Supporting Information

Selective Photocatalytic Reduction of Nitrobenzene to Anilines, Azoxybenzene, and Azobenzene: A Solvent-Dependent and Light-Induced Process Mediated by CdS/NH_2-MIL-125 Nanocomposite

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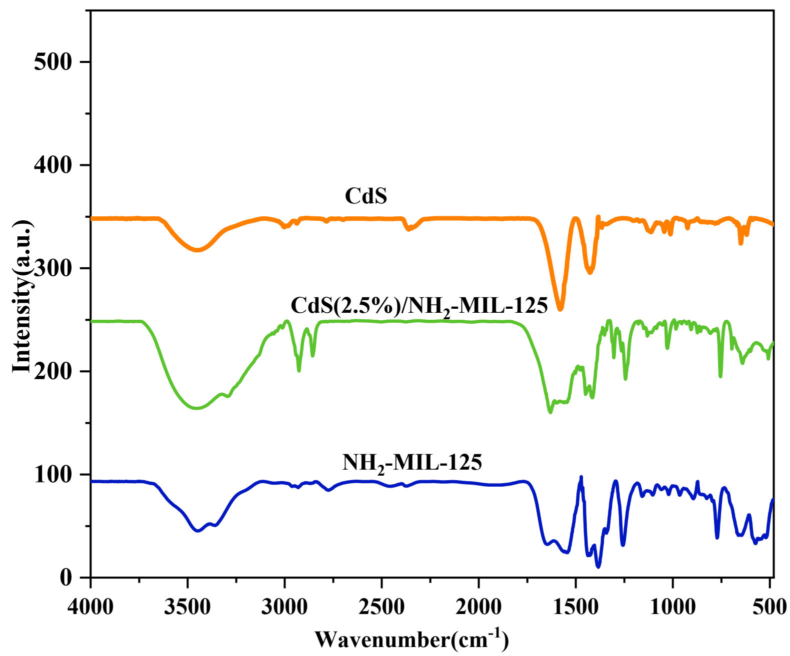


Fig. S1. FTIR Spectra of CdS, NH_2-MIL-125, and CdS/NH_2-MIL-125 nanocomposite

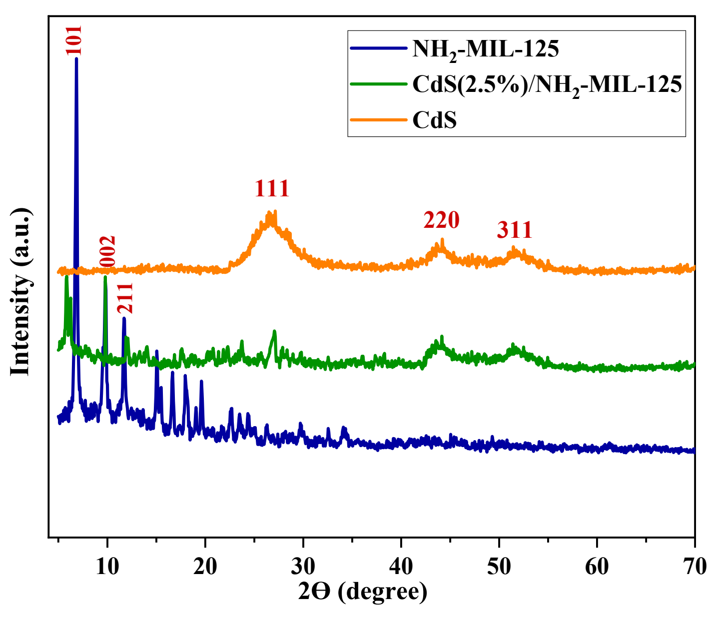


Fig. S2. XRD patterns of CdS, NH_2-MIL-125, and CdS/NH_2-MIL-125 nanocomposite

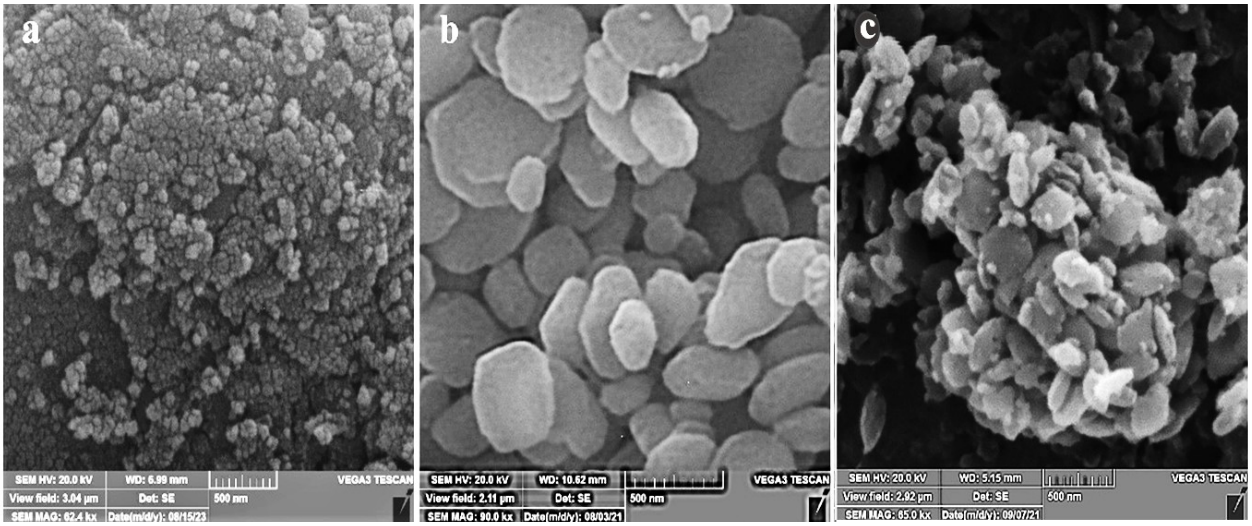
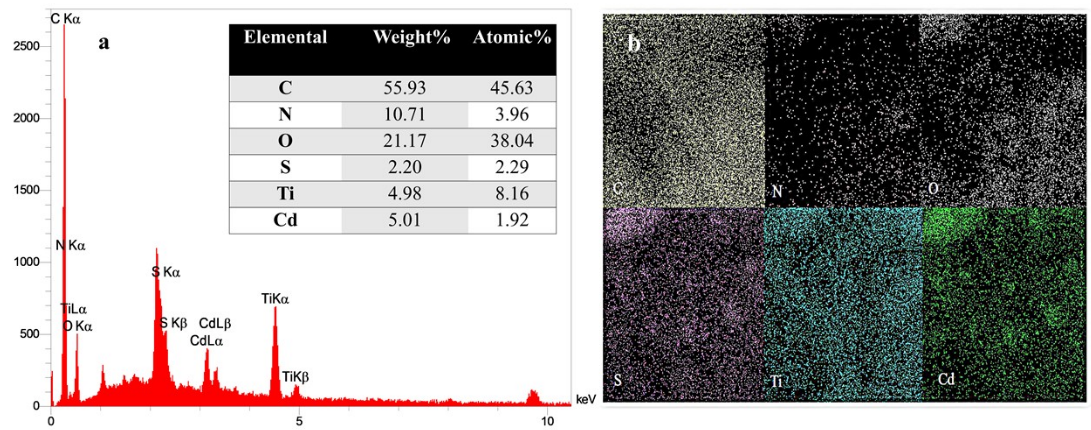


Fig. S3. SEM images of a) CdS, b) NH_2-MIL-125, and c) CdS/NH_2-MIL-125 nanocomposite



Elemental	Weight%	Atomic%
C	55.93	45.63
N	10.71	3.96
O	21.17	38.04
S	2.20	2.29
Ti	4.98	8.16
Cd	5.01	1.92

Fig. S4. (a) EDX point scan of the surface of CdS(2.5%)/NH_2-MIL-125 nanocomposite; (b) EDX mapping of CdS(2.5%)/NH_2-MIL-125

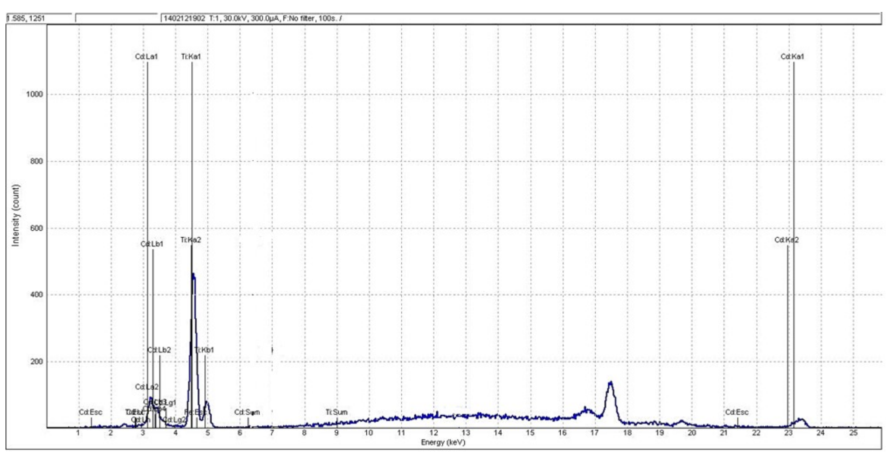


Fig. S5. XRF spectrum of the CdS(2.5%)/NH_2-MIL-125 nanocomposite.

The concentration and intensity of cadmium (Cd) in the XRF spectrum of the CdS(2.5%)/NH2-MIL-125 nanocomposite.

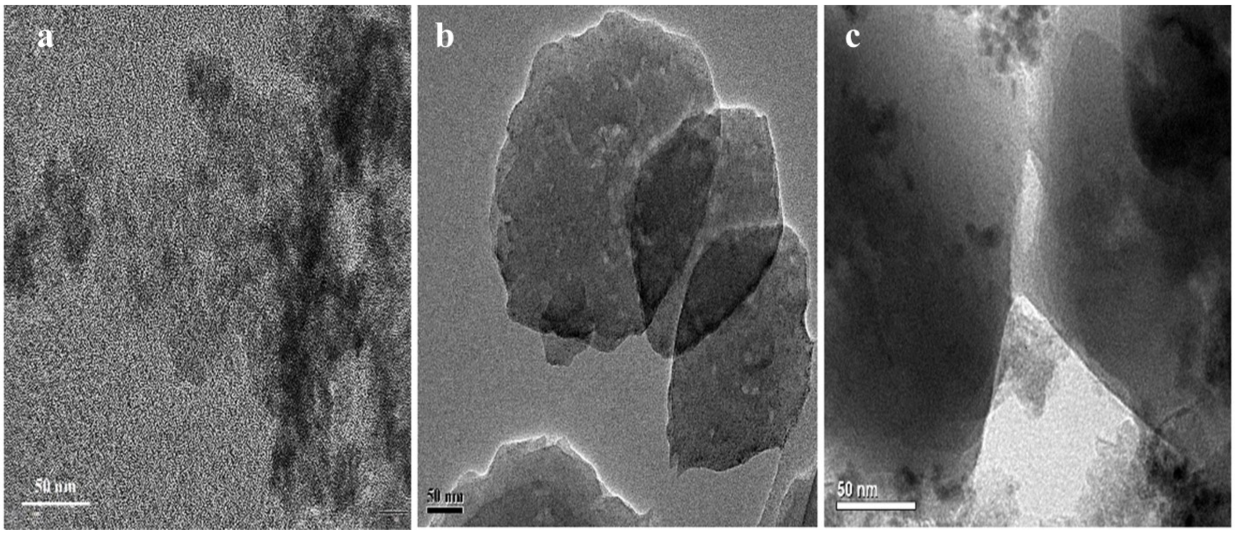


Fig. S6. HRTEM images of a) CdS, b) NH_2-MIL-125, and c) CdS/NH_2-MIL-125 nanocomposite

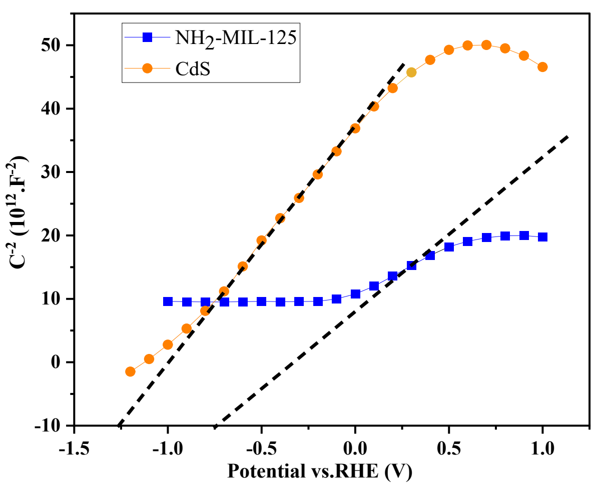


Fig. S7. Mott-Schottky plots of the (a) pure CdS and (b) NH_2-MIL-125.

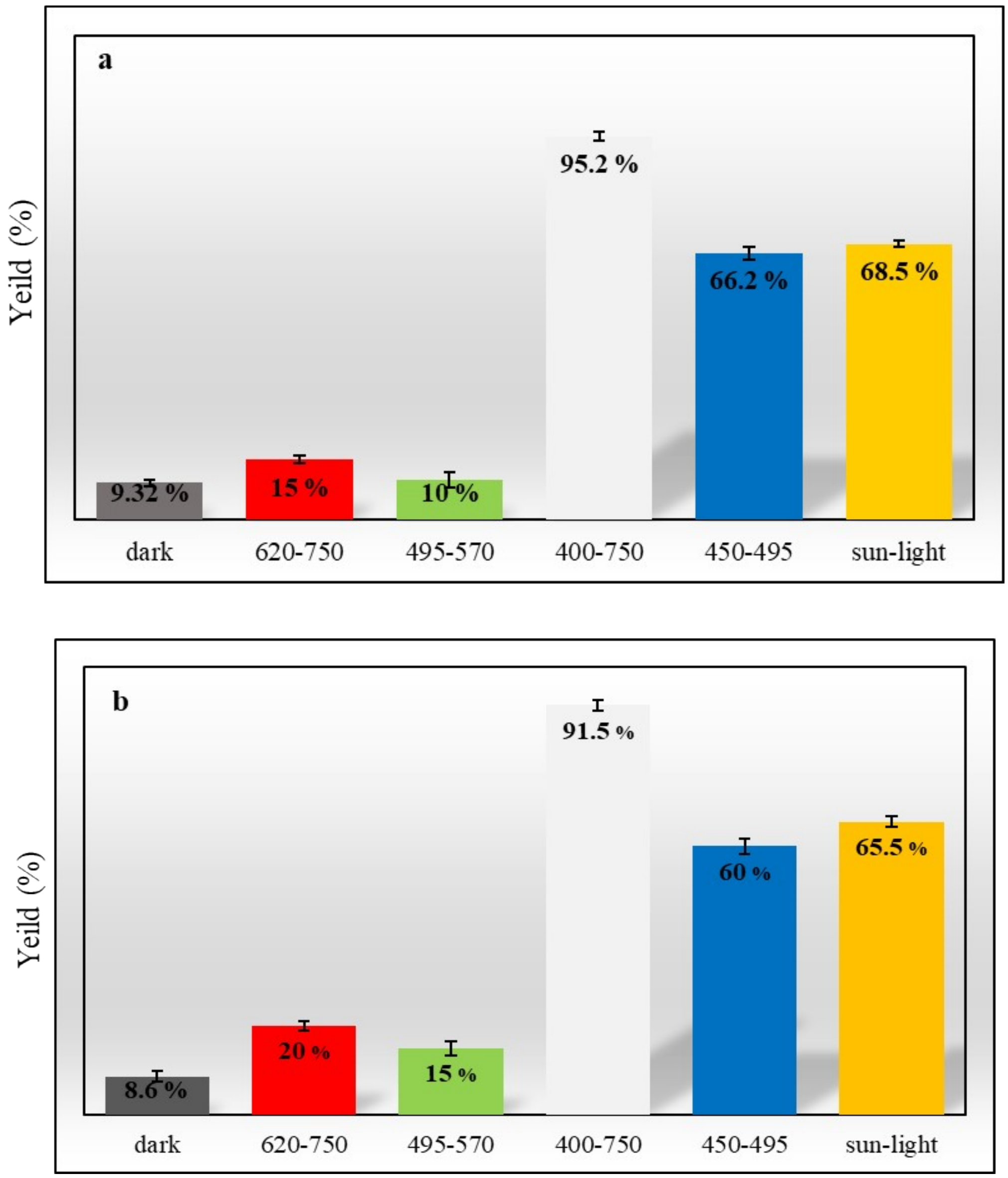
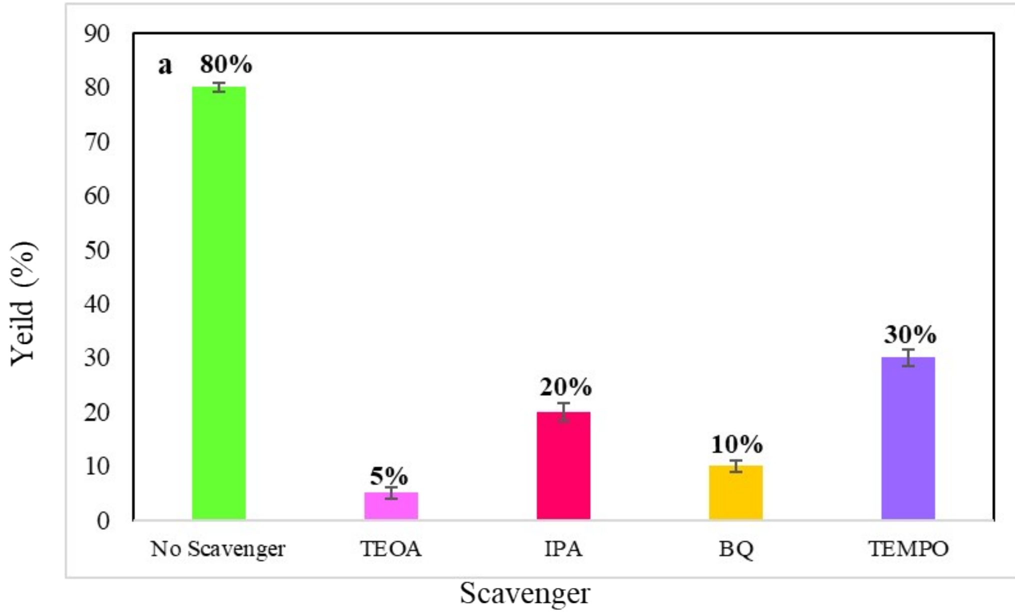


Fig S8. Efficiency of reduction reaction of nitroarenes to a) aniline, b) azobenzene product under different LEDs.



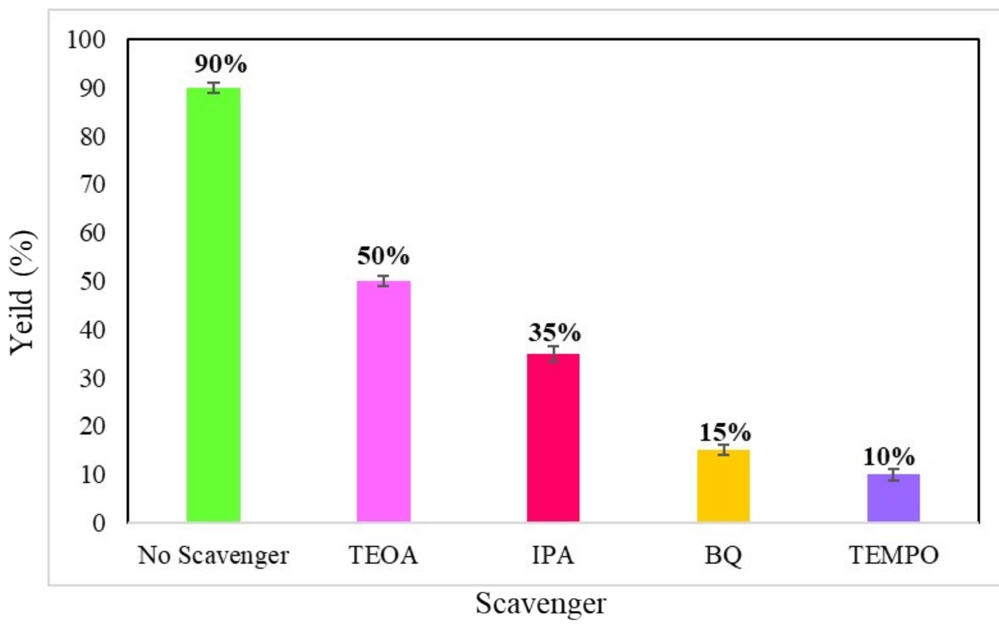


Fig S9. Control experiments for a) reduction of nitroarenes to azo-compounds b) reduction of nitroarenes to aniline.

Table S1. The concentration and intensity of cadmium (Cd) in the XRF spectrum of the CdS(2.5%)/NH_2-MIL-125 nanocomposite.

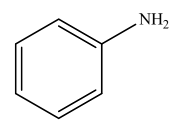
Composition	Elements	Concentration	Intensity
CdS (2.5%)/NH_2-MIL-125	Ti	38.7	97.9
	Cd	16.6	62.1

Table S2. Results BET for NH_2-MIL-125 and CdS/NH_2-MIL-125 nanocomposite

Photocatalyst	BET surface area (m^2,g^{-1})	Total pore volume (cm^3.g^{-1})	Average pore diameter (nm)
NH_2-MIL-125	396.9	0.39	3.9
CdS/NH_2-MIL-125	199.5	0.33	6.55

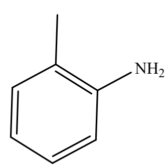
^{1}HNMR spectra of the synthesized compounds:

Aniline (**2a**)



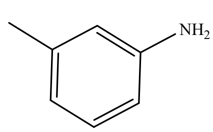
Yellow liquid, 85% yield; ^{1}H NMR (400 MHz, DMSO-*d6*); δ (ppm) =7.0 (t, *J* = 8 Hz, 2H, ArH), 6.5 (d, *J* = 8 Hz, 2H, ArH), 6.64 (t, *J* = 8 Hz, 1H, ArH), 4.98 (s, 2H, NH_2). ^{13}C NMR (DMSO, 101 MHz) δ (ppm) = 148.9, 129.3, 122.9, 115.4.

o-Toluidine (**2b**)

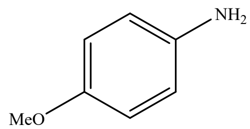


Black liquid, 80% yield; ^{1}H NMR (400 MHz, DMSO); δ (ppm) = 6.92 (t, *J* = 8 Hz,1H, ArH), 6.87 (t, J = 8 Hz,1H, ArH), 6.62 (d, *J* = 8 Hz,1H, ArH), 6.47 (d, *J* = 8 Hz,1H, ArH), 4.78 (s, 2H, NH_2), 2.05 (s, 3H, CH_3).^{13}C NMR (101 MHz, DMSO) δ (ppm) = 146.9, 130.3, 126.9, 121.4, 116.4, 114.3, 17.9.

m-Toluidine (**2c**)



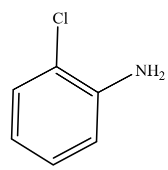
Yellow liquid, 78.3.3% yield; ^{1}H NMR (400 MHz, DMSO); δ (ppm) = 6.89 (t, *J* = 8 Hz,1H, ArH), 6.41 (d, *J* = 8 Hz,1H, ArH), 6.35 (s, 1H, ArH), 6.33 (d, *J* = 8 Hz,1H, ArH), 5.93 (s, 2H, NH_2), 2.16 (s, 3H, Me). ^{13}C NMR (101 MHz, DMSO) δ (ppm) = 148.9, 138.2, 129.1, 117, 114.7, 111.6, 21.7.



4-Methoxyaniline (**2d)**

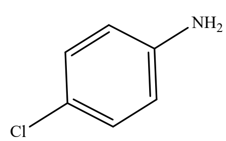
Black solid, 88% yield; ^{1}H NMR (400 MHz, DMSO); δ (ppm) =7.50 (d, *J* = 8 Hz,2H, ArH), 7.09 (d, *J* = 8 Hz,2H, ArH), 5.42 (s, 2H, NH_2), 4.04 (s, 3H, OCH_3). ^{13}C NMR (101 MHz, DMSO) δ (ppm) = 142.6, 141.8, 129.3, 121.5, 118.8, 118.

2-Chloroaniline (**2e**)



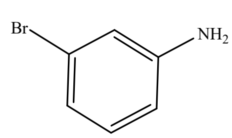
Yellow solide; 75% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 8.34 (d, *J* = 4 Hz,1H, ArH),, 8.08 (t, *J* = 4 Hz,1H, ArH), 7.38 (t, *J* = 8 Hz,1H, ArH), 7.18 (d, *J* = 8 Hz,1H, ArH), 6.68 (s, 2H, NH_2).^{13}C NMR (101 MHz, DMSO) δ (ppm) =142.6, 141.8, 129.3, 121.5, 118.8, 118.

4-Chloroaniline (**2f**)



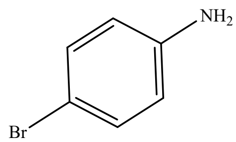
Yellow solide, 80% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 7.13 (d, *J* = 8 Hz,2H, ArH), 6.54 (d, *J* = 8 Hz,2H, ArH), 5.27 (s, 2H, NH_2).^{13}C NMR (76 MHz, DMSO) δ (ppm) = 148.5, 131.8, 116.2, 106.5.

