Supporting information

Cu(I)-Catalyzed Tandem Decarboxylative/C-H activation Coupling reaction of Cyclic diketone, proline and alkyne: Synthesis of $\alpha$-alkynylated pyrrolidine-oxyindoles

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General Information: All the reagents and solvents were purchased from Sigma-Aldrich or Merck chemical Co. and were used directly without any further purification. Organic solutions were concentrated under reduced pressure on a Büchi rotary evaporator. The progress of reaction was checked by thin-layer chromatography. The plates were visualized first with UV illumination followed by iodine. $^1$HNMR spectra were recorded at 200 or 300 MHz using Brucker DRX-200 or 300 spectrometer and are reported in parts per million (ppm) on the $\delta$ scale relative to tetramethylsilane as an internal standard. Coupling constants ($J$) reported in Hz. $^{13}$CNMR spectra were recorded at 50 or 75 MHz. Mass spectra were obtained using JEOL SX-102 (ESI) instrument. Elemental analysis was performed using a Perkin-Elmer autosystem XL analyzer.

Typical Procedure for the Synthesis of $\alpha$-alkynylated pyrrolidine-oxyindoles (4a-n): Typical procedure for the synthesis of $\alpha$-alkynylated pyrrolidine-oxyindole 4a, CuI (0.038 mg, 20 mol %) was added to a solution of proline (2a, 1.5 mmol, 0.173 mg) in acetitrile (5 mL). The mixture was stirred for 10 min under nitrogen atmosphere at room temperature, and then isatin (1a, 1 mmol, 0.147 mg), and alkyne (3a, 2 mmol, 0.204 mg) was added to the reaction mixture and reaction was heated in an oil bath at 100 $^0$C with stirring under nitrogen atmosphere until completion of reaction monitored through TLC. Upon completion (6-8 h) of the reaction, the mixture was then cooled to room temperature and filtered on celite. The filtrate was concentrated under reduced pressure to give the crude material, which was purified by column chromatography on silica gel (eluent: EtOAc/hexane), and afforded $\alpha$-substituted pyrrolidine-oxyindole 4a-n in good to excellent yield.

Typical Procedure for the Synthesis 6a-b: CuI (0.038 mg, 20 mol %) was added to a solution of proline (2a, 1.5 mmol, 0.173 mg) in acetitrile (5 mL). The mixture was stirred for 10 min under nitrogen atmosphere at room temperature, and then added acenaphthylene-1,2-dione 5a (1 mmol, 0.182 mg), and phenyl acetylene (3a, 2 mmol, 0.204 mg). The reaction was then heated at 100 $^0$C in a oil bath with stirring under nitrogen atmosphere until completion of reaction monitored through TLC. Upon completion (6-8 h) of the reaction, the mixture was then cooled to room temperature and filtered on celite.
The filtrate was concentrated under reduced pressure to give the crude material, which was purified by column chromatography on silica gel (eluent: EtOAc/hexane), and afforded desired 6a-b in good to excellent yield.

**Typical Procedure for the Synthesis of 8a-c:** CuI (0.038 mg, 20 mol %) was added to a solution of proline (2a, 1.5 mmol, 0.173 mg) in acetonitrile (5 mL). The mixture was stirred for 10 min under nitrogen atmosphere at room temperature, and then added aceanthrylene-1,2-dione 7a (1 mmol, 0.232 mg), and phenyl acetylene (3a, 2 mmol, 0.204). The reaction was then heated in at 100 °C in a oil bath with stirring under nitrogen atmosphere until completion of reaction monitored through TLC. Upon completion (6-8 h) of the reaction, the mixture was then cooled to room temperature and filtered on celite. The filtrate was concentrated under reduced pressure to give the crude material, which was purified by column chromatography on silica gel (eluent: EtOAc/hexane), and afforded desired 8a-c in good to excellent yield.

