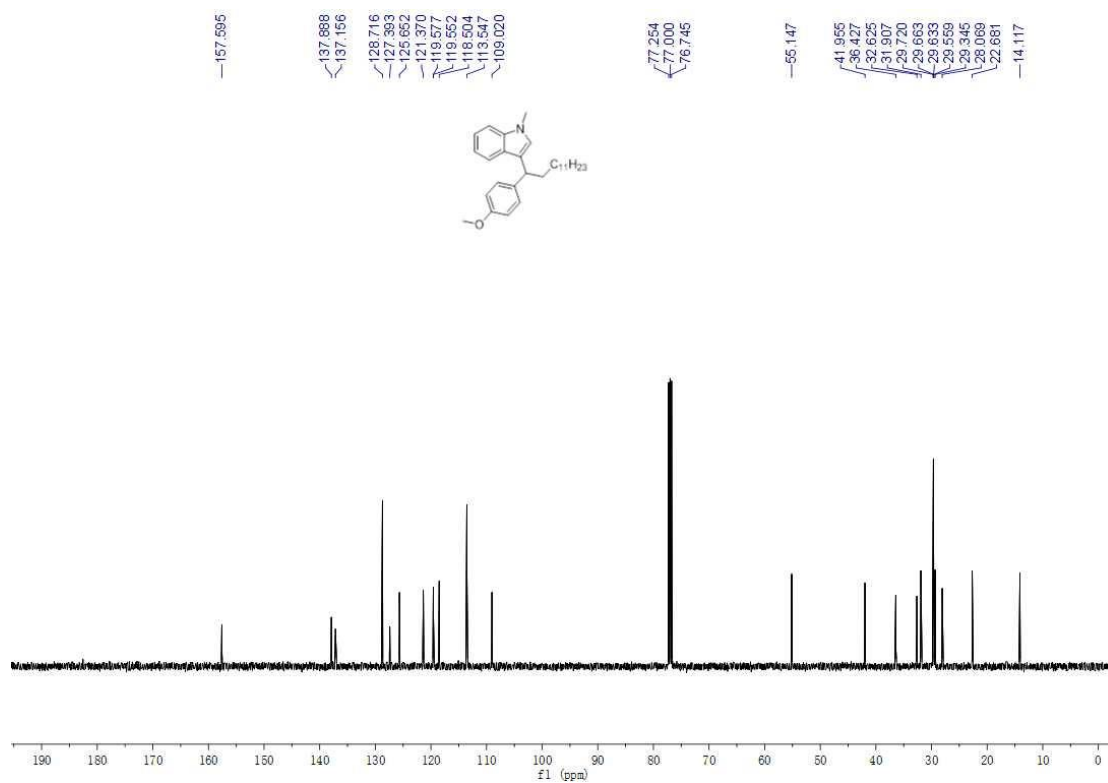
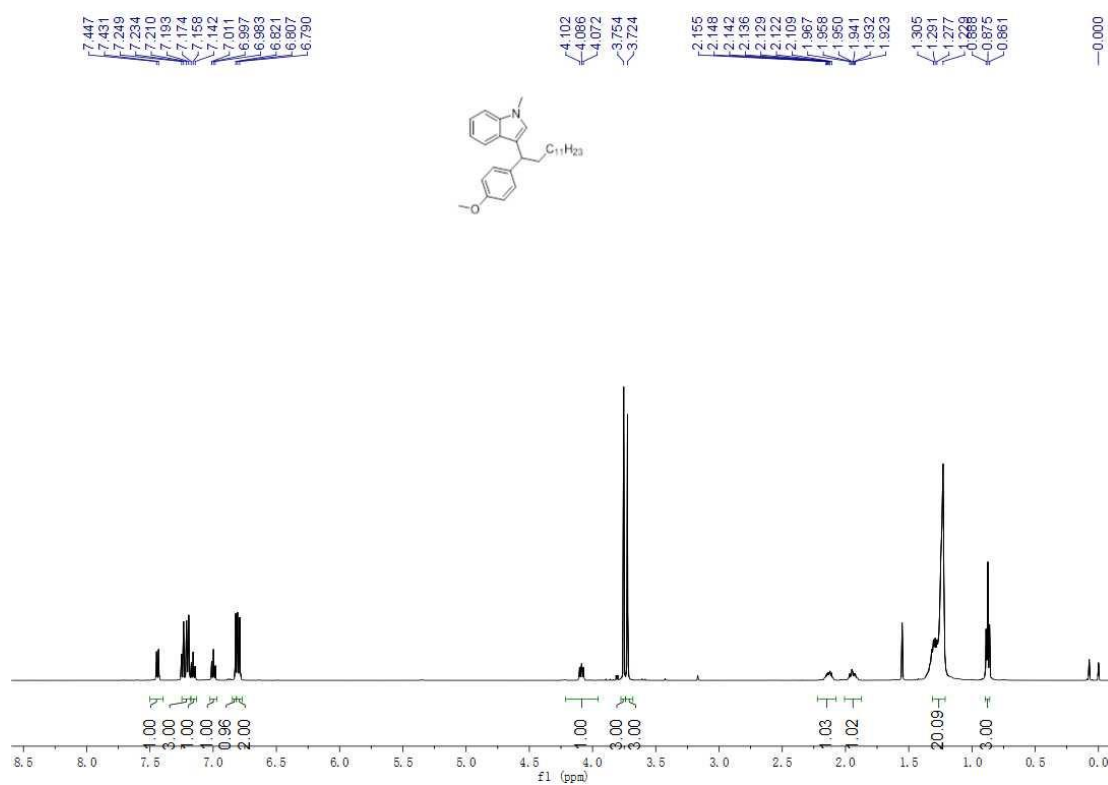
3-(1-(4-Methoxyphenyl)-3,3-dimethylbutyl)-1-methyl-1H-indole (4aga)



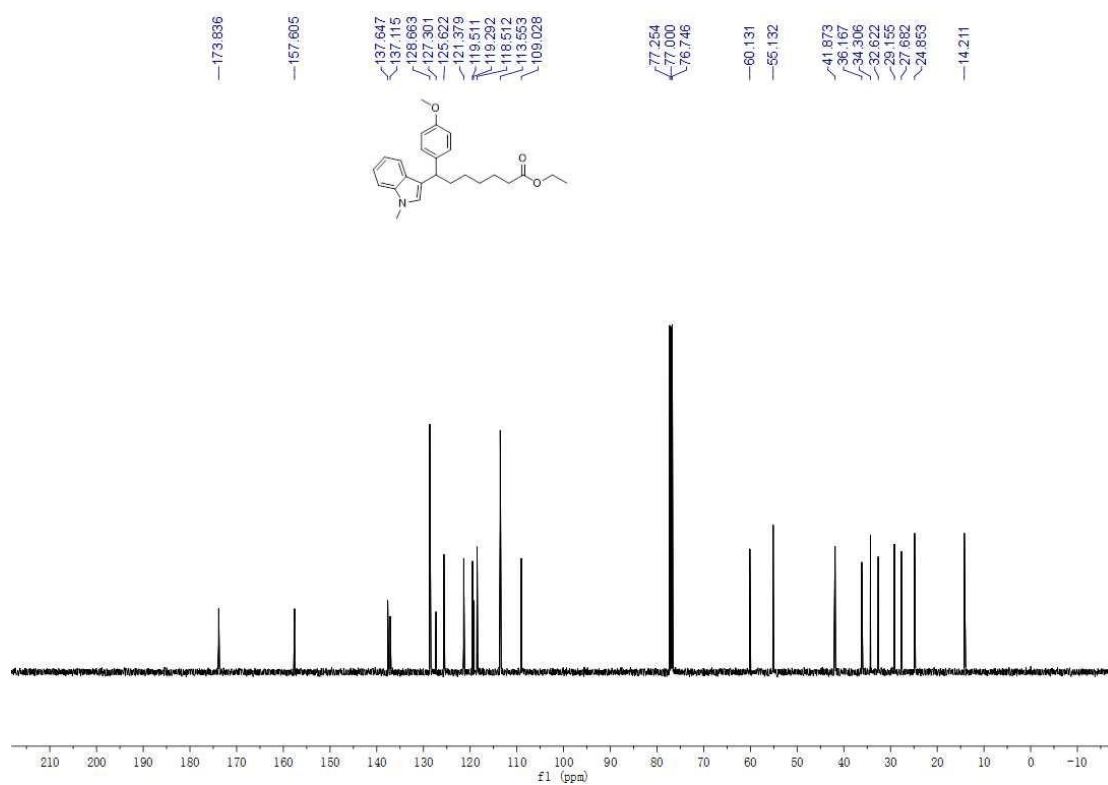
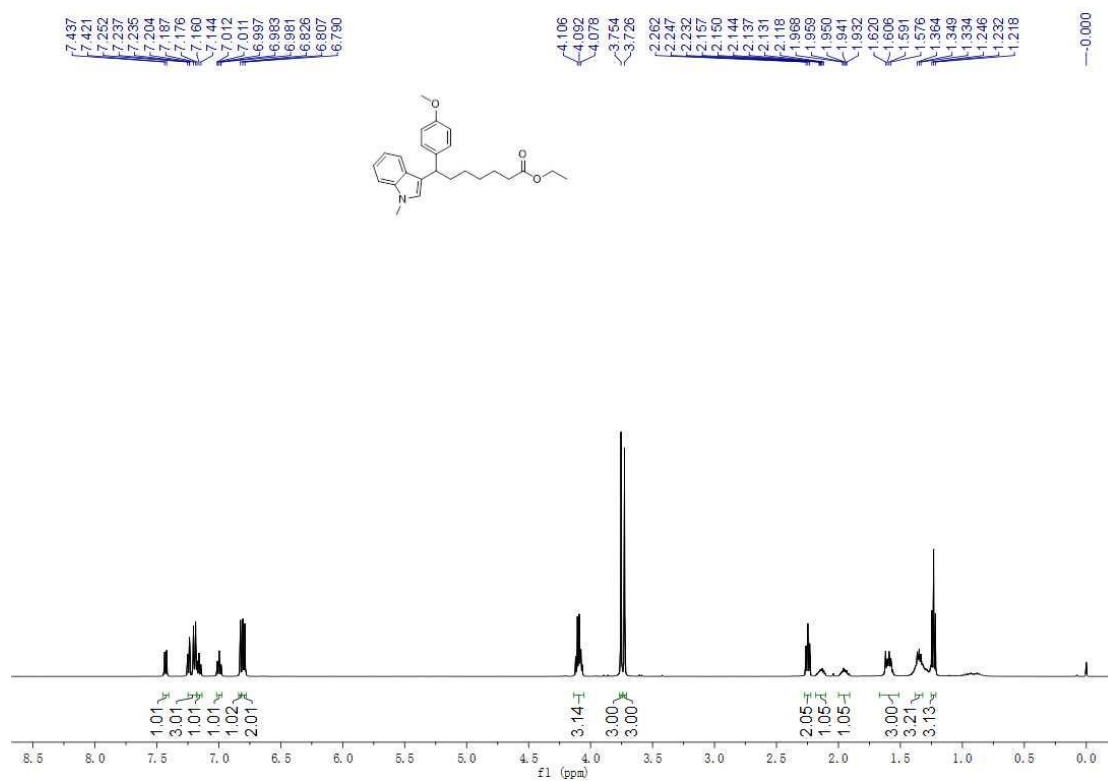
3-(1-(4-Methoxyphenyl)octyl)-1-methyl-1H-indole (4aha)



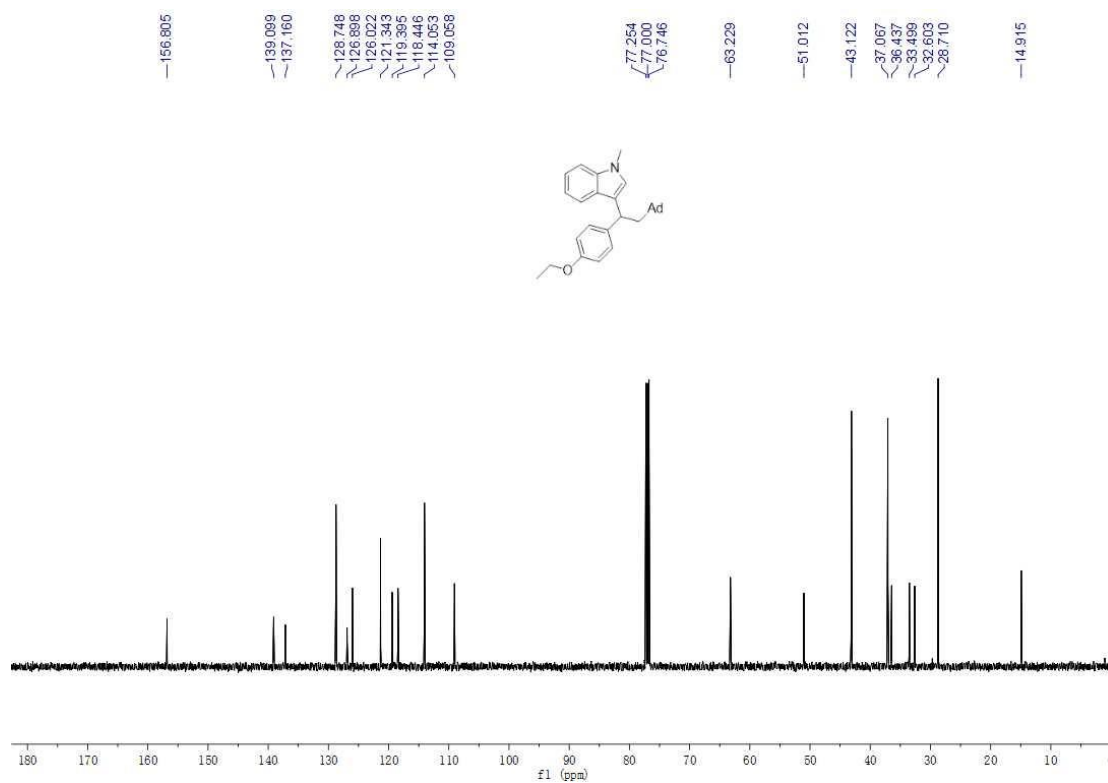
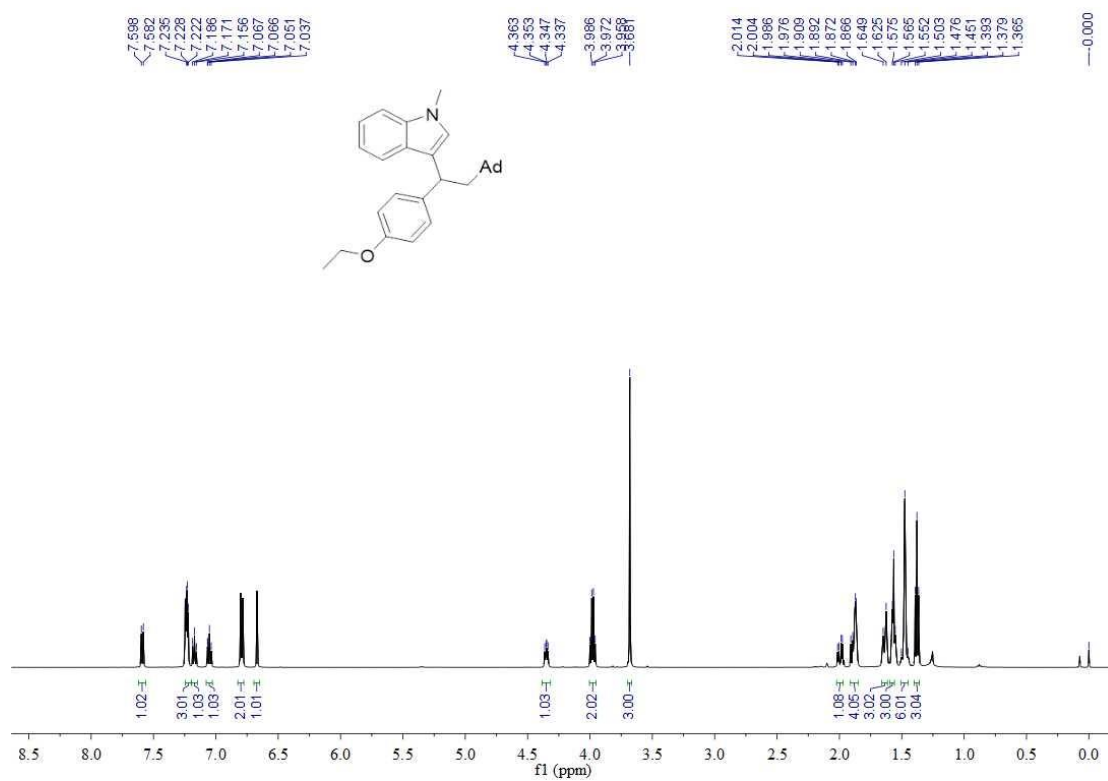
3-(1-(4-Methoxyphenyl)tridecyl)-1-methyl-1H-indole(4aia)



