

Synthesis of Functionalised Aromatic Oligamide Rods

Electronic Supplementary material

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Additional Experimental Details and Characterisation

Methyl-3-propyloxy-4-nitrobenzoate 3b

(Procedure A) methyl-3-hydroxy-4-nitrobenzoate **2** (600 mg, 3.0 mmol), K₂CO₃ (510 mg, 3.7 mmol), anhydrous DMF (15 mL), 1-bromopropane (450 μ L, 5.0 mmol). Purification by column chromatography (silica, 30 g, 20% EtOAc–CH₂Cl₂) gave the product (563 mg, 77%) as a bright yellow solid yield; m.p. 56–57°C (Found C 55.40, H 5.50, N 5.80%. calcd C 55.20, H 5.50, N 5.90%); *R*_f 0.6 (CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 1.07 (3H, t, *J* = 7.4, CH₃) 1.88 (2H, tq, *J* = 6.8 and 7.0, CH₂), 3.96 (3H, s, CO₂Me), 4.13 (2H, t, *J* = 6.3, CH₂), 7.67 (1H, d, *J* 8.2, ArCH), 7.73 (1H, s, Ar CH), 7.81 (1H, d, *J* 8.3, ArCH); δ_{C} (75 MHz, CDCl₃) 10.4, 14.2, 22.3, 52.8, 71.4, 115.5, 121.1, 125.1, 134.7, 142.6, 151.9, 165.3; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) = 3082, 2956, 2882, 1727 (CO), 1589 (Ar C=C); ESI-MS *m/z* 239.1 [M+H]⁺.

Methyl 3-benzyloxy-4-nitrobenzoate 3c

To a stirred solution of methyl-3-hydroxy-4-nitrobenzoate **2** (1.00 g, 5.1 mmol), benzyl alcohol (0.52 mL, 5.0 mmol) and triphenylphosphine (1.97 g, 7.5 mmol) in anhydrous THF (10 mL) in an atmosphere of nitrogen at 0°C was added dropwise DIAD (1.47 mL, 7.5 mmol). The reaction mixture was allowed to warm to room temperature, stirred for 15 h, concentrated and purified by column chromatography (silica, 40g, CH₂Cl₂). The resultant solid was recrystallised from the minimum amount of hexane yield the product (0.92 g, 66%) as yellow-white crystals; m.p. 85–87°C (Found: C, 62.70; H, 4.55; N, 4.80%. C₁₅H₁₃NO₅ requires: C, 62.72; H, 4.56; N, 4.88 %); *R*_f 0.70 (2 % MeOH in CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 3.95 (3H, s, CO₂Me) 5.28 (2H, s, benzylic CH₂), 6.69 (1H, d, *J* = 8.6, ArCH), 7.47–7.33 (5H, m, ArCH), 7.84 (2H, t, *J* = 7.3, ArCH); δ_{C} (75 MHz, CDCl₃) 53.30, 71.76, 116.43, 122.11, 125.82, 127.57, 128.85, 129.18, 135.19, 135.41, 143.19, 151.83, 165.57; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) = 3118, 3062, 2964 (CH), 1731 (CO); ESI-HRMS found *m/z* 310.0697 [M+Na]⁺, C₁₅H₁₃NNaO₅ requires 310.0686.

Methyl-3-(1-naphthyl)methoxy-4-nitro-benzoate 3d

(Procedure A) methyl-3-hydroxy-4-nitrobenzoic acid **2** (1.87 g, 9.5 mmol), 1-chloromethylnaphthalene (2.04 g, 11.5 mmol), potassium carbonate (4.00 g, 26.0 mmol) and dimethylformamide (30 mL) to yield the product (2.80 g, 87%) as a yellow powder; m.p. 144–146°C; *R*_f 0.80 (30% Et₂O in CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 3.95 (3H, s, CO₂Me), 5.70 (2H, s, naphthyl-CH₂), 7.47 (1H, t, *J* = 7.3, ArCH), 7.52 (1H, t, *J* = 6.9 Hz, ArCH), 7.57 (1H, t, *J* = 6.9, ArCH), 7.67–7.70 (2H, m, ArCH), 7.82 (1H, d, *J* = 8.3, ArCH), 7.85 (1H, d, *J* = 8.3, ArCH), 7.88 (1H, d, *J* = 7.9, ArCH), 7.96 (1H, s, ArCH), 8.04 (1H, d, *J* = 8.3 Hz, ArCH); δ_{C} (75 MHz, CDCl₃) 52.8, 70.1, 116.1, 121.8, 123.2, 125.3, 125.4, 126.1, 126.4, 126.7, 128.8, 129.4, 130.3, 131.0, 133.7, 134.8, 142.9, 151.4,

165.1. $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3427, 3060, 2954, 1919, 1723, 1606, 1515, 1435, 1305, 1245, 1112, 984, 795, 632; ESI-HRMS found m/z 360.0834 $[\text{M}+\text{Na}]^+$, $\text{C}_{10}\text{H}_{15}\text{NO}_5$ requires 360.0842.