**Typical Procedure for the Synthesis of 10:** CuI (0.038 mg, 20 mol %) was added to a solution of proline (2a, 1.5 mmol, 0.173 mg) in acetonitrile (5 mL). The mixture was stirred for 10 min under nitrogen atmosphere at room temperature, and then added 1H-indene-1,2,3-trione 9a (1 mmol, 0.160 mg), and phenyl acetylene (3a, 2 mmol, 0.204). The reaction was then heated in at 100 °C in a oil bath with stirring under nitrogen atmosphere until completion of reaction monitored through TLC. Upon completion (6-8 h) of the reaction, the mixture was then cooled to room temperature and filtered on celite. The filtrate was concentrated under reduced pressure to give the crude material, which was purified by column chromatography on silica gel (eluent: EtOAc/hexane), and afforded desired 10 in good to excellent yield.

**Characterization Data of Synthesized compounds**

**3-(2-(Phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4a):** Physical state: solid. ¹H NMR (300 MHz, CDCl₃) δ (ppm): 1.91-1.60 (m, 3H), 2.17-2.14 (m, 1H), 2.80 (t, J = 7.2 Hz, 2H), 4.80 (t, J = 7.1 Hz, 1H), 6.60 (s, 1H), 7.12-6.94 (m, 8H), 7.23 (d, J = 7.1 Hz, 1H), 9.34 (s, 1H); ¹³C NMR (75 MHz, CDCl₃) δ (ppm): 26.5, 33.3, 48.5, 70.9, 79.2, 110.6, 113.6, 121.6, 125.6, 126.4, 127.1, 127.8, 129.2, 132.4, 132.8, 138.7, 139.4, 141.5, 181.1; IR (KBr): 3480, 2921, 3021, 2135, 1678 cm⁻¹; ESI MS (m/z): 303 (M+H)⁺. Anal. Calcd. for C₂₀H₁₈N₂O: C, 79.44; H, 6.00; N, 9.26; Found: C, 79.48; H, 6.02; N, 9.22.

**5-Chloro-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4b):** Physical state: solid; ¹H NMR (300 MHz, CDCl₃) δ (ppm): 1.60-150 (m, 1H), 1.86-1.82 (m, 2H), 2.11-2.04 (m, 1H), 2.69-2.64 (m, 2H), 4.66 (t, J = 6.9Hz, 1H), 6.52 (s, 1H), 6.87-6.81 (m, 2H), 7.08-6.96 (m, 2H), 7.15 (dd, J = 8.2Hz, 8.3Hz, 4H), 9.99 (s, 1H); ¹³C
NMR (75 MHz, CDCl\textsubscript{3}) δ (ppm): 28.9, 31.0, 48.2, 70.6, 111.3, 125.5, 125.7, 126.1, 127.3, 128.0, 128.4, 129.2, 132.8, 133.0, 138.5, 138.9, 141.4, 178.6; IR (KBr): 3440, 2910, 3034, 2201, 1680 cm\textsuperscript{-1}; ESI MS (m/z): 337 (M+H). Anal. Calcd. for C\textsubscript{20}H\textsubscript{17}ClN\textsubscript{2}O: C, 71.32; H, 5.09; N, 8.32; Found: C, 71.34; H, 5.07; N, 8.33.

5-Bromo-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4c): Physical state: solid; \textsuperscript{1}H NMR (300 MHz, DMSO-d\textsubscript{6}) δ (ppm): 0.85-0.55 (m, 2H), 1.39-1.22 (m, 4H), 3.23 (t, J = 7.2Hz, 1H), 5.51 (s, 1H), 5.66 (d, J = 8.2Hz, 1H), 5.77-5.75 (m, 1H), 5.84 (s, 1H), 5.95 (d, J = 5.9Hz, 3H), 6.22 (dd, J = 8.2Hz, 8.2Hz, 1H), 9.36 (s, 1H); \textsuperscript{13}C NMR (50 MHz, DMSO-d\textsubscript{6}) δ (ppm): 26.1, 30.3, 47.8, 70.3, 77.6, 111.6, 112.5, 125.1, 127.1, 127.9, 128.5, 128.6, 132.0, 132.7, 133.2, 138.0, 141.6, 177.7; IR (KBr): 3390, 2919, 3019, 2224, 1665 cm\textsuperscript{-1}; ESI MS (m/z): 381 (M+H). Anal. Calcd. for C\textsubscript{20}H\textsubscript{17}BrN\textsubscript{2}O: C, 63.00; H, 4.49; N, 7.35; Found: C, 63.05; H, 4.43; N, 7.36.