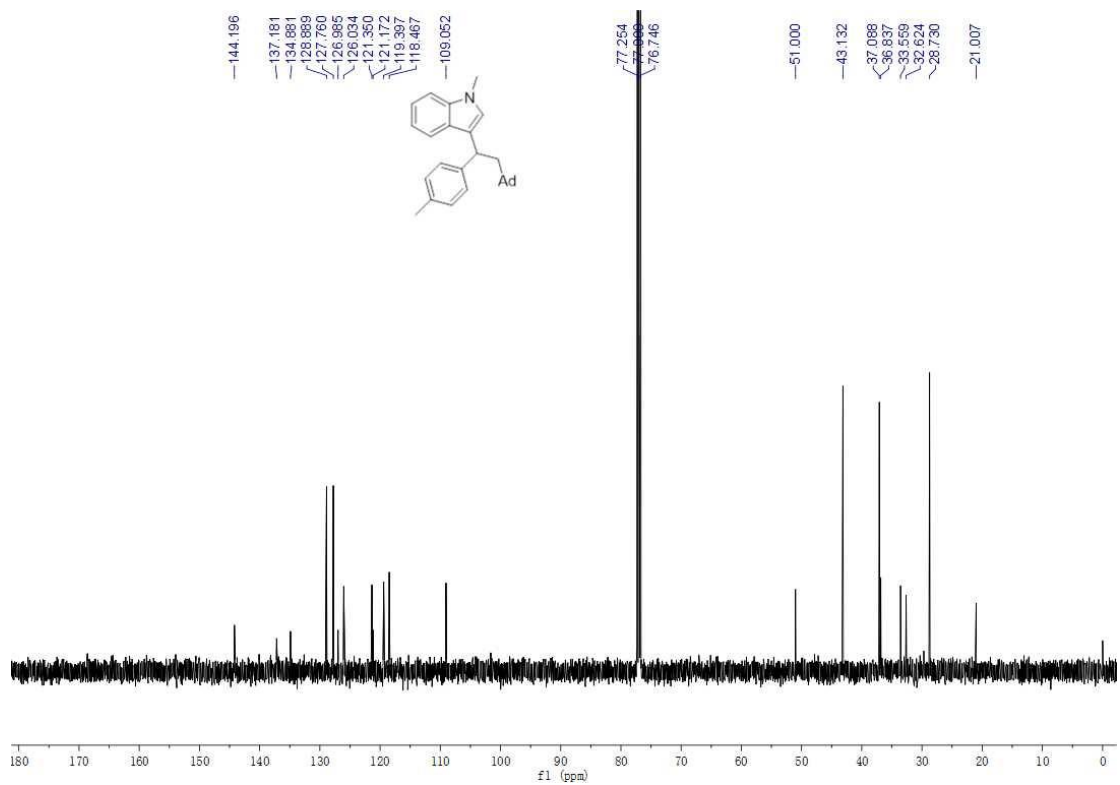
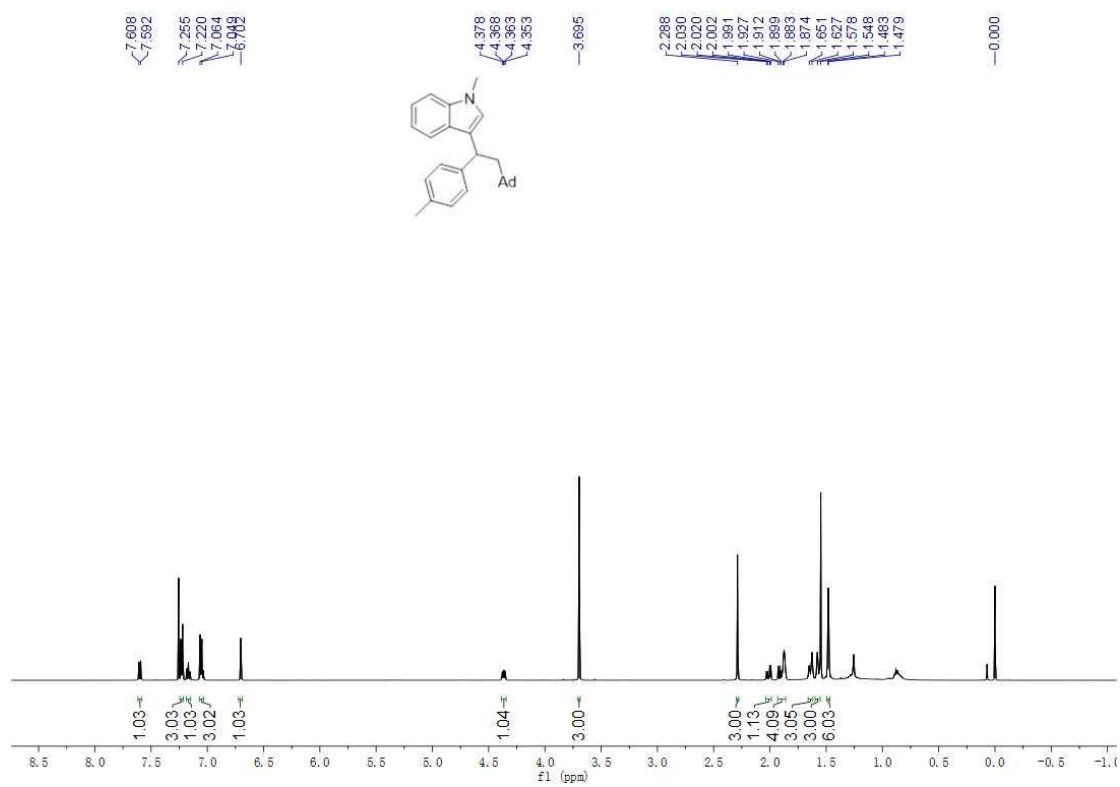
Ethyl 7-(4-methoxyphenyl)-7-(1-methyl-1H-indol-3-yl)heptanoate (4aja)



3-(2-(-Adamantan-1-yl)-1-(4-ethoxyphenyl)ethyl)-1-methyl-1H-indole (4baa)

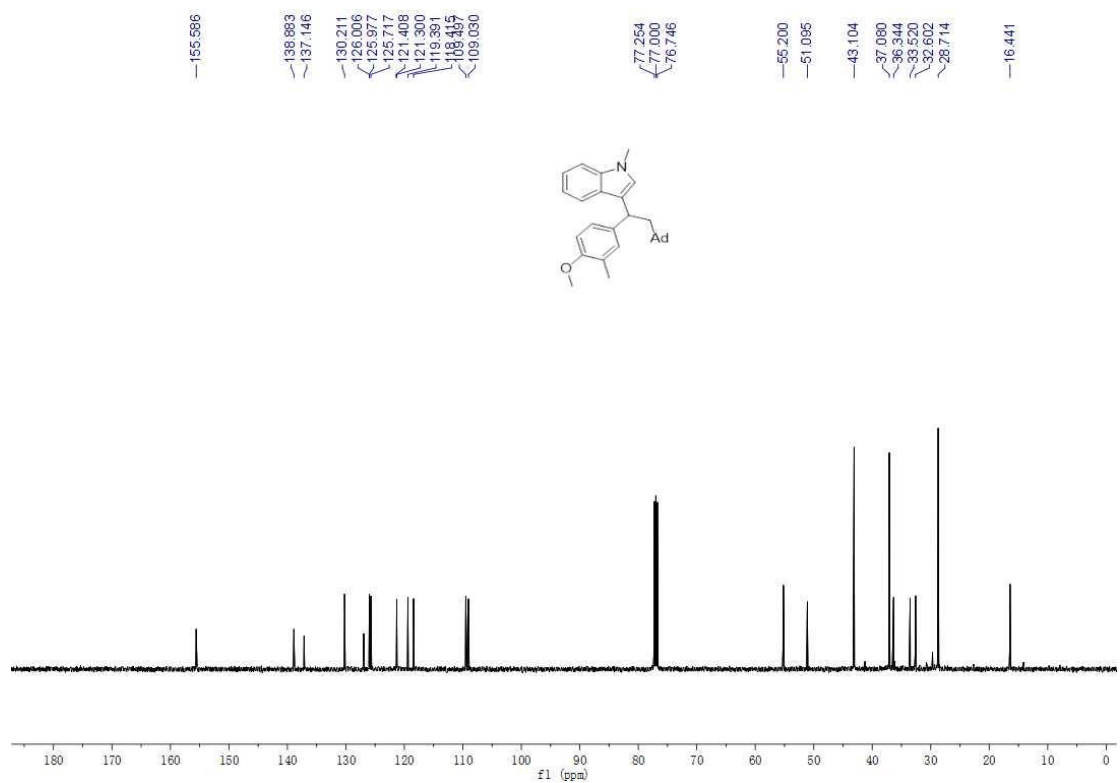
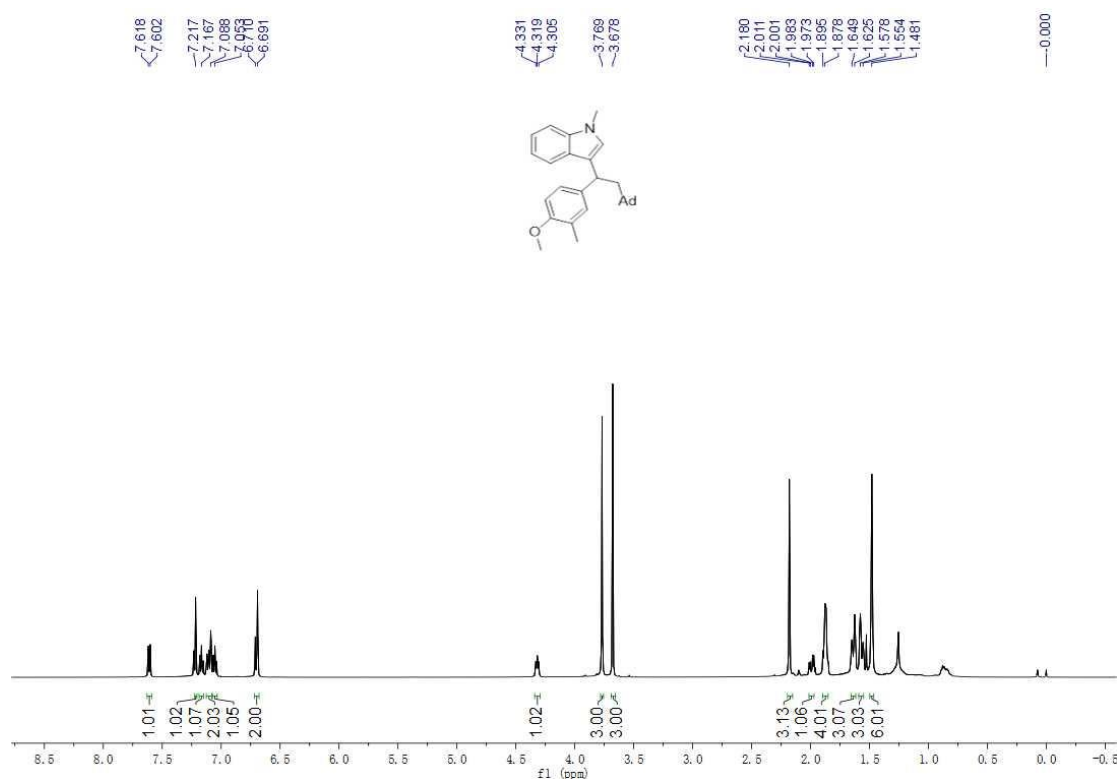


3-(2-(-Adamantan-1-yl)-1-(*p*-tolyl)ethyl)-1-methyl-1*H*-indole (4caa)



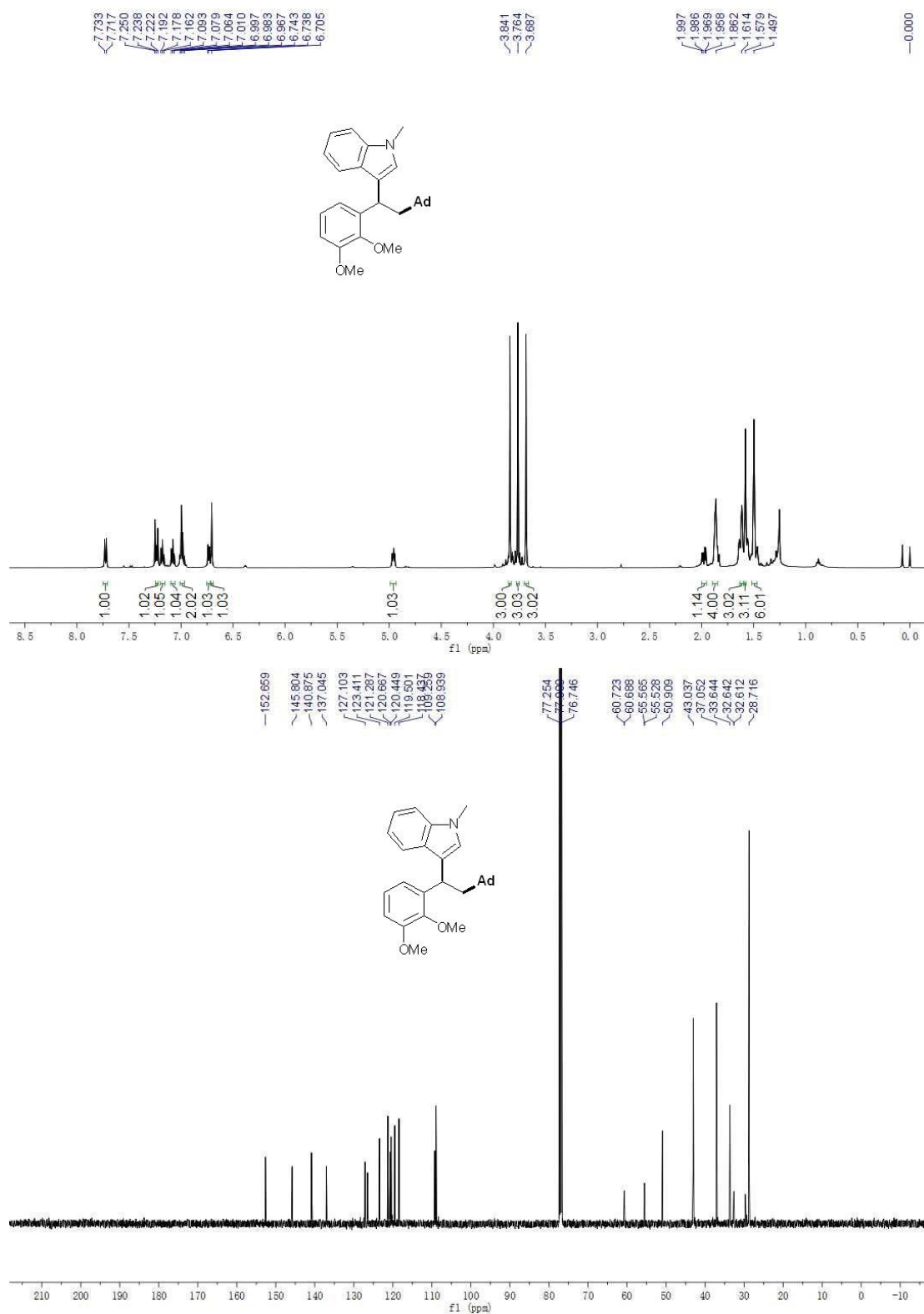
3-(2-(-Adamantan-1-yl)-1-(4-methoxy-3-methylphenyl)ethyl)-1-methyl-1H-indole

