Supporting Information

**Active Methylene Compounds (AMCs) Controlled Facile Synthesis of Acridine and Phenanthridine from Morita Baylis-Hillman Acetate**

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<table>
<thead>
<tr>
<th>Contents</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>General remarks and representative experimental procedure</td>
<td>2</td>
</tr>
<tr>
<td>Data of compounds</td>
<td>2-10</td>
</tr>
<tr>
<td>$^1$H and $^{13}$C NMR spectra of compounds</td>
<td>11-58</td>
</tr>
</tbody>
</table>
General remarks

All reactions were carried out under inert atmosphere using dry solvent. $^1$H NMR and $^{13}$C NMR spectra were recorded at ambient temperature using JEOL at 500 & 300 MHz and 125 & 75 MHz spectrometer respectively. IR spectra were recorded on VARIAN 3300 FTIR spectrophotometers in cm$^{-1}$ units. Melting points were measured using Buchi melting-point apparatus in an open capillary tube and are uncorrected (3a-3i, 4a-4c) and compounds 2a-2l are not melted up to 240 °C. High resolution mass spectra (HRMS) were obtained on Bruker Daltonics MicroTOF-Q-II. Thin-layer chromatography (TLC) was performed on glass plates (7.5 x 2.5 and 7.5 x 5.0 cm) coated with silica gel GF 254 and visualized by UV light.

Representative procedure for the synthesis of acridine derivatives:

To a solution of MBH acetate 1a (0.16 g, 0.5 mmol), was added ethylcyanoacetate (0.80 mL, 0.75 mmol) and potassium carbonate (0.103 g, 0.75 mmol), in DMF (2.0 mL) and reaction was stirred at room temperature. After completion of the reaction, Ethyl acetate was added to reaction mixture. Organic phase was then washed with water (3 times), concentrated and dried. Residue obtained was purified by column chromatography (hexane/ethyl acetate, 90:10) to obtain 2a (0.102 g) as yellow solid in 78% yield.

![Chemical structure of 1a and 2a](attachment:image)

4-Cyano-acridine-2-carboxylic acid methyl ester (2a): Reaction time: 30 min; yield: 78%; yellow solid; IR (KBr): ν 3066, 2227, 1723 cm$^{-1}$; $^1$H NMR (500 MHz, CDCl$_3$): δ 4.05 (s, 3H), 7.69 (t, J = 7.5 Hz, 1H), 7.95 (t, J = 7.5 Hz, 1H), 8.09 (d, J = 8.5 Hz, 1H), 8.42 (d, J = 9.0 Hz, 1H), 8.78 (s, 1H), 9.00 (d, J = 9.0 Hz, 2H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 52.93, 113.84, 116.81, 124.85, 126.37, 127.41, 127.62, 128.39, 130.24, 132.88, 136.12, 136.62, 139.02, 147.69, 151.15, 164.99; HRMS (ESI) exact mass calcd for C$_{16}$H$_{10}$N$_2$O$_2$: 263.0821 (M + H)$^+$ found: 263.0815 (M+ H)$^+$. 
4-Cyano-acridine-2-carboxylic acid ethyl ester (2b): Reaction time: 60 min; yield: 72%; yellow solid; IR (KBr): ν 2926, 2228, 1722 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.49 (t, J = 7.0 Hz, 3H), 4.51 (q, J = 7.0 Hz, 2H), 7.68 (t, J = 7.5 Hz, 1H), 7.95 (t, J = 7.5 Hz, 1H), 8.09 (d, J = 8.5 Hz, 1H), 8.41 (d, J = 8.5 Hz, 1H), 8.79 (s, 1H), 9.00 (s, 2H); ¹³C NMR (125 MHz, CDCl₃): δ 14.33, 62.07, 113.71, 116.88, 124.85, 126.70, 127.39, 127.58, 128.39, 130.21, 132.83, 136.22, 136.52, 139.00, 147.69, 151.10, 164.49; HRMS (ESI) exact mass calcd for C₁₇H₁₂N₂O₂: 277.0977 (M + H)⁺ found: 277.0974 (M + H)⁺.