Methyl-3-(2-naphthyl)methoxy-4-nitro-benzoate 3e

(Procedure A) methyl-3-hydroxy-4-nitrobenzoic acid **2** (2.6 g, 13.5 mmol), 2-bromomethylnaphthalene (3.3 g, 14.9 mmol), potassium carbonate (5.2 g, 34.0 mmol), and DMF to yield the product (4.4 g, 97%) as a yellow powder; m.p. 152–154 °C; R_f 0.8 (30% Et_2O in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 3.94 (3H, s, CO_2Me), 5.43 (2H, ArCH_2O), 7.46–7.50 (2H, m, ArCH), 7.55 (1H, d, $J = 8.5$, ArCH), 7.69 (1H, d, $J = 8.4$, ArCH), 7.81–7.92 (6H, m ArCH). δ_{C} (75 MHz, CDCl_3) 53.3, 72.0, 116.6, 122.2, 125.1, 125.8, 126.7, 126.8, 128.2, 128.5, 129.1, 132.9, 133.6, 133.7, 135.2, 143.3, 151.9, 165.5. $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3439, 3007, 2957, 2860, 1740, 1726, 1613, 1519, 1349, 1300, 1236, 1110, 1014, 975, 760, 744; HRMS found m/z 360.0840 $[\text{M}+\text{Na}]^+$, $\text{C}_{10}\text{H}_{15}\text{NO}_5$ requires 360.0842.

-Propyloxy-4-nitro benzoic acid 4b

(Using minor modifications to procedure B) A solution of methyl-3-propyloxy-4-nitrobenzoate (326.3 mg, 1.4 mmol) and NaOH (1 equivalent) in H_2O –methanol (1:3, 10 mL) was stirred at room temperature for 20 hours. The reaction mixture was acidified to pH 1 (1M HCl) and the precipitated product was filtered and dried under vacuum to give the product (214 mg, 68%) as a white/ cream powder; m.p. 194–195°C; δ_{H} (500 MHz, CD_3OD) 0.97 (3H, t, $J = 7.4$, CH_3), 1.75 (2H, tq, $J = 6.6$ and 7.1 , CH_2), 4.07 (2H, t, $J = 6.3$, CH_2), 7.60 (1H, d, $J = 8.2$, ArCH), 7.72 (1H, s, ArCH), 7.73 (1H, d, $J = 5.2$, ArCH); δ_{C} (75 MHz, CD_3OD) 8.9, 21.6, 22.4, 70.7, 114.9, 120.8, 124.1, 135.0, 151.1; $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 2970 (COOH), 1688, 1611, 1588, 1528, 1492, 1438, 1396, 1354, 1301, 1251; ESI-HRMS found m/z 224.0564 $[\text{M}-\text{H}]^-$, $\text{C}_{10}\text{H}_{11}\text{NO}_5$ requires 224.0637.

3-Benzyloxy-4-nitrobenzoic acid 4c

(Using minor modifications to procedure B) methyl-3-benzyloxy-4-nitro benzoate (250 mg, 0.87 mmol), 1M NaOH (1.5 mL, excess) in methanol (15 mL) was heated at reflux (65 °C) for 12 h. On cooling, the reaction mixture was acidified (1N HCl, ~2 mL) to ~ pH 1, precipitating the desired acid (191 mg, 80.3 %) as a pale cream paste that was collected by filtration and dried under a high vacuum; m.p. 210–212°C (Found: C, 60.95; H, 4.00; N, 5.00%. $\text{C}_{14}\text{H}_{11}\text{NO}_5$ requires: C, 61.54; H, 4.06; N, 5.13%); R_f 0.31 (15% MeOH in CH_2Cl_2); δ_{H} (500 MHz, CD_3OD) 5.22 (s, 2H, CH_2), 7.22 (t, 1H, $J = 7.3$ Hz, ArCH), 7.28 (t, 2H, $J = 7.2$ & 7.7 Hz, ArCH), 7.36 (d, 2H, $J = 7.4$ Hz, ArCH), 7.60 (d, 1H, $J = 8.3$ Hz, ArCH), 7.74 (d, 1H, $J = 8.3$ Hz, ArCH), 7.80 (s, 1H, ArCH); δ_{C} (300 MHz, CD_3OD) 72.59, 117.61, 123.26, 126.29, 128.75, 129.60, 129.95, 137.04, 137.40, 144.73, 152.60,

167.86; $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3411 (broad, COOH), 1692 (CO), 1530, 1431; ESI-HRMS found m/z 272.0556 $[\text{M-H}]^{-}$, $\text{C}_{14}\text{H}_{10}\text{NO}_5$ requires 272.0553.