5-Nitro-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4d): Physical state: solid; \textsuperscript{1}H NMR (300 MHz, DMSO-d\textsubscript{6}) δ (ppm): 0.58-0.36 (m, 3H), 0.86 (br, s, 1H), 1.65-1.60 (m, 2H), 3.29 (br, s, 1H), 5.59-5.58 (br, s, 1H), 5.77 (t, J = 2.6Hz, 2H), 5.96 (t, J = 6.4Hz, 4H), 6.51 (br, s, 1H), 7.03-6.99 (m, 1H), 10.03 (s, 1H); \textsuperscript{13}C NMR (75 MHz, DMSO-d\textsubscript{6}) δ (ppm): 26.6, 30.8, 48.6, 70.9, 77.8, 110.5, 121.6, 125.6, 127.2, 127.5, 127.7, 128.6, 133.0, 134.5, 138.1, 141.9, 149.3, 179.0; IR (KBr): 3460, 2930, 3034, 2205, 1666 cm\textsuperscript{-1}; ESI MS (m/z): 348 (M+H). Anal. Calcd. for C\textsubscript{20}H\textsubscript{17}N\textsubscript{3}O\textsubscript{3}: C, 69.15; H, 4.93; N, 12.10; Found: C, 69.18; H, 4.89; N, 12.12.

5-Fluoro-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4e): Physical state: solid; \textsuperscript{1}H NMR (300 MHz, CDCl\textsubscript{3}) δ (ppm): 1.96-1.88 (m, 2H), 2.22-2.12 (m, 2H), 2.78 (t, J = 6.6Hz, 2H), 4.77 (t, J = 6.7Hz, 1H), 6.60 (br, 1H), 6.76 (dd, J = 7.7Hz, 7.6Hz, 1H), 6.89-6.85 (m, 1H), 6.96 (dd, J = 8.9Hz, 8.8Hz, 1H), 7.05 (t, J = 3.3Hz, 2H), 7.16 (t, J = 3.6Hz, 3H), 8.82 (s, 1H); \textsuperscript{13}C NMR (75 MHz, CDCl\textsubscript{3}) δ (ppm): 26.6, 31.0, 48.2, 70.7, 110.6, 110.7, 113.6, 113.9, 115.5, 115.8, 125.8, 127.2, 128.0, 128.2, 128.3, 132.8, 133.2, 138.7, 139.1, 156.0, 159.2, 178.9; IR (KBr): 3455, 2940, 3025, 2230, 1670 cm\textsuperscript{-1}; ESI MS (m/z): 321 (M+H). Anal. Calcd. for C\textsubscript{20}H\textsubscript{17}FN\textsubscript{2}O: C, 74.98; H, 5.35; N, 8.74; Found: C, 74.99; H, 5.38; N, 8.71.