4-Cyano-acridine-2-carboxylic acid tert-butyl ester (2c): Reaction time: 90 min; yield: 72%; yellow solid; IR (KBr): ν 2975, 2224, 1713 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.68 (s, 9H), 7.67 (t, J = 7.5 Hz, 1H), 7.94 (t, J = 9.0 Hz, 1H), 8.08 (d, J = 8.5 Hz, 1H), 8.40 (d, J = 9.0 Hz, 1H), 8.73 (s, 1H), 8.93 (s, 1H), 8.99 (s, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 28.18, 82.80, 113.42, 117.03, 124.86, 127.36, 127.48, 128.20, 128.36, 130.19, 132.68, 136.16, 136.50, 138.88, 147.65, 150.98, 163.49; HRMS (ESI) exact mass calcd for C₁₉H₁₆N₂O₂: 305.1290 (M + H)⁺ found: 305.1279 (M + H)⁺.

Acridine-2,4-dicarbonitrile (2d): Reaction time: 30 min; yield: 68%; yellow solid; IR (KBr): ν 2903, 2255, 2216 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 7.74 (t, J = 7.5 Hz, 1H), 8.01 (t, J = 7.5 Hz, 1H), 8.12 (d, J = 8.5 Hz, 1H), 8.30 (s, 1H), 8.44 (d, J = 9.0 Hz, 1H), 8.66 (s, 1H), 8.97 (s, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 108.71, 115.53, 115.61, 116.91, 124.78, 127.65, 128.38, 128.46, 130.32, 133.63, 135.99, 138.23, 139.69, 146.46, 151.53; HRMS (ESI) exact mass calcd for C₁₅H₇N₃: 230.0718 (M + H)⁺ found: 230.0712 (M + H)⁺.

4-Cyano-7-methyl-acridine-2-carboxylic acid methyl ester (2e): Reaction time: 45 min; yield: 75%; yellow solid; IR (KBr): ν 2923, 2229, 1721 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 2.62 (s, 3H), 4.04 (s, 3H), 7.76-7.81 (m, 2H), 8.29 (d, J = 9.0 Hz, 1H), 8.73 (s, 1H), 8.84 (s, 1H), 8.96 (s, 1H); ¹³C NMR (125 MHz,
CDCl$_3$: $\delta$ 21.88, 52.87, 113.72, 116.89, 124.97, 126.20, 126.34, 127.56, 129.81, 135.58, 135.85, 136.51, 137.71, 137.81, 147.19, 150.16, 165.06; HRMS (ESI) exact mass calcd for C$_{17}$H$_{12}$N$_2$O$_2$: 277.0977 (M + H)$^+$ found: 277.0972 (M + H)$^+$.

**4-Cyano-6-methyl-acridine-2-carboxylic acid methyl ester (2f):**

Reaction time: 30 min; yield: 80%; yellow solid; IR (KBr): $\nu$ 2924, 2226, 1723 cm$^{-1}$; $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 2.65 (s, 3H), 4.04 (s, 3H), 7.50 (d, $J = 8.1$ Hz, 1H), 7.96 (d, $J = 8.1$ Hz, 1H), 8.17 (s, 1H), 8.74 (s, 1H), 8.90 (s, 1H), 8.96 (s, 1H); $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 22.38, 52.82, 113.58, 116.96, 124.56, 125.92, 128.05, 128.56, 130.22, 130.57, 136.03, 136.70, 138.59, 144.19, 147.95, 151.55, 165.20; HRMS (ESI) exact mass calcd for C$_{17}$H$_{12}$N$_2$O$_2$: 277.0977 (M + H)$^+$ found: 277.0972 (M + H)$^+$.

**4-Cyano-5-methyl-acridine-2-carboxylic acid methyl ester (2g):**

Reaction time: 30 min; yield: 82%; yellow solid; IR (KBr): $\nu$ 2924, 2229, 1722 cm$^{-1}$; $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 3.00 (s, 3H), 4.05 (s, 3H), 7.57 (t, $J = 8.0$ Hz, 1H), 7.78 (d, $J = 7.0$ Hz, 1H), 7.92 (d, $J = 8.5$ Hz, 1H), 8.75 (s, 1H), 8.93 (s, 1H), 8.98 (s, 1H); $^{13}$C NMR (125 MHz, CDCl$_3$): $\delta$ 18.04, 52.89, 114.15, 116.74, 124.60, 126.25, 127.44, 127.56, 132.15, 135.62, 136.38, 138.36, 138.85, 146.81, 150.41, 165.10; HRMS (ESI) exact mass calcd for C$_{17}$H$_{12}$N$_2$O$_2$: 277.0977 (M + H)$^+$ found: 277.0972 (M + H)$^+$.