(4eaa)



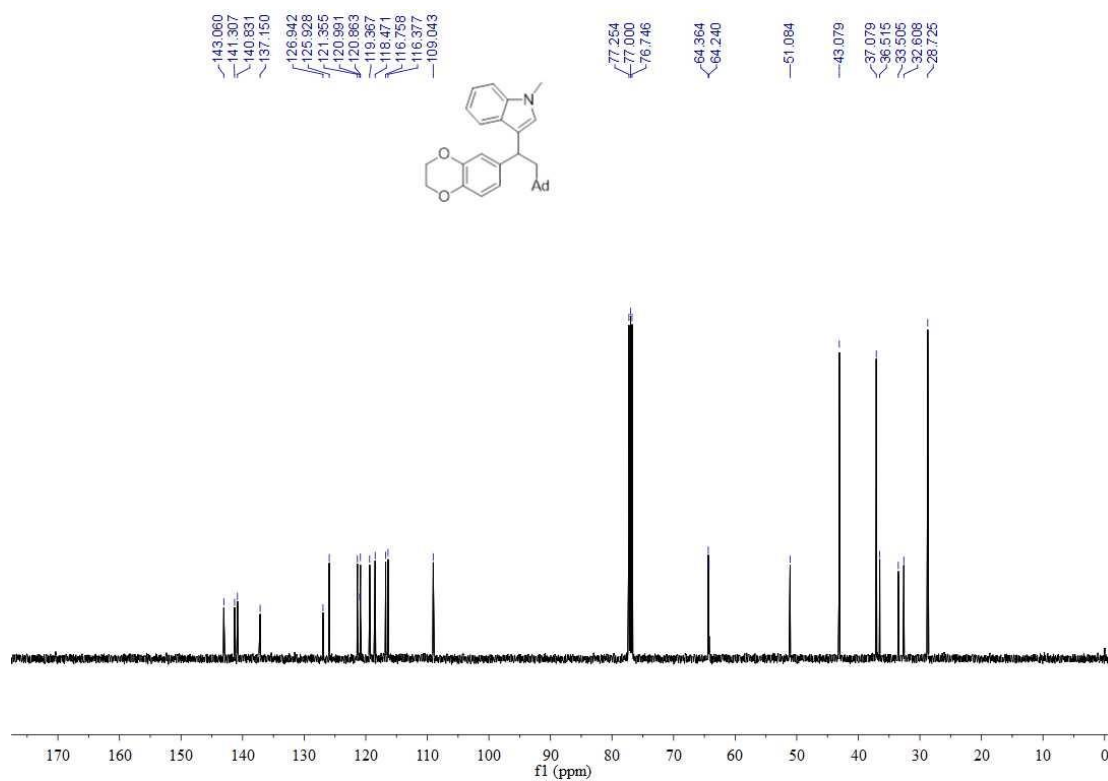
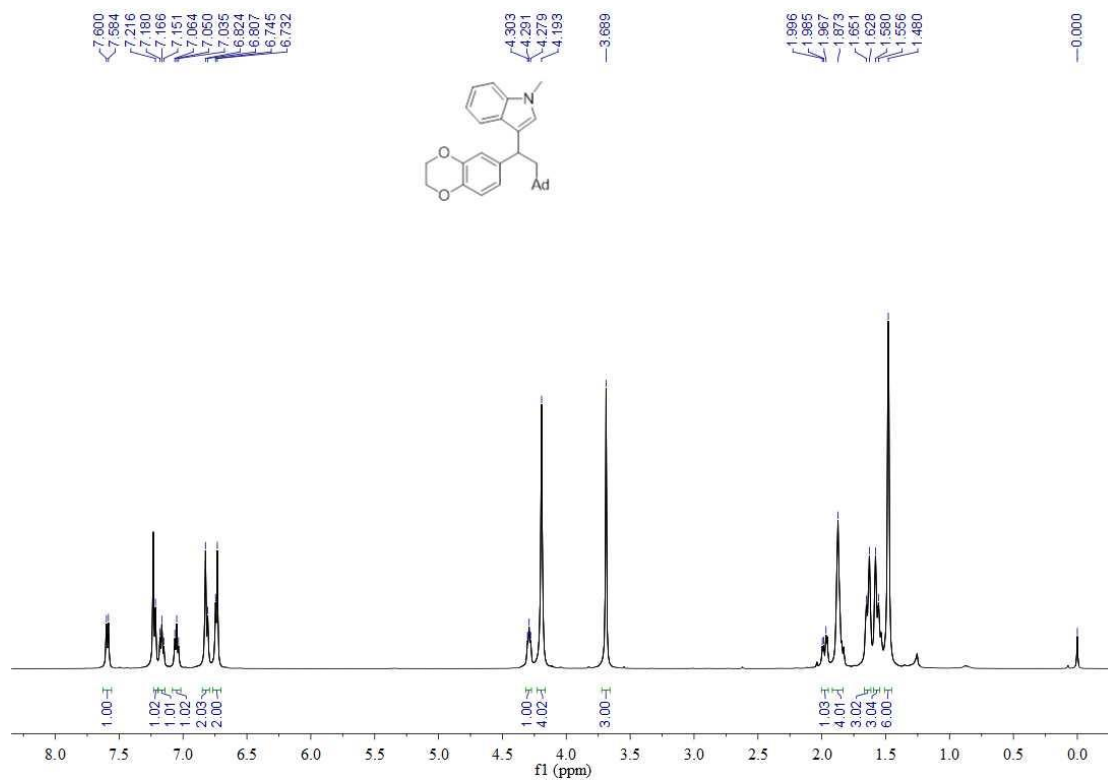
3-(2-(-Adamantan-1-yl)-1-(2,3-dimethoxyphenyl)ethyl)-1-methyl-1H-indole

(4faa)



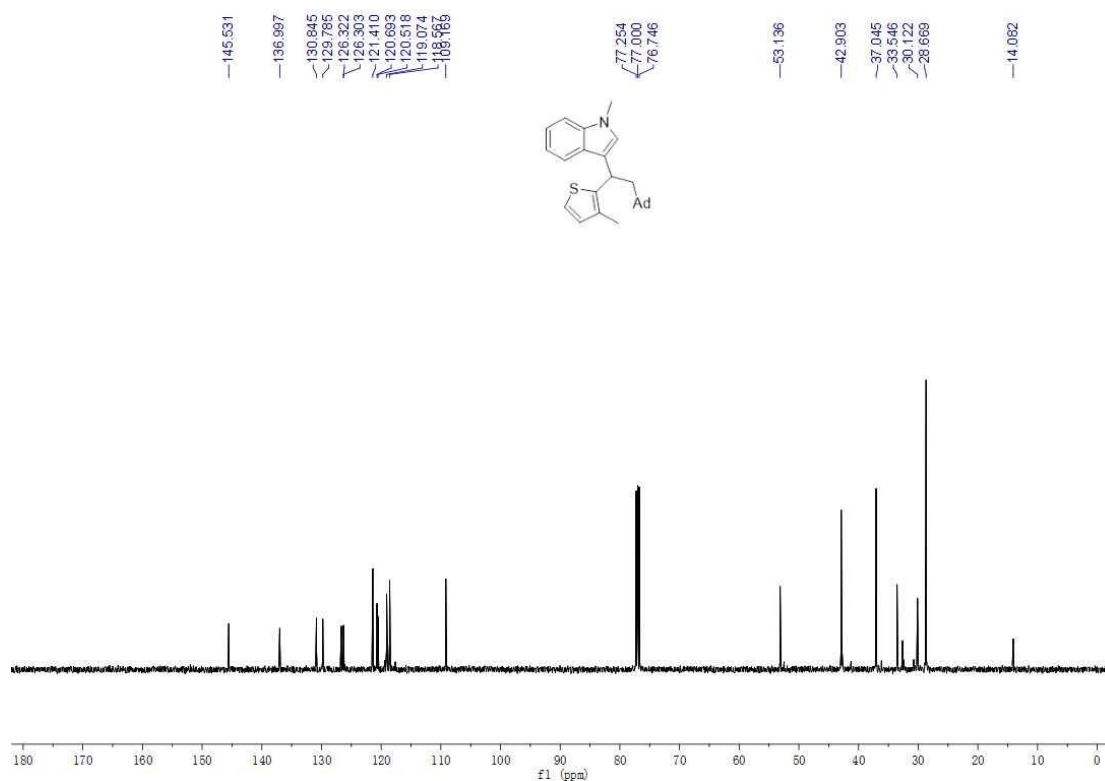
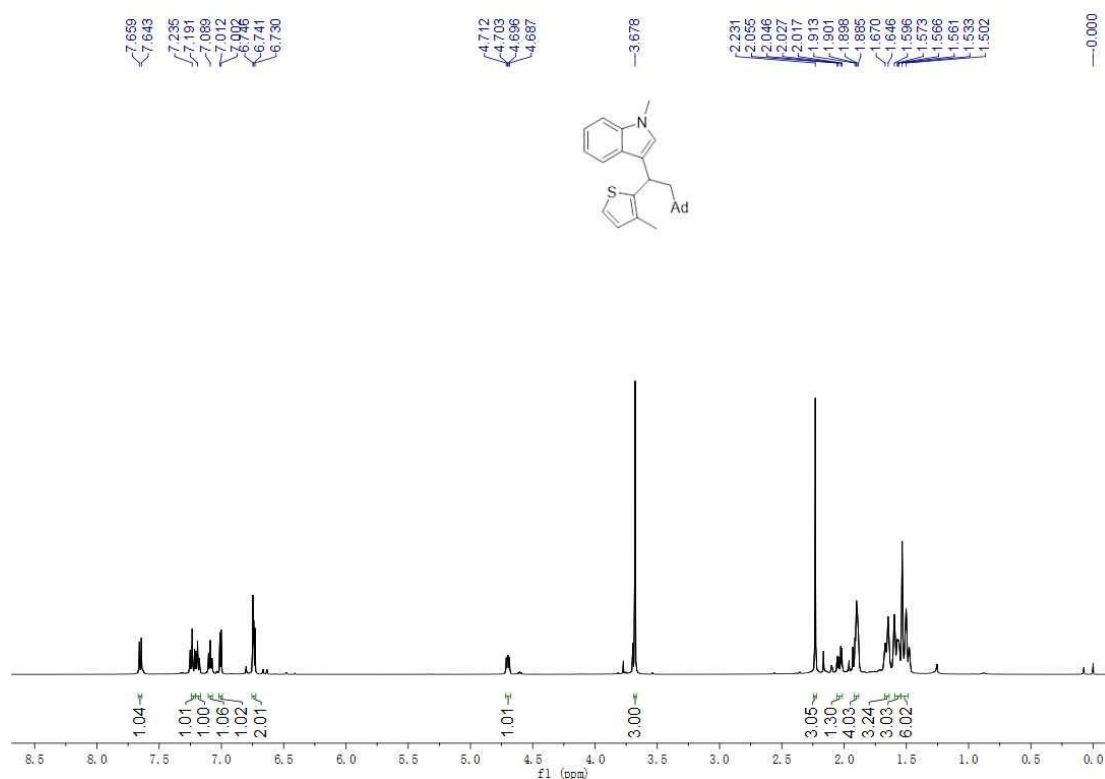
3-(2-(Adamantan-1-yl)-1-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)ethyl)-1-methyl-1

H-indole (4gaa)



3-(2-(Adamantan-1-yl)-1-(3-methylthiophen-2-yl)ethyl)-1-methyl-1H-indole

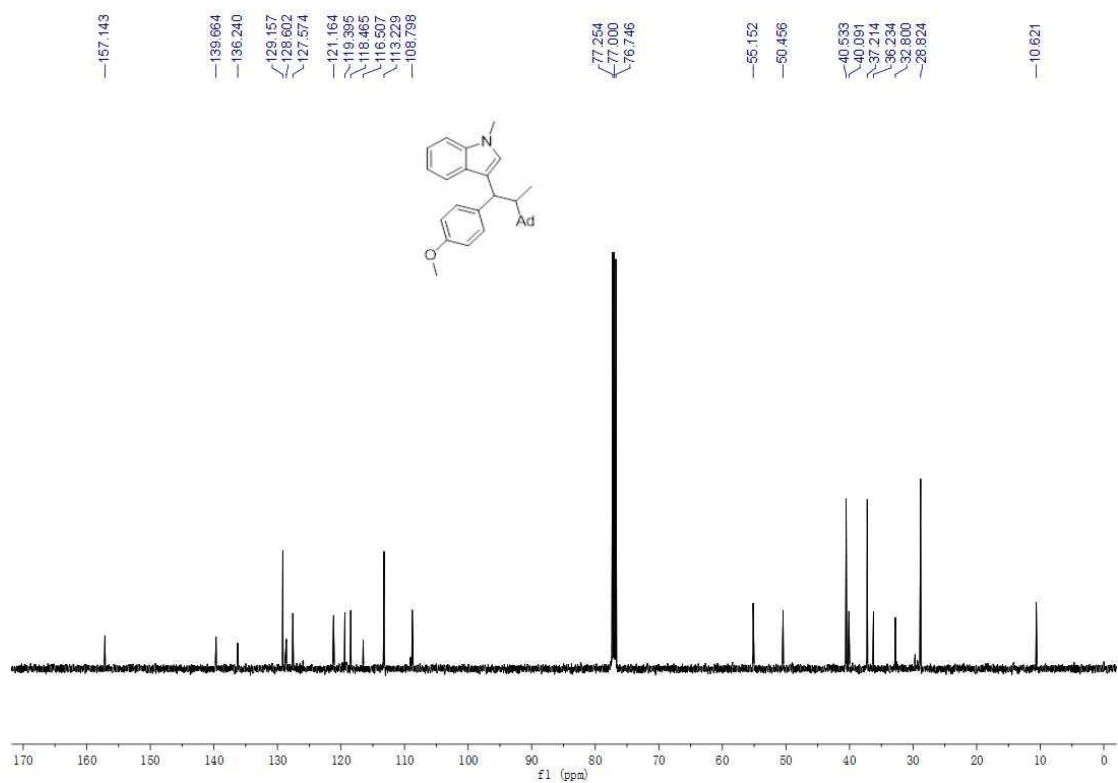
(4haa)