5-Iodo-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4f): Physical state: solid; \textsuperscript{1}H NMR (300 MHz, CDCl\textsubscript{3}) δ (ppm): 1.66-1.56 (m, 2H), 2.19-2.12 (m, 1H), 2.75-2.70 (m, 2H), 4.75 (t, J = 7.2Hz, 1H), 6.60 (br, s, 1H), 6.75 (d, J = 8.2Hz, 1H), 7.03-7.00 (m, 2H), 7.17-7.15 (m, 4H), 7.57 (dd, J = 8.7Hz, 8.1Hz, 1H), 9.04 (s, 1H); \textsuperscript{13}C NMR (75 MHz, CDCl\textsubscript{3}) δ (ppm): 27.2, 31.8,
48.9, 71.6, 84.9, 113.1, 126.1, 127.8, 128.5, 129.5, 132.9, 133.2, 135.3, 138.5, 139.4, 141.5, 181.0; IR (KBr): 3477, 2920, 3045, 2209, 1675 cm\(^{-1}\); ESI MS (m/z): 429 (M+H)+. Anal. Calcd. for C\(_{20}\)H\(_{17}\)IN\(_2\)O: C, 56.09; H, 4.00; N, 6.54; Found: C, 56.15; H, 4.01; N, 6.52.

1-Methyl-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4g): Physical state: solid; \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) (ppm): 1.61-1.54 (m, 1H), 1.81 (br, s, 2H), 2.73 (t, \(J = 7.4\)Hz, 2H), 3.19 (s, 3H), 4.73 (br, s, 1H), 6.44 (s, 1H), 6.81 (br, 3H), 6.87 (m, 5H), 7.02-6.87 (m, 5H), 7.27-7.20 (m, 2H); \(^{13}\)C NMR (75 MHz, CDCl\(_3\)) \(\delta\) (ppm): 10.5, 19.7, 26.4, 28.9, 31.0, 41.0, 48.0, 70.7, 78.3, 108.0, 121.1, 125.6, 125.8, 126.2, 126.7, 127.3, 128.8, 132.1, 132.9, 139.7, 143.3, 177.2; IR (KBr): 3465, 2921, 3027, 2205, 1677 cm\(^{-1}\); ESI MS (m/z): 317 (M+H). Anal. Calcd. for C\(_{21}\)H\(_{20}\)N\(_2\)O: C, 79.72; H, 6.37; N, 8.85; Found: C, 79.74; H, 6.33; N, 8.86.

1-Ethyl-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4h): Physical state: solid; \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) (ppm): 1.36 (t, \(J = 6.9\)Hz, 3H), 1.59-1.50 (m, 1H), 1.80-1.70 (m, 2H), 2.09-2.04 (m, 1H), 2.69-2.63 (m, 2H), 3.84 (q, \(J = 6.8\)Hz, 2H), 4.69 (t, \(J = 6.4\)Hz, 1H), 6.51 (br, s, 1H), 6.95-6.84 (m, 5H), 7.18-7.01 (m, 4H); IR (KBr): 3463, 2919, 3021, 2205, 1678 cm\(^{-1}\); ESI MS (m/z): 331 (M+H). Anal. Calcd. for C\(_{22}\)H\(_{22}\)N\(_2\)O: C, 79.97; H, 6.71; N, 8.48; Found: C, 79.99; H, 6.69; N, 8.49.

3-(2-(Phenylethynyl)pyrrolidin-1-yl)-1-propylindolin-2-one (4i): Physical state: solid; \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) (ppm): 0.94 (t, \(J = 7.4\)Hz, 3H), 1.72-1.63 (m, 3H), 1.88-1.84 (m, 2H), 2.15-2.07 (m, 1H), 2.74-2.70 (m, 2H), 3.79-3.57 (m, 2H), 4.75 (t, \(J = 7.1\) Hz, 1H), 4.69 (s, 1H), 6.86 (d, \(J = 8.7\)Hz, 1H), 6.92-6.90 (m, 2H), 7.07-6.95 (m, 5H), 7.24-7.19 (m, 1H); IR (KBr): 3450, 2930, 2205, 1677 cm\(^{-1}\); ESI MS (m/z): 345 (M+H)+. Anal. Calcd. for C\(_{23}\)H\(_{24}\)N\(_2\)O: C, 80.20; H, 7.02; N, 8.13; Found: C, 80.23; H, 7.01; N, 8.12.