3-(1-naphthyl)methoxy-4-nitro-benzoic acid 4d

(Procedure B) methyl-3-(1-naphthyl)methoxy-4-nitro-benzoate **3d** (0.54 g, 1.59 mmol), 10% aqueous sodium hydroxide (10 mL), THF (40 mL), and methanol (40 mL) to yield product (0.50 g, quant.) as an off-white powder; m.p. 218–220°C; δ_{H} (300 MHz, DMSO- d_6) 5.85 (2H, s, naphthyl CH_2), 7.52–7.62 (3H, m, ArCH), 7.67–7.71 (2H, m, ArCH), 7.95–8.03 (3H, m, ArCH), 8.09–8.16 (2H, m, ArCH); δ_{C} (75 MHz, DMSO- d_6) 69.8, 116.5, 122.0, 124.3, 125.3, 125.7, 126.5, 126.8, 127.0, 128.8, 129.4, 131.3, 131.6, 133.6, 136.0, 142.7, 150.9, 166.1; $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3065, 2657, 1714, 1614, 1524, 1492, 1350, 1256, 1152, 1051, 1001, 785, 743, 526; ESI-HRMS found m/z 322.0712 $[\text{M-H}]^{-}$, $\text{C}_{18}\text{H}_{12}\text{NO}_5$ requires 322.0721.

3-(2-naphthyl)methoxy-4-nitro-benzoic acid 4e

(Procedure B) **3e** (2.70 g, 8.0 mmol), 10% aqueous sodium hydroxide (10 mL), THF (40 mL), and methanol (40 mL) to yield a crystalline yellow powder (2.60 g, quant) m.p. 252–253 °C (Found: C, 63.55; H, 4.05; N, 3.95%. $\text{C}_{18}\text{H}_{12}\text{NO}_5 \cdot \text{H}_2\text{O}$ requires: C, 63.34; H, 4.43; N, 4.10%); δ_{H} (300 MHz, DMSO- d_6) 5.56 (2H, s, naphthyl- CH_2), 7.51–7.60 (3H, m, ArCH), 7.67 (1H, dd $J = 8.3$ and 1.5 , ArCH), 7.89–8.02 (6H, m, ArCH); δ_{C} (75 MHz, DMSO- d_6) 71.2, 116.4, 122.0, 125.5, 125.7, 126.6, 126.7, 126.8, 129.0, 128.2, 128.6, 133.0, 133.7, 136.0, 142.7, 150.9, 166.1; $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3058, 2911, 2613, 1694, 1607, 1521, 1492, 1427, 1350, 1310, 1254, 1035, 955, 814, 777, 623. ESI-MS 322 $[\text{M-H}]^{+}$.

Methyl 3-propyloxy-4-aminobenzoate 5b

To a stirred solution of methyl-3-propoxy-4-nitrobenzoate **3b** (300 mg, 1.3 mmol) in anhydrous methanol (10 mL), under an atmosphere of nitrogen, was added 10% palladium on charcoal (30 mg). The nitrogen atmosphere was evacuated under vacuum and hydrogen gas (1 L, excess) introduced *via* a balloon. The reaction mixture was stirred for 12 h, filtered through a celite pad, concentrated and dried under vacuum to give the product (260 mg, 99%) as a cream white solid; m.p. 52–53°C (Found: C, 62.9; H, 7.1; N, 6.6%. $\text{C}_{11}\text{H}_{15}\text{NO}_3$ requires: C, 63.14; H, 7.23; N, 6.69%); δ_{H} (500 MHz, CDCl_3) 1.06 (3H, t, $J = 7.7$, CH_3), 1.85 (2H, tq, $J = 6.8$ and 7.6 , CH_2), 3.86 (3H, s, CO_2Me), 4.01 (2H, t, $J = 6.4$, CH_2), 4.22 (2H, s, NH_2), 6.66 (1H, d, $J = 8.9$, ArCH), 7.44 (1H, s, ArCH), 7.53 (1H, d, $J = 7.9$, ArCH); δ_{C} (75 MHz, CDCl_3) 10.6, 22.6, 51.7, 69.9, 112.1, 113.1, 119.5, 123.9, 141.2, 145.5, 167.4; $\nu_{\max}/\text{cm}^{-1}$ (solid state) = 3499, 3371, 2950, 2874, 1690 (CO), 1432; ESI-MS m/z 210.1 $[\text{M+H}]^{+}$.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-nitro-benzoylamido)-benzoate 6aa