3-Bromoaniline (**2g**)



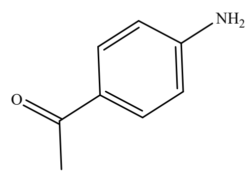
Brown solide, 83% yield; ^{1}H NMR (301 MHz, DMSO) δ (ppm) = 6.96 (d, *J* = 8 Hz,1H, ArH), 7.26 (s, 1H, ArH), 7.30 (d, *J* = 8 Hz,1H, ArH), 7.37 (t, *J* = 8 Hz,1H, ArH), 5.83 (s, 2H, NH_2). ^{13}C NMR (75 MHz, DMSO) δ (ppm) = 131.8, 129.1, 128.8, 127, 124.6, 120.2.

4-Bromoaniline (**2h**)

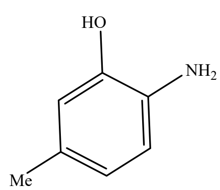


Brown solid; 73% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 7.59 (d, *J* = 8 Hz,2H, ArH), 6.56 (d, *J* = 8 Hz,2H, ArH), 5.87 (s, 2H, NH_2).^{13}C NMR (101 MHz, DMSO) δ (ppm) = 147.6, 128.4, 118.6, 115.1.

1-(4-Aminophenyl) ethenone (**2i**)



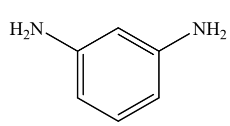
Yellow solid, 70% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 7.72 (d, *J* = 12 Hz,2H, ArH), 6.62 (d, *J* = 12 Hz,2H, ArH), 6.05 (s, 2H, NH_2), 2.40 (s, 3H, Me).^{13}C NMR (101 MHz, DMSO) δ (ppm) = 195.4, 154, 131, 125.3, 112.9, 26.3.



2-Amino-5-methylphenol (**2j**)

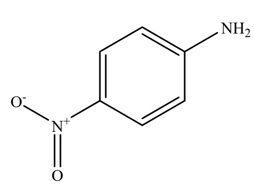
Yellow solid; 75% yield. ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 8.70 (s, 1H, OH), 6.51 (d, *J* = 8 Hz,2H, ArH), 6.42 (s, 2H, ArH), 6.22 (d, *J* = 8 Hz,2H, ArH), 4.41 (s, 2H, NH_2), 2.10 (s, 3H, Me). ^{13}C NMR (101 MHz, DMSO) δ (ppm) =142.2, 136.7, 128.2, 117.1, 115.6, 114.7, 21.

Benzene-1,3-diamine (**2k**)



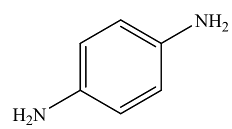
Yellow solide; 60% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 7.38 (t,1H, ArH), 7.26 (s, 1H, ArH), 6.96 (dd, 1H, ArH), 6.94 (dd, *J* = 8 Hz, 1H, ArH), 5.82 (s, 4H, NH_2).^{13}C NMR (101 MHz, DMSO) δ (ppm) = 131.2, 130.2, 122.6, 121.9.

4-Nitroaniline (**2l**)



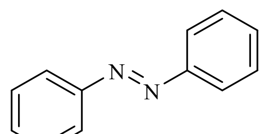
Yellow solide; 20% yield; ^{1}H NMR (400 MHz, DMSO); δ (ppm) =7.96 (d, *J* = 12 Hz, 2H, ArH), 6.61 (d, *J* = 12 Hz, 2H, ArH), 6.75 (s, 2H, NH_2).^{13}C NMR (101 MHz, DMSO) δ (ppm) = 167.4, 152.2, 131.1, 113.1.

Benzene-1,4-diamine (**2m**)



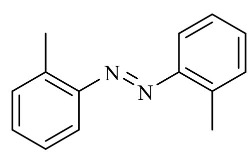
White solid; 50% yield; ^{1}H NMR (400 MHz, DMSO) δ (ppm) = 6.39 (s, 4H, ArH), 4.20 (s, 4H, NH_2). ^{13}C NMR (76 MHz, DMSO) δ (ppm) = 139.4, 115.9.

1,2-Diphenyldiazene (**3a**)



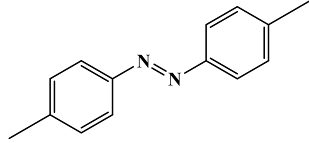
Yellow solid, 18 mg, 80% yield; m.p.: 67-68 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 66-67 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm)= 8.27 (d, J = 12 Hz, 4H, ArH), 7.75 (t, J = 12 Hz, 2H, ArH), 7.57 (d, J = 12 Hz, 4H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 163.7, 147, 129.1, 120.2.

1,2-Di-o-tolyldiazene (**3b)**



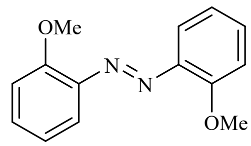
Dark Yellow solid, 16.2 mg, 75% yield; m.p.: 140-141 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 142-143 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) = 7.75 (m, 2H, ArH), 7.49 (d, *J* = 12 Hz, 2H, ArH), 7.31 (m, 2H, ArH), 7.09 (d, *J* = 14.6 Hz, 2H, ArH), 2.45 (s, 6H, Me). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 130, 129.5, 124.9, 122.8, 119.9, 115.7, 29.7.

1,2-Di-p-tolyldiazene (**3c**)



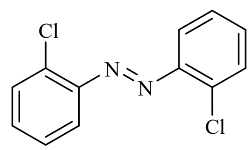
Yellow solid, 20 mg, 73% yield; m.p.:139-140 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 140-142 °C]. ^{1}H NMR (500 MHz, $CDCl_3$); δ (ppm) = 8.12 (d, *J* = 8.1 Hz, 4H, ArH), 7.30 (d, *J* = 8.1 Hz, 4H, ArH), 2.49 (s, 6H, CH_3). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) =146.2, 129.7, 123.7, 21.6.

1,2-Bis(2-methoxyphenyl) diazene (**3d**)



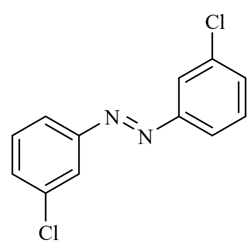
Orang solid, 14.2 mg, 78% yield; m.p.: 154-156 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 156-157 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) = 8.26 (d, *J* = 8 Hz, 2H), 7.92 (d, *J* = 8 Hz, 2H, ArH), 6.93-6.96 (dd, 4H, ArH), 3.82 (s, 6H, OCH_3). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 161.6, 147.1, 124.4, 114.2, 55.6.

1,2-Bis(2-chlorophenyl) diazene (**3e**)



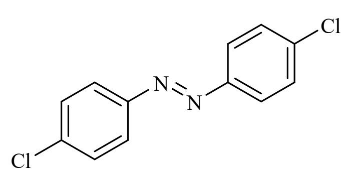
Orang solid, 12 mg, 65% yield; m.p.: 189-191 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 186-187 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) = 9.11 (t, *J* = 8 Hz, 2H, ArH), 8.62 (dd, 4H, ArH), 7.84 (t, *J* = 8 Hz, 2H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 159.6,135.26, 131.3, 130.2, 122.4, 121.9.

1,2-Bis(3-chlorophenyl) diazene (**3f**)



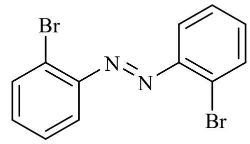
Yellow solid, 16.2 mg, 70% yield; m.p.: 182-183 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 180-181 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) = 7.92 (s, 2H, ArH), 7.87 (t, 2H, ArH), 7.50 (m, 4H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 159.1,136.2, 131.3, 130.2, 129.4, 124.2.

1,2-Bis(4-chlorophenyl) diazene (**3g**)



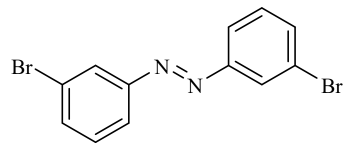
Yellow solid, 17mg, 73% yield; m.p: 180-182°C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 178-179 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) = 7.87 (d, *J* = 8 Hz, 4H, ArH), 7.49 (d, *J* = 8 Hz, 4H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) = 163.9, 147.9, 128.6, 120.8.

1,2-Bis(2-bromophenyl) diazene (**3h**)



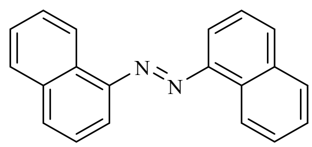
Yellow solid, 11 mg, 63% yield; m.p.: 202-204 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 200-201 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) =7.75 (dd, 2H, ArH), 7.64 (t, J=2.4, 2H, ArH), 7.35 (t, J=8, 2H, ArH), 7.10 (dd, 2H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) =129.6, 129.3, 128.5, 128.4, 127.1, 123.6.

1,2-Bis(3-bromophenyl) diazene (**3i**)



Yellow solid, 13 mg, 65% yield; m.p: 201-203 °C [Lit, (Wang et, al. 2023, Yan et, al. 2020) 198-199 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) =7.64 (d, *J*=8, 2H, ArH), 7.42 (d, *J*=8, 2H, ArH), 7.32 (s, 2H, ArH), 7.24 (t, *J*=8, 2H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) =129.3, 123.2, 122.6, 118.2, 117.6, 108.4.

1,2-Di(naphthalen-1-yl) diazene (**3j**)



Yellow solid, 20 mg, 74% yield; m.p.: 250-252 °C. [Lit, (Wang et, al. 2023, Yan et, al. 2020) 249-250 °C]. ^{1}H NMR (400 MHz, $CDCl_3$); δ (ppm) =7.42 (m, 2H, ArH), 7.26 (d, *J* = 8 Hz, 4H, ArH), 6.98 (m, 2H, ArH), 6.84 (d, *J* = 8.4 Hz,4H, ArH), 6.66 (t, *J* = 6 Hz,2H, ArH). ^{13}C NMR ($CDCl_3$, 125 MHz) δ (ppm) =129.6, 129.3, 128.5, 128.4, 127.1, 123.6.

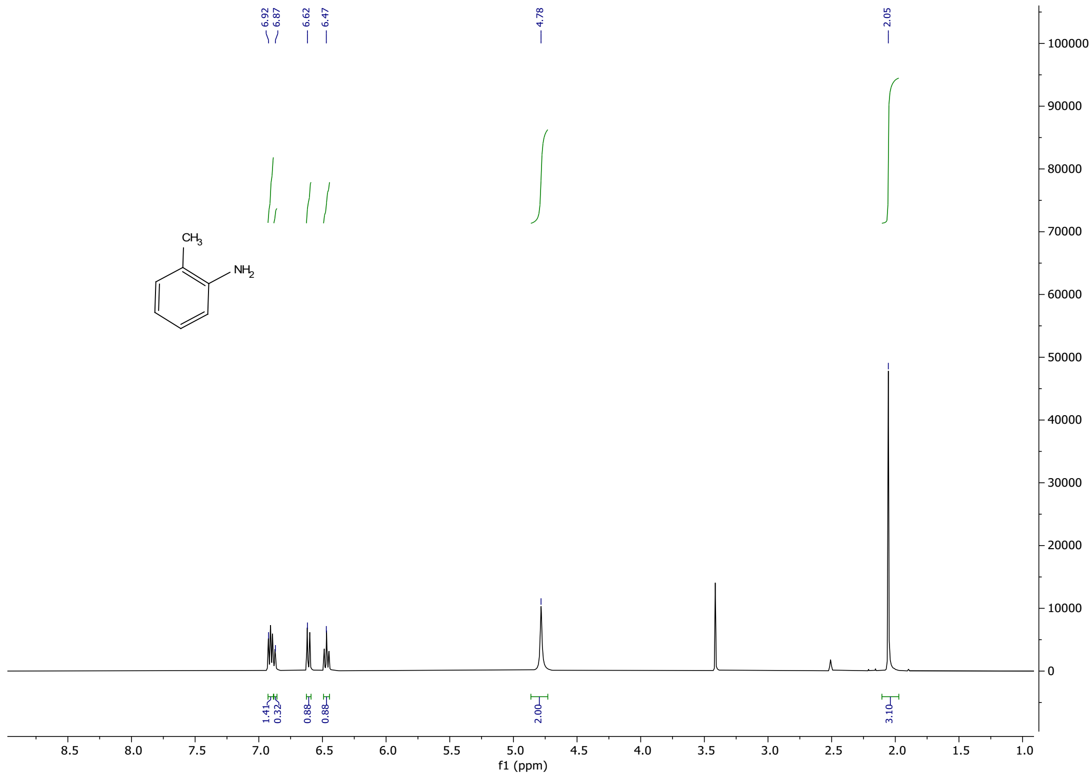


Fig. S7. [1]HNMR (400 MHz, DMSO) spectrum of 2b.

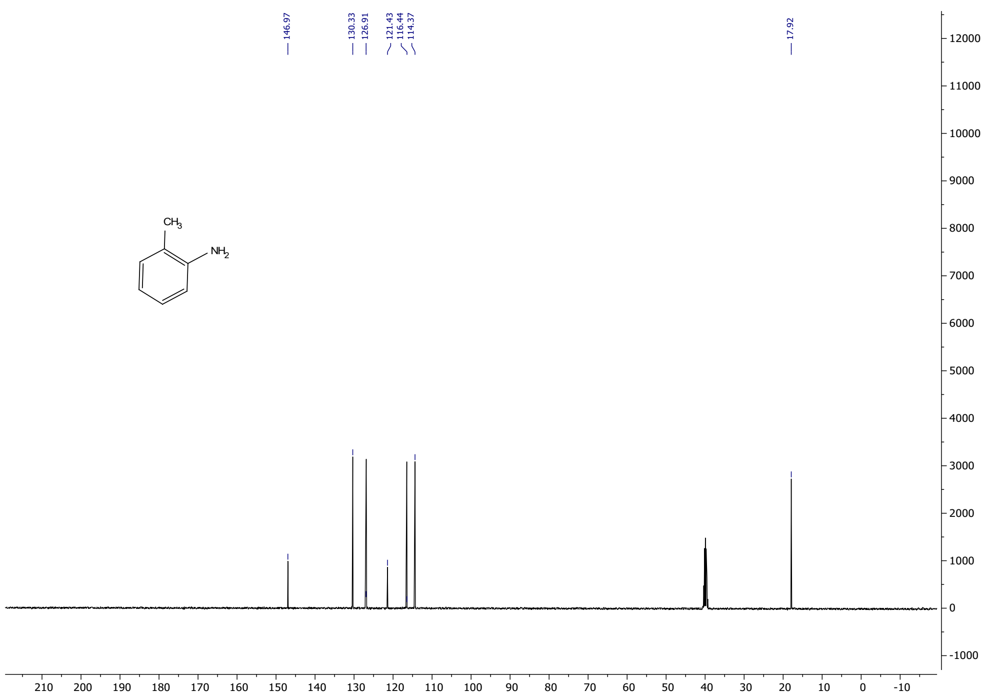


Fig. S8. [13]CNMR (400 MHz, DMSO) spectrum of 2b.

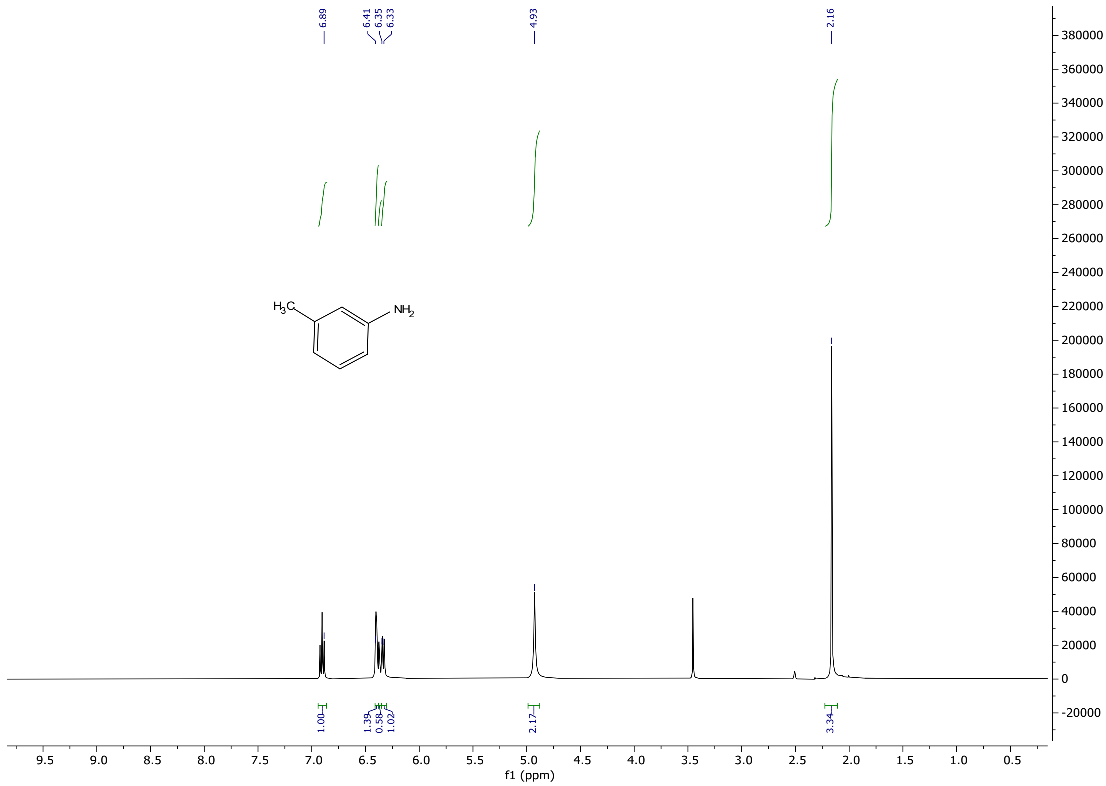


Fig. S9. ¹HNMR (400 MHz, DMSO) spectrum of 2c.

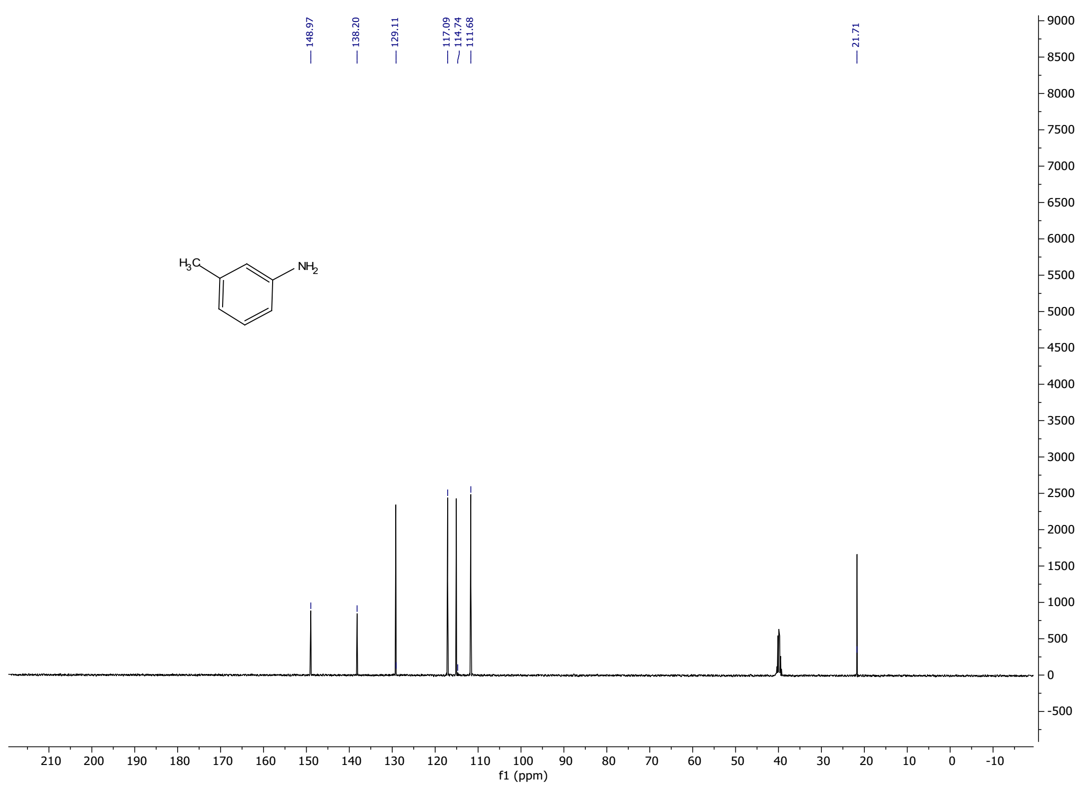


Fig. S10. ¹³CNMR (400 MHz, DMSO) spectrum of 2c.

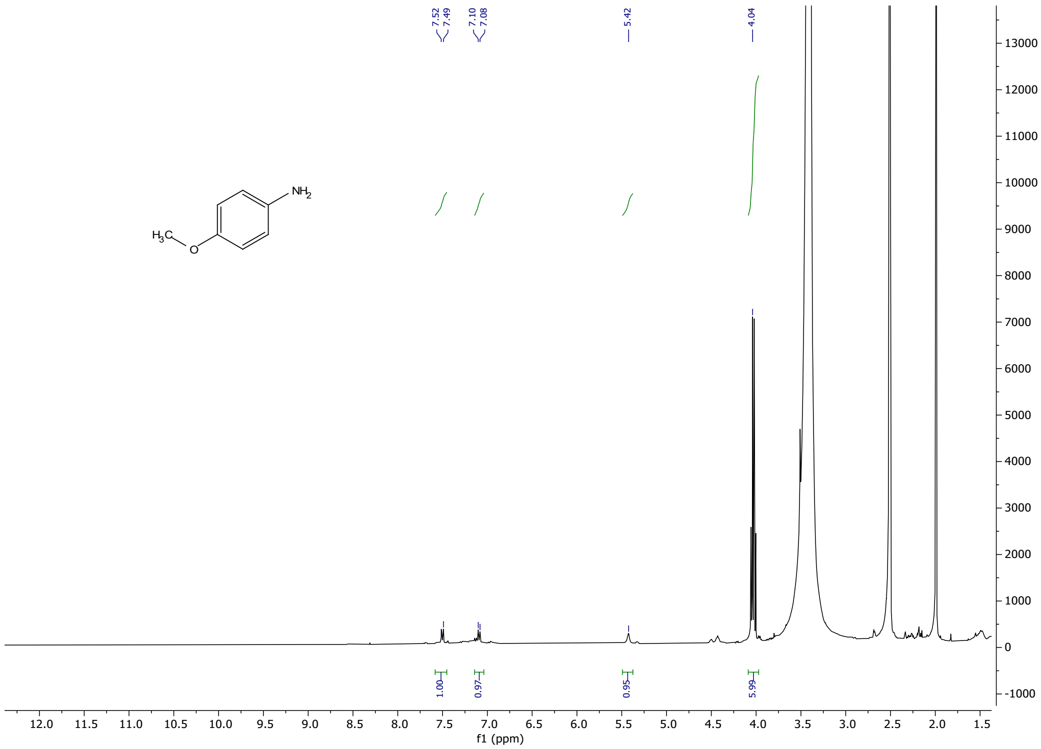


Fig. S11. [1]HNMR (400 MHz, DMSO) spectrum of 2d.

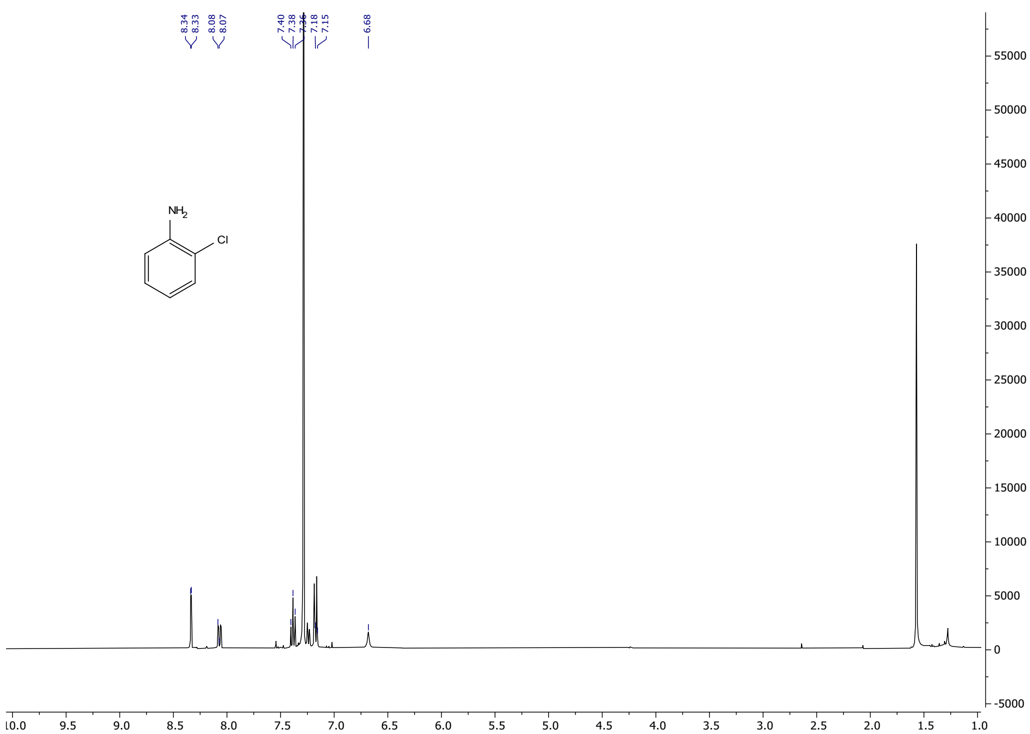


Fig. S12. ¹HNMR (400 MHz, DMSO) spectrum of 2e.