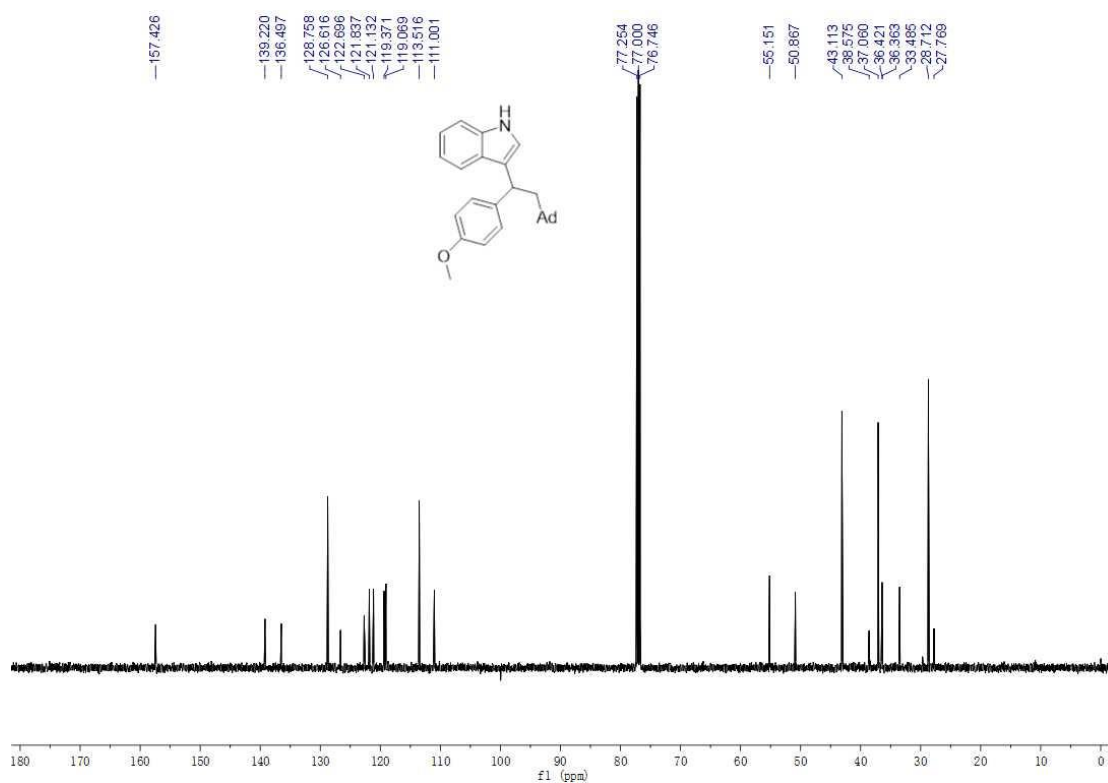
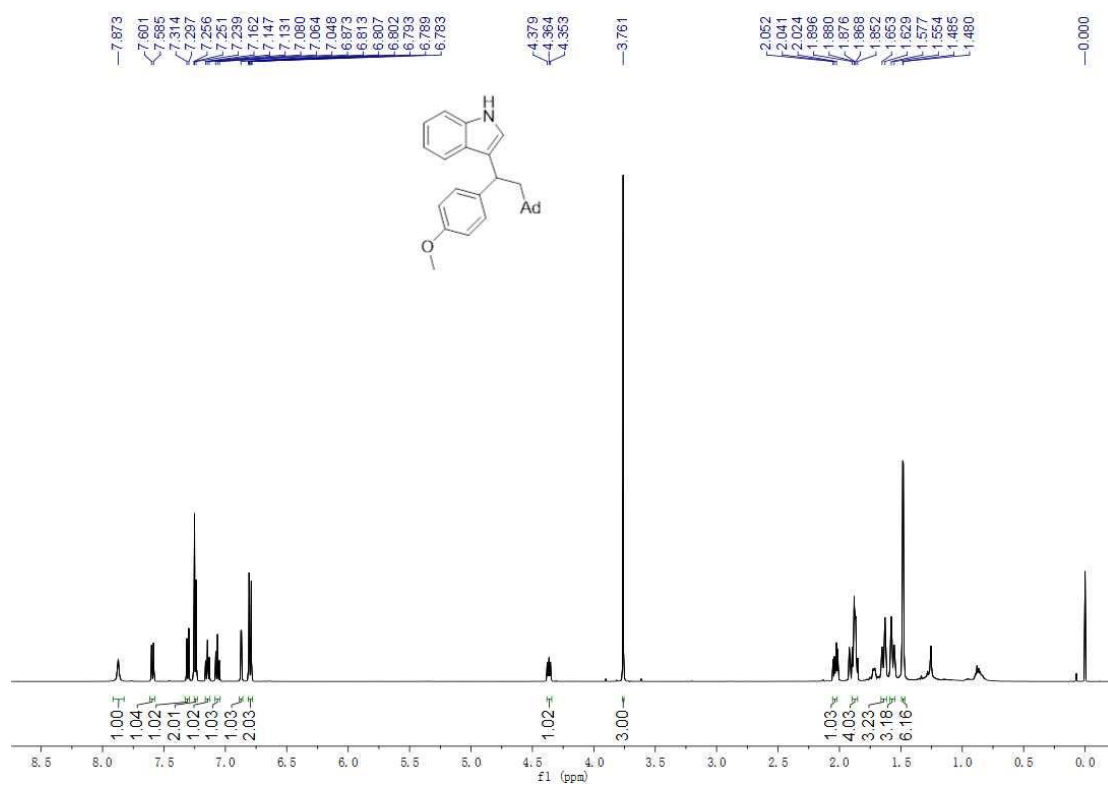
Chemical structure of 1-(4-methoxyphenyl)-2-(2-methyl-1H-indol-3-yl)ethan-1-one is shown above the spectrum.

¹H NMR spectrum (CDCl₃) showing peaks from 0.00 to 8.55 ppm. Integration values are provided below the peaks.

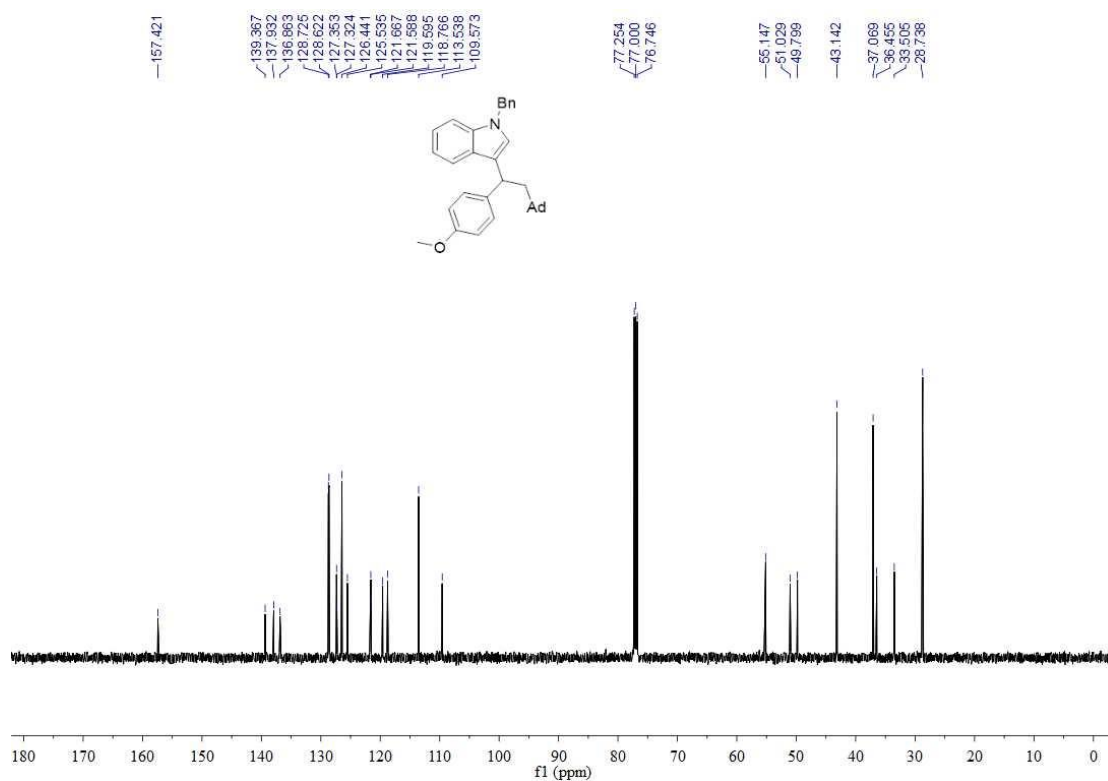
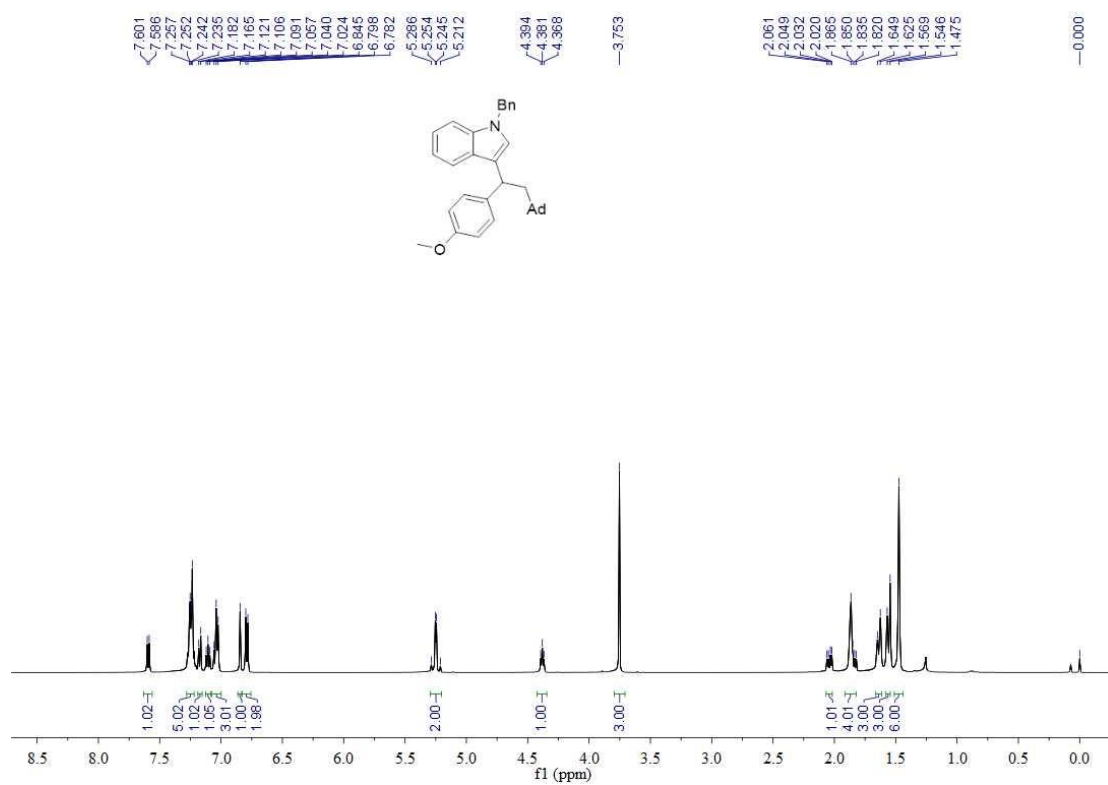
Chemical shift labels (ppm): 7.559, 7.543, 7.250, 7.243, 7.221, 7.221, 6.768, 6.751, 4.695, 4.687, 3.769, 3.739, 1.870, 1.865, 1.851, 1.842, 1.656, 1.656, 1.598, 1.589, 1.589, 1.583, 1.572, 1.572, 1.528, 1.509, 1.504, 0.989, 0.974, 0.000.



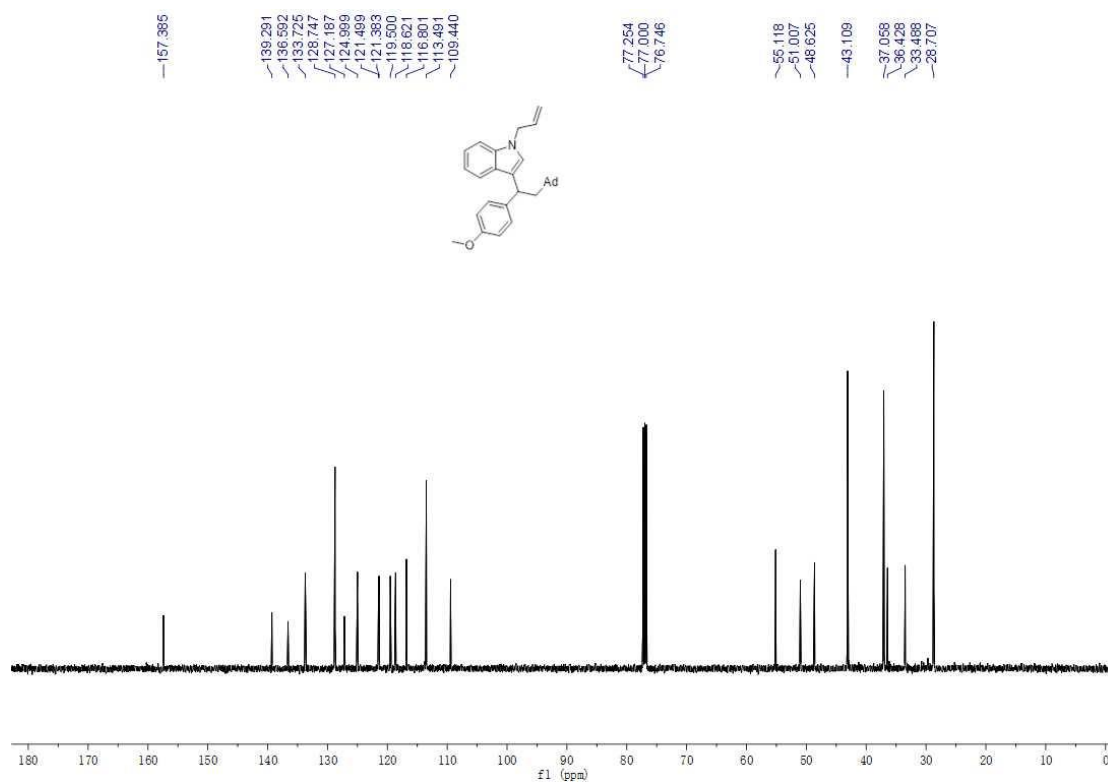
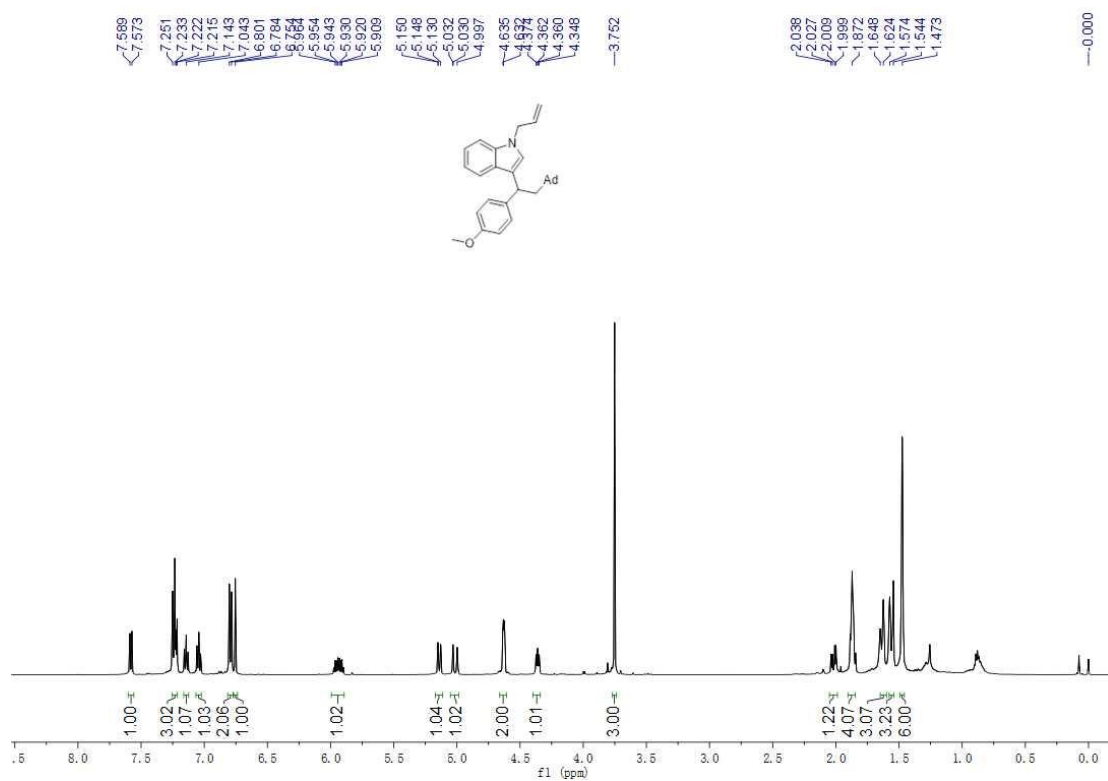
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1H-indole (4aab)