**4-Cyano-7-methoxy-acridine-2-carboxylic acid methyl ester (2h):**

Reaction time: 50 min; yield: 74%; yellow solid; IR (KBr): $\nu$ 2926, 2232, 1723 cm$^{-1}$; $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 4.01 (s, 3H), 4.04 (s, 3H), 7.20 (s, 1H), 7.62 (d, $J = 7.0$ Hz, 1H), 8.29 (d, $J = 9.5$ Hz, 1H), 8.70 (s, 1H), 8.79 (s, 1H), 8.94 (s, 1H); $^{13}$C NMR (125 MHz, CDCl$_3$): $\delta$ 52.81, 56.06, 105.91, 112.75, 117.12, 123.33, 123.79, 123.87, 125.26, 129.61, 136.06, 136.61, 138.29, 148.29, 153.35, 163.67, 165.15; HRMS (ESI) exact mass calcd for C$_{17}$H$_{12}$N$_2$O$_3$: 293.0926 (M + H)$^+$ found: 293.0921(M + H)$^+$. 
4-Cyano-6-methoxy-acridine-2-carboxylic acid methyl ester (2i):
Reaction time: 30 min; yield: 75%; yellow solid; IR (KBr): ν 2920, 2227, 1717 cm\(^{-1}\); \(^1\)H NMR (500 MHz, CDCl\(_3\)): δ 4.04 (s, 3H), 4.06 (s, 3H), 7.33 (d, J = 7.0 Hz, 1H), 7.62 (s, 1H), 7.94 (d, J = 9.5 Hz, 1H), 8.75 (s, 1H), 8.83 (s, 1H), 8.95 (s, 1H); \(^1^3\)C NMR (125 MHz, CDCl\(_3\)): δ 52.82, 56.06, 105.89, 112.72, 117.12, 123.31, 123.76, 123.85, 125.23, 129.60, 136.05, 136.60, 138.28, 148.27, 153.33, 163.65, 165.14; HRMS (ESI) exact mass calcd for C\(_{17}\)H\(_{12}\)N\(_2\)O\(_3\): 293.0926 (M + H)\(^+\) found: 293.0921 (M + H)\(^+\).

4-Cyano-5-ethyl-acridine-2-carboxylic acid methyl ester (2j):
Reaction time: 30 min; yield: 82%; yellow solid; IR (KBr): ν 2924, 2229, 1722 cm\(^{-1}\); \(^1\)H NMR (500 MHz, CDCl\(_3\)): δ 1.50 (t, J = 7.5 Hz, 3H), 3.52 (q, J = 7.5 Hz, 2H), 4.05 (s, 3H), 7.60 (t, J = 7.5 Hz, 1H), 7.78 (d, J = 7.0 Hz, 1H), 7.92 (d, J = 8.5 Hz, 1H), 8.75 (s, 1H), 8.93 (s, 1H), 8.98 (s, 1H); \(^1^3\)C NMR (125 MHz, CDCl\(_3\)): δ 14.54, 24.74, 52.88, 114.20, 116.73, 124.57, 126.20, 126.23, 127.56, 127.70, 130.54, 135.55, 136.34, 138.87, 143.98, 146.79, 149.85, 165.12; HRMS (ESI) exact mass calcd for C\(_{18}\)H\(_{14}\)N\(_2\)O\(_2\): 291.1130 (M + H)\(^+\) found: 291.1128 (M + H)\(^+\).

6-Chloro-4-cyano-acridine-2-carboxylic acid methyl ester (2k):
Reaction time: 90 min; yield: 70%; yellow solid; IR (KBr): ν 2924, 2233, 1729 cm\(^{-1}\); \(^1\)H NMR (500 MHz, CDCl\(_3\)): δ 4.06 (s, 3H), 7.76 (d, J = 7.0 Hz, 1H), 7.86 (t, J = 7.5 Hz, 1H), 8.35 (d, J = 9.0 Hz, 1H), 8.83 (s, 1H), 9.09 (s, 1H), 9.41 (s, 1H); \(^1^3\)C NMR (125 MHz, CDCl\(_3\)): δ 53.02, 113.78, 116.51, 125.07, 125.78, 127.06, 127.20, 129.47, 131.74, 132.21, 136.78, 136.87, 147.95, 151.26, 164.77; HRMS (ESI) exact mass calcd for C\(_{16}\)H\(_{9}\)ClN\(_2\)O\(_2\): 297.0430 (M + H)\(^+\) found: 297.0425 (M + H)\(^+\).
7-Bromo-4-cyano-acridine-2-carboxylic acid methyl ester (2l):