(Procedure C) **4a** (150 mg, 0.67 mmol), **5a** (140 mg, 0.67 mmol), chloroform (8 mL), Cl_2PPh_3 (533 mg, 1.60 mmol). The reaction mixture was then heated at reflux (61 °C) for 48 hours before being concentrated and purified by column chromatography (5% EtOAc in CH_2Cl_2) to yield the product (233 mg, 84%) as a pale yellow solid; m.p. 108–110 °C (Found: C, 60.50; H, 5.85; N, 6.55 %. $\text{C}_{21}\text{H}_{24}\text{N}_2\text{O}_7$ requires: C, 60.57; H, 5.81; N, 6.73 %); R_f 0.61 (5% EtOAc in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 1.46 (d, 6H, $J = 1.5$ Hz, CH_3), 1.48 (d, 6H, $J = 5$ Hz, CH_3), 3.96 (s, 3H, CO_2Me), 4.83 (m, 2H, CHCH_3), 7.38 (d, 1H, $J = 8.3$, ArCH), 7.64 (d, $J = 1.7$, ArCH), 7.72 (d, $J = 1.6$, ArCH), 7.77 (d, 1H, $J = 8.5$, ArCH), 7.91 (d, 1H, $J = 8.3$, ArCH), 8.63 (d, 1H, $J = 8.5$, ArCH), 8.83 (s, 1H, NH); δ_{C} (75 MHz, CDCl_3): 22.23, 22.60, 52.62, 72.24, 73.49, 113.42, 115.79, 117.56, 119.24, 123.62, 126.21, 132.56, 139.92, 143.22, 146.25, 151.97, 163.58, 167.05; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) = 3389 (NH), 3080, 2990 (CH), 1703, 1674 (CO); ESI-HRMS found m/z 417.1661 $[\text{M}+\text{H}^+]$, $\text{C}_{21}\text{H}_{25}\text{N}_2\text{O}_7$ requires 417.1656.

Methyl-3-isopropoxy-4-(3-benzyloxy-4-nitro-benzoylamido)-benzoate 6ac

(Procedure C) **5a** (683.4 mg, 3.26 mMol), **4c** (1.17 g, 4.27 mMol), Cl_2PPh_3 (6.0 g, 18.5 mmol) and chloroform (70 mL) to yield a yellow solid (1.3 g, 87%); m.p. 132–133 °C (Found C 64.45, H 5.40, N 6.00%. $\text{C}_{25}\text{H}_{24}\text{N}_2\text{O}_7$ requires: C 64.65, H 5.21, N 6.03%); $R_f = 0.8$ (30% Et_2O in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 1.44 (6H, d, $J = 6.0$, iPr CH_3), 3.91 (3H, s, CO_2Me), 4.78 (1H, sept, $J = 6.0$, iPrCH), 5.33 (2H, s, Benzyl CH_2), 7.32–7.49 (6H, m, ArCH), 7.60 (1H, s, ArCH), 7.72 (1H, d, $J = 8.5$, ArCH), 7.79 (1H, s, ArCH), 7.95 (1H, d, $J = 8.3$, ArCH), 8.57 (1H, d, $J = 8.5$, ArCH), 8.78 (1H, br, NH) δ_{C} (75 MHz, CDCl_3) 22.2, 52.2, 71.5, 71.9, 113.1, 114.9, 117.7, 119.0, 123.3, 125.9, 126.0, 127.2, 128.5, 128.9, 132.1, 134.9, 139.9, 142.1, 145.9, 152.2, 162.9, 166.6. $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) = 3422, 3072, 2981, 1718, 1677, 1596, 1513, 1264, 1114, 993, 872, 762, 607; ESI-MS $[\text{M}+\text{H}]^+$ m/z 465.3.

Methyl-3-propoxy-4-(3-benzyloxy-4-nitro-benzoylamido)-benzoate 6bc

(Procedure C) **5c** (193.1 mg, 0.7 mmol), **4b** (150.0 mg, 0.7 mmol), chloroform (40 mL), Cl_2PPh_3 (600 mg, 1.8 mmol). Purification (SiO_2 chromatography) afforded the product (307.8 mg, 94%) as a yellow solid; m.p. 194–196 °C (Found: C, 64.0; H, 5.0; N, 5.65 %. $\text{C}_{25}\text{H}_{24}\text{N}_2\text{O}_7$ requires: C, 64.65; H, 5.21; N, 6.03%); δ_{H} (500 MHz, CDCl_3) 1.11 (3H, t, $J = 7.4$, CH_3), 1.92 (2H, tq, $J = 7.0$ and 6.9, CH_2), 3.92 (3H, s, CO_2Me), 4.14 (2H, t, $J = 6.4$, CH_2), 5.33 (2H, s, benzylic- CH_2), 7.36 (1H, d, $J = 7.0$, ArCH), 7.41 (3H, dd, $J = 7.7$ and 7.5, ArCHs), 7.48 (2H, d, $J = 7.2$, ArCH), 7.60 (1H, s, ArCH), 7.75 (1H, d, $J = 8.4$, ArCH), 7.79 (1H, s, ArCH), 7.95 (1H, d, $J = 8.3$, ArCH), 8.57 (1H, d, $J = 8.4$, ArCH), 8.76 (1H, s, NH); ^{13}C NMR (300 MHz, CDCl_3) δ 10.6, 22.5, 52.2, 70.5, 71.4, 111.7, 114.8, 117.7, 118.7, 123.3, 125.9, 126.1, 127.1, 128.5, 128.8, 131.4, 134.9, 139.8, 142.0,