3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-benzyl-1H-indole (4aac)

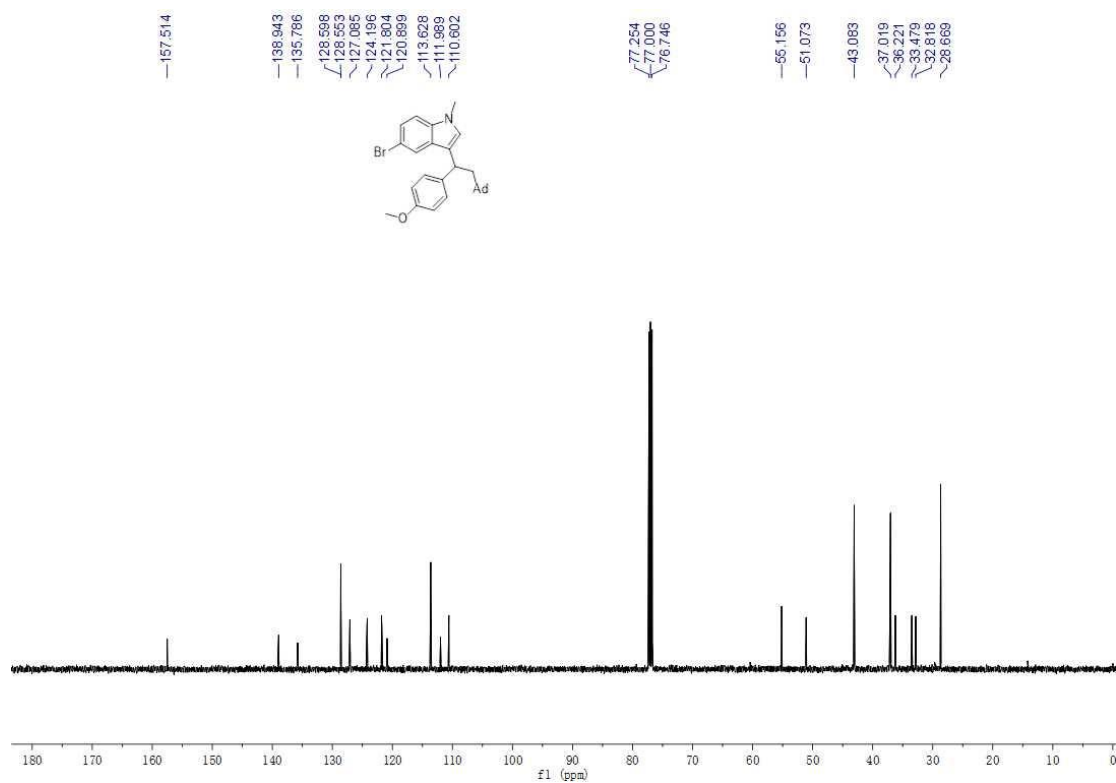
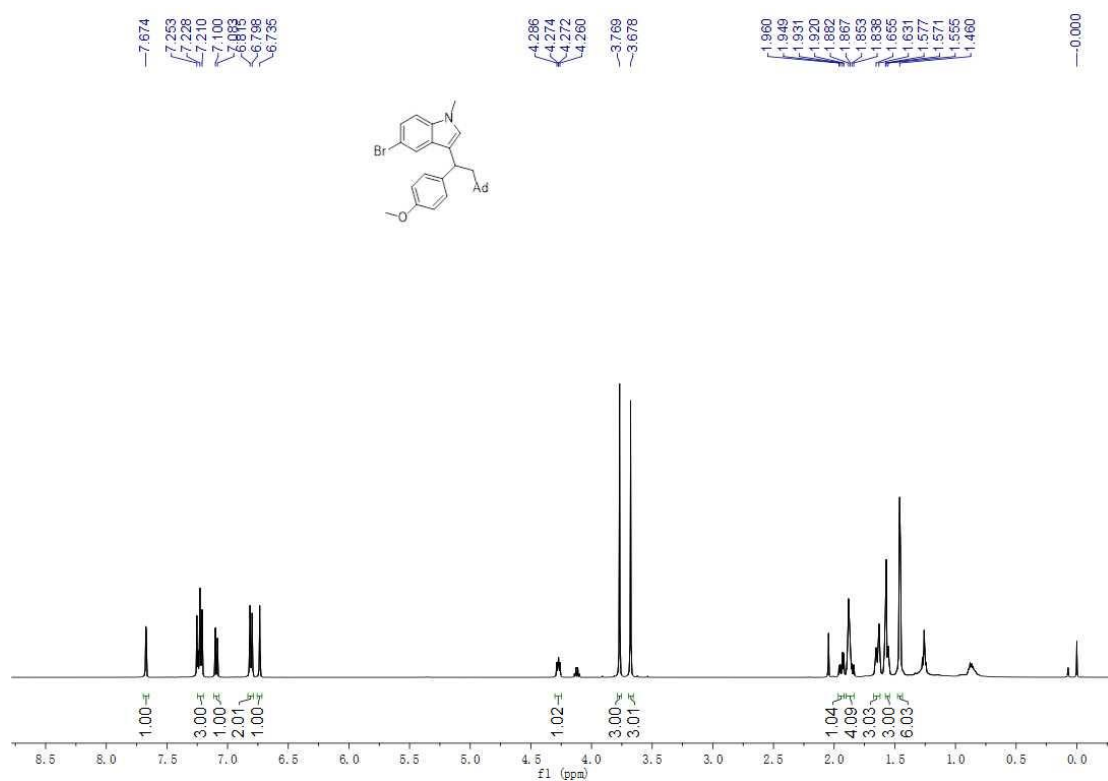


3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-allyl-1H-indole (4aad)



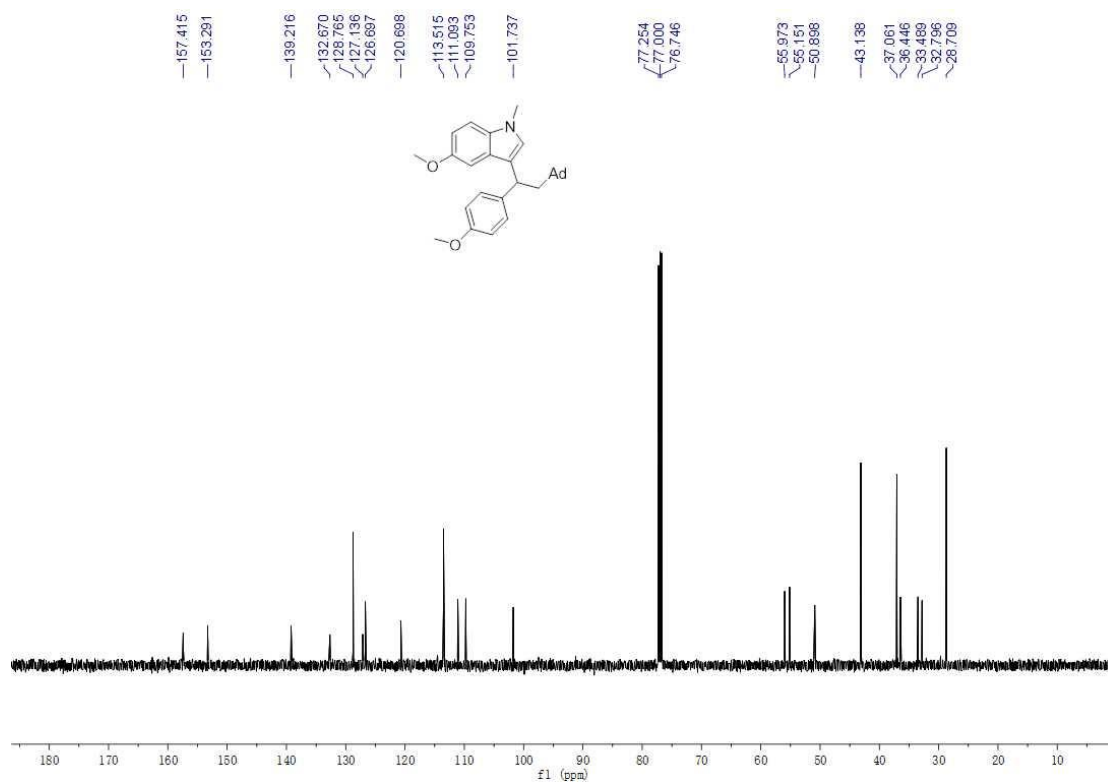
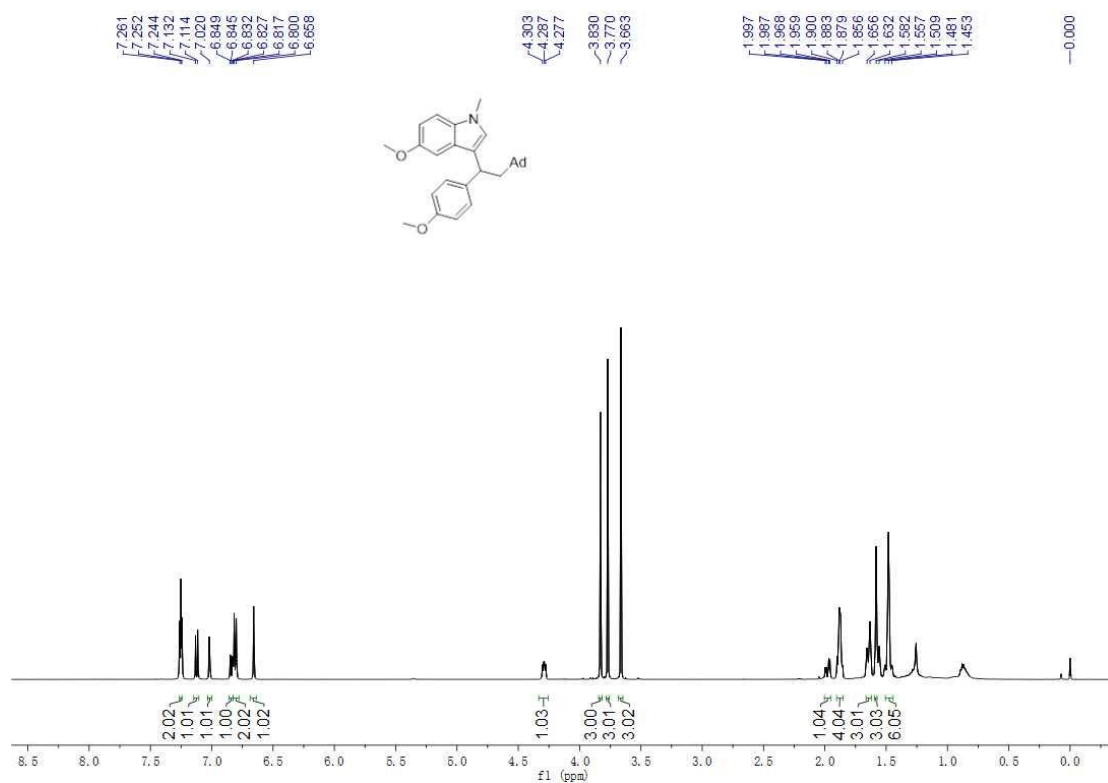
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-5-bromo-1-methyl-1H-indole

(4aae)



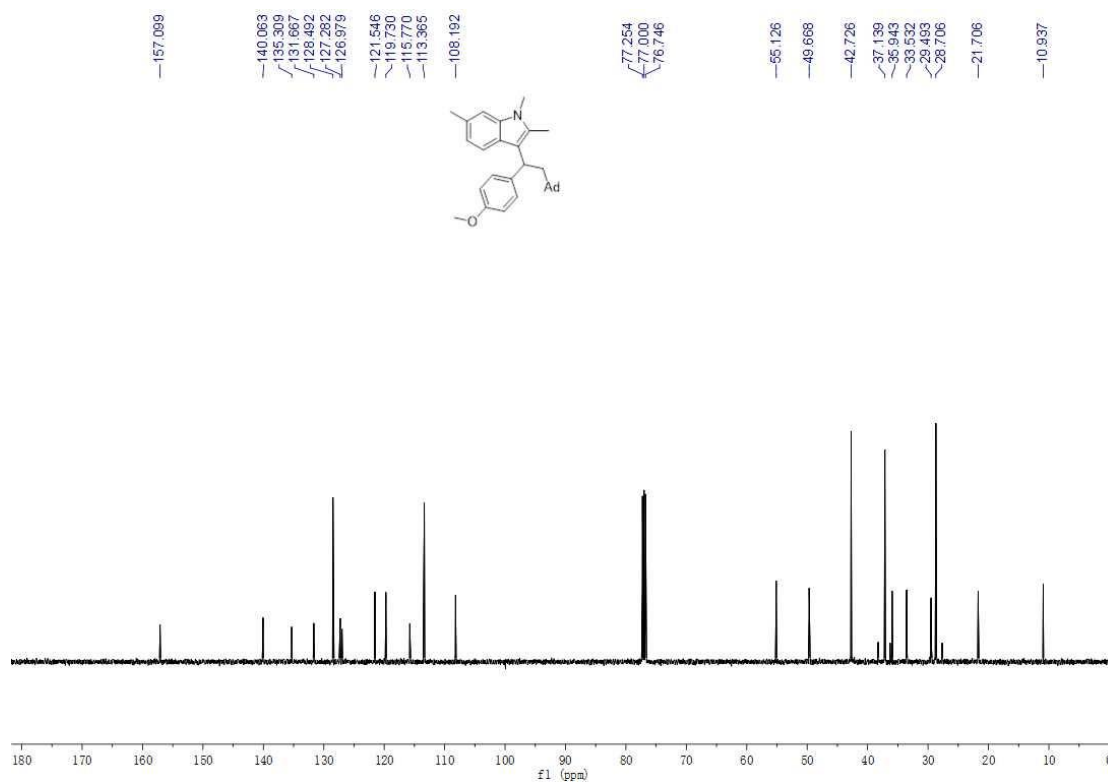
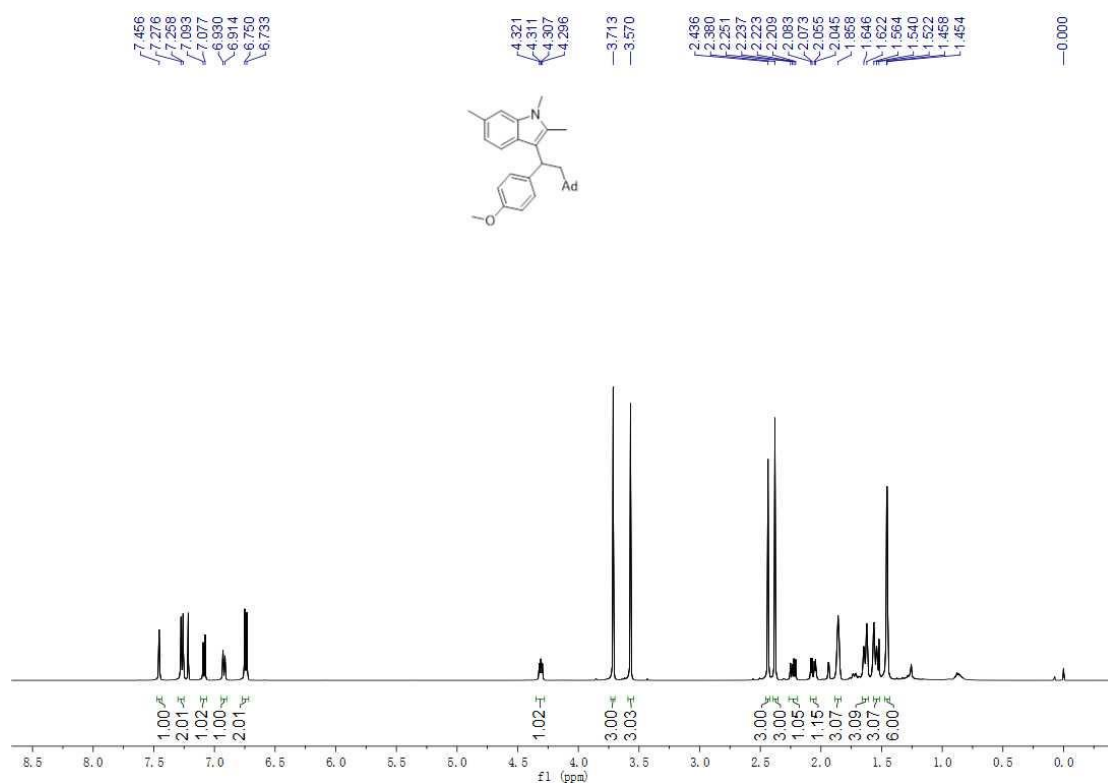
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2,6-trimethyl-1H-indole