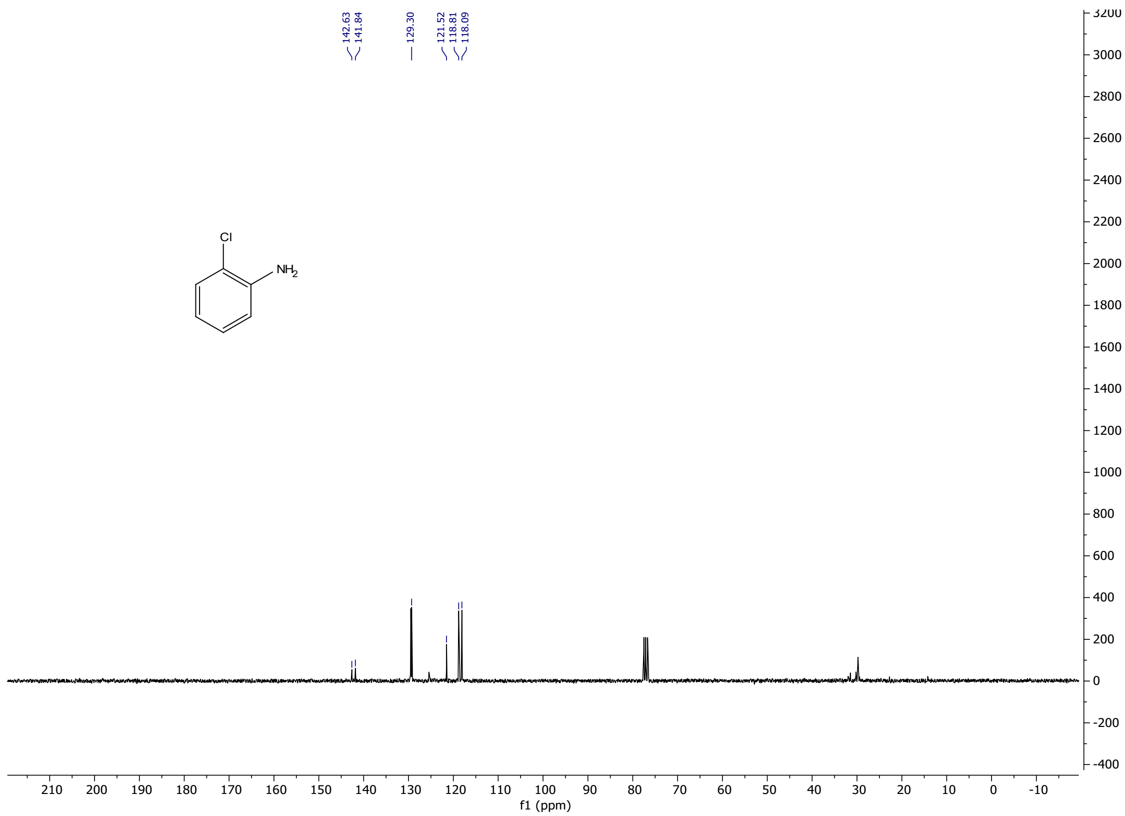


Fig. S13. ¹³CNMR (400 MHz, DMSO) spectrum of 2e.

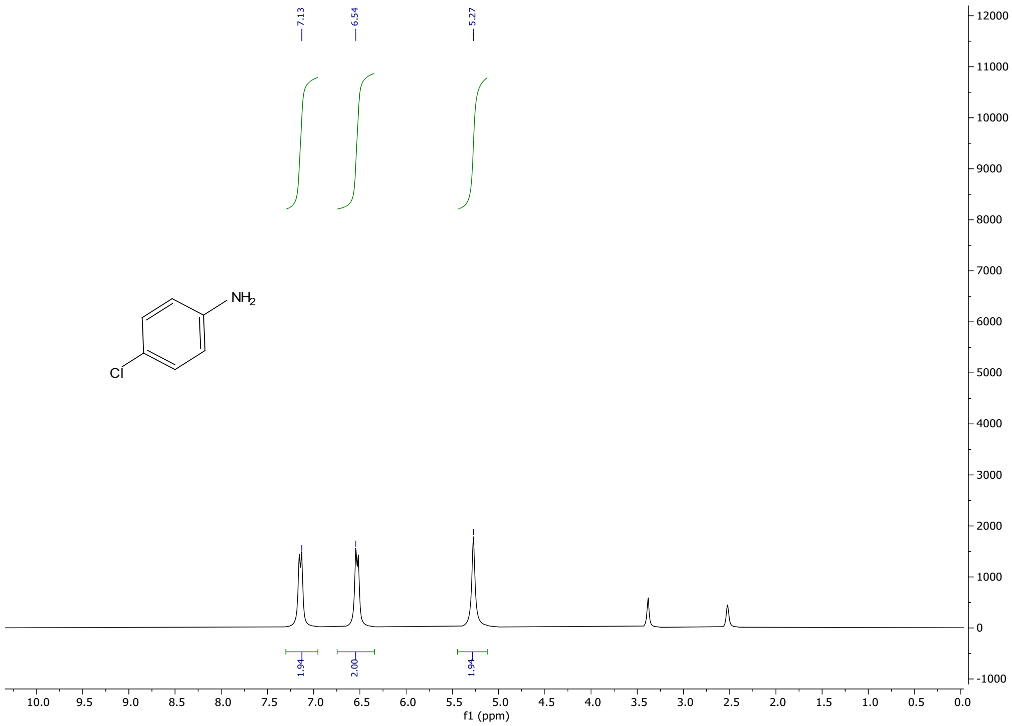


Fig. S14. [1]HNMR (400 MHz, DMSO) spectrum of 2f.

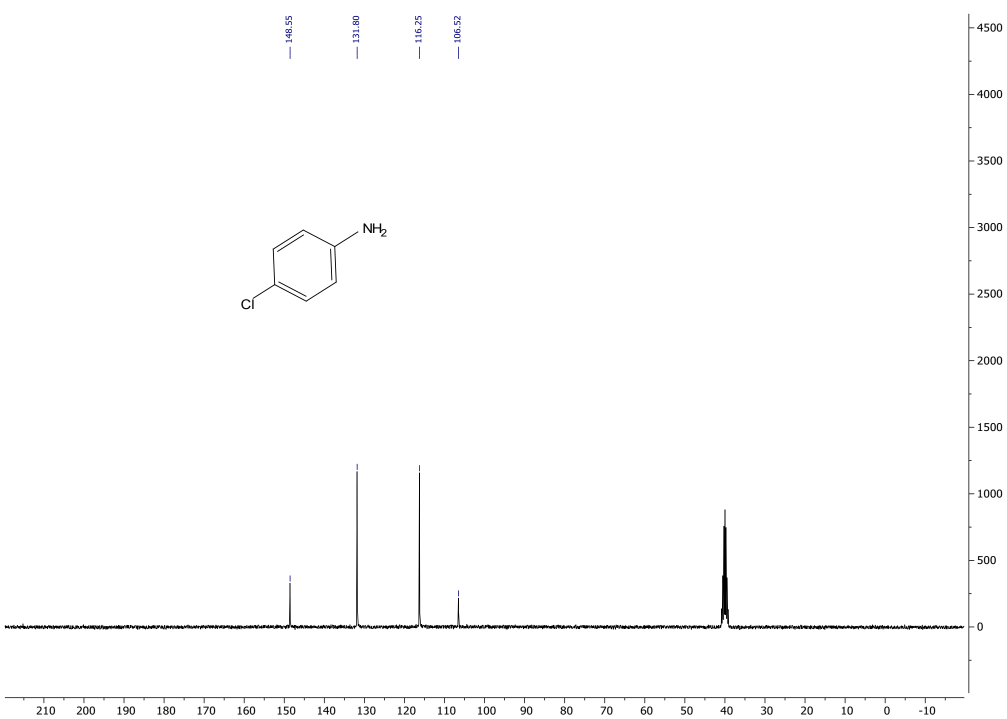


Fig. S15. [13]CNMR (400 MHz, DMSO) spectrum of 2f.

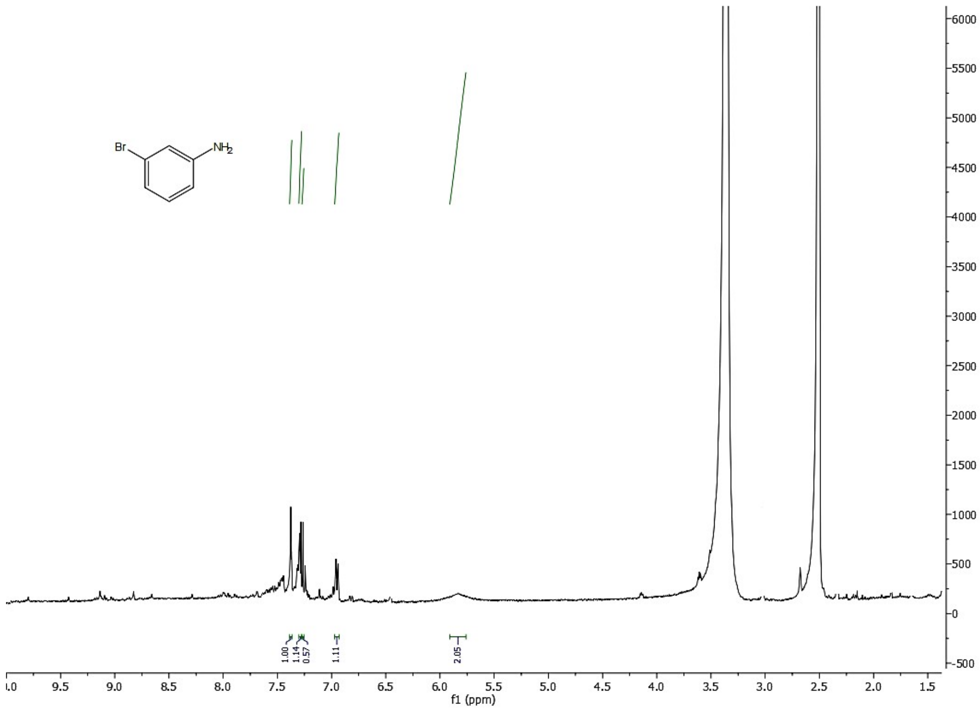


Fig. 16. [1]HNMR (400 MHz, DMSO) spectrum of 2g.

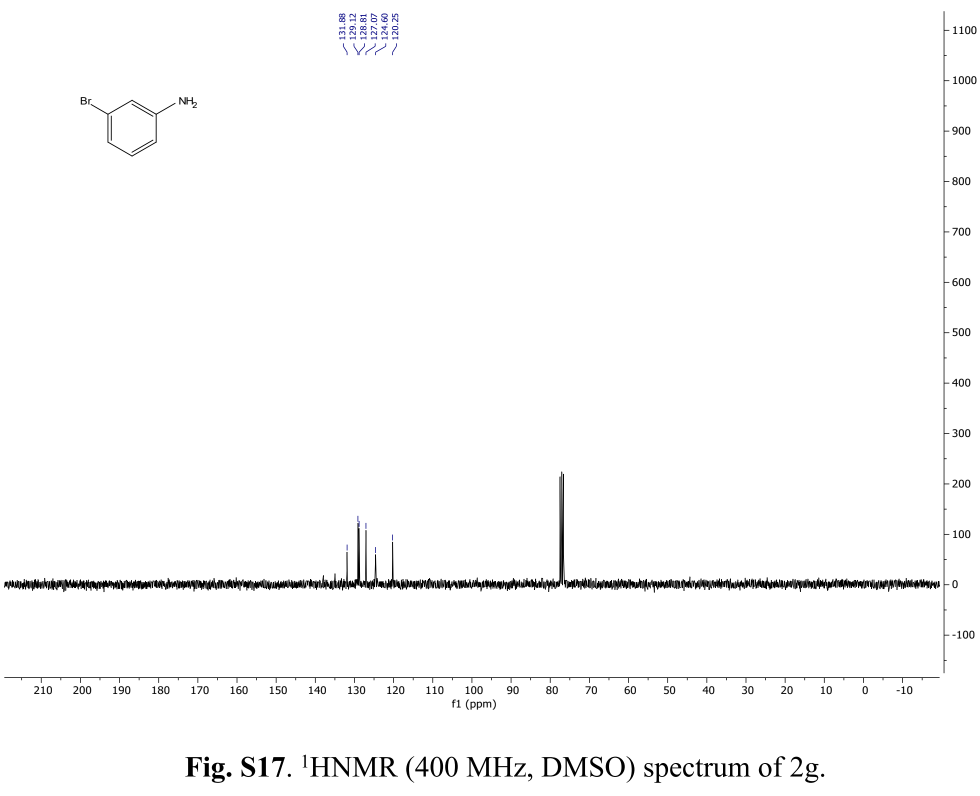


Fig. S17. [1]HNMR (400 MHz, DMSO) spectrum of 2g.

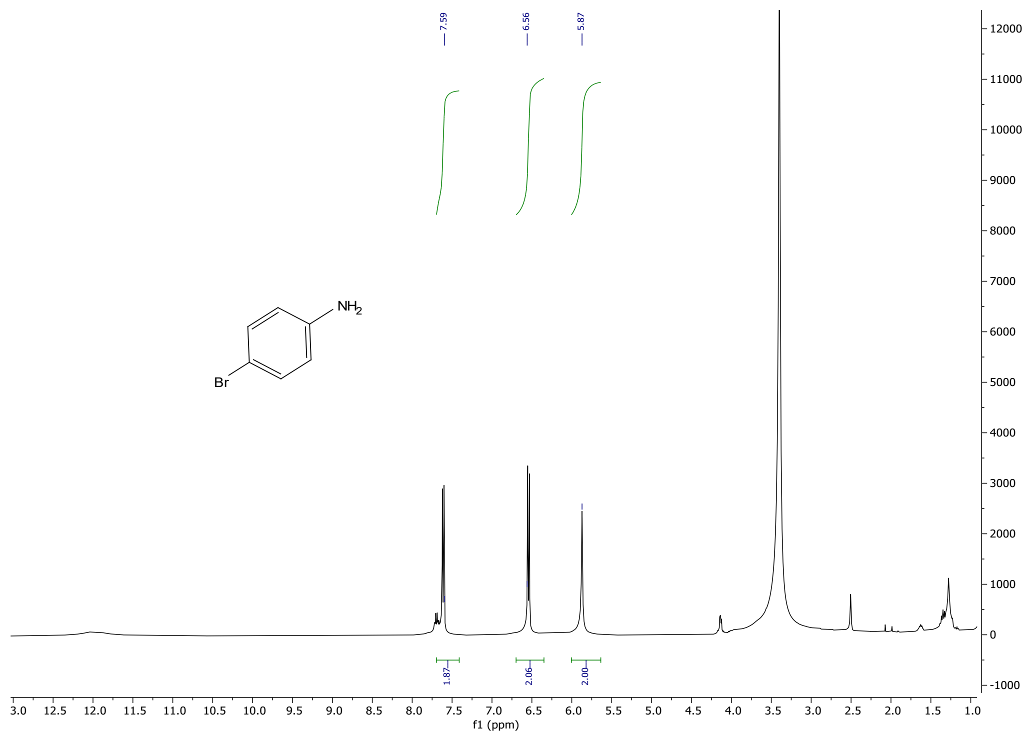


Fig. S18. [1]HNMR (400 MHz, DMSO) spectrum of 2h.

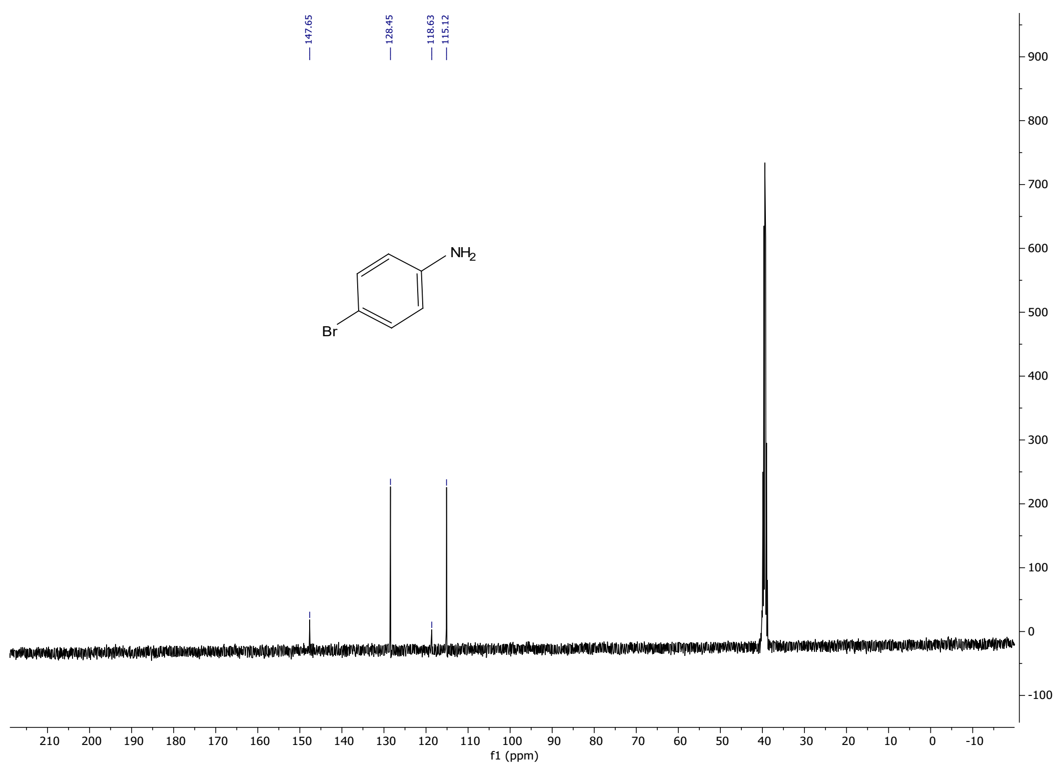


Fig. S19. [13]CNMR (400 MHz, DMSO) spectrum of 2h.

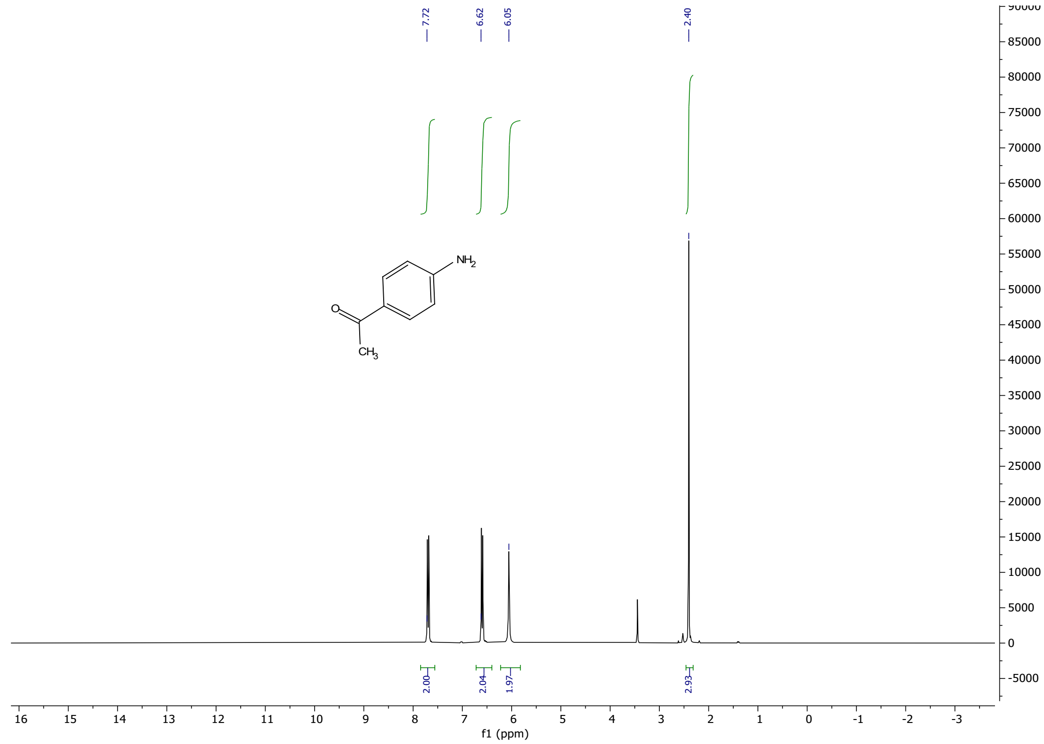


Fig. S20. [1]HNMR (400 MHz, DMSO) spectrum of 2i.

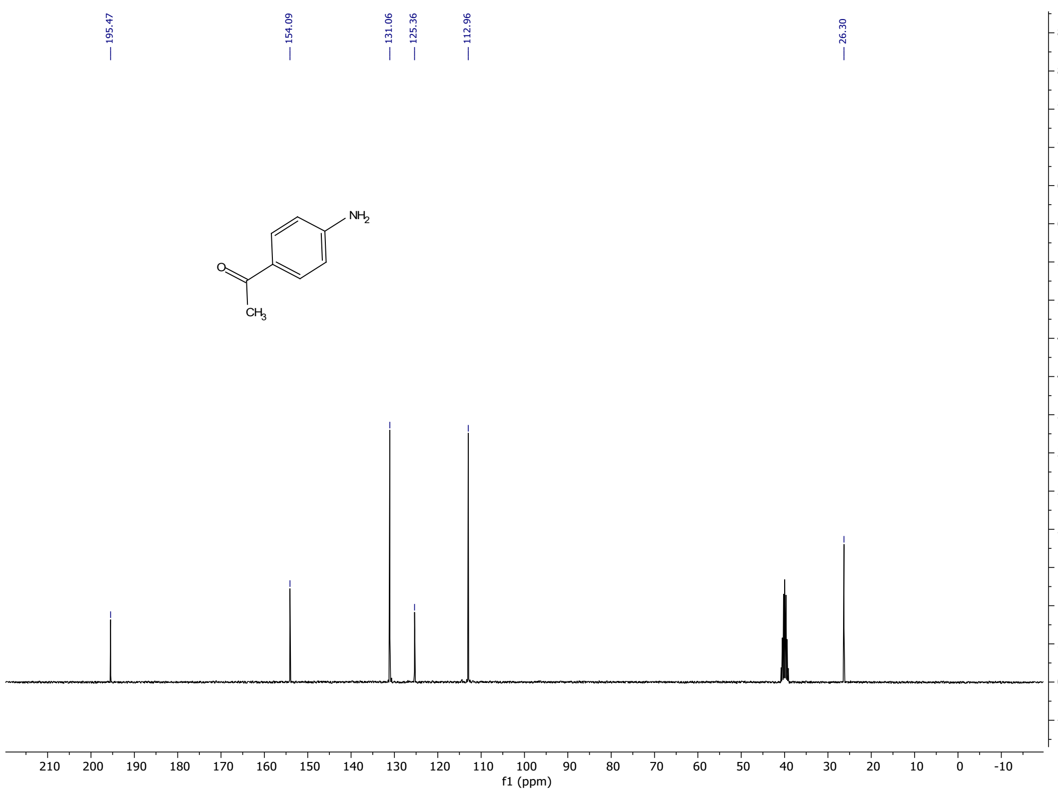


Fig. S21. ^{13}CNMR (400 MHz, DMSO) spectrum of 2i.

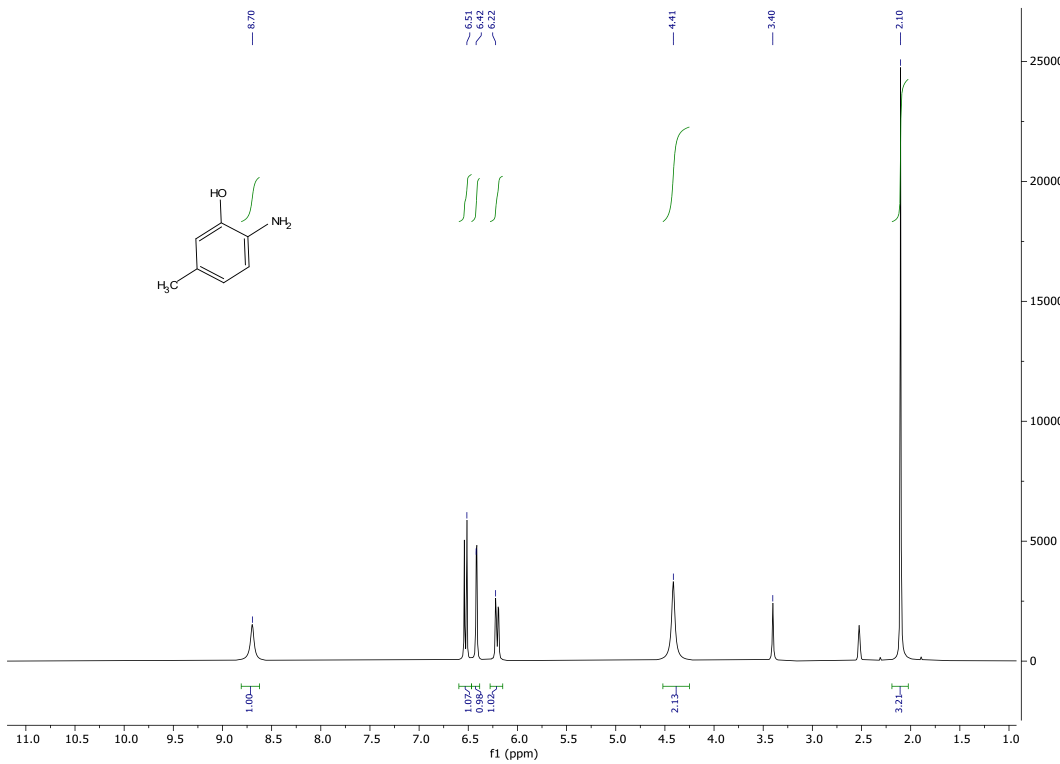


Fig. S22. ^{1}HNMR (400 MHz, DMSO) spectrum of 2j.