147.0, 152.2, 162.9, 166.6; $\nu_{\max}/\text{cm}^{-1}$ (solid state) 3424 (NH), 3073, 2967, 2878, 2620, 1938, 1682 (CO), 1592 (Ar C=C), 1531 (NO₂); ESI-HRMS found m/z 465.1664 [M+H]⁺, C₂₅H₂₅N₂O₇ requires 465.1656.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-amino-benzoylamido)-benzoate 7aa

To a stirred solution of **6aa** (100 mg, 0.24 mmol) in anhydrous methanol (7 mL), under an atmosphere of nitrogen, was added palladium on charcoal catalyst (10 mg, 10% catalyst). The nitrogen atmosphere was evacuated under vacuum and hydrogen gas (1 L, excess) introduced *via* a balloon. The reaction mixture was stirred for 6 h until TLC indicated the reaction was complete. The mixture was passed through a celite pad, concentrated and dried under high vacuum to yield the product (74 mg, 79.8%) as a cream solid; m.p. 148–149°C; R_f 0.30 (5% EtOAc in CH₂Cl₂); δ_H (300 MHz, CDCl₃) 1.44 (d, 6H, J 6.1 Hz, CH₃), 1.46 (d, 6H, J 6.1 Hz, CH₃), 3.95 (s, 3H, CO₂Me), 4.75 (m, 2H, CH), 6.83 (d, 1H, J = 8.1, ArCH), 7.30 (d, 1H, J = 8.1, ArCH), 7.50 (d, 1H, J = 1.7, ArCH), 7.61 (d, 1H, J = 1.7, ArCH), 7.74 (d, 1H, J = 8.5, ArCH), 8.66 (d, 1H, J = 8.5, ArCH), 8.79 (s, 1H, NH); δ_C (75 MHz, CDCl₃) 22.2, 52.1, 70.8, 71.6, 112.3, 113.0, 113.6, 118.4, 119.8, 123.4, 124.1, 124.4, 133.5, 141.4, 144.8, 145.5, 165.1, 166.9; $\nu_{\max}/\text{cm}^{-1}$ (solid state) 3503, 3433, 3365 (NH₂), 2972 (CH), 1711 (CO); ESI-HRMS found m/z 387.1916 [M+H]⁺, C₂₁H₂₇N₂O₅ requires 387.1914.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-amino-benzoylamido)-benzoate 7aa

(Alternative preparation using procedure D) **6aa** (0.47 g, 1.13 mmol), SnCl₂·H₂O (1.20 g, 5.65 mmol), ethyl acetate (30 mL). Yield: 385 mg, 88% (data as above).

Methyl-3-isopropoxy-4-(3-benzyloxy-4-amino-benzoylamido)-benzoate 7ac

(Procedure C) **6ac** (1.00 g, 2.15 mmol), SnCl₂·H₂O (2.50 g, 11.1 mmol) and ethyl acetate (90 mL) to yield a yellow oil (0.81 g, 87%) that solidified upon standing overnight; m.p. 152–154 °C; R_f = 0.65 (30% Et₂O in CH₂Cl₂); δ_H (300 MHz, CDCl₃) 1.41 (6H, d J = 6 Hz, i Pr CH₃), 3.89 (3H, s, CO₂Me), 4.31 (2H, br, NH₂), 4.72 (1H, sept J = 6 Hz, i PrCH), 5.14 (2H, s, -CH₂Ph) 6.74 (1H, d J = 8.2 Hz, ArCH), 7.26–7.57 (6H, m, ArCH), 7.56 (2H, d J = 6 Hz, ArCH), 7.71 (1H, d J = 8.5 Hz, ArCH), 8.62 (1H, d J = 8.5 Hz, ArCH), 8.74 (1H, br, NH); δ_C (75 MHz, CDCl₃) 22.1, 51.9, 70.4, 71.6, 111.2, 113.1, 113.3, 118.3, 120.2, 123.3, 123.8, 124.3, 126.8, 127.6, 128.1, 128.4, 128.6, 133.4, 136.4, 140.7, 145.5, 145.8, 164.9, 166.8; $\nu_{\max}/\text{cm}^{-1}$ (solid state) 3483, 3457, 3321, 2944, 1720, 1707, 1654, 1595, 1516, 1346, 1263, 1133, 1013, 763, 626; ESI-HRMS found m/z 435.1910 [M+H]⁺, C₂₅H₂₆N₂O₆ requires 435.1914.