1-Butyl-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4j): Physical state: solid; \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) (ppm): 0.88 (t, \(J = 7.3\)Hz, 1H), 1.31-1.22 (m, 2H), 1.61-1.56 (m, 3H), 1.85 (d, \(J = 6.2\)Hz, 2H), 2.13-2.08 (m, 1H), 2.73 (br, s, 2H), 3.65-3.55 (m, 1H), 3.76-3.69 (m, 1H), 4.76 (br, s, 1H), 4.64 (br, s, 1H), 6.46-6.80 (m, 3H), 6.91 (d, \(J = 6.9\)Hz, 1H), 7.02-6.95 (m, 4H), 7.24-7.19 (m, 1H); IR (KBr): 3420, 2930, 3019, 2229, 1681 cm\(^{-1}\); ESI MS (m/z): 359 (M+H)+. Anal. Calcd. for C\(_{24}\)H\(_{26}\)N\(_2\)O: C, 80.41; H, 7.31; N, 7.81; Found: C, 80.44; H, 7.29; N, 7.82.
**1-Benzyl-3-(2-(phenylethynyl)pyrrolidin-1-yl)indolin-2-one (4k):** Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.64-1.52 (m, 1H), 1.85 (br, s, 2H), 2.12-2.10 (m, 1H), 2.74 (d, $J = 6.5$Hz, 2H), 4.70 (d, $J = 15.5$Hz, 1H), 5.09 (d, $J = 15.6$Hz, 1H), 6.46 (s, 1H), 6.69 (d, $J = 7.6$Hz, 1H), 6.82 (d, $J = 7.3$Hz, 2H), 6.91 (t, $J = 7.4$Hz, 1H), 6.99-6.94 (m, 3H), 7.05 (d, $J = 6.8$Hz, 1H), 7.19-7.10 (m, 7H); $\text{IR (KBr)}$: 3427, 2950, 3015, 2220, 1672 cm$^{-1}$; $\text{ESI MS (m/z)}$: 393 (M+H)$^+$. Anal. Calcd. for C$_{27}$H$_{24}$N$_2$O: C, 82.62; H, 6.16; N, 7.14; Found: C, 82.64; H, 6.13; N, 7.12.

**3-(2-(p-Tolylethynyl)pyrrolidin-1-yl)indolin-2-one (4l):** Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.93-1.79 (m, 4H), 2.21 (s, 3H), 2.79-2.74 (m, 2H), 4.78 (t, $J = 8.0$Hz, 1H), 6.54 (br, s, 1H), 7.00-6.91 (m, 7H), 7.25-7.20 (m, 1H), 9.07 (s, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 20.3, 26.3, 31.1, 48.2, 70.7, 78.8, 110.3, 121.3, 125.3, 126.1, 126.2, 128.3, 129.7, 131.2, 136.6, 139.1, 141.2, 180.5; $\text{IR (KBr)}$: 3455, 2960, 3054, 2264, 1676 cm$^{-1}$; $\text{ESI MS (m/z)}$: 317 (M+H)$^+$. Anal. Calcd. for C$_{21}$H$_{20}$N$_2$O: C, 79.72; H, 6.37; N, 8.85; Found: C, 79.74; H, 6.34; N, 8.83.

**3-(2-(m-Tolylethynyl)pyrrolidin-1-yl)indolin-2-one (4m):** Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.90-1.72 (m, 4H), 2.24 (s, 3H), 2.80-2.73 (m, 2H), 4.77 (t, $J = 8.1$Hz, 1H), 6.51 (br, s, 1H), 7.03-6.94 (m, 6H), 7.28-7.19 (m, 1H), 7.75 (s, 1H), 9.09 (s, 1H); $\text{IR (KBr)}$: 3458, 2970, 3025, 2245, 1679 cm$^{-1}$; $\text{ESI MS (m/z)}$: 317 (M+H)$^+$. Anal. Calcd. for C$_{21}$H$_{20}$N$_2$O: C, 79.72; H, 6.37; N, 8.85; Found: C, 79.73; H, 6.34; N, 8.84.