(4aaf)



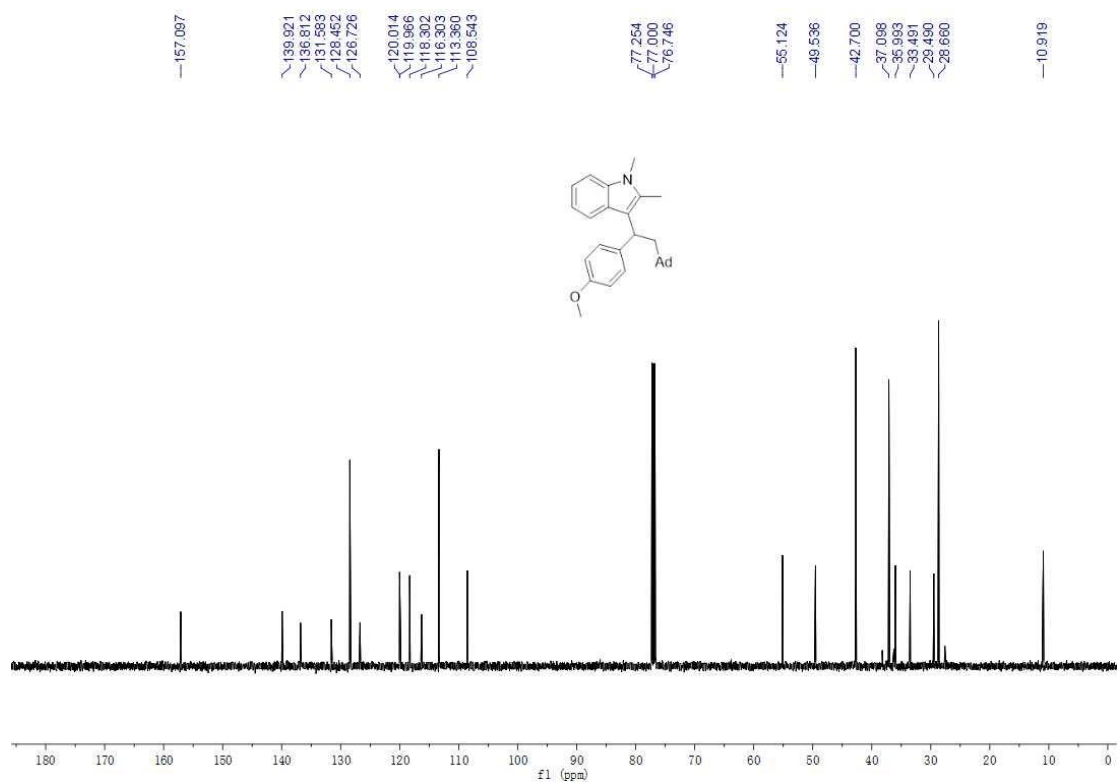
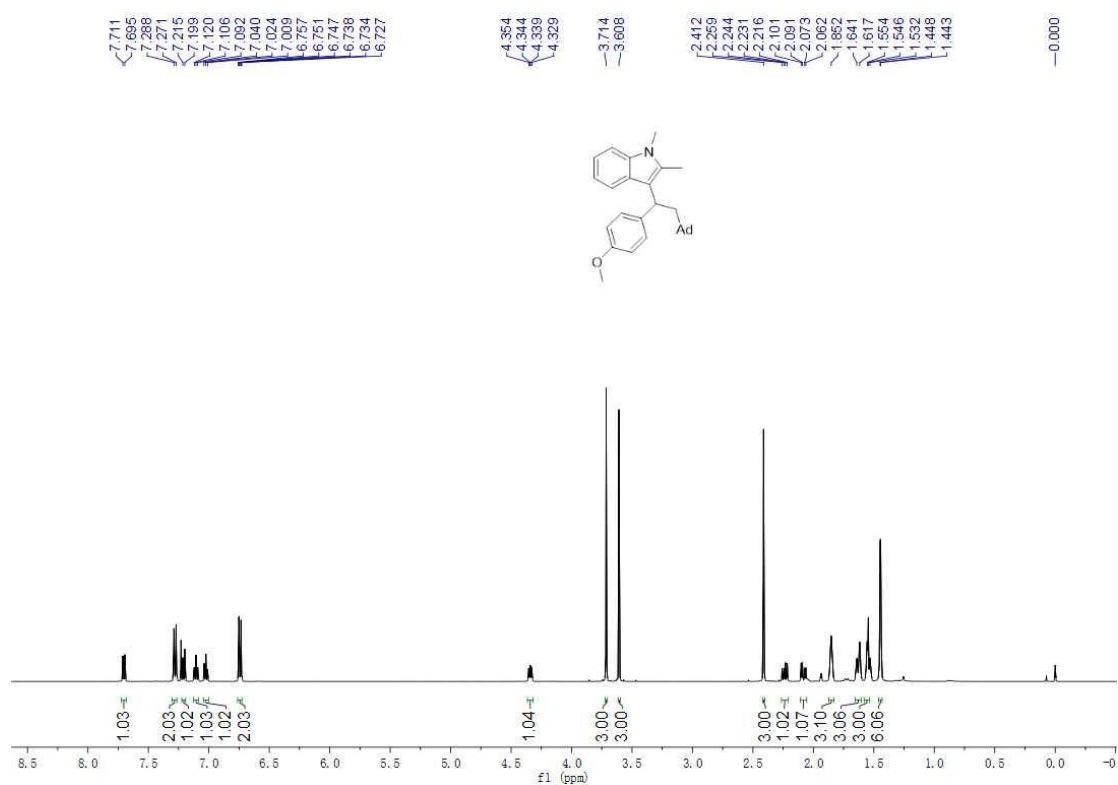
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2,6-trimethyl-1*H*-indole

(4aag)



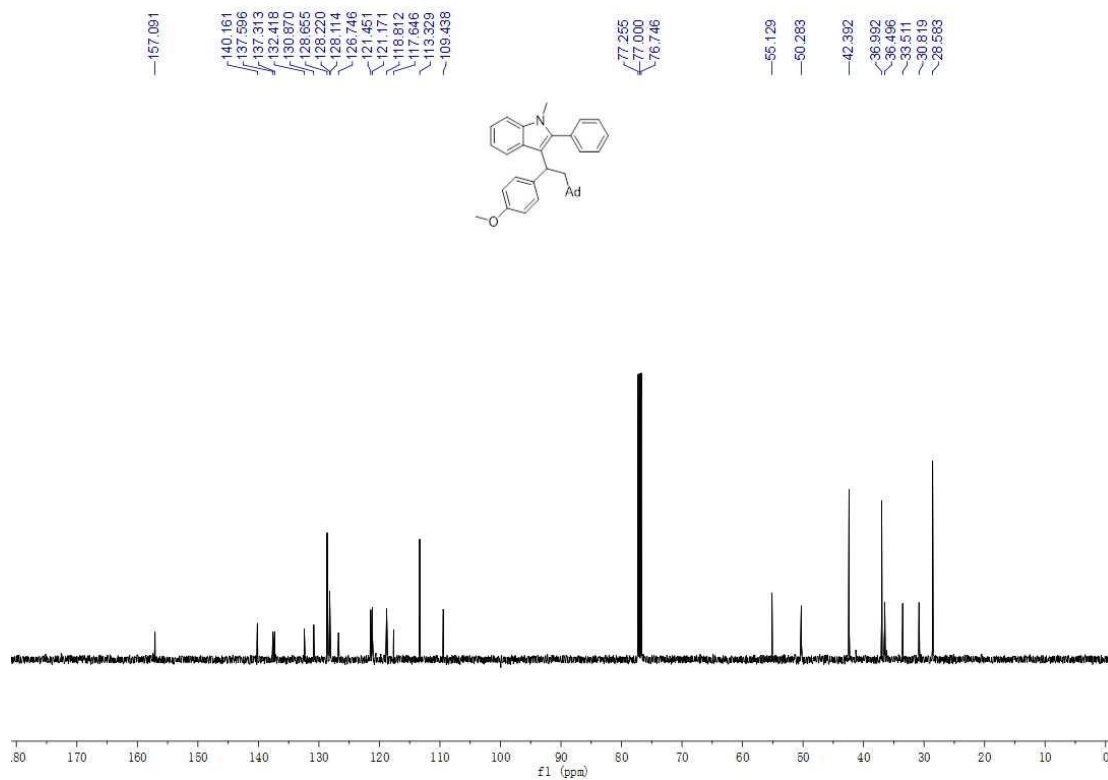
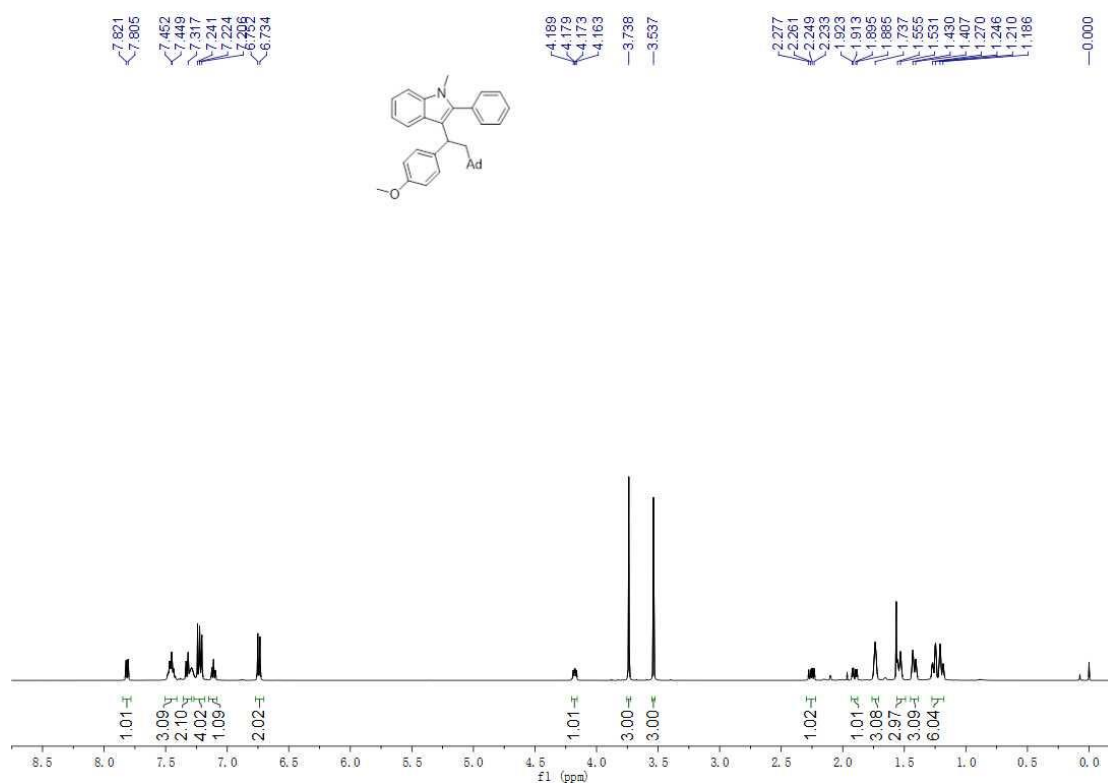
3-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2-dimethyl-1H-indole

(4aah)