Reaction time: 120 min; yield: 64%; yellow solid; IR (KBr): ν 2924, 2215, 1729 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 4.06 (s, 3H), 7.76-7.77 (m, 1H), 7.86 (t, J = 7.5 Hz, 1H), 8.35 (d, J = 8.5 Hz, 1H), 8.83 (s, 1H), 9.09 (s, 1H), 9.42 (s, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 52.92, 113.84, 116.80, 124.85, 126.38, 127.41, 127.62, 128.39, 130.24, 132.88, 136.12, 136.61, 139.01, 147.69, 151.16, 164.99; HRMS (ESI) exact mass calcd for C₁₆H₉BrN₂O₂: 340.9925 (M + H)⁺ found: 340.9920 (M + H)⁺.

Representative procedure for the synthesis of phenanthridine derivatives:

To a solution of MBH acetate 1a (0.16 g, 0.5 mmol), was added cyanoacetamide (0.63 g, 0.75 mmol) and potassium carbonate (0.103 g, 0.75 mmol), in DMF (2.0 mL) and reaction was stirred at room temperature. After completion of the reaction, Ethyl acetate was added to reaction mixture. Organic phase was then washed with water (3 times), concentrated and dried. Residue obtained was purified by column chromatography (hexane/ethyl acetate, 93:7) to obtain 3a (0.91 g) as white solid in 62% yield.

6-Chloro-10-cyano-phenanthridine-8-carboxylic acid methyl ester (3a):

Reaction time: 2.5 h; yield: 62%; white solid; mp: 174-176°C; IR (KBr): ν 2924, 2226, 1732 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 4.08 (s, 3H), 7.84 (t, J = 7.0 Hz, 1H), 7.94 (t, J = 7.5 Hz, 1H), 8.18 (d, J = 7.5 Hz, 1H), 8.92 (s, 1H), 9.44 (s, 1H), 9.71 (d, J = 8.5 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 53.20, 108.35, 119.17, 121.74, 124.65, 125.49, 128.73, 129.33, 130.09, 132.23, 134.38, 136.56, 140.14, 144.93, 151.22, 164.14; HRMS (ESI) exact mass calcd for C₁₆H₉ClN₂O₂: 297.0431 (M + H)⁺ found: 297.0430 (M + H)⁺.
6-Chloro-10-cyano-phenanthridine-8-carboxylic acid ethyl ester (3b): Reaction time: 3 h; yield: 60%; white solid; mp: 180-182°C; IR (KBr): v 2985, 2224, 1730 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.50 (t, J = 7.0 Hz, 3H), 4.54 (q, J = 7.5 Hz, 2H), 7.82 (t, J = 8.0 Hz, 1H), 7.92 (t, J = 7.0 Hz, 1H), 8.15 (d, J = 8.5 Hz, 1H), 8.89 (s, 1H), 9.40 (s, 1H), 9.67 (d, J = 8.5 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 14.30, 62.45, 108.19, 119.19, 121.68, 124.58, 125.39, 128.67, 129.66, 130.03, 132.16, 134.30, 136.39, 140.12, 144.82, 151.20, 163.60; HRMS (ESI) exact mass calcd for C₁₇H₁₁ClN₂O₂: 311.0587 (M + H)+ found: 311.0561 (M + H)+.

6-Chloro-10-cyano-phenanthridine-8-carboxylic acid tert-butyl ester (3c): Reaction time: 3 h; yield: 60%; white solid; mp: 208-210°C; IR (KBr): ν 2987, 2225, 1713 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.69 (s, 9H), 7.81 (t, J = 8.5 Hz, 1H), 7.91 (t, J = 8.0 Hz, 1H), 8.15 (d, J = 8.0 Hz, 1H), 8.83 (s, 1H), 9.36 (s, 1H), 9.67 (d, J = 8.5 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 28.13, 83.46, 107.96, 119.36, 121.76, 124.56, 125.35, 128.61, 130.02, 131.17, 132.02, 134.22, 136.14, 140.18, 144.77, 151.28, 162.58; HRMS (ESI) exact mass calcd for C₁₉H₁₅ClN₂O₂: 339.0900 (M + H)+ found: 339.0876 (M + H)+.