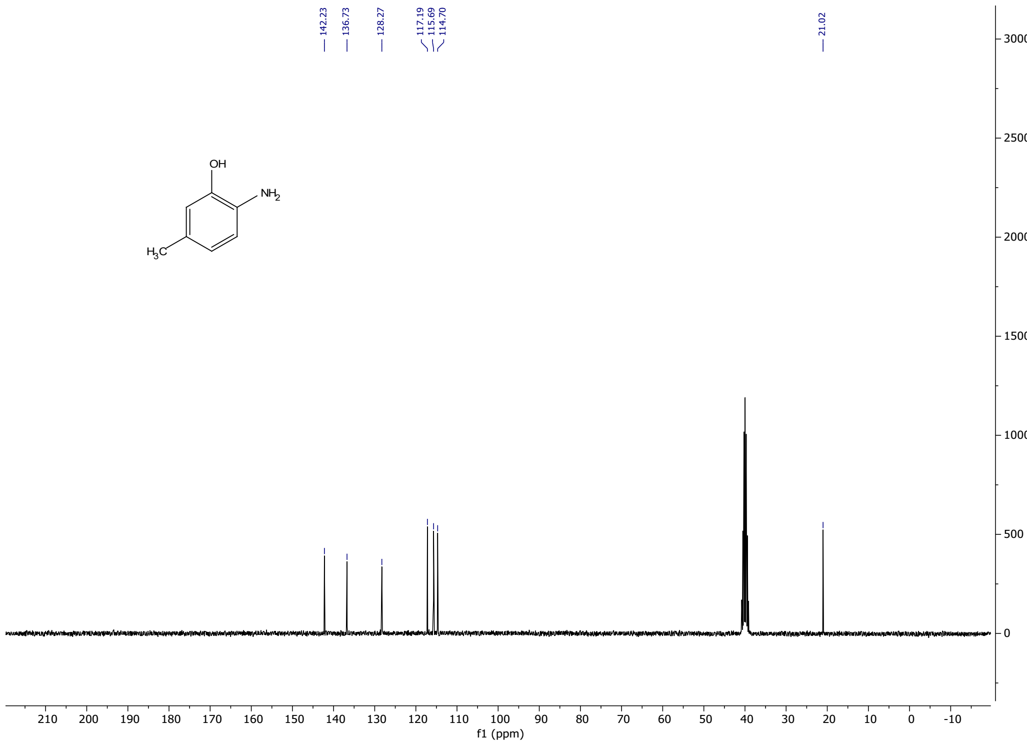


Fig. S23. [13]CNMR (400 MHz, DMSO) spectrum of 2j.

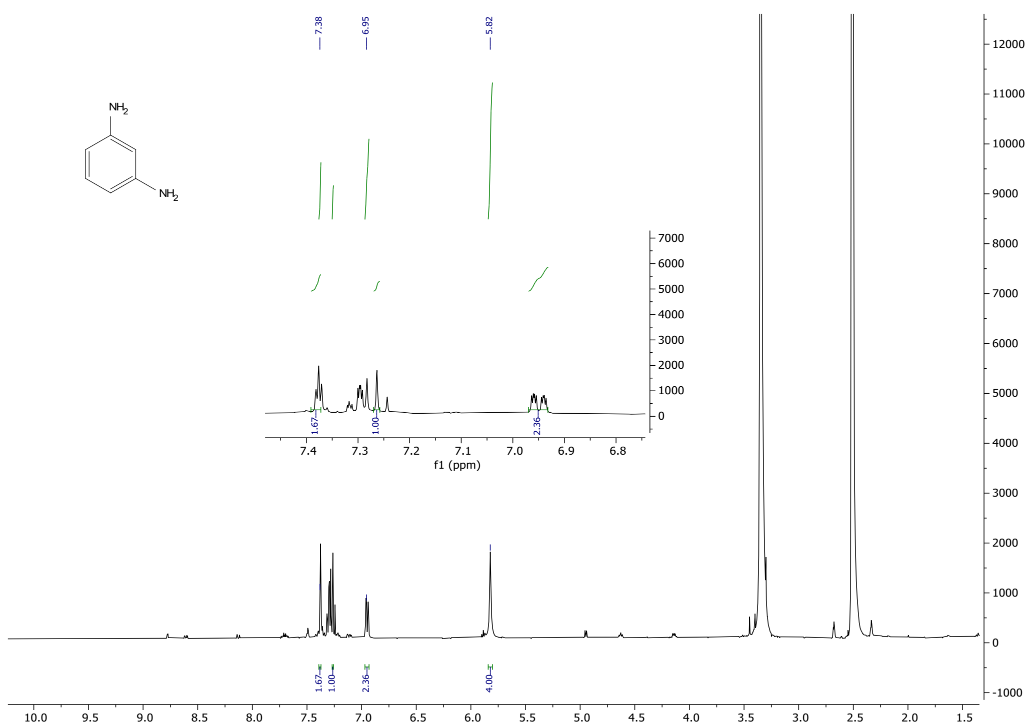


Fig. S24. [1]HNMR (400 MHz, DMSO) spectrum of 2k.

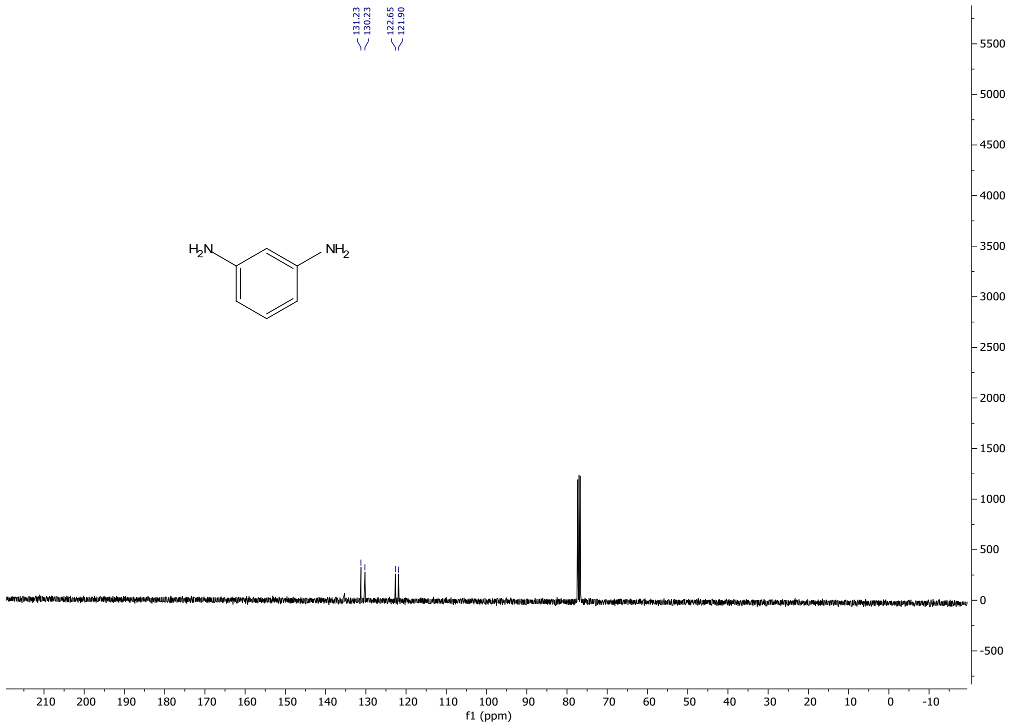


Fig. S25. [13]CNMR (400 MHz, DMSO) spectrum of 2k.

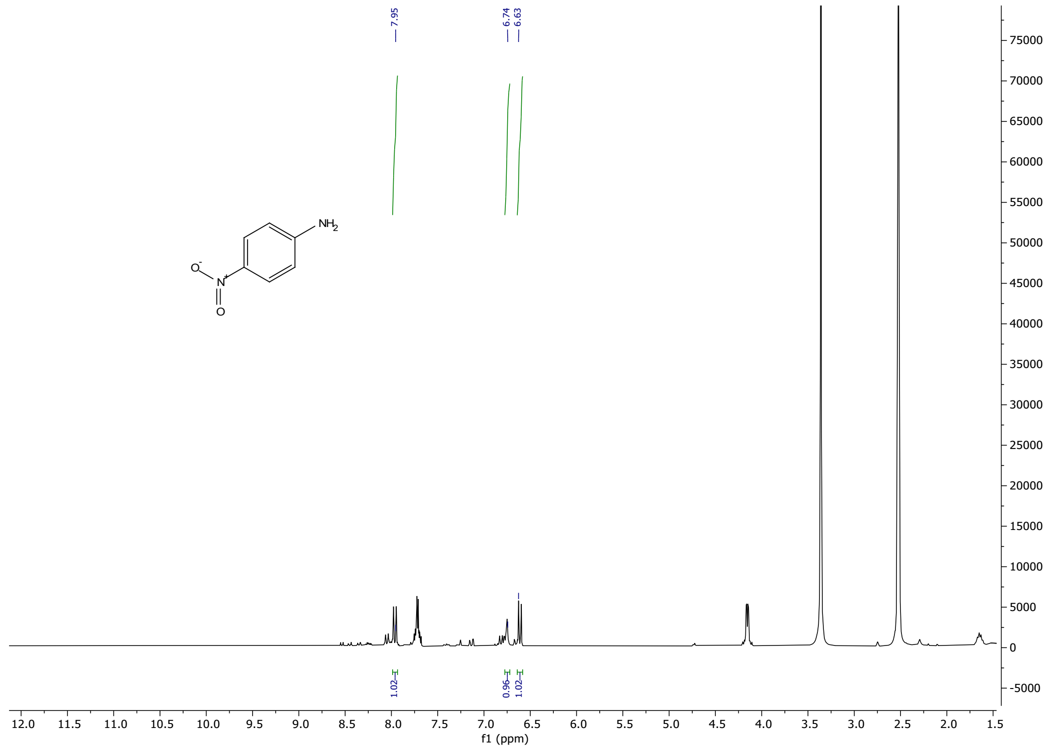


Fig. S26. [1]HNMR (400 MHz, DMSO) spectrum of 2l.

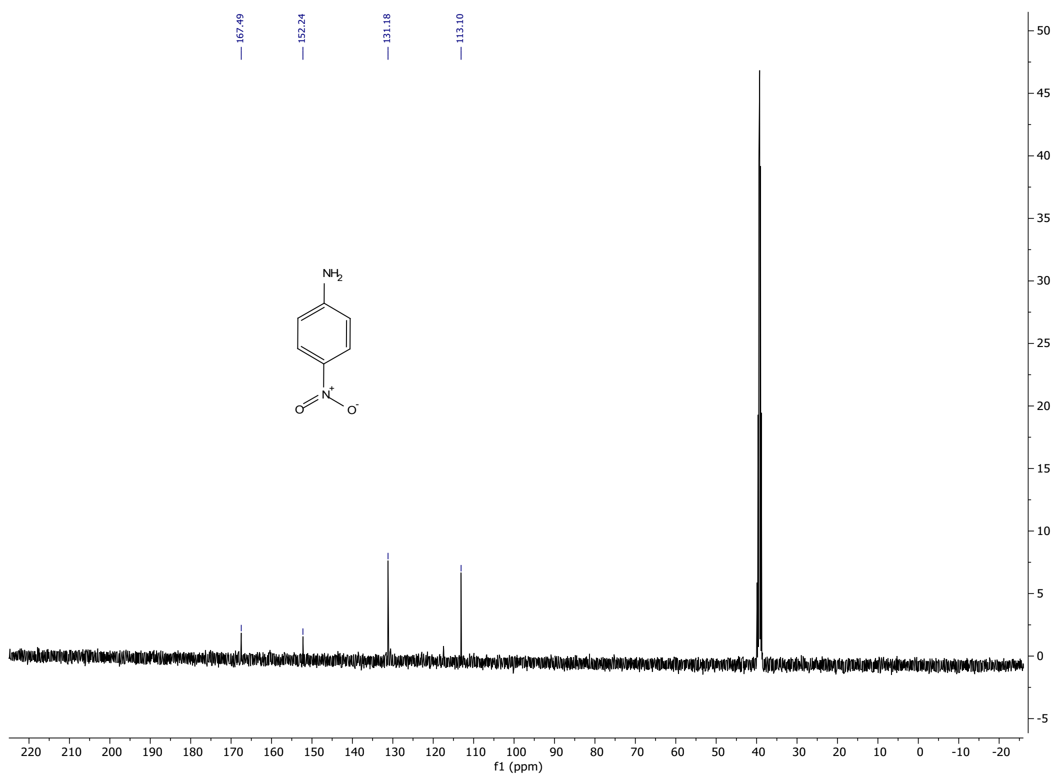


Fig. S27. [13]CNMR (400 MHz, DMSO) spectrum of 2l.

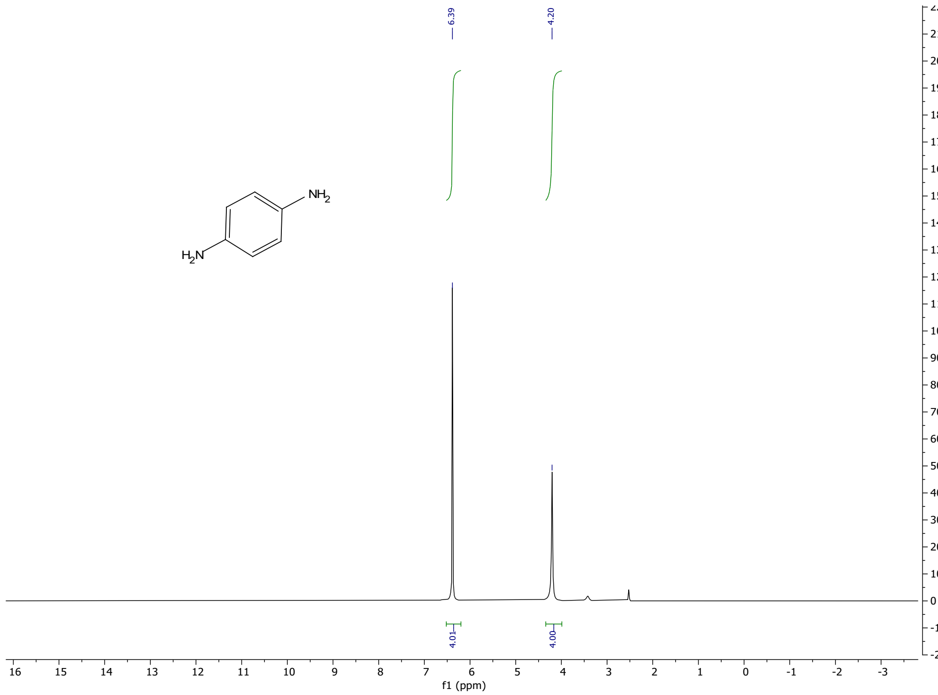


Fig. S28. ^{1}HNMR (400 MHz, DMSO) spectrum of 2m.

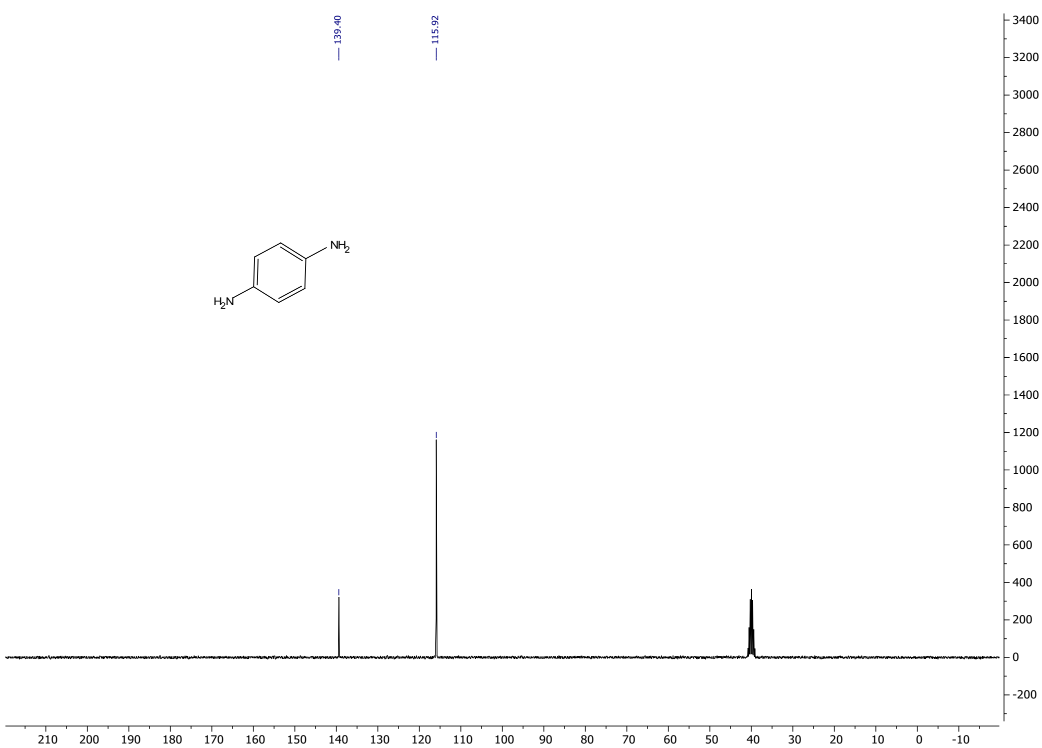


Fig. S29. ^{13}CNMR (400 MHz, DMSO) spectrum of 2m.

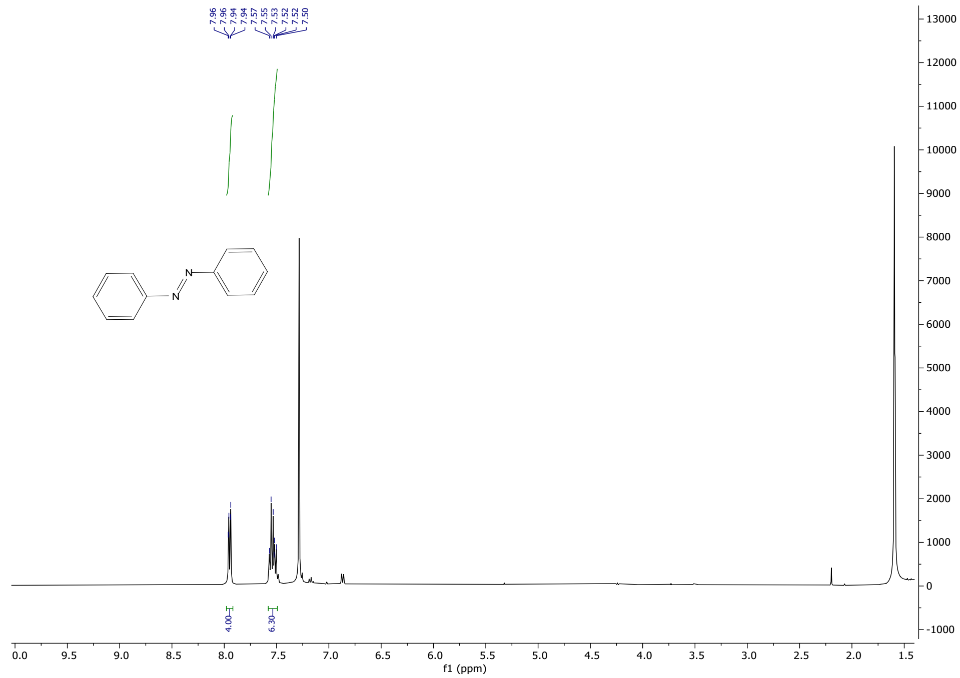


Fig. S30. [1]HNMR (400 MHz, $CDCl_3$) spectrum of 3a.

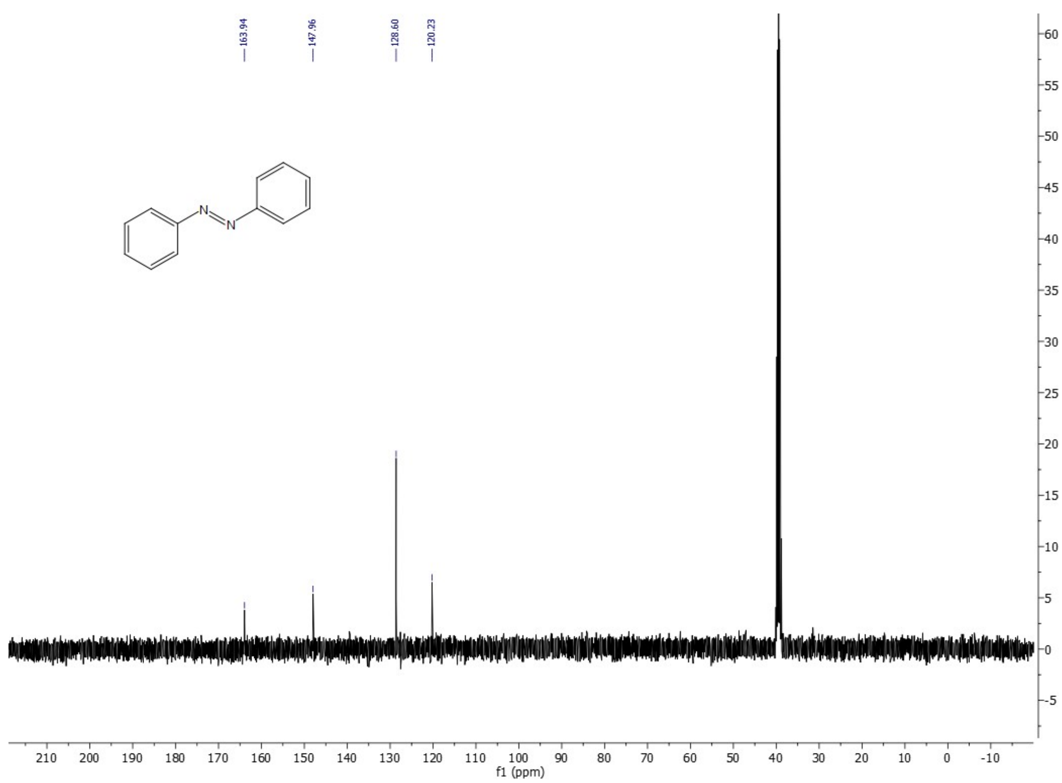


Fig. S31. [13]CNMR (125 MHz, $CDCl_3$) spectrum of 3a.

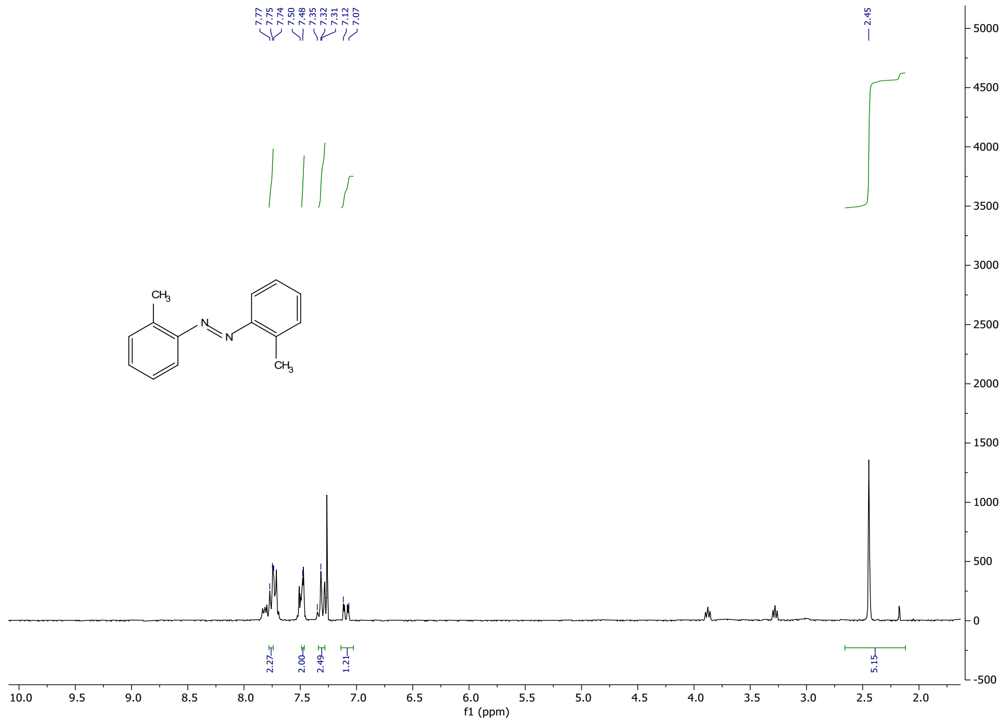


Fig. S32. ^{1}HNMR (500 MHz, $CDCl_3$) spectrum of 3b.