Methyl-3-propoxy-4-(3-benzyloxy-4-amino-benzoylamido)-benzoate 7bc

(Procedure D) **6bc** (150.0 mg, 0.3 mmol), SnCl₂·2H₂O (380.0 mg, 1.7 mmol) afforded the product (108.3 mg, 83%) as a slightly yellow solid; m.p. 140–142°C (Found: C, 68.85; H, 5.9; N, 6.0%. C₂₅H₂₆N₂O₅ requires: C, 69.11; H, 6.03; N, 6.45 %); δ_H (500 MHz, CDCl₃)

1.12 (3H, t, $J = 7.3$, CH₃), 1.92 (2H, tq, $J = 6.9$ and 6.7 , CH₂), 3.91 (3H, s, CO₂Me), 4.11 (2H, t, $J = 6.2$, CH₂), 4.26 (2H, s, NH₂), 5.16 (2H, s, benzylic-CH₂), 6.75 (1H, d, $J = 8.0$, ArCH), 7.29 (1H, d, $J = 7.8$, ArCH), 7.42-7.36 (3H, m, ArCHs), 7.46 (2H, d, $J = 7.0$, ArCH), 7.56 (2H, s, ArCH), 7.72 (1H, d, $J = 8.2$, Ar 6-CH), 8.62 (1H, d, $J = 8.4$, ArCH), 8.73 (1H, s, NH); δ_{C} (75 MHz, CDCl₃) 11.1, 23.0, 52.5, 70.7, 70.9, 111.59, 111.9, 113.9, 118.6, 118.7, 120.7, 123.9, 124.5, 124.9, 128.2, 128.7, 129.1, 133.1, 136.9, 141.1, 146.4, 147.2, 165.4, 167.3; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3477, 3436, 3339, 2967, 2947, 2871, 1625 (CO), 1598; ESI-HRMS found m/z 433.1769 [M-H]⁻, C₂₅H₂₅N₂O₅ requires 433.1842.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-(3-isopropoxy-4-nitro-benzoylamido)-benzoylamido)-benzoate 8aaa

(Procedure C) **7aa** (0.436 g, 1.23 mmol), **4a** (0.348 mg, 1.54 mmol), Cl₂PPh₃ (2.200g, 6.81 mmol), and chloroform (50 mL) to yield a faint yellow solid (0.579 mg, 84%); m.p. 192–193 °C; R_{f} 0.8 (30% Et₂O in CH₂Cl₂), δ_{H} (300 MHz, DMSO-*d*₆) 1.37-1.34 (18H, m, 3 x *i*PrCH₃), 3.86 (3H, s, CO₂Me), 4.80-4.73 (2H, m, *i*PrCH), 4.96 (1H, sept $J = 6.0$ Hz, *i*PrCH), 7.65-7.56 (5H, m, ArCH) 7.81 (1H, s, ArCH), 7.99 (1H, d $J = 8.4$, ArCH), 8.09 (1H, d $J = 8.1$, ArCH), 8.22 (1H, d $J = 8.4$, ArCH), 9.37 (1H, s, NH), 9.70 (1H, s, NH); δ_{C} (75 MHz, CDCl₃) 22.2, 22.6, 52.6, 72.2, 72.3, 73.5, 112.2, 113.5, 115.8, 117.6, 119.0, 119.2, 119.5, 123.7, 125.5, 126.3, 131.0, 131.7, 133.3, 139.9, 143.3, 146.2, 147.0, 152.0, 163.7, 184.8, 167.2; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3432, 2982, 1713, 1683, 1595, 1349, 1111, 1004, 844, 763, 604; ESI-HRMS found m/z 594.2439 [M+H]⁺, C₃₁H₃₅N₃O₉ requires 594.2439.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-(3-benzyloxy-4-nitro-benzoylamido)-benzoylamido)-benzoate 8aac

(Procedure C) **7aa** (55 mg, 0.14 mmol), **4c** (39 mg, 0.14 mmol), Cl₂PPh₃ (114 mg, 0.342 mmol), chloroform (5 mL). Reaction was heated at reflux (65 °C) for 24 h. Purification by column chromatography (10 % EtOAc in CH₂Cl₂) afforded target material (66 mg, 73.5%) as a pale yellow solid; m.p. 200–202 °C (Found: C, 66.3; H, 5.5; N, 6.05%. C₃₅H₃₅N₃O₉ requires: C, 65.51; H, 5.50; N, 6.55 %); R_{f} 0.42 (10% EtOAc in CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 1.46 (d, 12H, $J = 6.0$ Hz, 2 x CH₃), 3.92 (s, 3H, CO₂Me), 4.80 (m, 2H, CH), 5.35 (s, 2H, benzylic-CH₂), 7.36 (t, 1H, $J = 7.3$, ArCH), 7.40 (m, 4H, ArCH), 7.49 (d, 2H, $J = 7.5$, ArCH), 7.62 (dd, 2H, $J = 12.0$ and 1.4 , ArCH), 7.73 (dd, 1H, $J = 8.4$ and 1.4 , ArCH), 7.80 (d, 1H, $J = 1.1$, ArCH), 7.97 (1H, d, $J = 8.2$, ArCH), 8.63 (t, 2H, $J = 7.5$, ArCH), 8.77 (s, 1H, NH), 8.86 (s, 1H, NH); δ_{C} (75 MHz, CDCl₃) 22.63, 52.54, 71.83, 72.24, 72.34, 112.26, 113.50, 115.23, 118.11, 118.99, 119.13, 119.61, 123.73, 125.50, 126.48, 127.55, 128.93, 129.26, 131.06, 131.65, 133.32, 135.29, 140.18, 142.48, 146.17, 147.06, 152.61, 163.41, 164.76, 167.20; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3425 (NH), 2977 (CH),

1715, 1678 (CO), 1517; ESI-HRMS found m/z 664.2271 $[M+Na]^+$, $C_{35}H_{35}N_3NaO_9$ requires 664.2266.