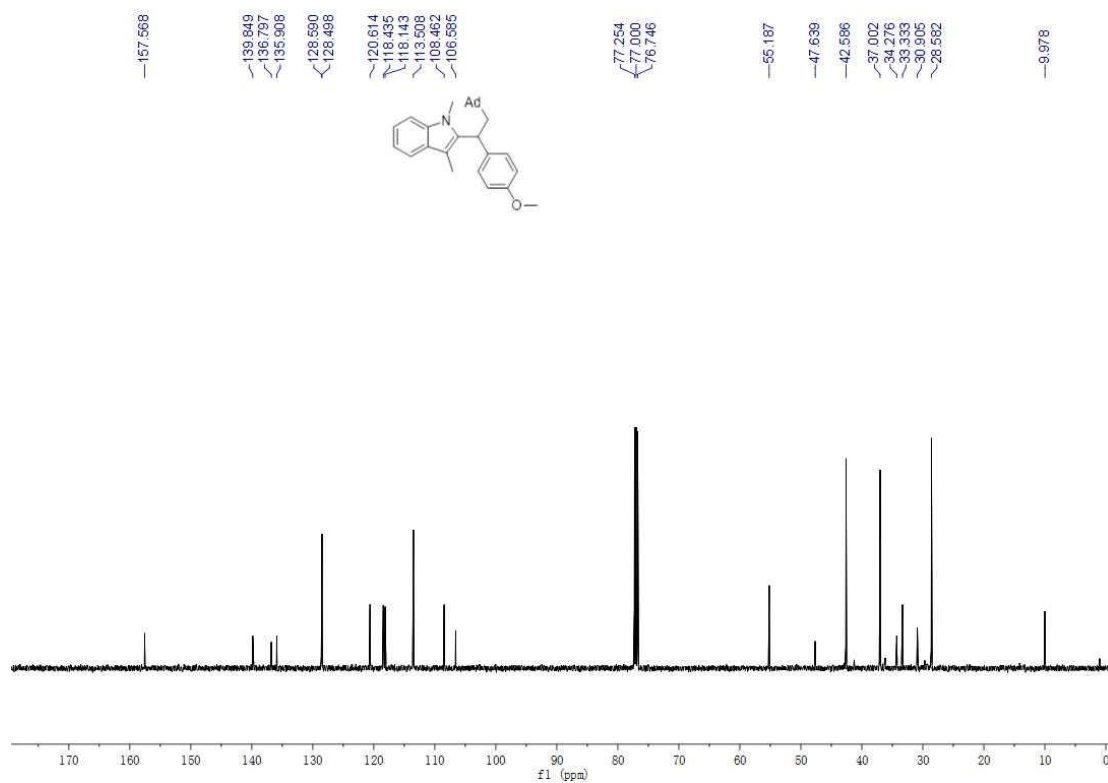
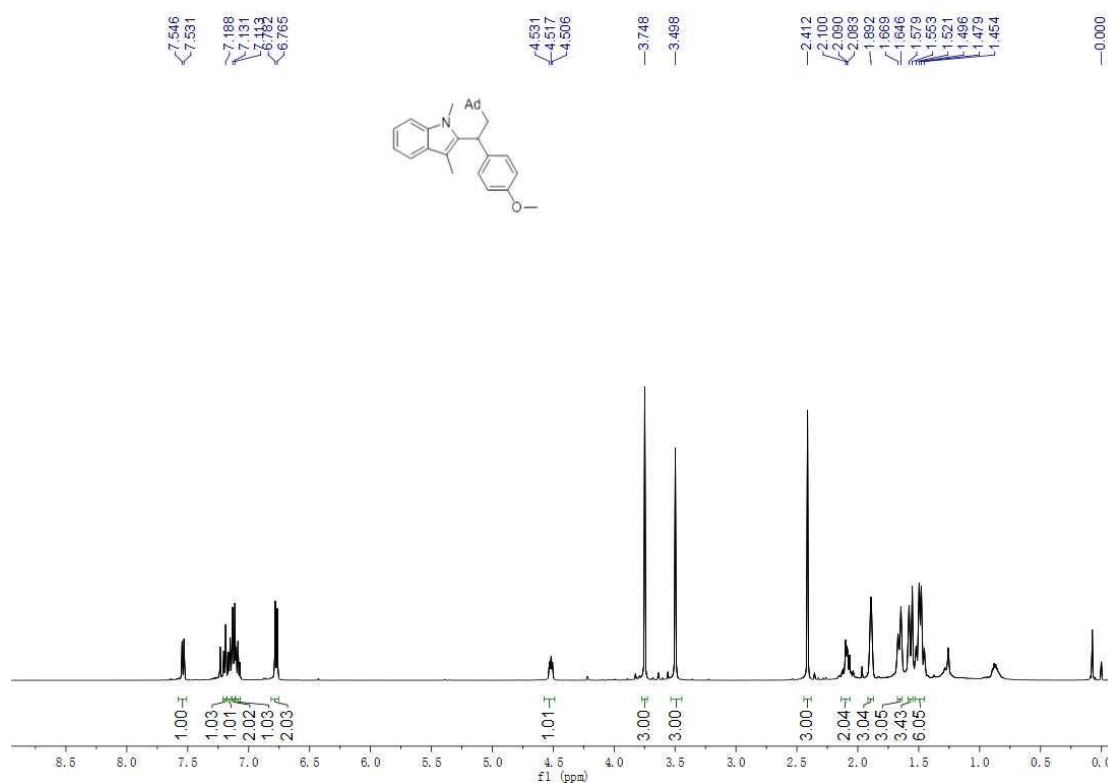
3-(2-(4-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1-methyl-2-phenyl-1H-indole

(4aai)

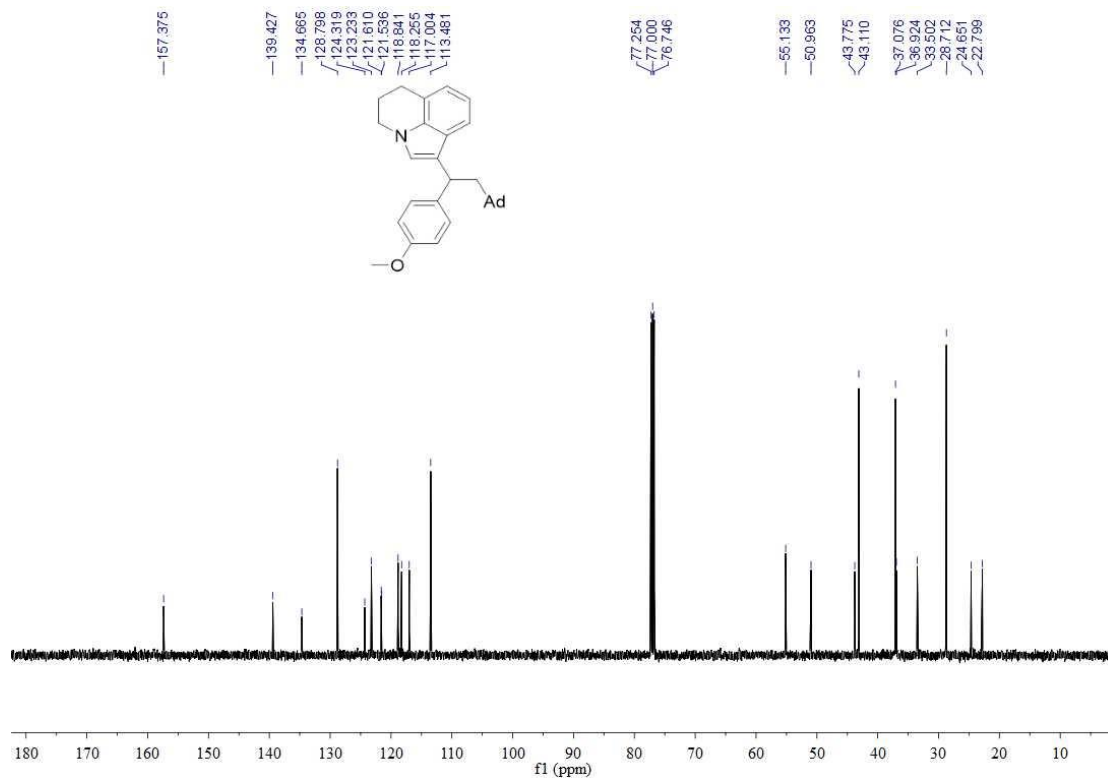
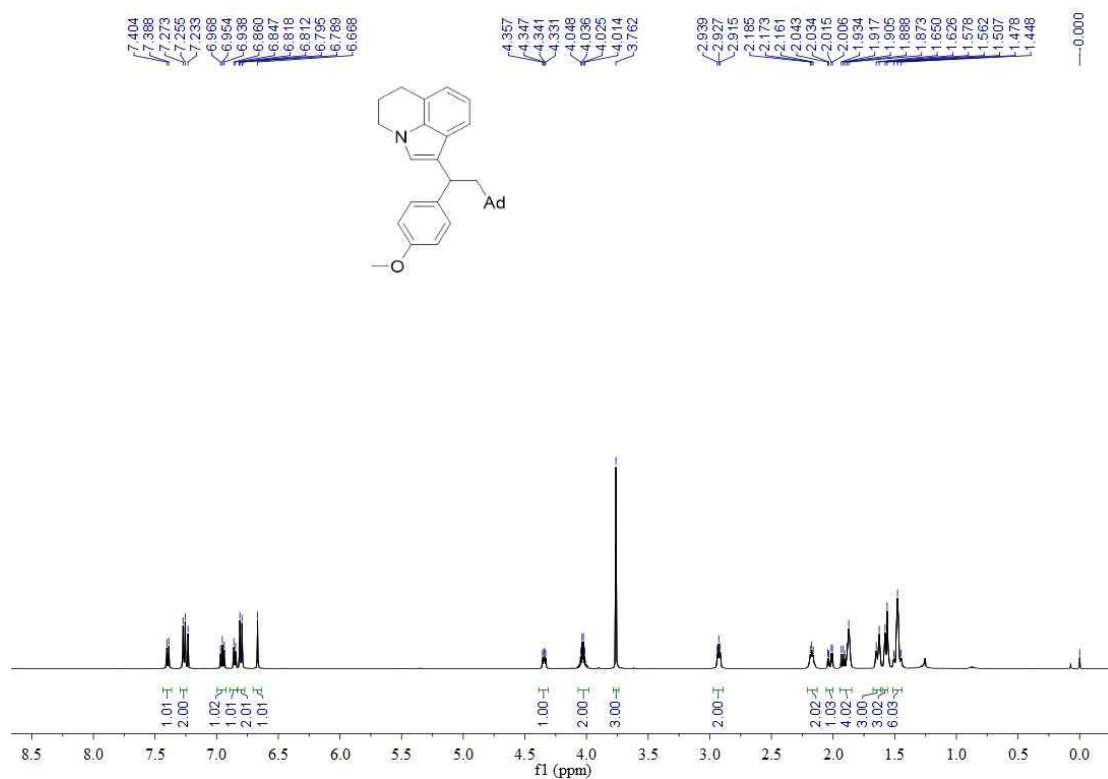


2-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,3-dimethyl-1H-indole

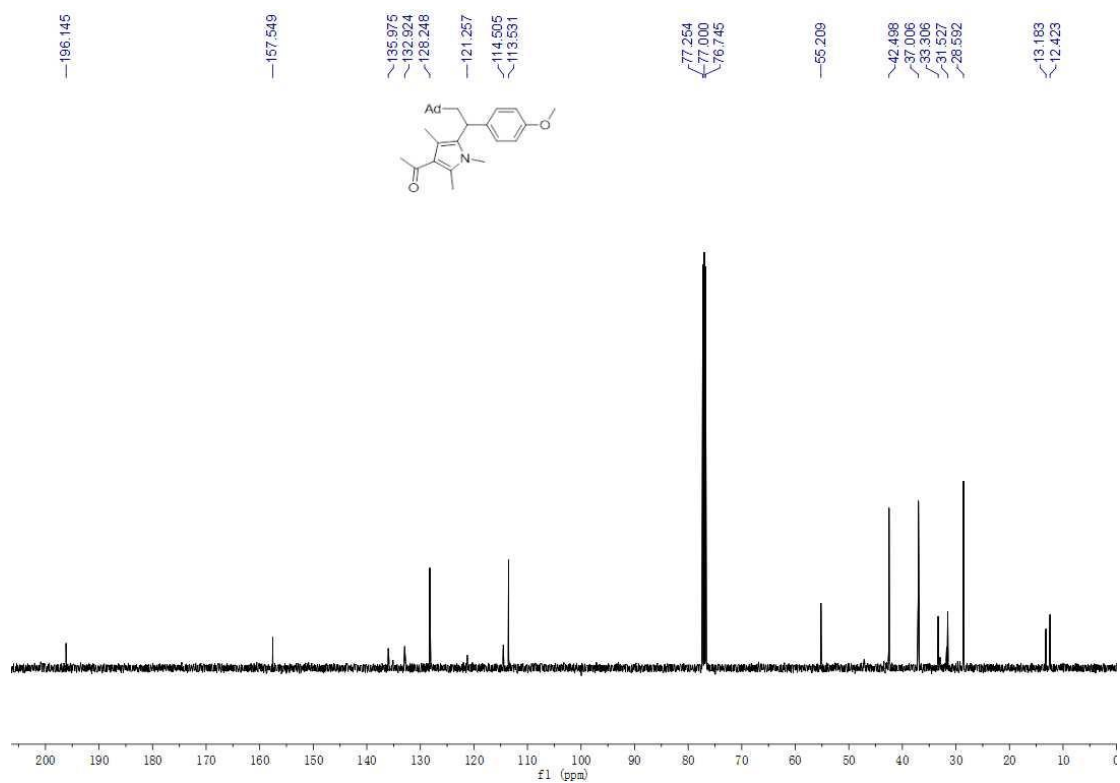
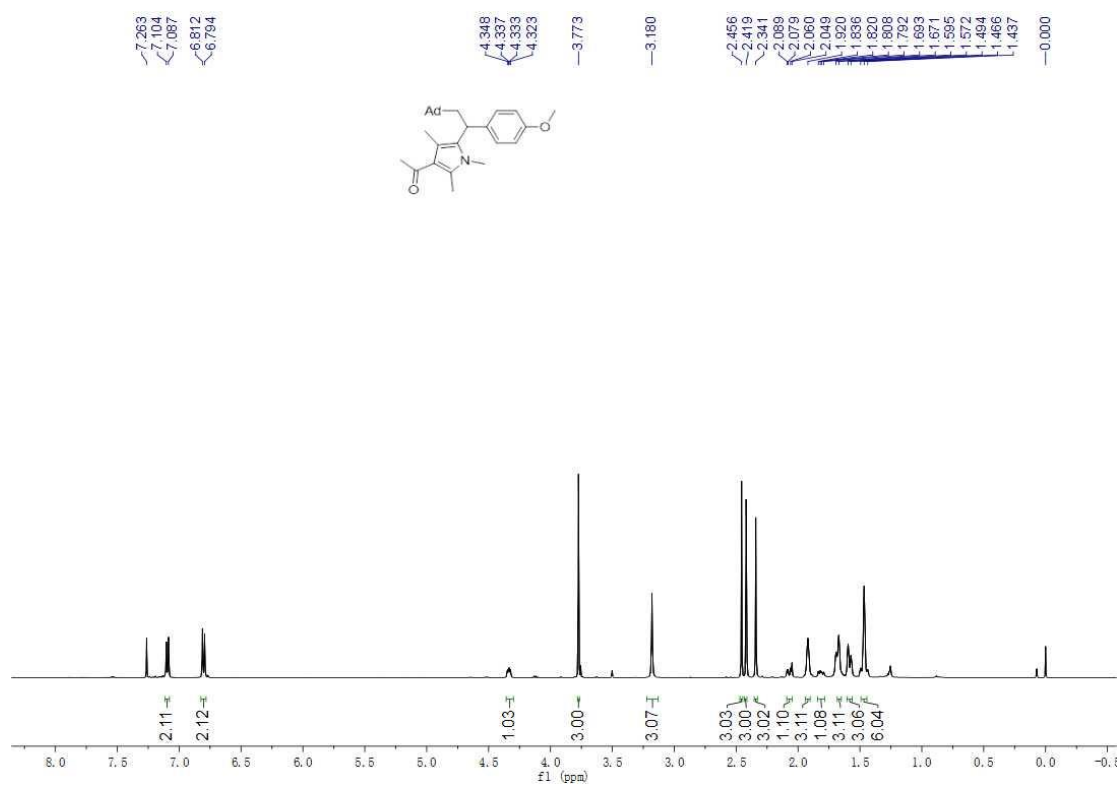
(4aaj)