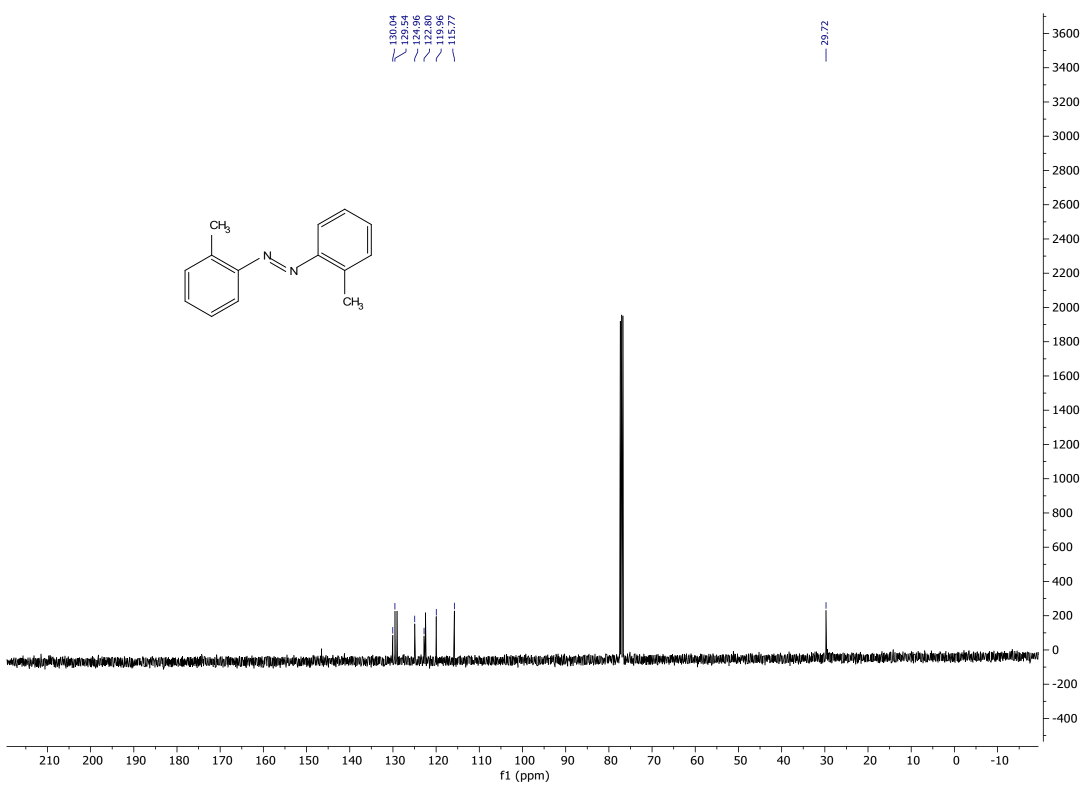


Fig. S33. ^{13}CNMR (125 MHz, $CDCl_3$) spectrum of 3b.

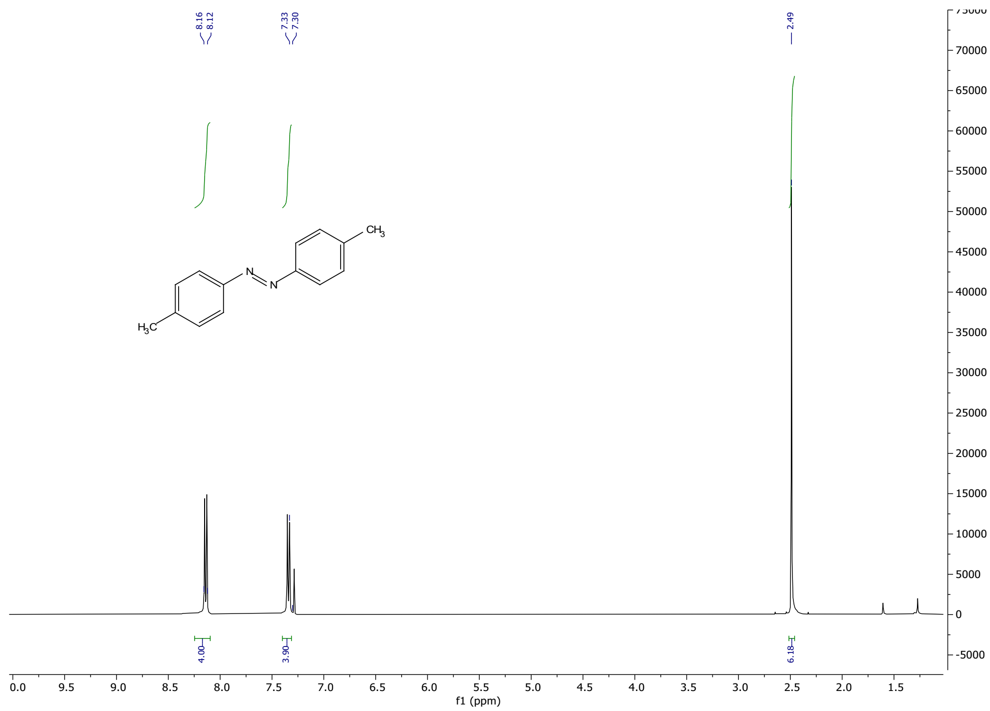


Fig. S34. [1]HNMR (400 MHz, $CDCl_3$) spectrum of 3c.

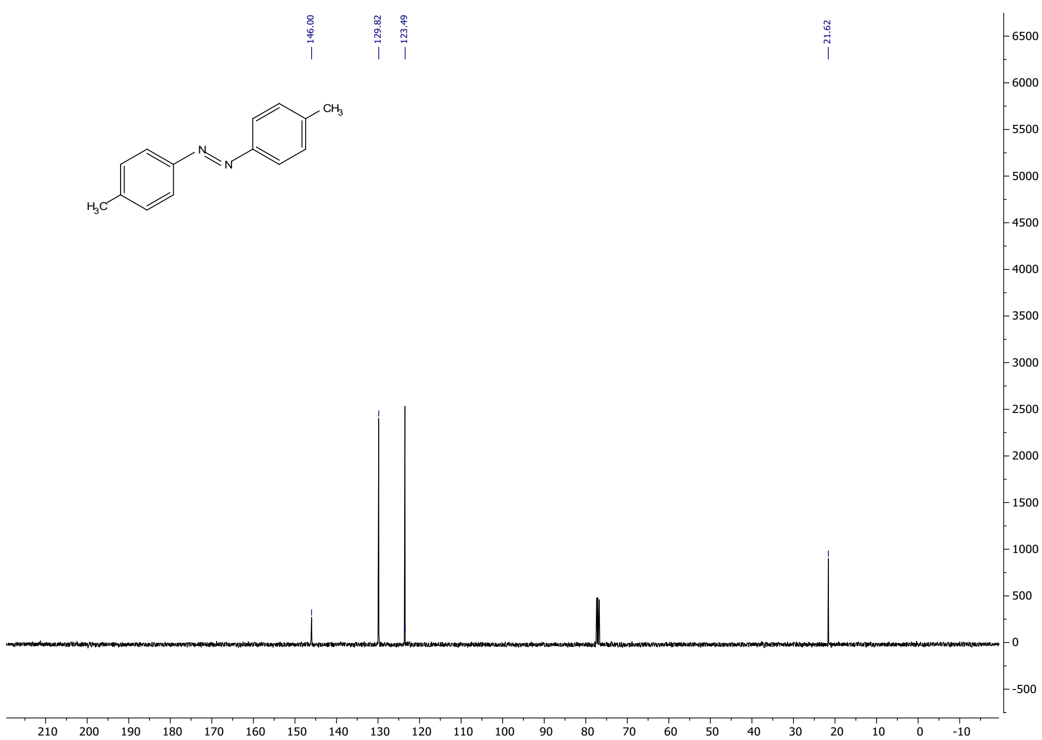


Fig. S35. ^{13}CNMR (125 MHz, $CDCl_3$) spectrum of 3c.

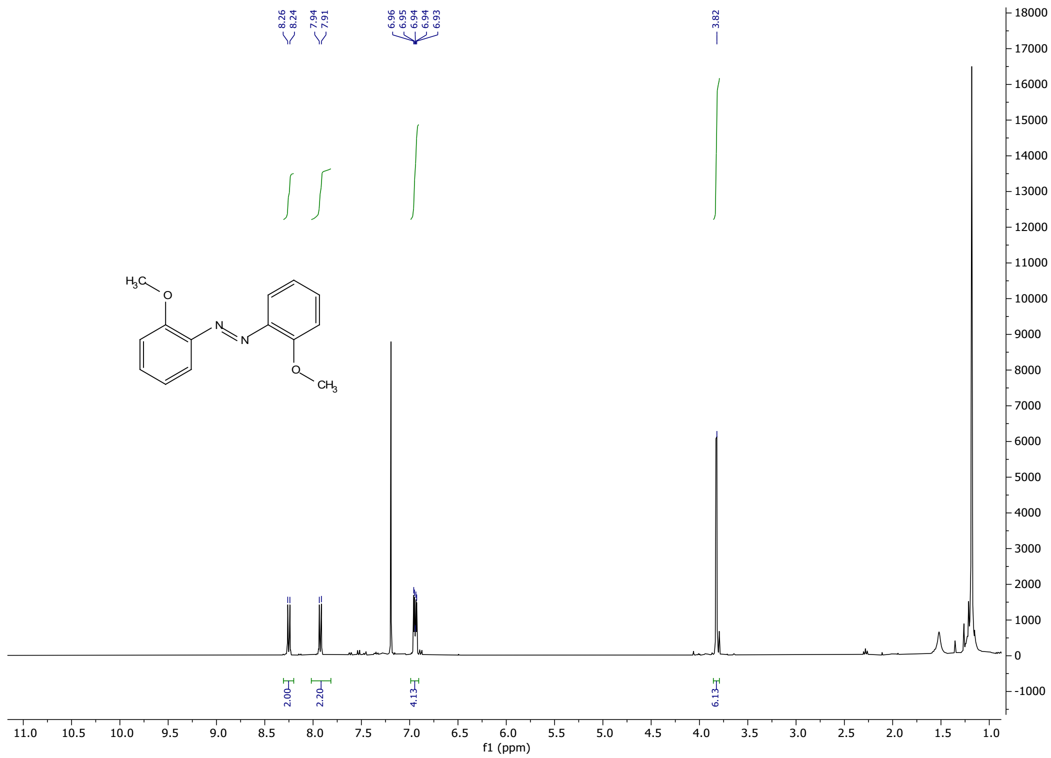


Fig. S36. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3d.

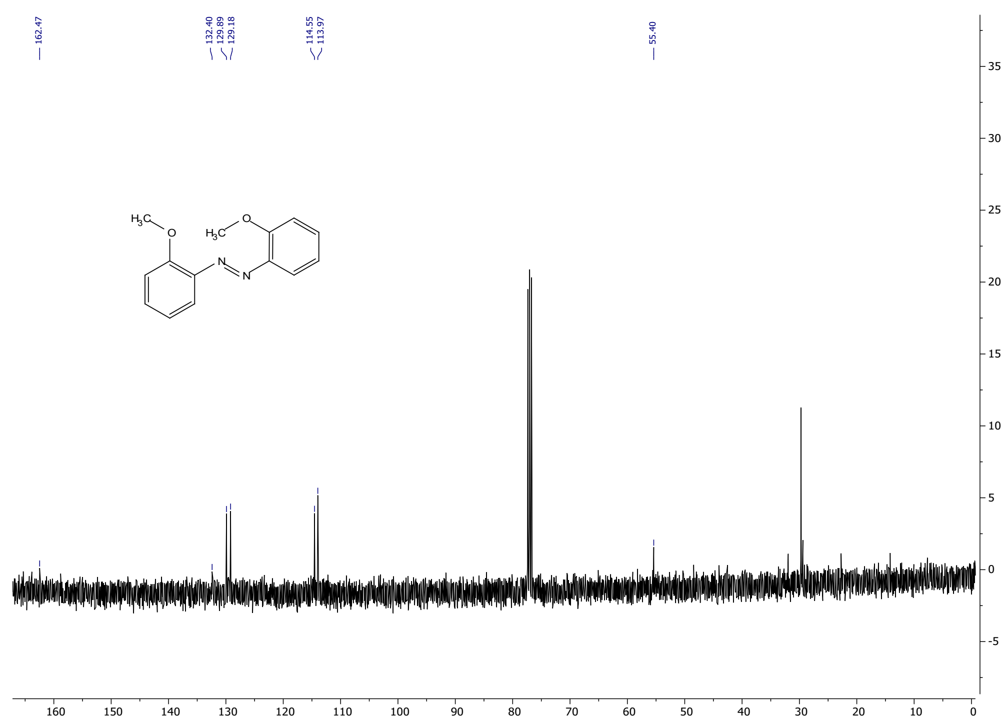


Fig. S37. ^{13}CNMR (400 MHz, $CDCl_3$) spectrum of 3d.

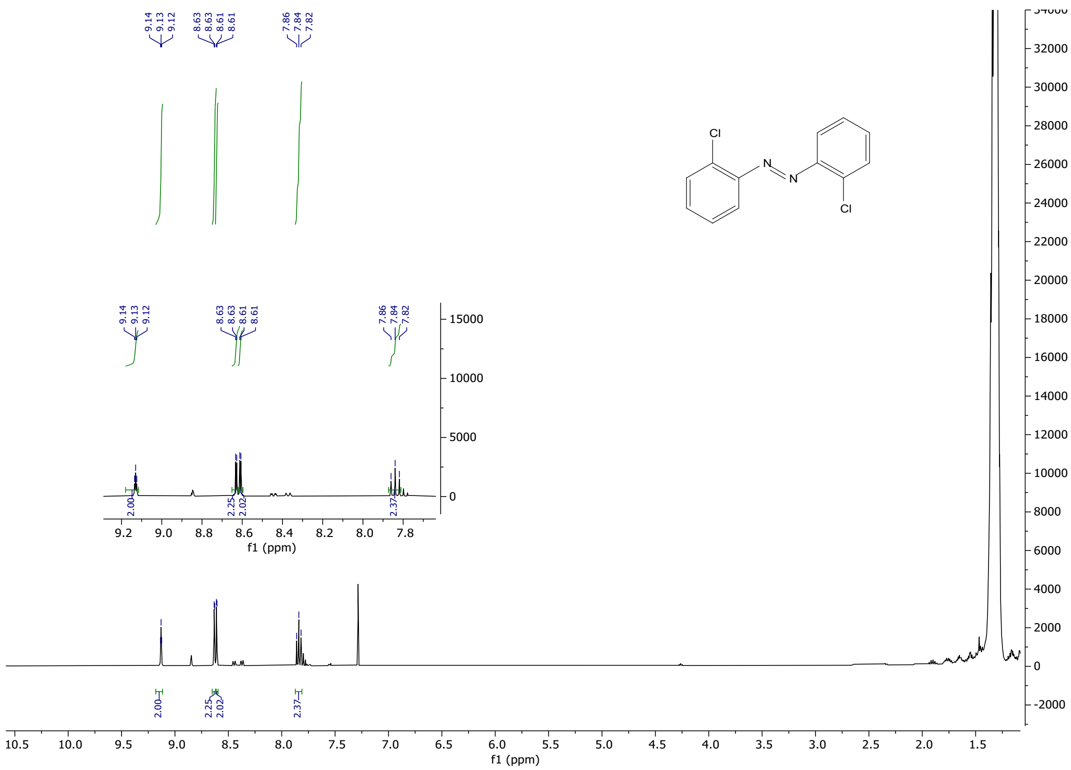


Fig. S38. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3e.

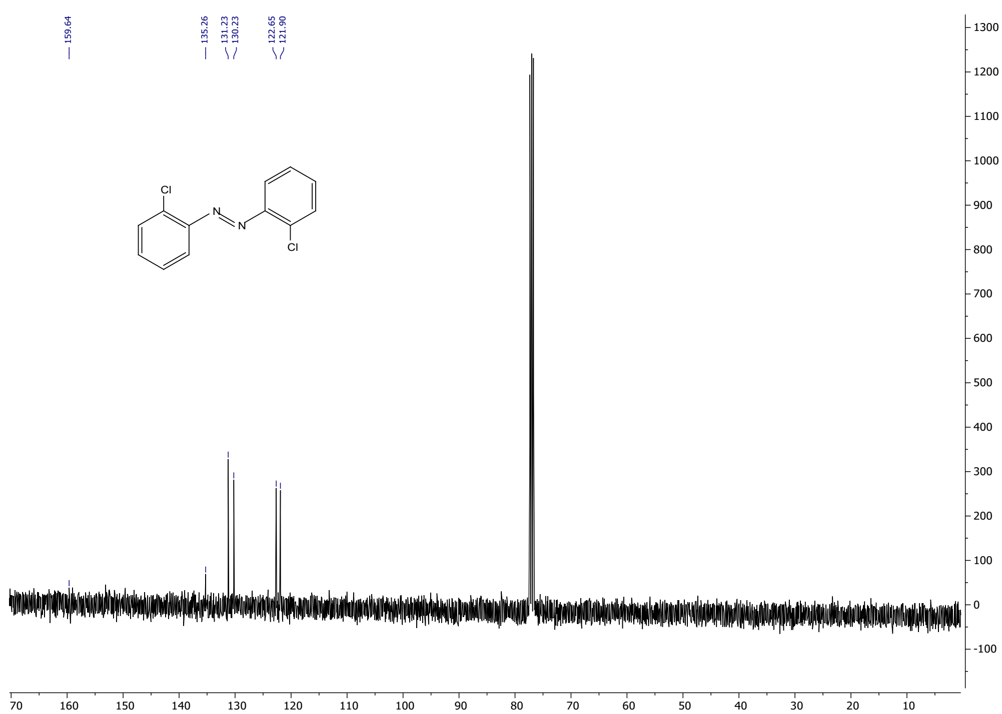


Fig. S39. ^{13}CNMR (400 MHz, $CDCl_3$) spectrum of 3e.

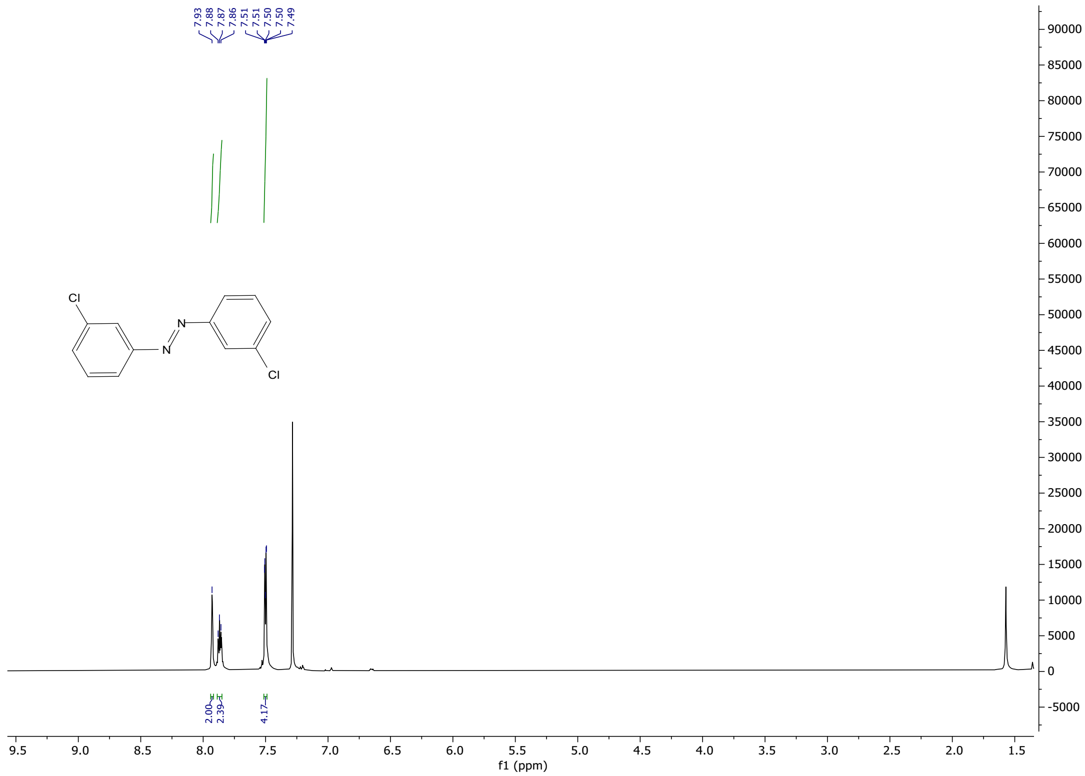


Fig. S40. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3f.

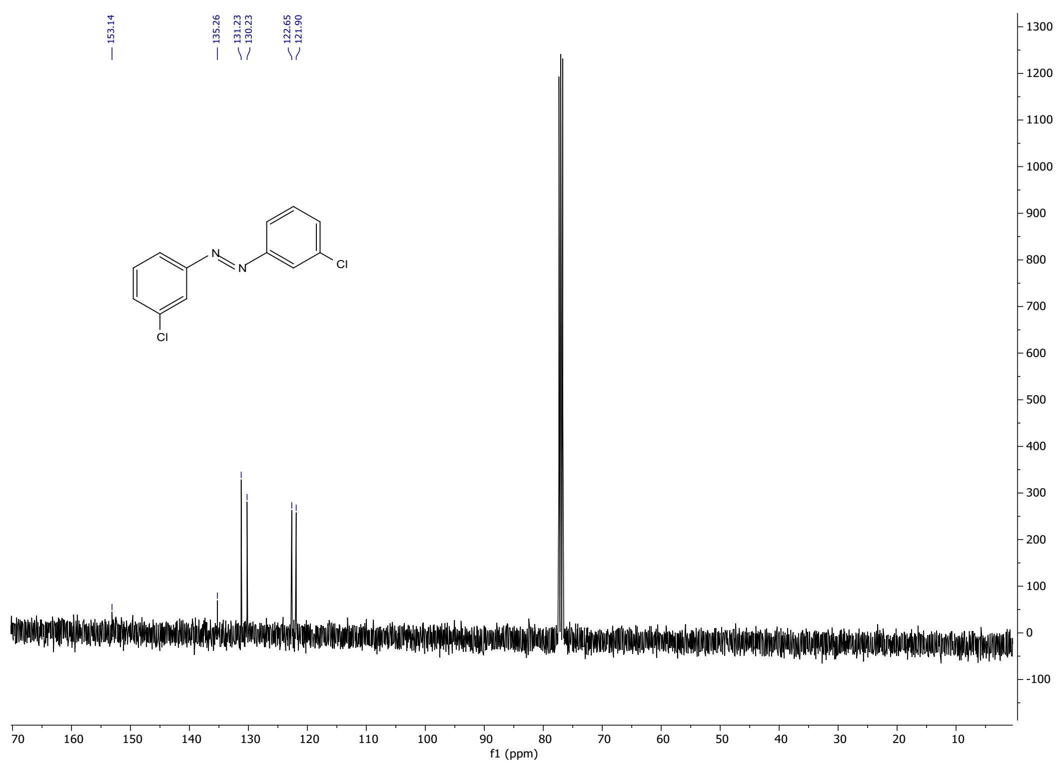


Fig. S41. [13]CNMR (400 MHz, $CDCl_3$) spectrum of 3f.

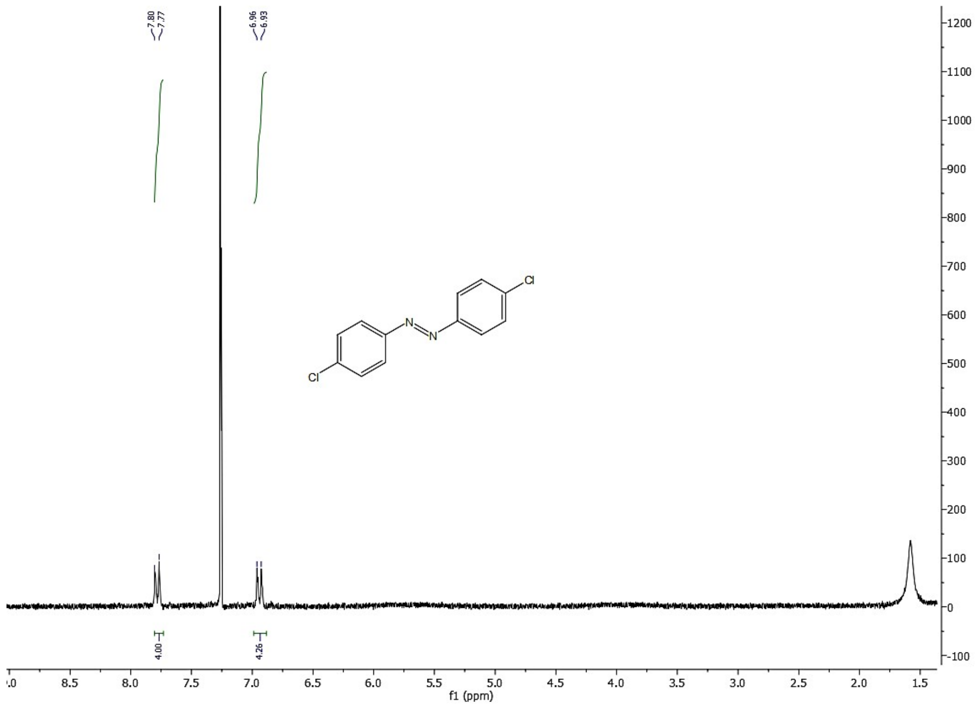


Fig. S42. [1]HNMR (400 MHz, $CDCl_3$) spectrum of 3g.