Methyl-3-isopropoxy-4-(3-benzyloxy-4-(3-(1-naphthoxy)-4-nitro-benzoylamido)-benzoylamido)-benzoate 8acd

(Procedure C) **7ac** (0.25 g, 0.576 mmol) **4d** (0.25 g, 1.34 mmol), Cl_2PPh_3 (1.60g, 4.95 mmol) and chloroform (75 mL) to yield the product (0.32 g, 75%) as a yellow solid; m.p. 182–183 °C (Found: C, 66.2; H, 5.1; N, 5.35%. $C_{43}H_{37}N_3O_9 \cdot 2H_2O$ requires: C, 66.57; H, 5.33; N, 5.42%); R_f = 0.8 (30% Et_2O in CH_2Cl_2); δ_H (300 MHz, $CDCl_3$) 1.45 (6H, d, J = 6.0, iPr CH_3), 3.92, (3H, s, CO_2Me), 4.78 (1H, sept J = 6.0, $iPrCH$), 5.26 (2H, s, Benzyl CH_2), 5.65 (2H, s, naphthyl CH_2), 7.27-7.64 (12H, m, ArCH), 7.73 (1H, d, J = 8.5 Hz, ArCH), 7.77 (1H, s, ArCH), 7.84-7.91 (4H, m, ArCH), 8.02 (1H, d J = 8 Hz, ArCH), 8.62 (1H, d, J = 8.5 Hz, ArCH), 8.67 (1H, d J = 8.5 Hz, ArCH), 8.77 (1H, br, NH), 8.87 (1H, br NH); δ_C (75 MHz, $CDCl_3$) 22.3, 52.1, 70.2, 71.7, 71.9, 111.6, 113.2, 114.5, 118.2, 118.7, 119.2, 119.4, 123.4, 125.3, 126.0, 126.2, 126.7, 126.8, 127.9, 128.8, 129.0, 129.6, 130.2, 131.0, 131.1, 133.0, 133.8, 135.6, 139.4, 145.8, 147.8, 163.0, 164.2, 166.8. ν_{max}/cm^{-1} (solid state) 3483, 3422, 3330, 2978, 1707, 1596, 1516, 1484, 1349, 1264, 1111, 1001, 954, 849, 764, 702, 604. ESI-MS m/z 740 $[M+H]^+$, 762 $[M+Na]^+$.

Methyl-3-propoxy-4-(3-benzyloxy-4-(3-isopropoxy-4-nitro-benzoylamido)-benzoylamido)-benzoate 8bca

(Procedure C) **7bc** (75.4 mg, 0.2 mmol), **4a** (40.6 mg, 0.2 mmol), chloroform (20 mL), Cl_2PPh_3 (200 mg, 0.6 mmol) afforded the product (97.0 mg, 86%) as a yellow solid; m.p. 197–199 °C; δ_H (500 MHz, $CDCl_3$) 1.14 (3H, t, J 7.4, CH_3), 1.37 (6H, d, J = 6.0, CH_3), 4.15 (2H, t, J = 6.5, CH_2), 1.95 (2H, tq, J = 7.1 and 6.9, CH_2), 3.92 (3H, s, CO_2Me), 4.67 (1H, hep, J = 7.0, CH), 5.26 (2H, s, benzylic- CH_2), 7.49-7.43 (6H, m, ArCH), 7.68 (2H, d, J = 9.8, ArCH), 8.75 (1H, s, NH), 7.79-7.74 (3H, m, ArCH), 8.62 (1H, d, J = 8.4, ArCH), 8.68 (1H, d, J = 8.3, ArCH), 8.86 (1H, s, NH); δ_C (75 MHz, $CDCl_3$) 8.8, 19.9, 20.7, 50.3, 68.6, 69.7, 71.2, 109.5, 109.7, 113.2, 115.7, 116.6, 117.2, 117.5, 121.5, 123.3, 123.9, 126.1, 127.1, 127.1, 128.8, 129.1, 130.2, 133.7, 137.2, 141.0, 145.1, 145.8, 149.6, 161.3, 162.4, 164.9; ν_{max}/cm^{-1} (solid state) 3606, 3430 (NH_2), 2966, 2933, 2876, 1709 (CO), 1599, 1525, 1488 (NO_2); ESI-HRMS found m/z 640.2326 $[M-H]^-$, $C_{35}H_{34}N_3O_9$ requires 640.2373.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-(3-isopropoxy-4-amino-benzoylamido)-benzoylamido)-benzoate 9aaa