**Methyl 3-(1-(2-oxoindolin-3-yl)pyrrolidin-2-yl)propionate (4n):** Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 2.24-1.80 (m, 4H), 2.67 (t, $J = 6.6$Hz, 2H), 3.47 (s, 3H), 4.66 (t, $J = 7.3$Hz, 1H), 6.94-6.83 (m, 3H), 7.19-7.14 (m, 2H), 8.35 (s, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 22.0, 30.6, 31.2, 47.6, 51.0, 71.6, 110.1, 121.2, 125.2, 125.8, 129.1, 133.4, 141.5, 146.0, 161.9, 179.5; $\text{IR (KBr)}$: 3480, 2967, 3025, 2325, 1723, 1680 cm$^{-1}$; $\text{ESI MS (m/z)}$: 285 (M+H)$^+$. Anal. Calcd. for C$_{16}$H$_{16}$N$_2$O$_3$: C, 67.59; H, 5.67; N, 9.85; Found: C, 67.62; H, 5.69; N, 9.83.

**2-(2-(Phenylethynyl)pyrrolidin-1-yl)acenaphthylen-1(2H)-one (6a):** Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 2.24-1.80 (m, 4H), 2.67 (t, $J = 6.6$Hz, 2H), 3.47 (s, 3H), 4.66 (t, $J = 7.3$Hz, 1H), 6.94-6.83 (m, 3H), 7.19-7.14 (m, 2H), 8.35 (s, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 22.0, 30.6, 31.2, 47.6, 51.0, 71.6, 110.1, 121.2, 125.2, 125.8, 129.1, 133.4, 141.5, 146.0, 161.9, 179.5; $\text{IR (KBr)}$: 3480, 2967, 3025, 2325, 1723, 1680 cm$^{-1}$; $\text{ESI MS (m/z)}$: 285 (M+H)$^+$. Anal. Calcd. for C$_{16}$H$_{16}$N$_2$O$_3$: C, 67.59; H, 5.67; N, 9.85; Found: C, 67.62; H, 5.69; N, 9.83.
2-(2-(p-Tolylethynyl)pyrrolidin-1-yl)acenaphthylen-1(2H)-one (6b): Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.81-1.67 (m, 4H), 2.12 (s, 3H), 2.46-2.35 (m, 1H), 2.66-2.51 (m, 1H), 4.77 (br, 1H), 6.58 (s, 1H), 6.68 (d, $J = 7.8$Hz, 2H), 6.76 (d, $J = 7.8$Hz, 2H), 7.29 (br, 1H), 7.58 (t, $J = 7.3$Hz, 1H), 7.79 (t, $J = 7.6$Hz, 1H), 7.89 (d, $J = 8.4$Hz, 1H), 8.14 (dd, $J = 8.2$Hz, 6.7Hz, 2H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 20.1, 21.8, 25.7, 28.8, 30.4, 31.1, 32.9, 49.0, 69.8, 81.8, 113.2, 122.0, 122.6, 124.5, 125.3, 127.2, 127.4, 127.9, 130.0, 130.1, 130.5, 131.4, 131.7, 135.3, 136.2, 138.4, 139.1, 141.6, 202.1; IR (KBr): 3030, 2970, 2265, 1718 cm$^{-1}$; ESI MS (m/z): 352 (M+H)$^+$. Anal. Calcd. for C$_{25}$H$_{21}$NO: C, 85.44; H, 6.02; N, 3.99; Found: C, 85.48; H, 6.01; N, 3.94.