6-Chloro-10-cyano-3-methyl-phenanthridine-8-carboxylic acid methyl ester (3d): Reaction time: 1.5 h; yield: 70%; white solid; mp: 244-246°C; IR (KBr): ν 2922, 2226, 1726 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 2.63 (s, 3H), 4.07 (s, 3H), 7.65 (d, J = 8.5 Hz, 1H), 7.96 (s, 1H), 8.87 (s, 1H), 9.40 (s, 1H), 9.56 (d, J = 8.5 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 21.66, 53.14, 107.99, 119.26, 119.42, 124.37, 125.08, 128.79, 129.67, 130.36, 134.40, 136.59, 140.05, 143.29, 145.13, 151.22, 164.23; HRMS (ESI) exact mass calcd for C₁₇H₁₁ClN₂O₂: 311.0587 (M + H)+ found: 311.0570 (M + H)+.

6-Chloro-10-cyano-3-methoxy-phenanthridine-8-carboxylic acid methyl ester (3e): Reaction time: 2h; yield: 67%; white solid; mp: 250-
252°C; IR (KBr): ν 2924, 2223, 1727 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 4.01 (s, 3H), 4.07 (s, 3H), 7.42 (d, J = 11.5 Hz, 1H), 7.56 (s, 1H), 8.86 (s, 1H), 9.38 (s, 1H), 9.59 (d, J = 9.5 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 53.09, 55.84, 107.44, 110.25, 115.68, 119.31, 119.38, 124.23, 125.93, 128.05, 134.58, 136.54, 140.24, 147.18, 151.93, 162.51, 164.27; HRMS (ESI) exact mass calcd for C₁₇H₁₁ClN₂O₃: 327.0536 (M + H)+ found: 327.0528 (M + H)+.

**3,6-Dichloro-10-cyano-phenanthridine-8-carboxylic acid methyl ester (3f):** Reaction time: 3.5 h; yield: 54%; white solid; mp: 230-232°C; IR (KBr): ν 2922, 2225, 1727 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 4.09 (s, 3H), 7.78 (d, J = 7.0 Hz, 1H), 8.16 (s, 1H), 8.91 (s, 1H), 9.42 (s, 1H), 9.63 (d, J = 9.0 Hz, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 53.27, 108.28, 118.95, 120.17, 125.40, 125.86, 129.24, 129.33, 129.59, 134.51, 136.04, 138.28, 140.38, 145.60, 152.59, 163.97; HRMS (ESI) exact mass calcd for C₁₆H₈Cl₂N₂O₂: 331.0041 (M + H)+ found: 331.0040 (M + H)+.

6-Chloro-phenanthridine-8,10-dicarboxylic acid 10-ethyl ester 8-methyl ester (3g): Reaction time: 5 h; yield: 59%, white solid; mp: 238-240°C; IR (KBr): ν 2927, 1732, 1606 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.41 (t, J = 7.5 Hz, 3H), 4.05 (s, 3H), 4.55 (q, J = 7.0 Hz, 2H), 7.63 (t, J = 8.0 Hz, 1H), 7.81 (t, J = 8.0 Hz, 1H), 8.13 (d, J = 8.5 Hz, 1H), 8.20 (d, J = 8.5 Hz, 1H), 8.57 (s, 1H), 9.27 (s, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 13.93, 52.86, 62.66, 121.98, 125.54, 125.84, 127.28, 129.00, 129.72, 130.91, 131.41, 131.62, 132.27, 134.50, 144.83, 151.58, 165.18, 169.88; HRMS (ESI) exact mass calcd for C₁₈H₁₄ClNO₄: 344.0689 (M + H)+ found: 344.0688 (M + H)+.

6-Chloro-3-methyl-phenanthridine-8,10-dicarboxylic acid 10-ethyl ester 8-methyl ester (3h): Reaction time: 3.5 h; yield: 65%; white solid; mp: 128-130°C; IR (KBr): ν 2984, 1730, 1607 cm⁻¹; ¹H NMR (500 MHz, CDCl₃): δ 1.41 (t, J = 7.0 Hz, 3H), 2.58 (s, 3H), 4.04 (s, 3H), 4.54 (q, J = 7.5 Hz, 2H), 7.45 (d, J = 7.0
Hz, 1H), 7.91 (s, 1H), 8.06 (d, J = 8.5 Hz, 1H), 8.54 (s, 1H); 13C NMR (125 MHz, CDCl3): δ 13.96, 21.52, 52.81, 62.58, 119.64, 125.17, 125.54, 128.47, 129.01, 129.28, 131.10, 131.66, 132.16, 134.53, 141.69, 145.02, 151.57, 165.26, 169.98; HRMS (ESI) exact mass calcd for C19H16ClNO4: 358.0846 (M + H)+ found: 358.0841 (M + H)+.