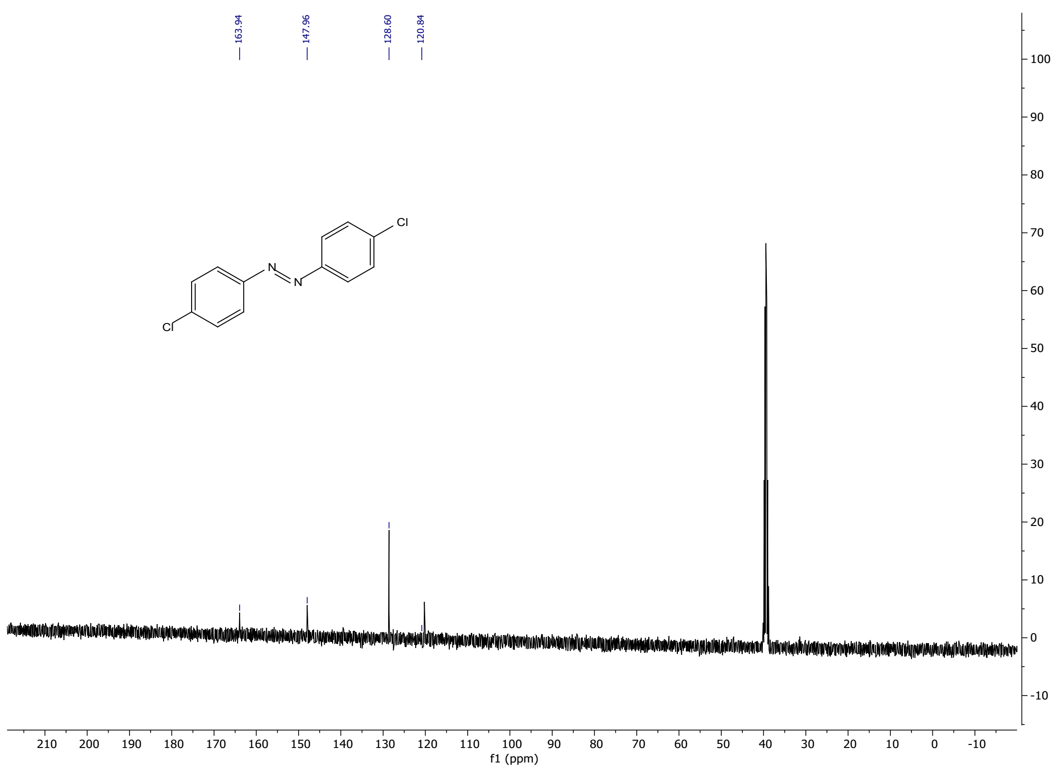


Fig. S43. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3g.

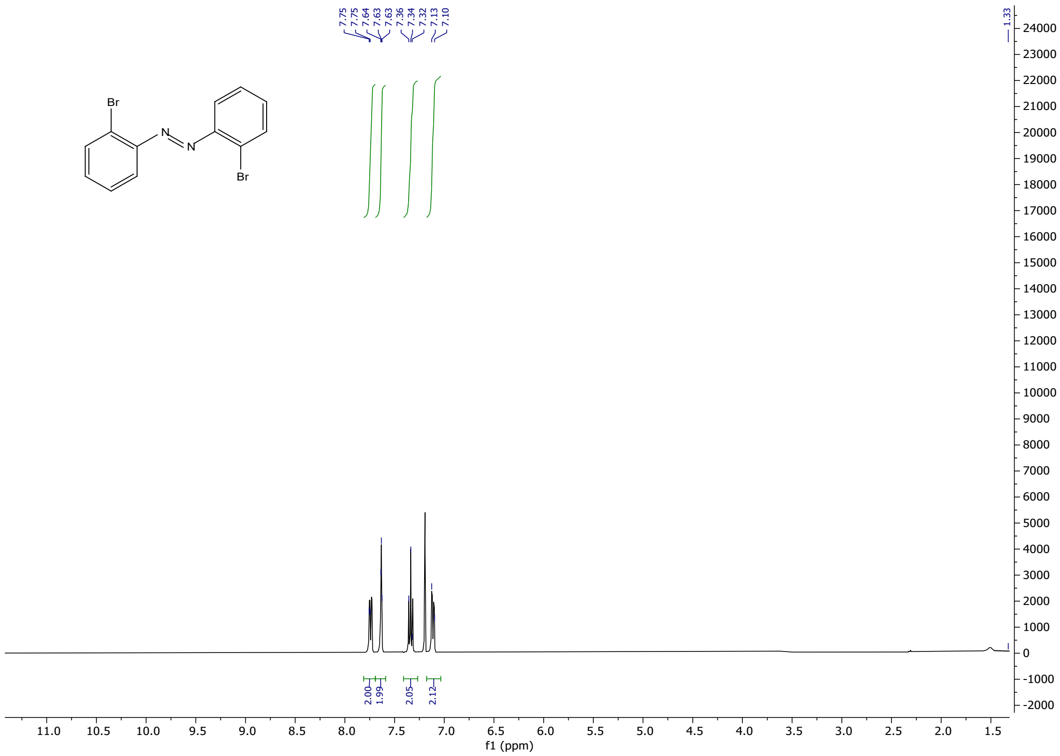


Fig. S44. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3h.

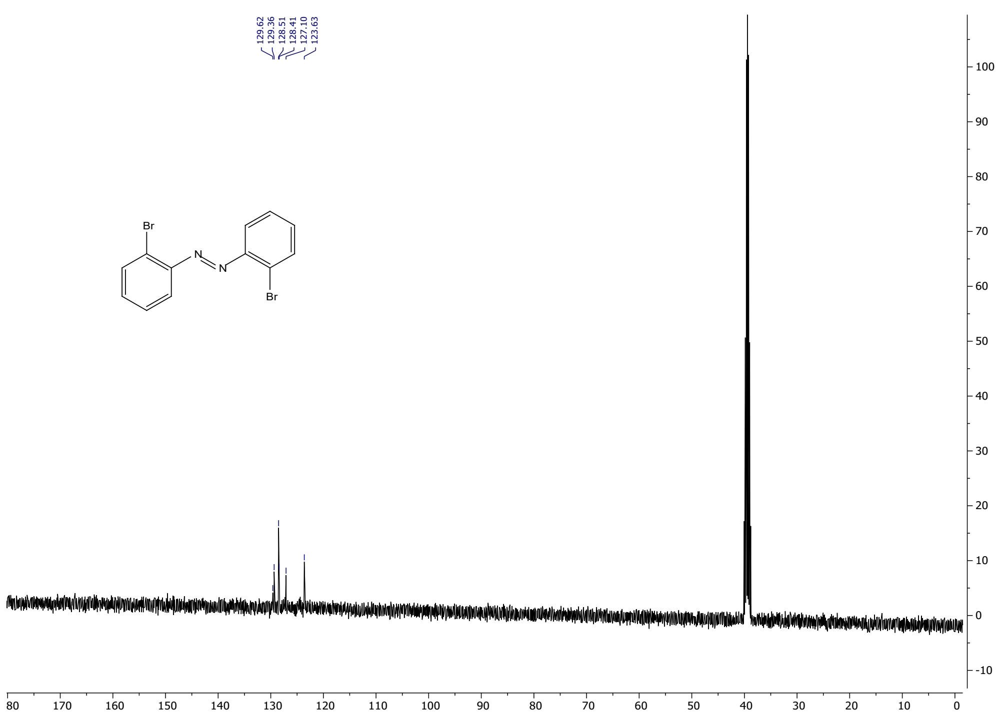


Fig. S45. ^{13}CNMR (400 MHz, $CDCl_3$) spectrum of 3h.

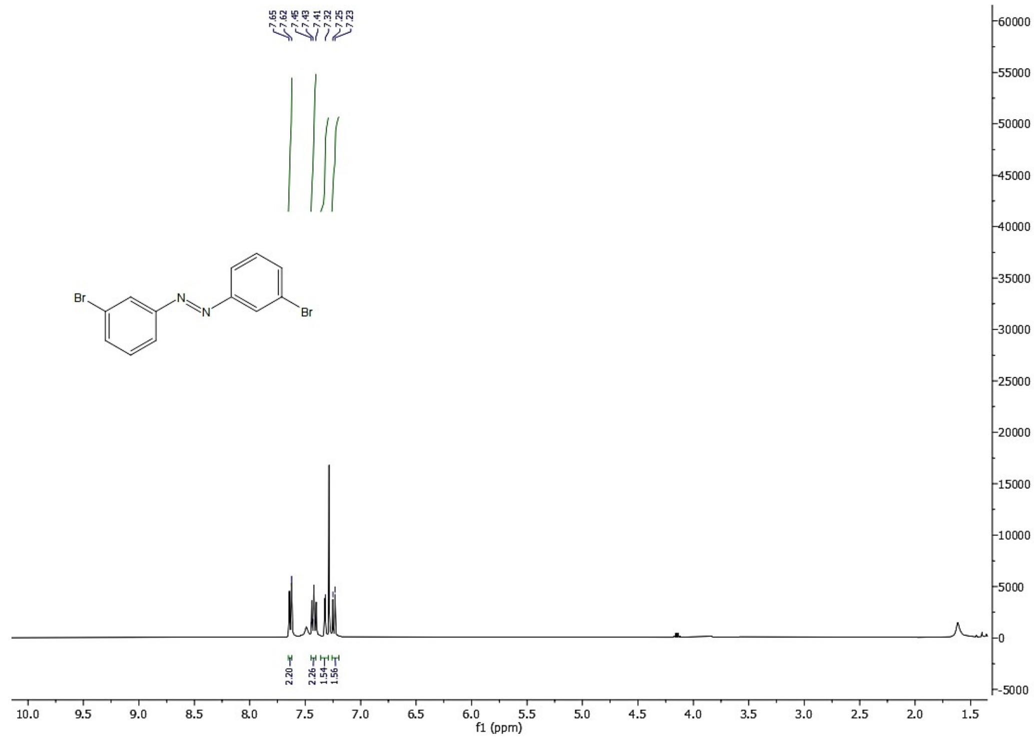


Fig. S46. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3i.

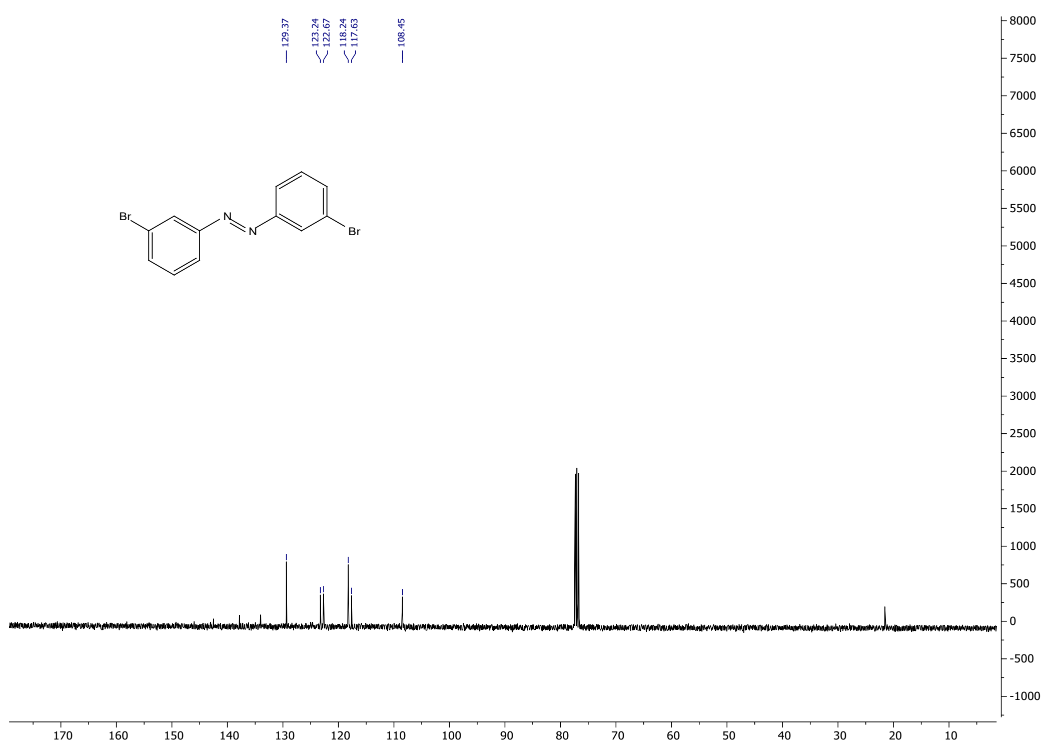


Fig**. S47**. ^{13}CNMR (400 MHz, $CDCl_3$) spectrum of 3i.

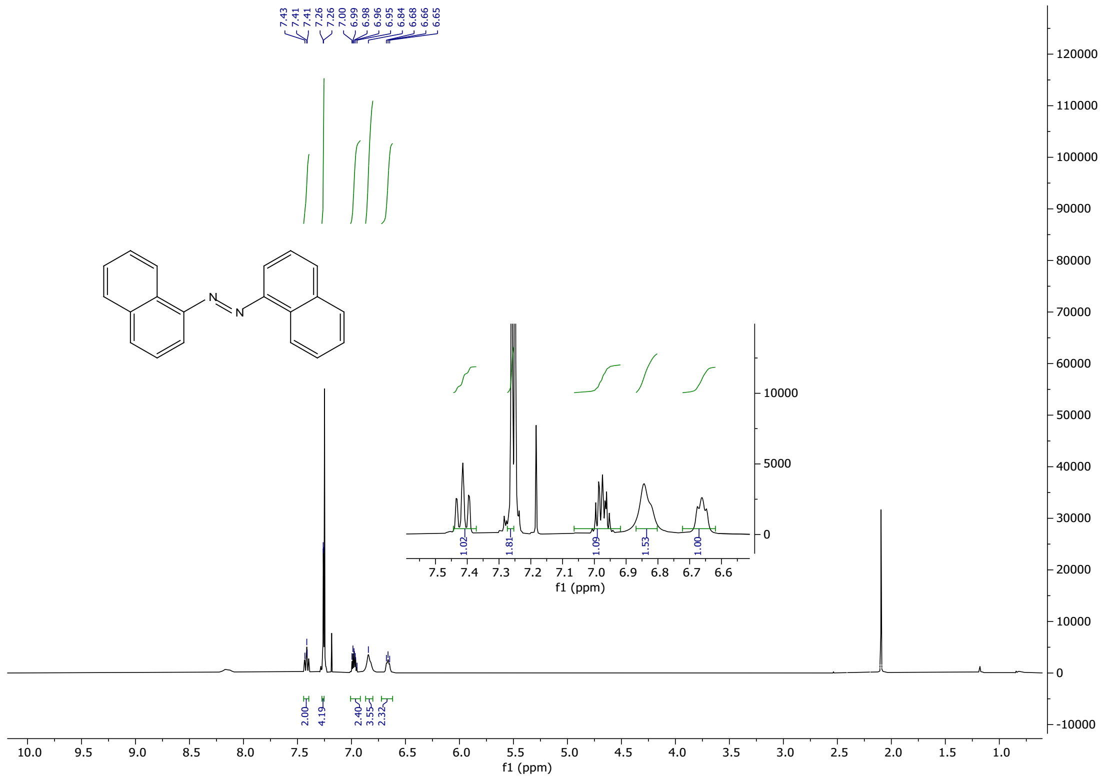


Fig. S48. ^{1}HNMR (400 MHz, $CDCl_3$) spectrum of 3j.

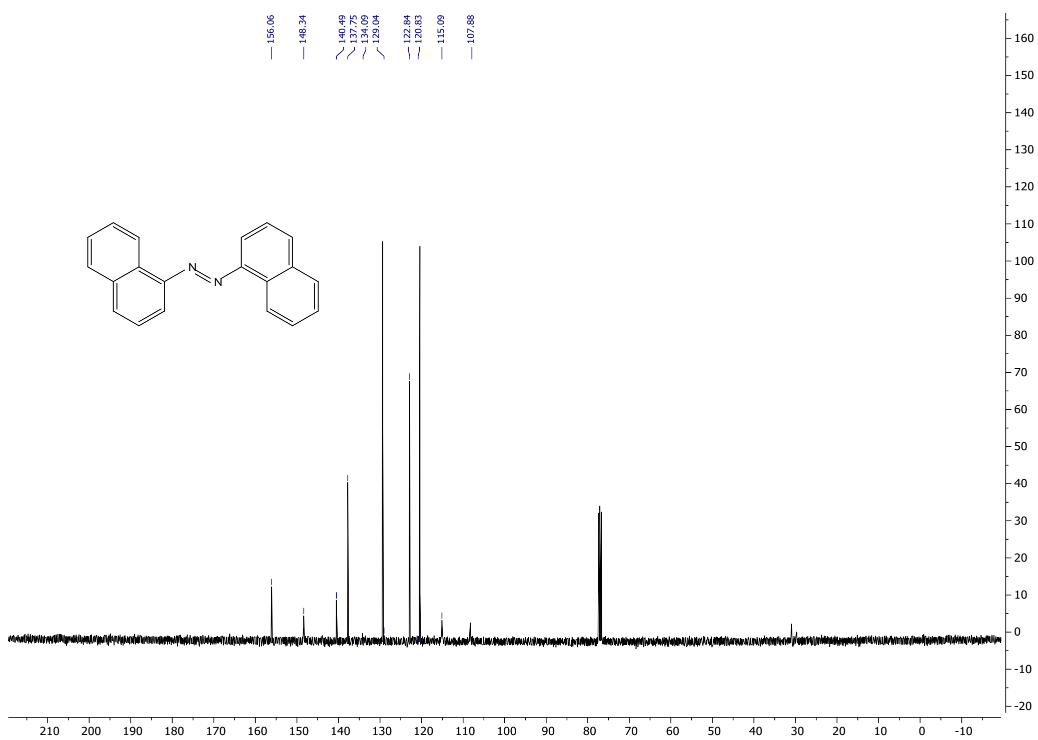


Fig. S49. ^{13}CNMR (400 MHz, $CDCl_3$) spectrum of 3j.

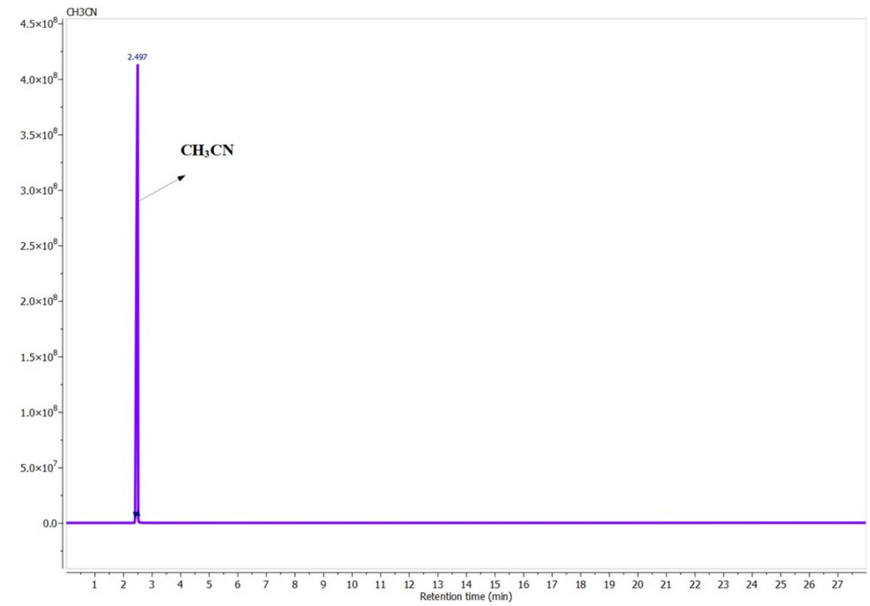


Fig. S50. Gas Chromatography (GC): CH_3CN

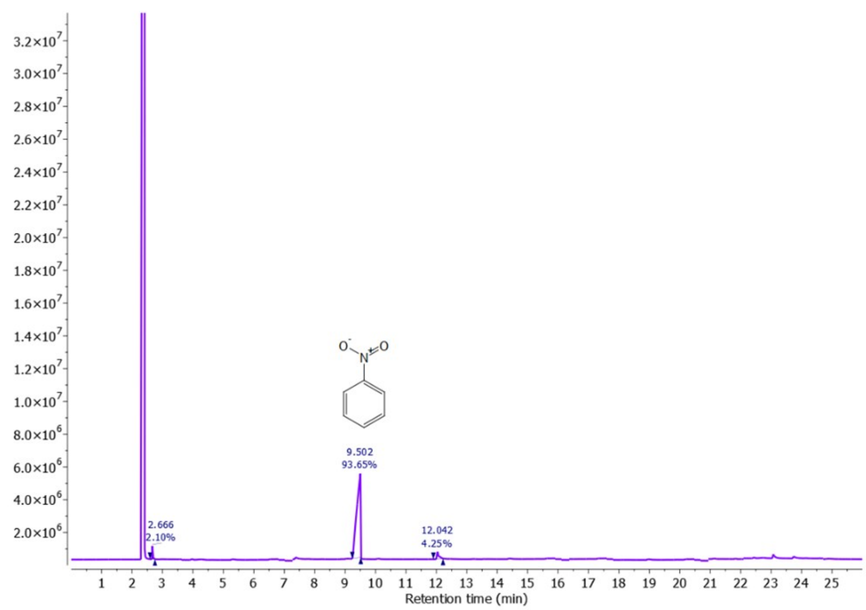


Fig. S51. Gas Chromatography (GC): CH_3CN, Nitrobenzene

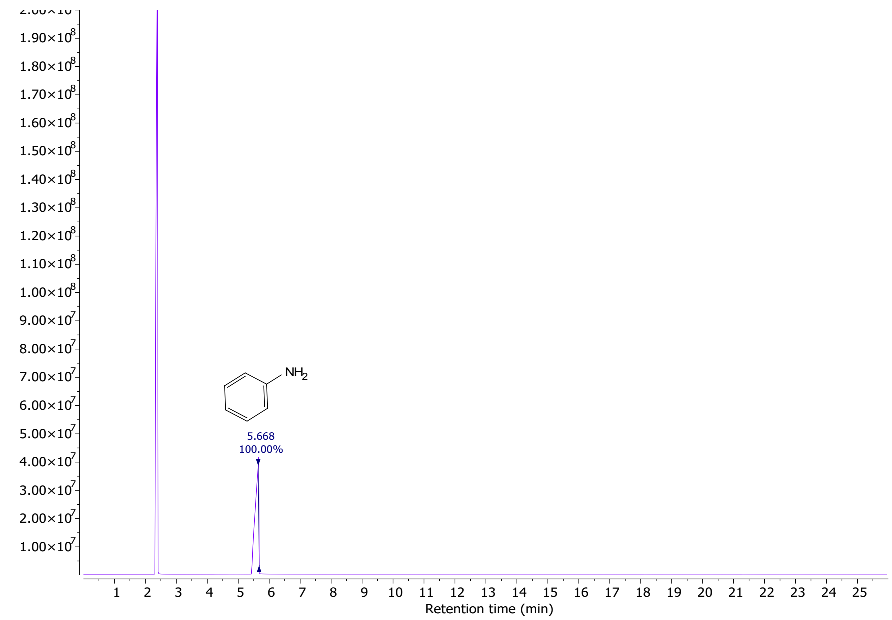


Fig. S52. Gas Chromatography (GC): CH_3CN, Aniline

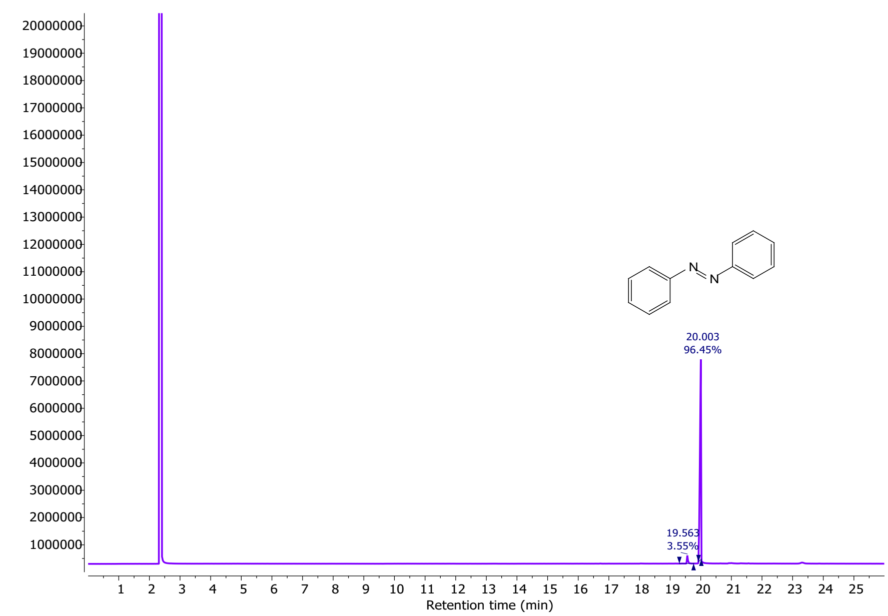


Fig. S53. Gas Chromatography (GC): CH_3CN, Azobenzene

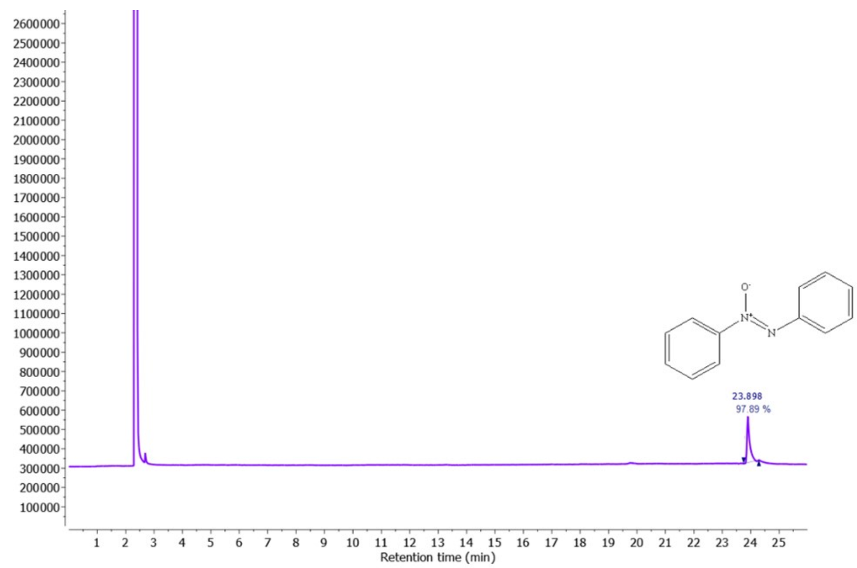


Fig. S54. Gas Chromatography (GC): CH_3CN, Azoxybenzene

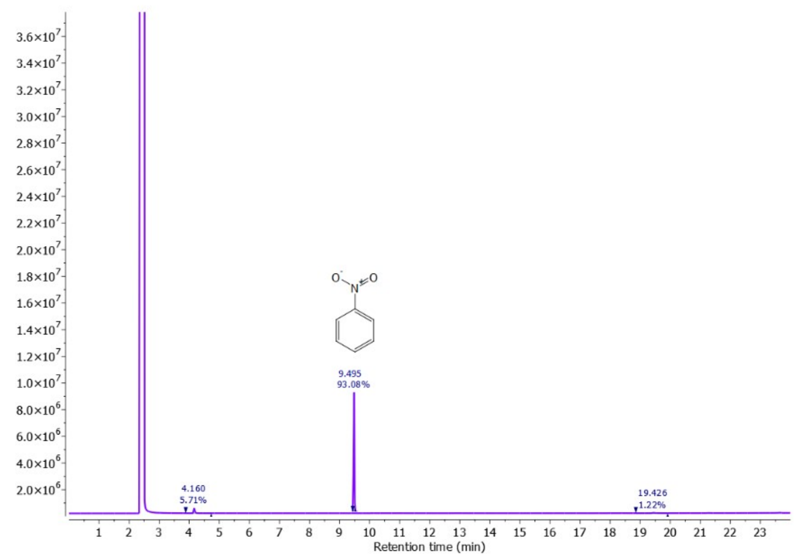


Fig. S55. Gas Chromatography (GC) Reaction Conditions: without catalyst, 0.2 mmol nitrobenzene, 2 mL methanol, 6 eq hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature

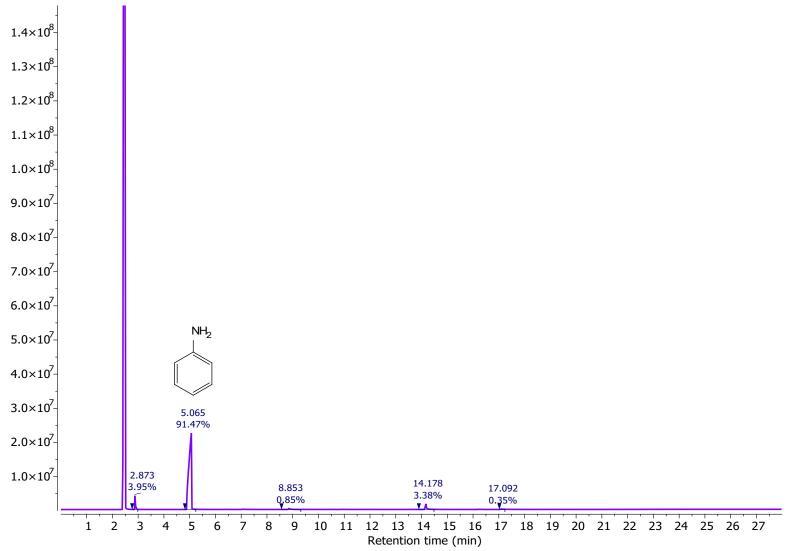


Fig. S56. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

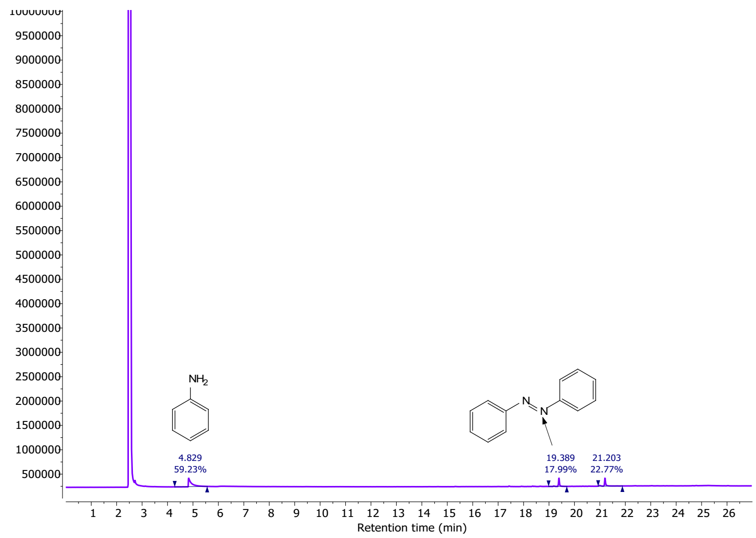


Fig. S57. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

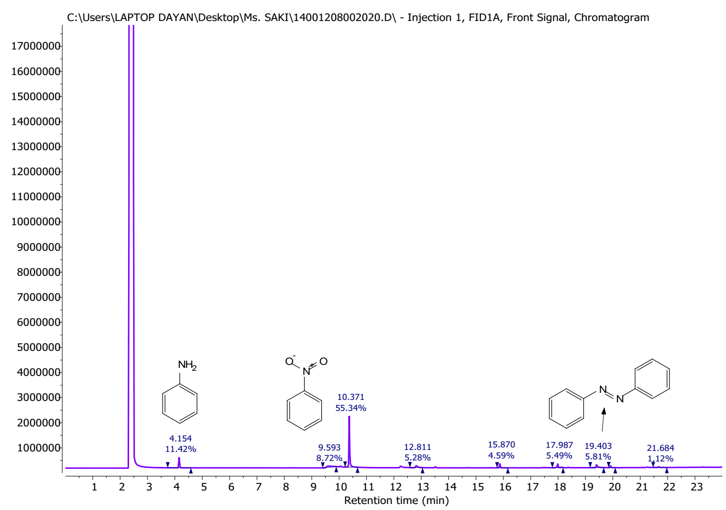


Fig. S58. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of water solvent, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

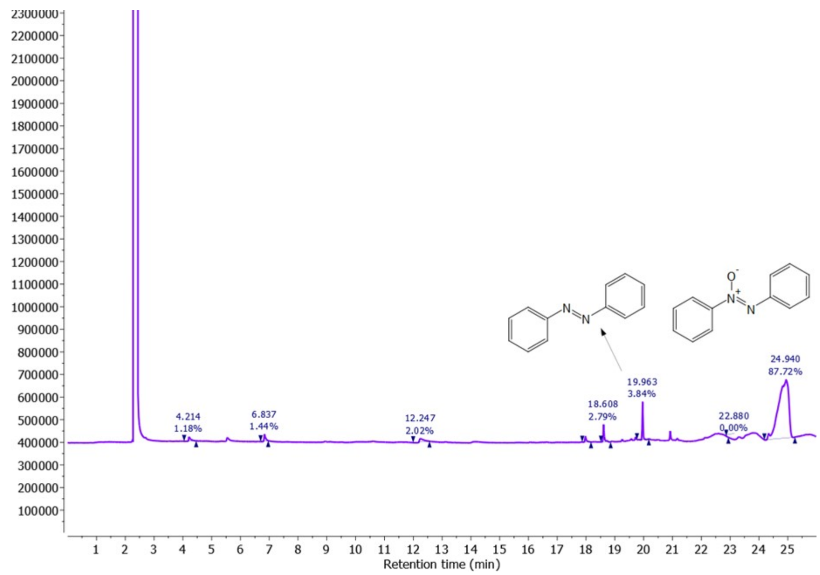


Fig. S59. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of tetrahydrofuran, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

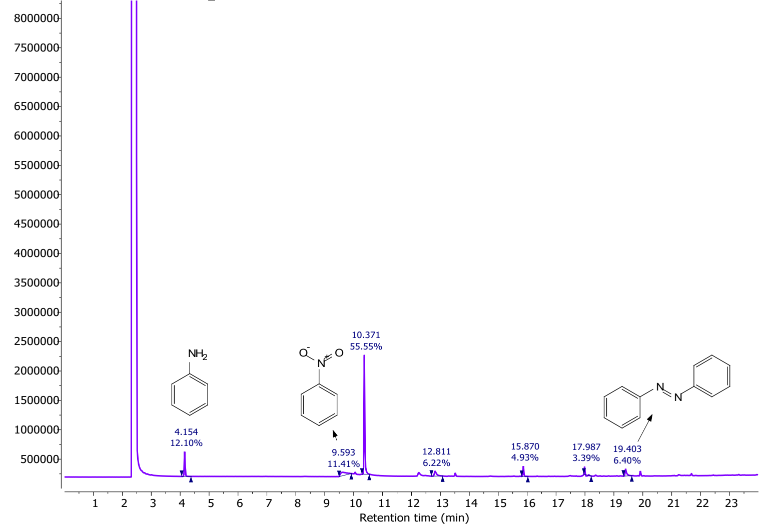


Fig. S60. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, air atmosphere, time: 24 hours, room temperature.

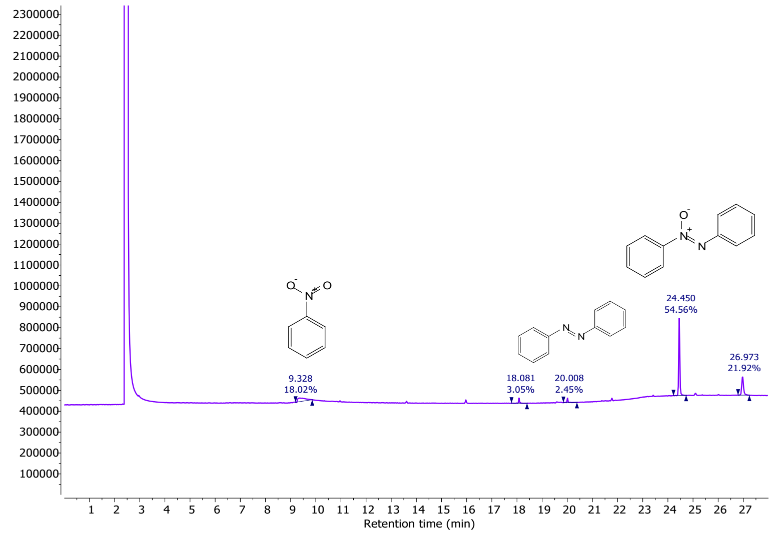


Fig. S61. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, oxygen atmosphere, time: 24 hours, room temperature.

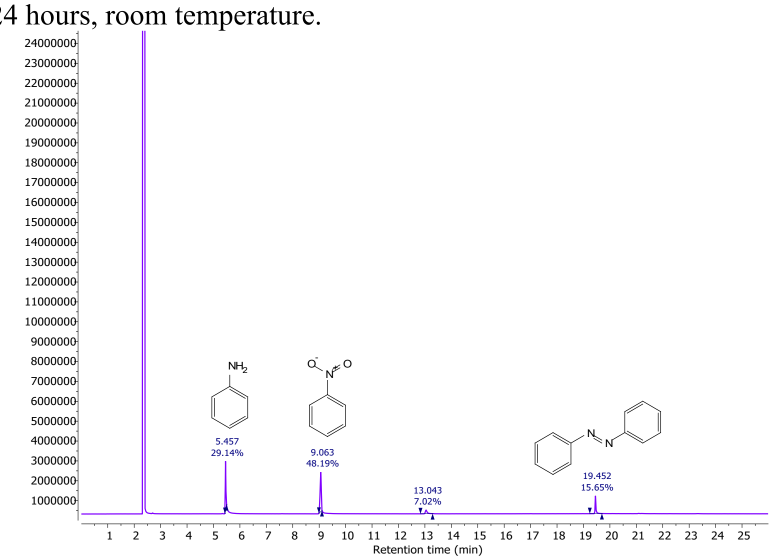


Fig. S62. Gas Chromatography (GC) Reaction conditions: 8 mg CdS photocatalyst, 0.2 mmol nitrobenzene, 2 mL methanol, 6 eq hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

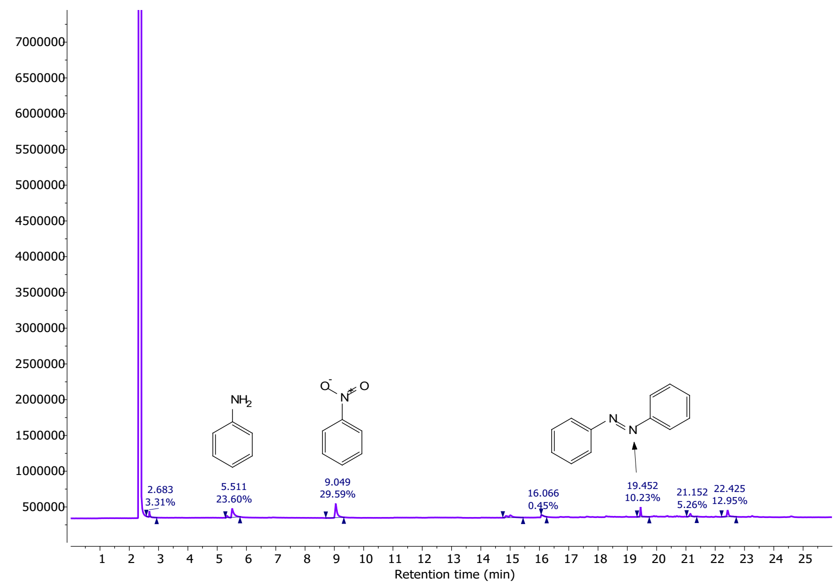


Fig. S63. Gas chromatography (GC) reaction conditions: 8 mg of NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 ml of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

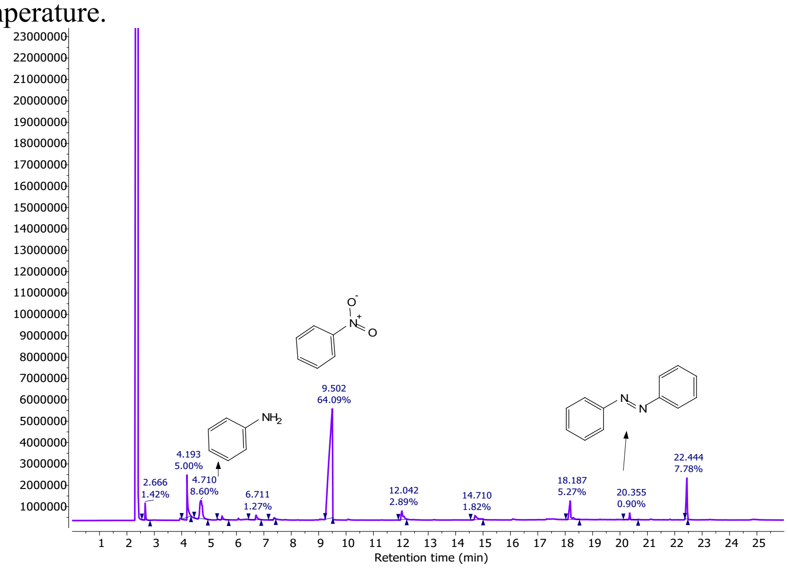


Fig. S64. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, darkness, argon atmosphere, time: 24 hours, room temperature .

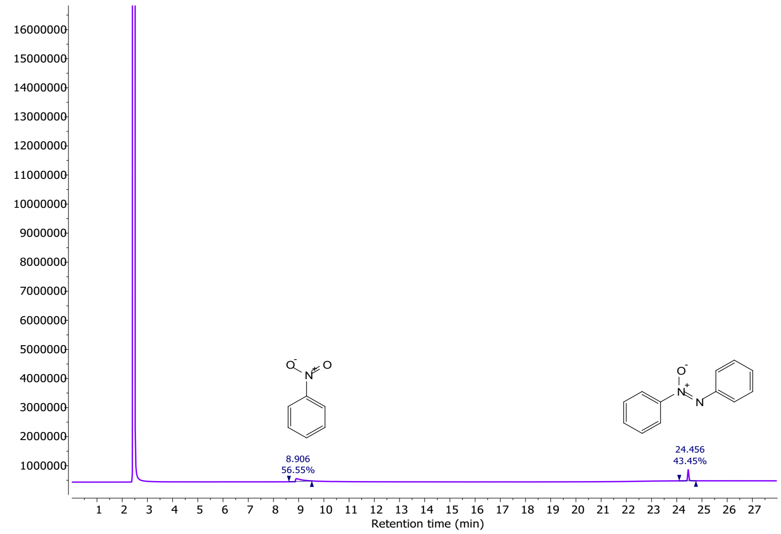


Fig. S65. Gas Chromatography (GC) Reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 6 hours, room temperature.

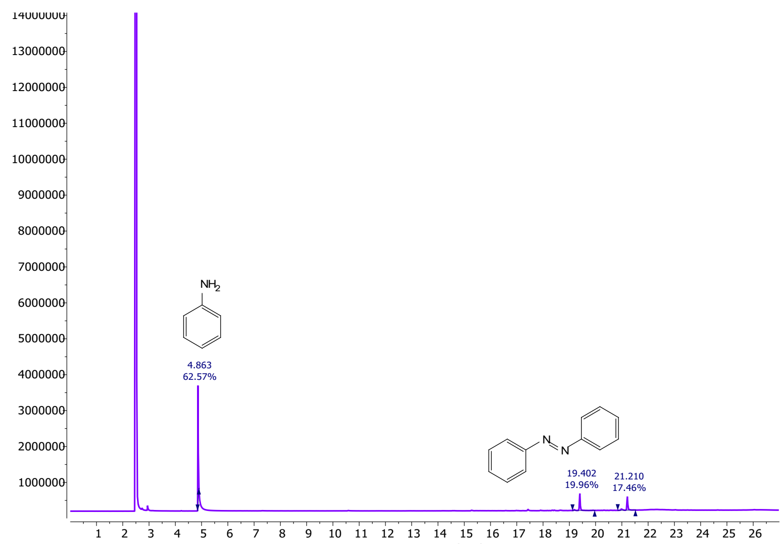


Fig. 66 Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 18 hours, room temperature.

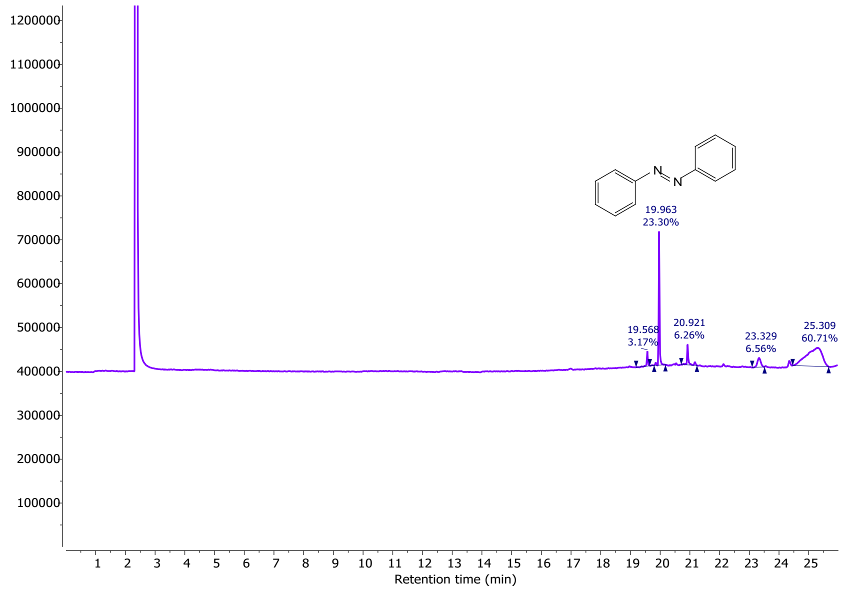


Fig. S67. Gas Chromatography (GC) Reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 12 W white lamp, oxygen atmosphere, time: 24 hours, room temperature.

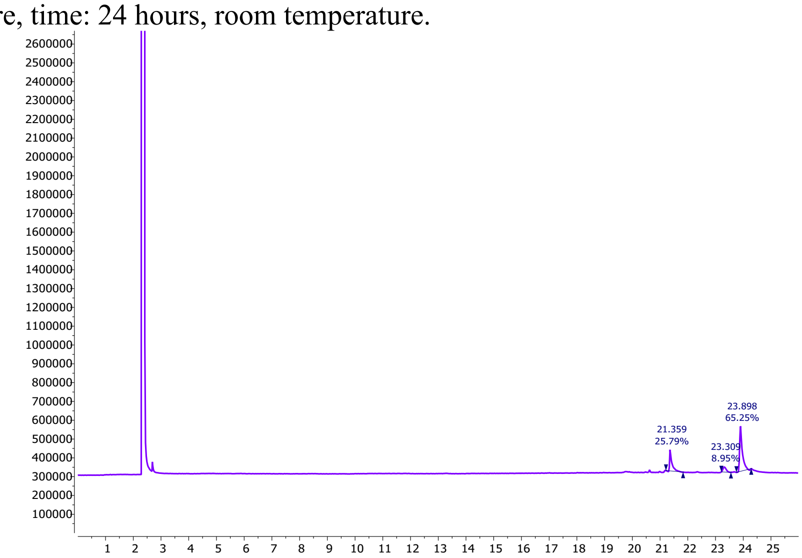


Fig. S68. Gas Chromatography (GC) Reaction Conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.5 mmol of nitrobenzene, 2 mL of tetrahydrofuran, 4 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature

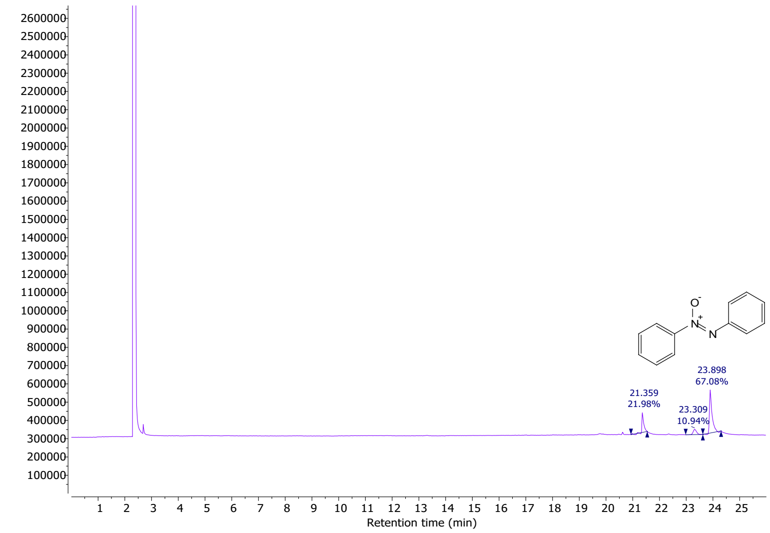


Fig. S69. Gas Chromatography (GC) reaction conditions: 8 mg CdS photocatalyst, 0.2 mmol nitrobenzene, 2 mL tetrahydrofuran, 6 eq hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

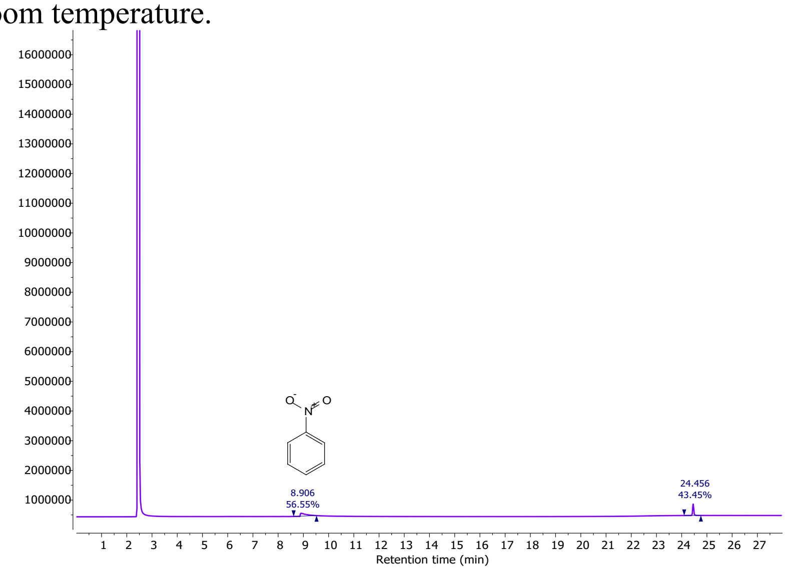


Fig. S70. Gas Chromatography (GC) Reaction conditions: 8 mg NH_2-MIL-125 photocatalyst, 0.2 mmol nitrobenzene, 2 mL tetrahydrofuran, 6 eq hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature

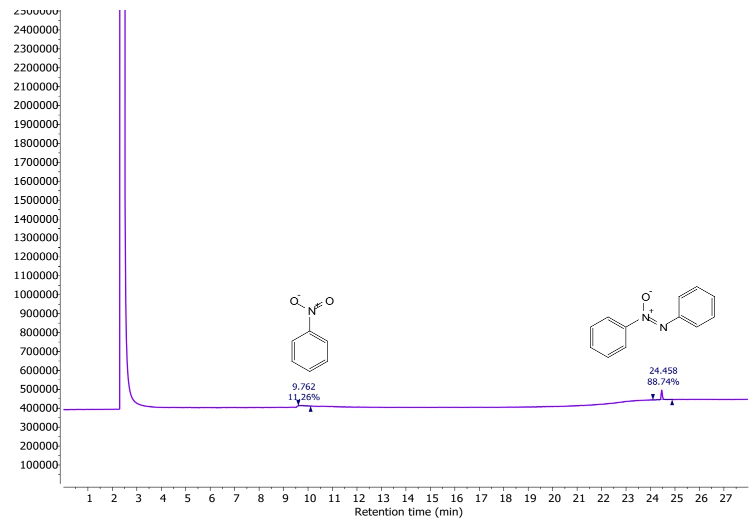


Fig. S71. Gas Chromatography (GC) reaction conditions: 10 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of tetrahydrofuran, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

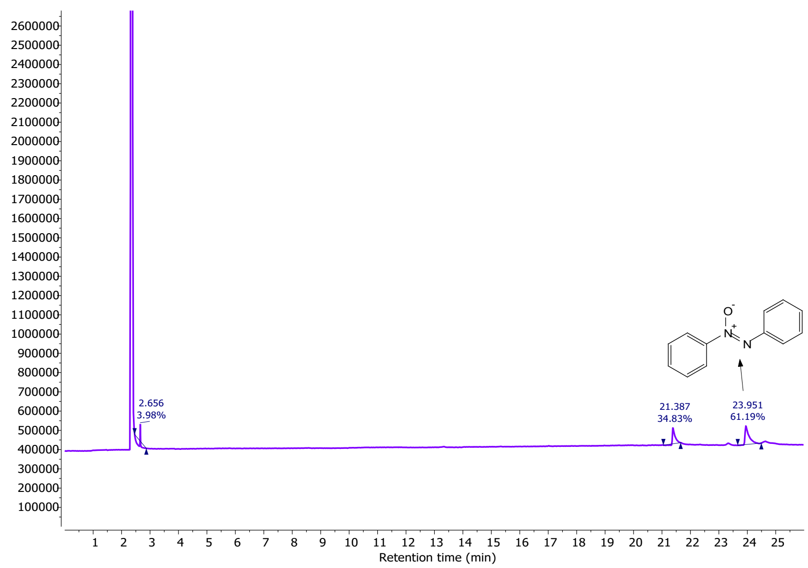


Fig. S72. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of tetrahydrofuran solvent, 6 eq of hydrazine hydrate, 9Wblue lamp, argon atmosphere, time: 24 hours, room temperature.