2-(2-(Phenylethynyl)pyrrolidin-1-yl)aceanthrylen-1(2H)-one (8a): Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.82-1.60 (m, 3H), 2.15-2.08 (m, 1H), 2.45-2.40 (m, 1H), 2.69-2.61 (m, 1H), 4.79 (t, $J = 6.6$Hz, 1H), 6.61 (s, 1H), 6.91-6.76 (m, 5H), 7.47 (t, $J = 8.4$Hz, 1H), 7.61 (t, $J = 7.5$Hz, 1H), 7.72 (t, $J = 7.5$Hz, 1H), 7.93 (d, $J = 8.6$Hz, 1H), 8.13 (d, $J = 8.4$Hz, 1H), 8.65 (s, 1H), 9.21 (d, $J = 8.6$Hz, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 26.6, 31.4, 50.1, 70.9, 83.0, 123.0, 125.3, 125.6, 125.7, 126.3, 126.7, 127.3, 128.2, 128.6, 129.1, 129.4, 132.4, 133.6, 133.7, 134.0, 136.5, 140.3, 203.5; IR (KBr): 3031, 2975, 2260, 1721 cm$^{-1}$; ESI MS (m/z): 388 (M+H)$^+$. Anal. Calcd. for C$_{28}$H$_{21}$NO: C, 86.79; H, 5.46; N, 3.61; Found: C, 86.81; H, 5.44; N, 3.59.

2-(2-(p-Tolylethynyl)pyrrolidin-1-yl)aceanthrylen-1(2H)-one (8b): Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.86-1.69 (m, 3H), 2.07 (s, 3H) 2.19-2.14 (m, 1H), 2.50-2.45 (m, 1H), 2.73-2.65 (m, 1H), 4.83 (t, $J = 7.2$Hz, 1H), 6.62 (s, 1H), 6.73 (t, $J = 8.8$Hz, 4H), 7.24 (d, $J = 4.6$Hz, 1H), 7.53 (t, $J = 8.4$Hz, 1H), 7.65 (t, $J = 7.4$Hz, 1H), 7.76 (t, $J = 7.8$Hz, 1H), 7.98 (d, $J = 8.6$Hz, 1H), 8.18 (d, $J = 8.4$Hz, 1H), 8.70 (s, 1H), 9.25 (d, $J = 8.5$Hz, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 20.2, 25.8, 28.9, 30.6, 49.2, 70.2, 82.2, 124.5, 124.7, 124.9, 125.3, 125.8, 126.5, 127.8, 128.0, 128.2, 128.4, 130.3, 131.5, 131.9, 132.8, 135.8, 136.2, 139.3, 143.7, 202.8; IR (KBr): 3032, 2960, 2255, 1719 cm$^{-1}$; ESI MS (m/z): 402 (M+H)$^+$. Anal. Calcd. for C$_{29}$H$_{23}$NO: C, 86.75; H, 5.77; N, 3.49; Found: C, 86.78; H, 5.74; N, 3.48.

2-(2-(p-Tolylethynyl)pyrrolidin-1-yl)aceanthrylen-1(2H)-one (8c): Physical state: solid; $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ (ppm): 1.10 (s, 9H), 1.88-1.74 (m, 3H), 2.19-2.13 (m, 1H), 2.52-2.47 (m, 1H), 2.69 (t, $J = 8.4$Hz, 1H), 4.83 (t, $J = 7.5$Hz, 1H), 6.68 (s, 1H), 6.77 (d, $J = 8.3$Hz, 2H), 6.93 (d, $J = 8.3$Hz, 2H), 7.30 (t, $J = 6.6$Hz, 1H), 7.56 (d, $J = 6.8$Hz, 1H), 7.67 (d, $J = 7.6$Hz, 1H), 7.78 (d, $J = 7.9$Hz, 1H), 8.01 (d, $J = 8.6$Hz, 1H), 8.20 (d, $J = 8.4$Hz, 1H), 8.73 (s, 1H), 9.26 (d, $J = 8.5$Hz, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$) $\delta$ (ppm): 25.5, 29.9, 30.4, 33.2,
48.7, 69.8, 81.6, 121.8, 123.9, 124.2, 124.4, 124.5, 124.6, 125.5, 126.2, 127.5, 127.8, 128.0, 129.6, 131.2, 131.5, 132.4, 135.5, 138.7, 143.3, 149.1, 202.5; **IR (KBr):** 3018, 2960, 2265, 1723 cm\(^{-1}\); **ESI MS (m/z):** 444 (M+H\(^+\)). Anal. Calcd. for C\(_{32}\)H\(_{29}\)NO: C, 86.65; H, 6.59; N, 3.16; Found: C, 86.68; H, 6.58; N, 3.14.