6-Chloro-3-methoxy-phenanthridine-8,10-dicarboxylic acid 10-ethyl ester 8-methyl ester (3i): Reaction time: 4 h; yield: 62%; white solid; mp: 140-142°C; IR (KBr): ν 2955, 1724, 1605 cm⁻¹; 1H NMR (500 MHz, CDCl3): δ 1.40 (t, J = 7.0 Hz, 3H), 3.98 (s, 3H), 4.04 (s, 3H), 4.53 (q, J = 7.5 Hz, 2H), 7.22-7.24 (m, 1H), 7.52 (s, 1H), 8.07 (d, J = 9.5 Hz, 1H), 8.53 (s, 1H), 9.23 (s, 1H); 13C NMR (125 MHz, CDCl3): δ 13.97, 52.77, 55.73, 62.56, 109.66, 115.91, 118.22, 124.38, 126.98, 127.78, 130.58, 131.86, 132.36, 134.61, 146.88, 152.20, 161.56, 165.30, 169.96; HRMS (ESI) exact mass calcd for C19H16ClNO5: 374.0795 (M + H)+ found: 374.0790 (M + H)+.

6-Chloro-9H-phenanthridine-8,10,10-tricarboxylic acid diethyl ester methyl ester (4a): Reaction time: 2.5 h; yield: 67%; white solid; mp: 114-116°C; IR (KBr): ν 2984, 1757, 1734, 1690, 1632 cm⁻¹; 1H NMR (500 MHz, CDCl3): δ 1.15 (t, J = 7.5 Hz, 6H), 3.45 (s, 2H), 3.88 (s, 3H) 4.16-4.25 (m, 4H), 7.50 (t, J = 8.0 Hz, 1H), 7.69 (t, J = 8.0 Hz, 1H), 7.89 (d, J = 8.5 Hz, 1H), 7.93 (s, 1H), 7.99 (d, J = 8.5 Hz, 1H); 13C NMR (125 MHz, CDCl3): δ 13.73, 31.17, 52.37, 59.66, 62.81, 124.95, 125.82, 125.86, 126.96, 128.90, 129.49, 130.61, 130.81, 141.96, 148.28, 149.41, 165.62, 169.57; HRMS (ESI) exact mass calcd for C21H20ClNO6: 418.1057 (M + H)+ found: 418.1052 (M + H)+.

6-Chloro-3-methyl-9H-phenanthridine-8,10,10-tricarboxylic acid trimethyl ester (4b): Reaction time: 2 h; yield: 74%; white solid; mp: 154-156°C; IR (KBr): ν 2953, 1739, 1731, 1705, 1620 cm⁻¹; 1H NMR (500 MHz, CDCl3): δ 2.54 (s, 3H), 3.56 (s, 2H), 3.80 (s, 6H), 3.85 (s, 3H), 7.37 (d, J = 8.0 Hz, 1H), 7.66-
7.70 (m, 1H), 7.86 (s, 1H), 7.94 (s, 1H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 21.48, 30.50, 52.21, 53.28, 62.21, 124.16, 125.70, 127.52, 127.79, 129.10, 129.56, 134.61, 134.68, 140.94, 147.81, 153.91, 166.38, 170.14; HRMS (ESI) exact mass calcd for C$_{20}$H$_{18}$ClNO$_6$: 404.0901 (M + H)$^+$ found: 404.0907 (M + H)$^+$.

6-Chloro-3-methoxy-9H-phenanthridine-8,10,10-tricarboxylic acid trimethyl ester (4c): Reaction time: 2 h; yield: 70%; white solid; mp: 120-122°C; IR (KBr): ν 2961, 1735, 1738, 1703, 1618 cm$^{-1}$; $^1$H NMR (500 MHz, CDCl$_3$): δ 3.55 (s, 2H), 3.81 (s, 3H), 3.84 (s, 6H), 3.94 (s, 3H), 7.18 (d, J = 11.5 Hz, 1H), 7.40 (s, 1H), 7.64-7.69 (m, 1H), 7.90 (s, 1H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 30.52, 52.17, 53.34, 55.62, 62.27, 108.24, 120.55, 122.83, 122.95, 127.00, 128.92, 134.64, 134.73, 149.55, 154.25, 161.54, 166.43, 170.19; HRMS (ESI) exact mass calcd for C$_{20}$H$_{18}$ClNO$_7$: 420.0850 (M + H)$^+$ found: 420.0845 (M + H)$^+$.