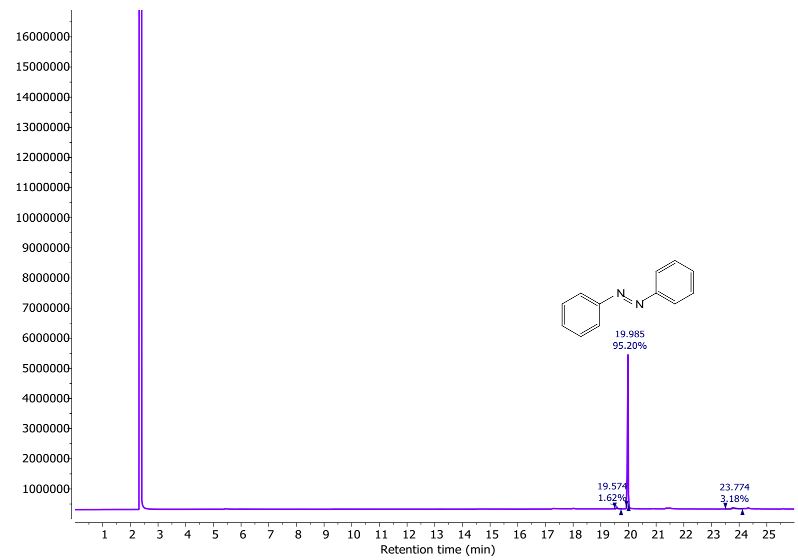


Fig. S73. Gas Chromatography (GC) Reaction Conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

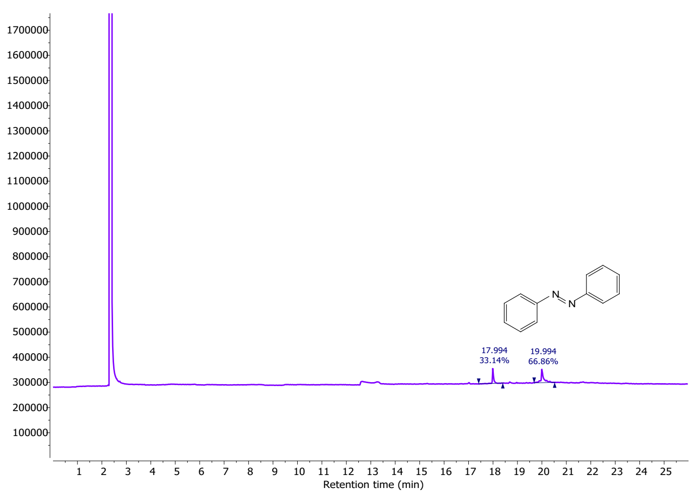


Fig. S74. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

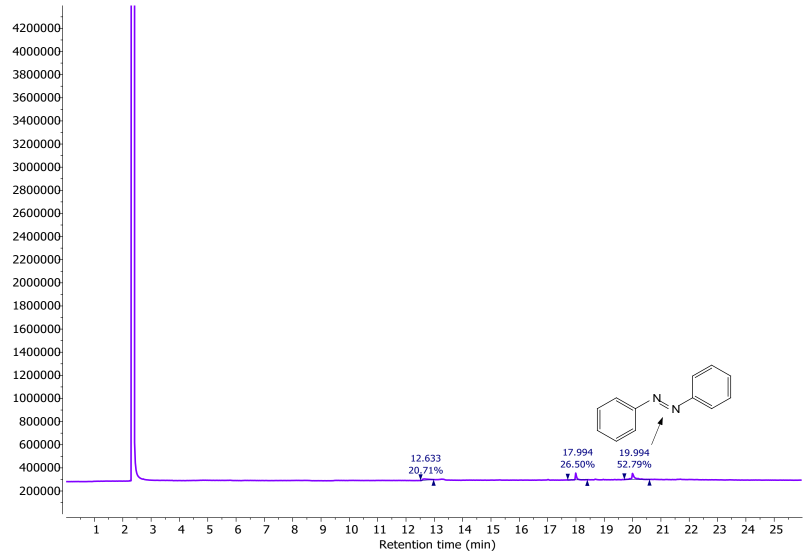


Fig. S75. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of acetonitrile solvent, 0.5 mmol of K_2CO_3, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

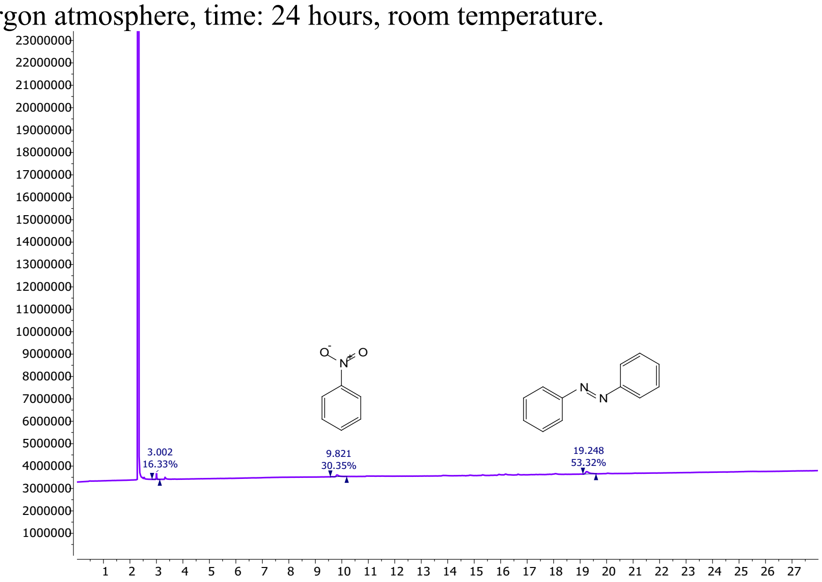


Fig. S76. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 ml of ethanol, 6 eq of hydrazine hydrate, 0.4 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

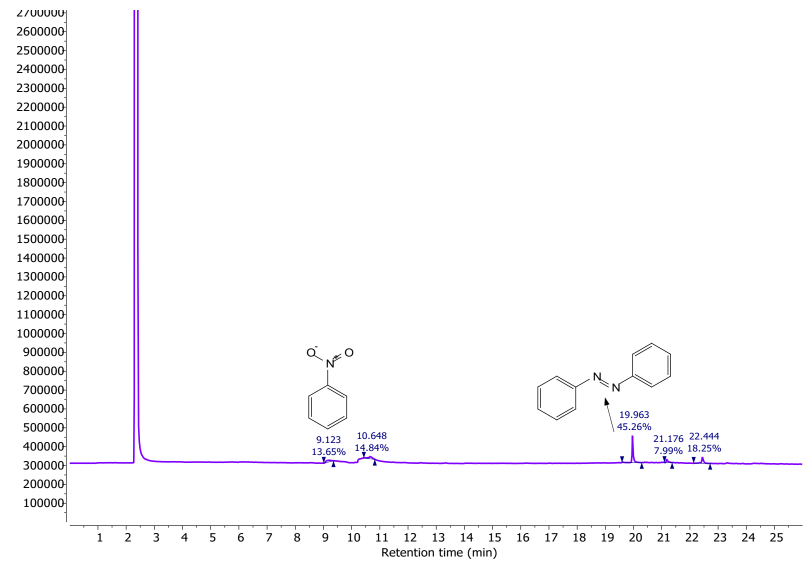


Fig. S77. Gas Chromatography (GC) Reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 catalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 12 hours, room temperature.

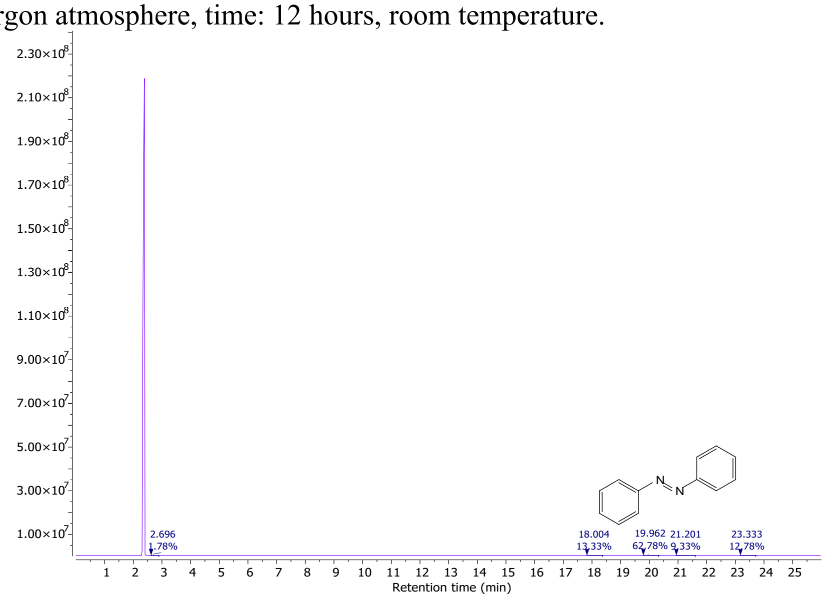


Fig. S77. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of methanol, 4 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

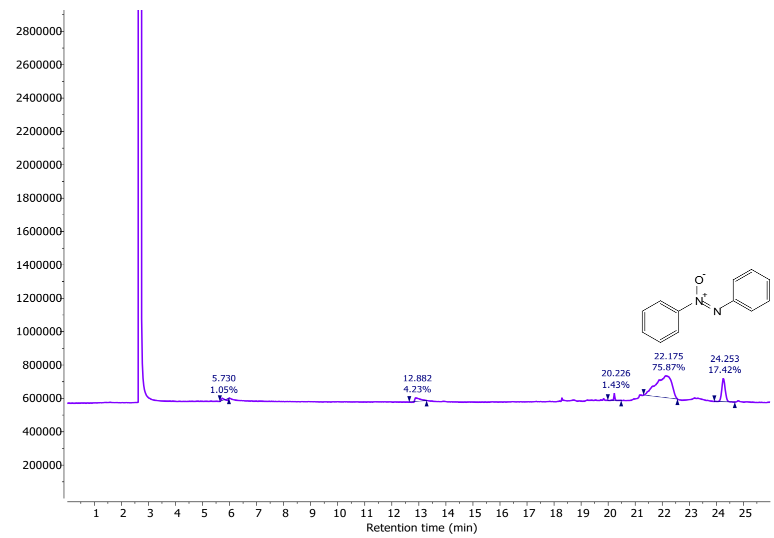


Fig. S78. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, oxygen atmosphere, time: 24 hours, room temperature.

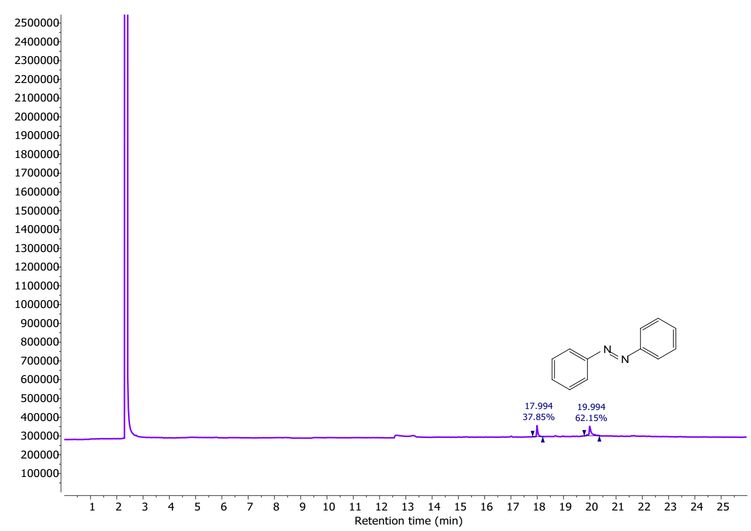


Fig. S79. Gas Chromatography (GC) reaction conditions: 8 mg CdS photocatalyst, 0.2 mmol nitrobenzene, 2 mL ethanol, 6 eq hydrazine hydrate, 0.5 mmol potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

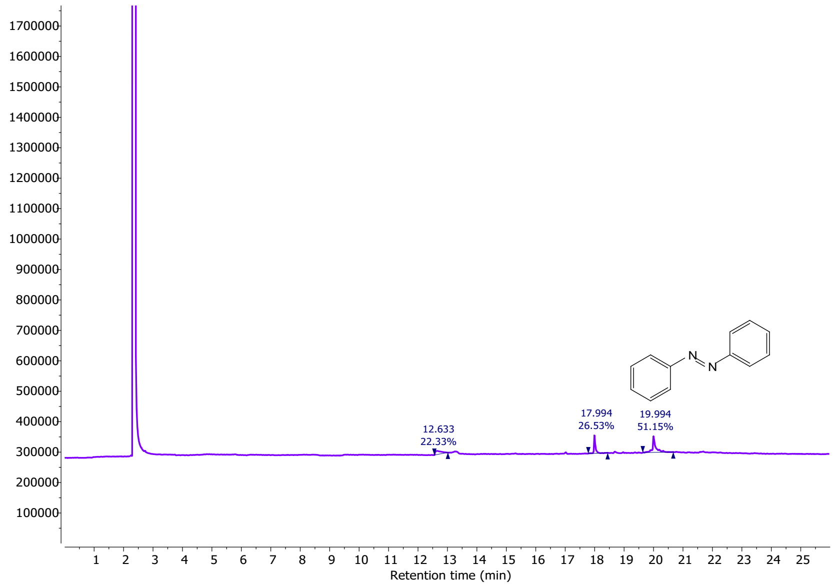


Fig. S80. Gas Chromatography (GC) reaction conditions: 8 mg of NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12-W white lamp, argon atmosphere, time: 24 hours, room temperature.

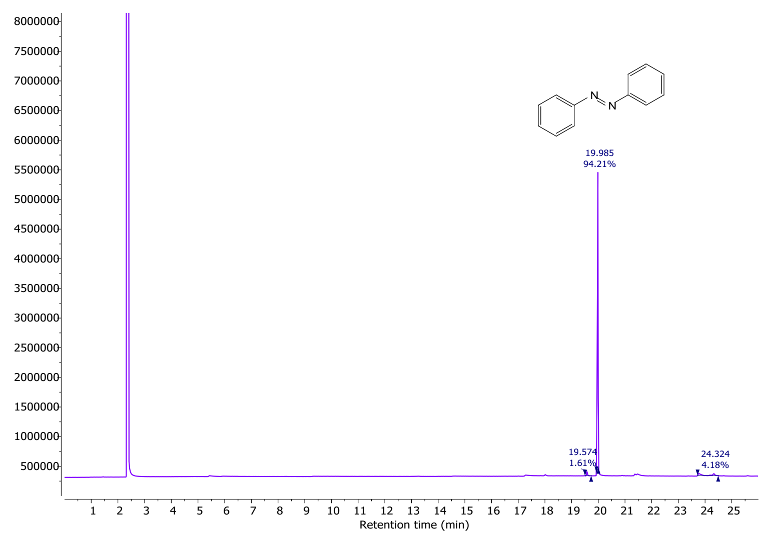


Fig. S81. Gas Chromatography (GC) Reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 ml of ethanol, 8 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature **.**

Fig. S82. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(3.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 ml of ethanol, 0.5 mmol of K_2CO_3, 6 eq of hydrazine hydrate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature **.**

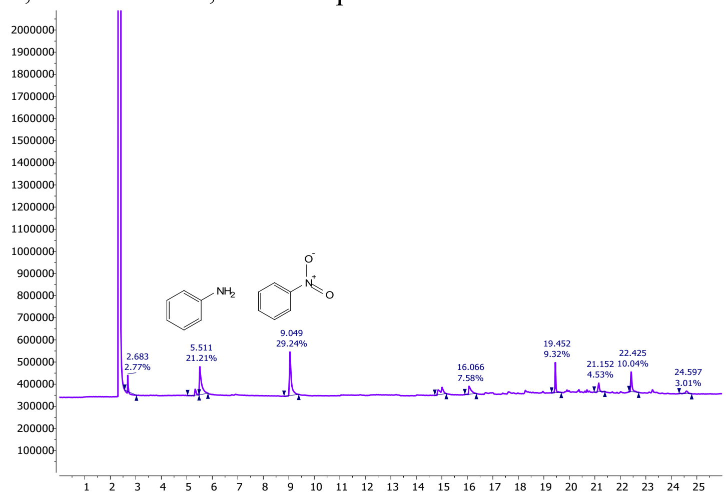


Fig. S83. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 8 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, darkness, argon atmosphere, time: 24 hours, room temperature.

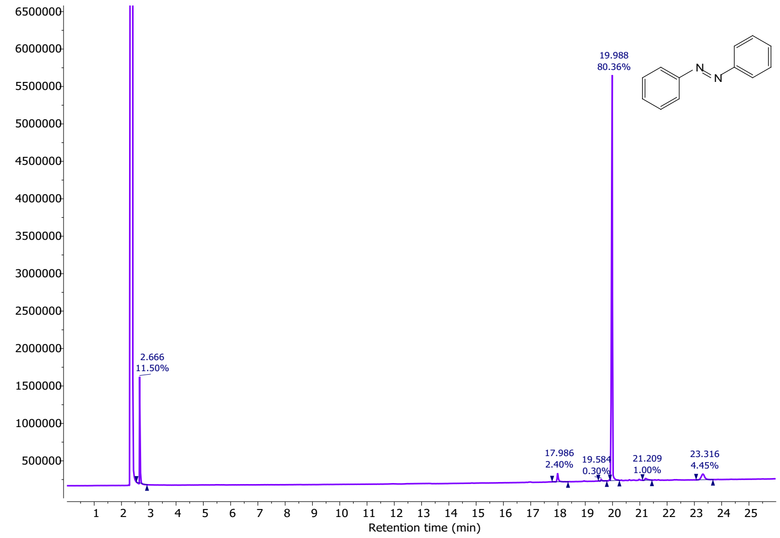


Fig. S84. Gas Chromatography (GC) Reaction conditions: 10 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.5 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.

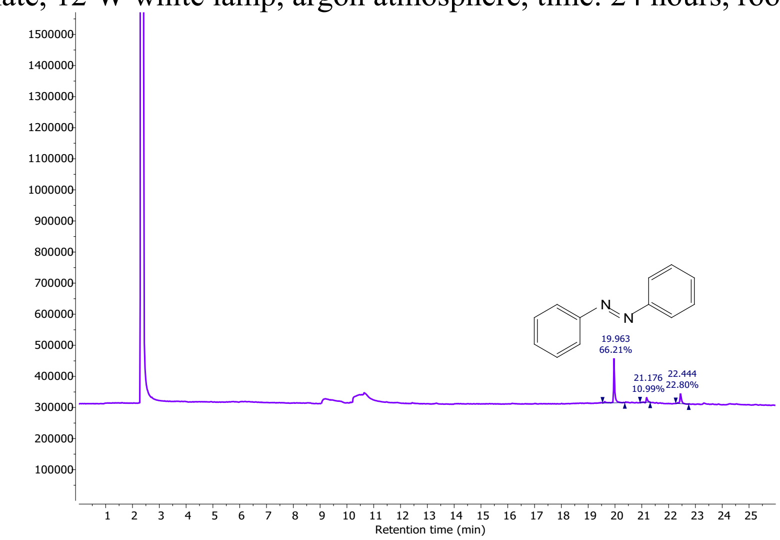


Fig. S85. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 0.5 mmol of K_2CO_3, 6 eq of hydrazine hydrate, 12 W blue lamp, argon atmosphere, time: 24 hours, room temperature.

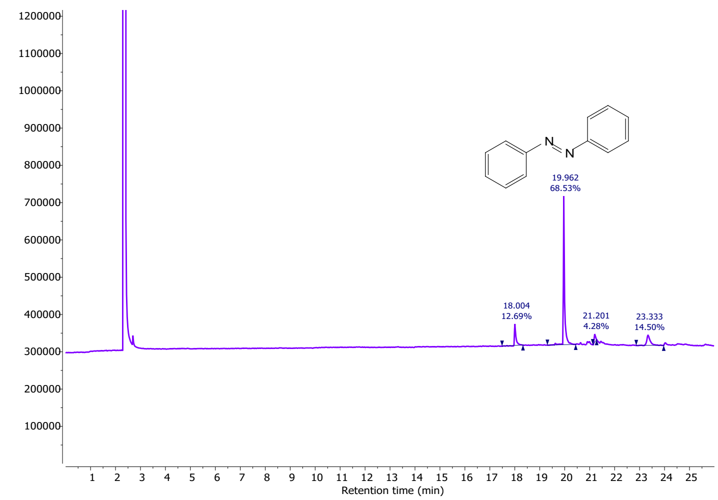


Fig. S86. Gas Chromatography (GC) reaction conditions: 8 mg of CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 0.5 mmol of K_2CO_3, 6 eq of hydrazine hydrate, natural sunlight, argon atmosphere, time: 24 hours, room temperature.

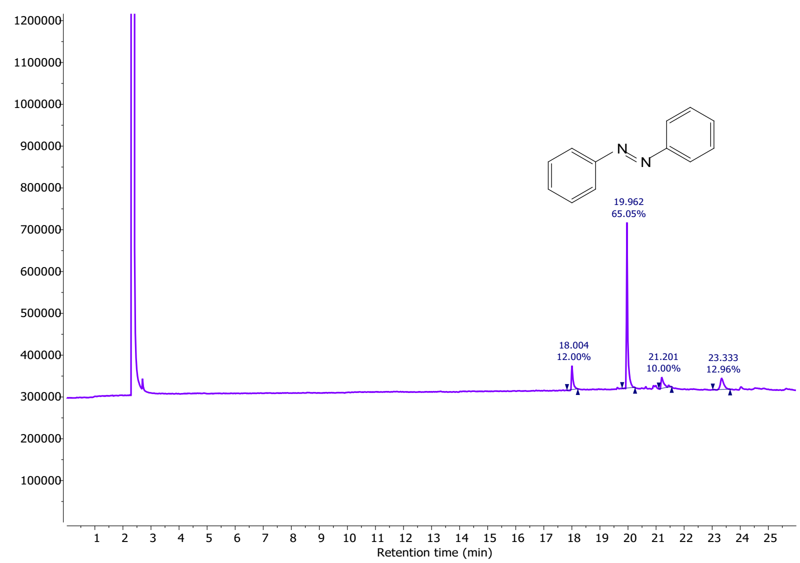


Fig. S87. Gas Chromatography (GC) reaction conditions: 8 mg of recycled CdS(2.5%)/NH_2-MIL-125 photocatalyst, 0.2 mmol of nitrobenzene, 2 mL of ethanol, 6 eq of hydrazine hydrate, 0.5 mmol of potassium carbonate, 12 W white lamp, argon atmosphere, time: 24 hours, room temperature.