2-(2-(Phenylethynyl)pyrrolidin-1-yl)-1\(H\)-indene-1,3(2\(H\))-dione (10a): Physical state: solid; \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) (ppm): 2.29-2.12 (m, 2H), 2.70 (t, \(J = 8.3\)Hz, 3H), 3.34-3.26 (m, 1H), 5.93 (s, 1H), 6.58 (s, 1H), 7.24-7.19 (m, 2H), 7.35 (d, \(J = 7.2\)Hz, 2H), 7.45 (t, \(J = 7.3\)Hz, 2H), 7.51 (d, \(J = 7.3\)Hz, 1H), 7.60 (t, \(J = 7.1\)Hz, 1H), 7.91 (t, \(J = 7.4\)Hz, 1H); \(^{13}\)C NMR (75 MHz, CDCl\(_3\)) \(\delta\) (ppm): 22.9, 26.5, 44.8, 99.4, 115.0, 122.4, 124.6, 125.6, 126.0, 127.7, 127.9, 128.6, 132.2, 133.4, 135.4, 138.7, 147.3, 169.5; **IR (KBr):** 3040, 2961, 2280, 1722 cm\(^{-1}\); **ESI MS (m/z):** 316 (M+H\(^+\)). Anal. Calcd. for C\(_{21}\)H\(_{17}\)NO\(_2\): C, 79.98; H, 5.43; N, 4.44; Found: C, 79.99; H, 5.41; N, 4.41.

Spectral data (1H NMR and 13C NMR) of all the synthesised compounds.

Figure 1. \(^1\)H Spectrum of 4a
Figure 2. $^{13}$C Spectrum of 4a

Figure 3. $^1$H Spectrum of 4b
Figure 4. $^{13}$C Spectrum of 4b

Figure 5. $^1$H Spectrum of 4c
Figure 6. $^{13}$C Spectrum of 4c

Figure 7. $^1$H Spectrum of 4d
Figure 8. $^{13}$C Spectrum of 4d

Figure 9. $^1$H Spectrum of 4e
Figure 10. $^{13}\text{C}$ Spectrum of 4e

Figure 11. $^1\text{H}$ Spectrum of 4f
Figure 12. $^{13}$C Spectrum of 4f

Figure 13. $^1$H Spectrum of 4g
Figure 14. $^{13}$C Spectrum of 4g

Figure 15. $^1$H Spectrum of 4h
Figure 16. $^1$H Spectrum of 4i

Figure 17. $^{13}$C Spectrum of 4i
Figure 18. $^1$H Spectrum of 4j

Figure 19. $^1$H Spectrum of 4k
Figure 20. $^1$H Spectrum of 4l

Figure 21. $^{13}$C Spectrum of 4l
Figure 24. $^{13}$C Spectrum of 4n

Figure 25. $^1$H Spectrum of 6a
Figure 26. $^1$H Spectrum of 6b

Figure 27. $^{13}$C Spectrum of 6b
Figure 28. $^1$H Spectrum of 8a

Figure 29. $^{13}$C Spectrum of 8a
Figure 30. $^1$H Spectrum of 8b

Figure 31. $^{13}$C Spectrum of 8b
Figure 32. $^1$H Spectrum of 8c

Figure 33. $^{13}$C Spectrum of 8c
Figure 34. $^1$H Spectrum of 10a

Figure 35. $^{13}$C Spectrum of 10a