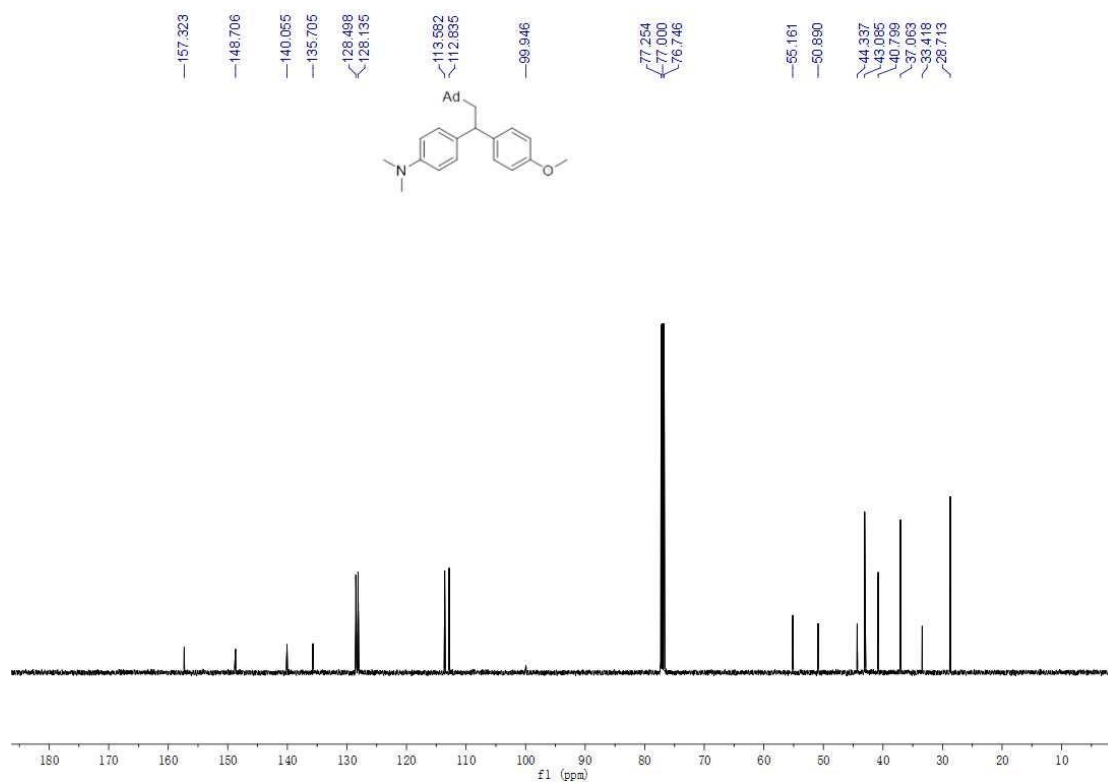
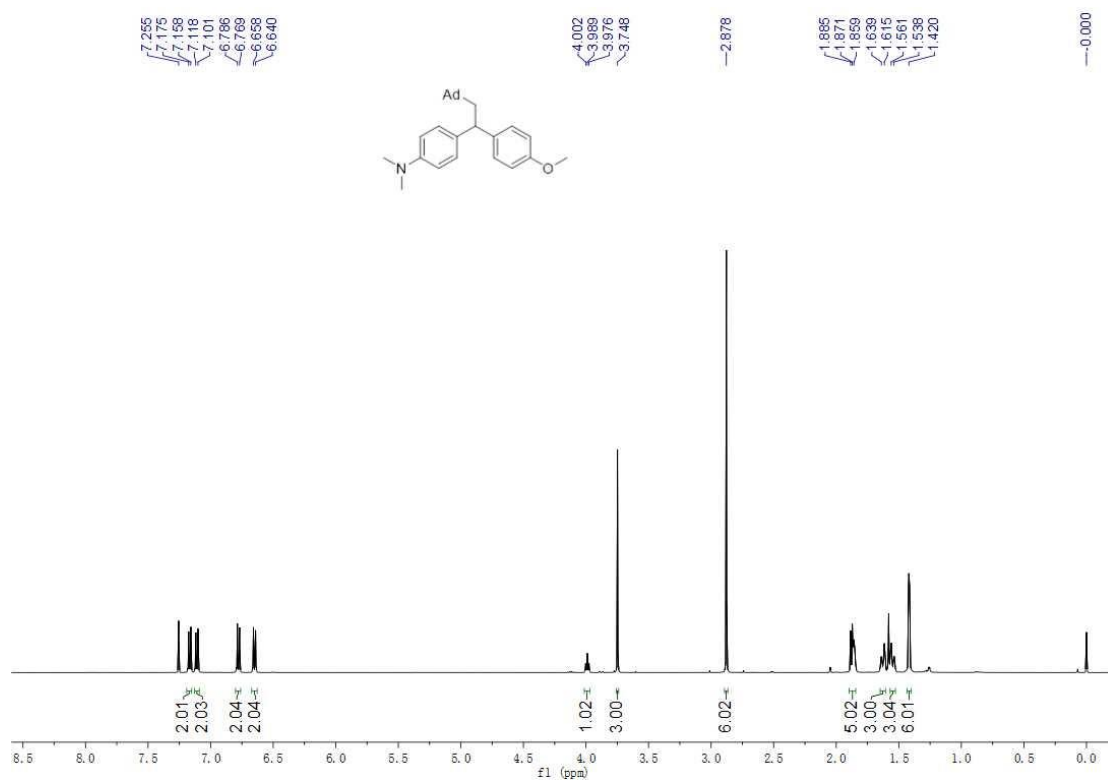
1-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-5,6-dihydro-4*H*-pyrrolo[3,2,1-*ij*]quinoline (4aal)



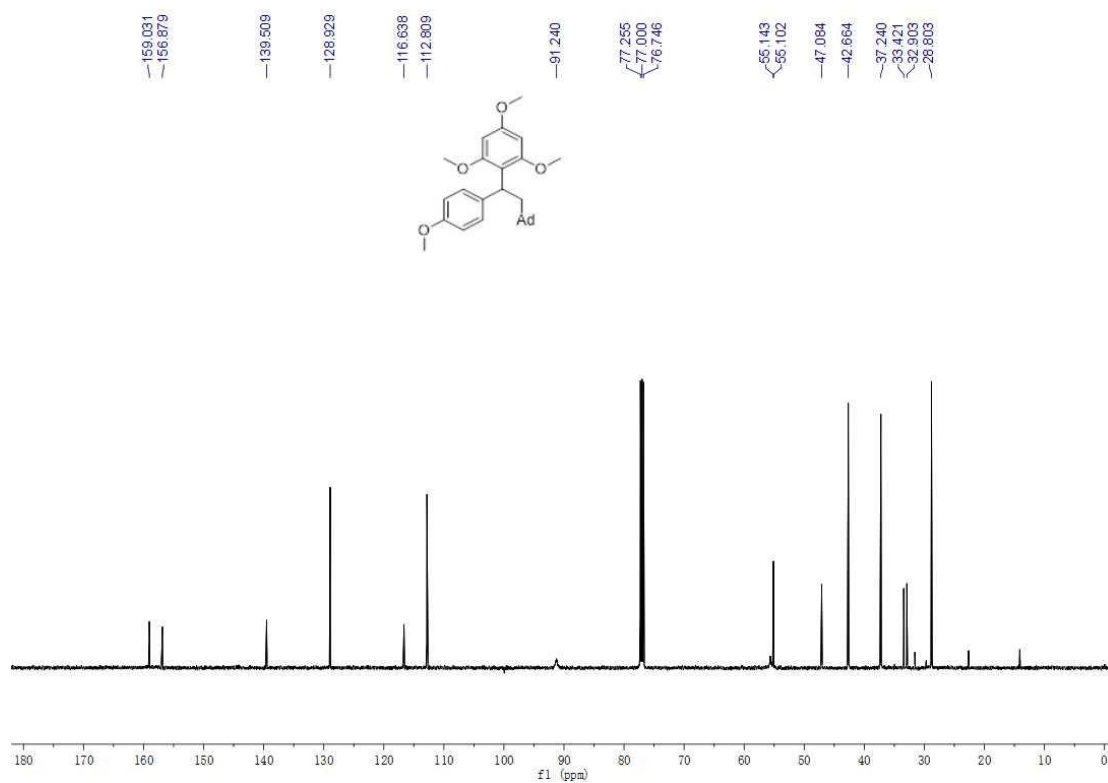
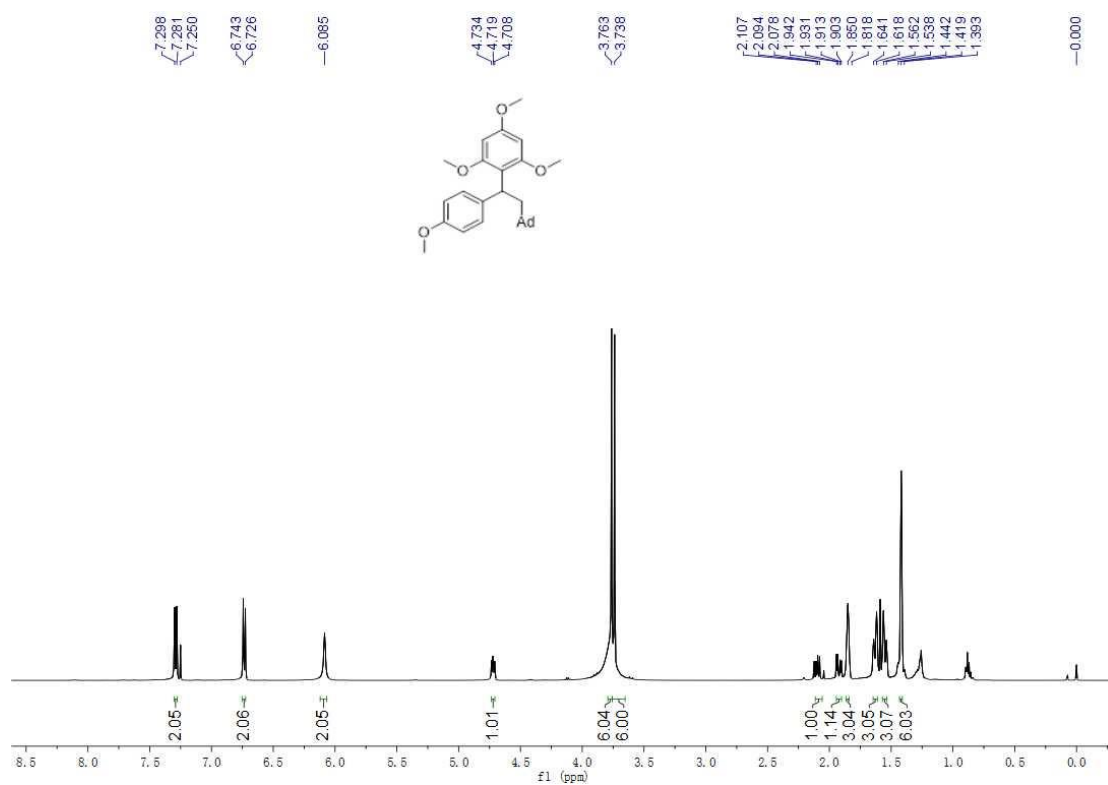
1-(5-(2-(-Adamantan-1-yl)-1-(4-methoxyphenyl)ethyl)-1,2,4-trimethyl-1H-pyrrol-3-yl)ethan-1-one (4aam)



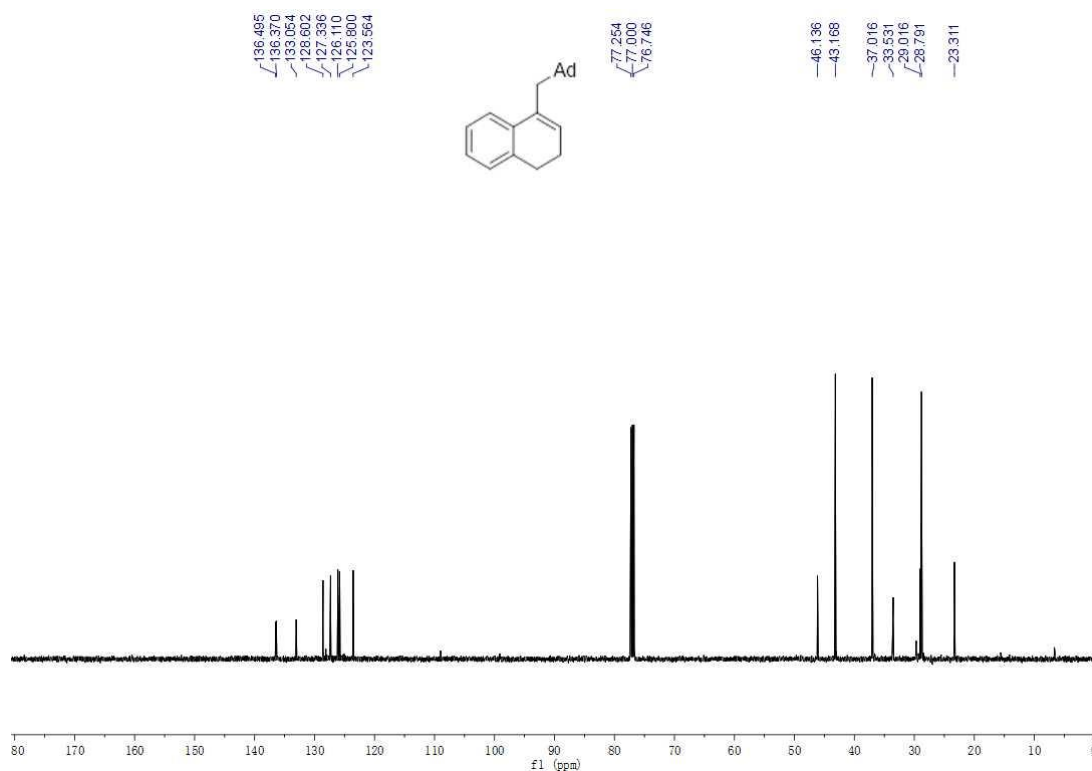
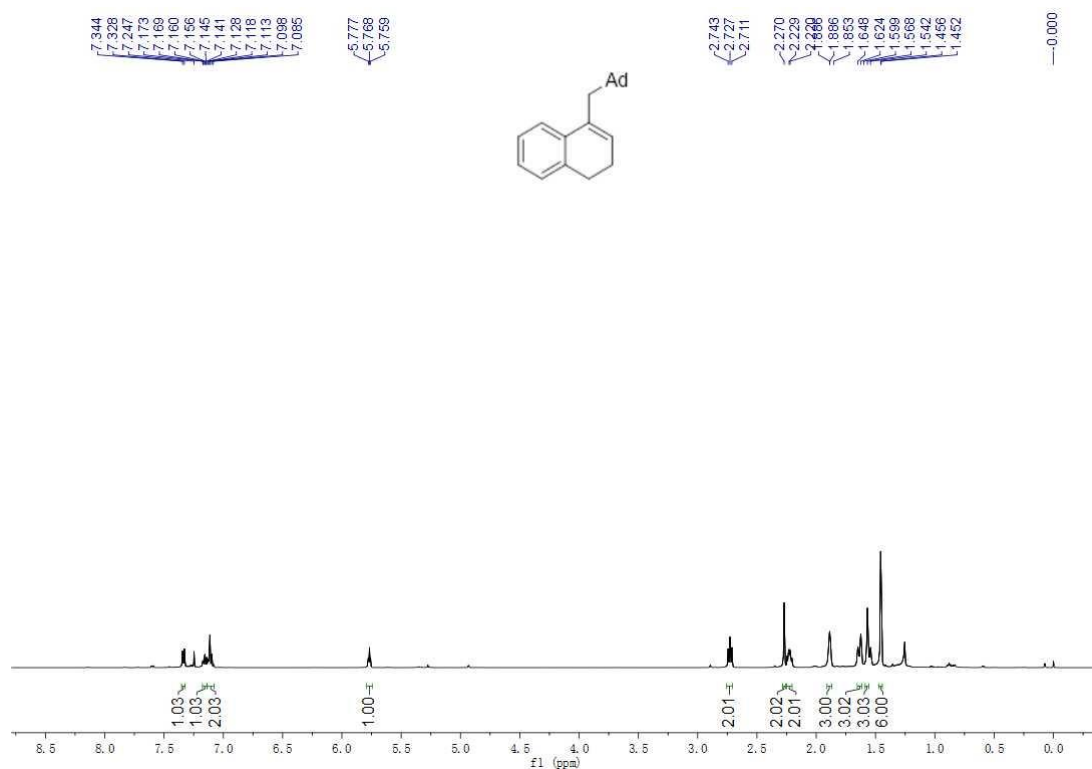
4-(2-(*Ad*-1-yl)-1-(4-methoxyphenyl)ethyl)-*N,N*-dimethylaniline (4aan)



1-(2-(4-Methoxyphenyl)-2-(2,4,6-trimethoxyphenyl)ethyl)adamantane (4aao)



1-((3,4-Dihydronaphthalen-1-yl)methyl)adamantane (5k)



Ethyl 7,7-diphenylhept-6-enoate (5l)