(Procedure D), **8aaa** (0.414 g, 0.74 mmol) $SnCl_2 \cdot H_2O$ (1.012 g, 4.49 mmol) and ethyl acetate (40mL) to yield the product (0.329 g, 83%) as a pale yellow oil that solidified upon standing; m.p. 182–183 °C; R_f = 0.65 (30% Et_2O in CH_2Cl_2); δ_H (300 MHz, $CDCl_3$) 1.40-1.46 (18H, 3 x $iPrCH_3$), 3.91 (3H, s, CO_2Me), 4.70 (1H, sept, J = 6.0, $iPrCH$) 4.74-

4.81 (2H, m, 2 different *i*PrCH), 6.75 (1H, d, $J = 8.1$, ArCH), 7.28 (1H, d $J = 8.1$, ArCH), 7.40 (1H, d $J = 8.5$, ArCH), 7.45 (1H, s, ArCH), 7.60 (2H, s, ArCH), 7.72 (1H, d, $J = 8.5$, ArCH), 8.63 (1H, d, $J = 8.5$, ArCH), 8.71 (1H, d, $J = 8.5$, ArCH), 8.73 (1H, br, NH), 8.87 (1H, br, NH). δ_{C} (75 MHz, CDCl₃) 22.2, 52.0, 70.8, 71.7, 71.8, 111.8, 112.3, 113.1, 113.6, 118.5, 118.6, 118.9, 119.9, 123.3, 123.9, 124.8, 129.1, 132.7, 133.1, 141.5, 144.8, 145.7, 146.3, 164.6, 165.1, 166.8. $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3356, 2975, 2618, 2250, 1595, 1513, 1346, 871, 749, 594. HRMS (M+H) Found 564.2713 calculated 564.2704.

Methyl-3-isopropoxy-4-(3-isopropoxy-4-(3-benzyloxy-4-amino-benzoylamido)-benzoylamido)-benzoate 9aac

(Procedure D) **8aac** (71 mg, 0.1mmol), SnCl₂.H₂O (125 mg, 0.6mmol). Purification by column chromatography (40% Et₂O in CH₂Cl₂) yielded the product (61 mg, 89%) as a pale yellow solid; m.p. 198–199°C (Found: C, 68.7; H, 6.15; N, 6.6%. C₃₅H₃₇N₃O₇ requires: C, 68.72; H, 6.10; N, 6.87 %); R_{f} 0.35 (40% Et₂O in CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 1.45 (2xd, 12H, J 6.1 Hz, CH₃), 3.91 (s, 3H, CO₂Me), 4.78 (m, 2H, CH), 5.18 (s, 2H, Benzylic CH₂), 7.30 (dd, 1H, J 1.7 and 8.1 Hz, ArCH), 7.39 (m, 4H, ArCH), 7.46 (d, 2H, J 7.2 Hz, ArCH), 7.57 (d, 1H, 1.7 Hz, ArCH), 7.60 (t, 2H, J 1.9 Hz, ArCH), 7.72 (dd, 1H, J 1.6 and 8.4 Hz, ArCH), 8.62 (1H, J 8.5 Hz, ArCH), 8.68 (d, 1H, $J = 8.4$, ArCH), 8.73 (s, 1H, NH), 8.87 (s, 1H, NH); δ_{C} (75 MHz, CDCl₃): 22.23, 52.09, 70.53, 71.72, 71.83, 111.26, 111.84, 113.10, 113.45, 118.52, 118.71, 118.91, 120.26, 123.32, 123.99, 124.86, 127.78, 128.29, 128.55, 129.17, 132.67, 133.14, 136.48, 140.77, 145.75, 145.94, 146.38, 164.67, 165.05, 166.85; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3469, 3434, 3358 (NH), 2977, 2950 (CH), 1704, 1688 (CO); ESI-HRMS found 612.2704 m/z [M+H]⁺, C₃₅H₃₇N₃O₉ requires 612.2704.

Methyl-3-isopropoxy-4-(3-benzyloxy-4-(3-(1-naphthoxy-4-amino-benzoylamido)-benzoylamido)-benzoate 9acd

(Procedure D) **9acd** (103.3 mg, 0.14 mmol), SnCl₂.H₂O (235.3 mg, 1.04 mmol), and ethyl acetate (50 mL) to yield product (66.5 mg, 67%) as a yellow oil that solidified upon standing; m.p. 260–262 °C; R_{f} = 0.65 (30% Et₂O in CH₂Cl₂); δ_{H} (500 MHz, CDCl₃) 1.46 (6H, d, $J = 6.0$, *i*PrCH₃), 3.00 (2H, br, NH₂), 3.91 (3H, s, CO₂Me), 4.77 (1H, sept, $J = 6.0$, *i*PrCH), 5.25 (2H, s, ArCH₂O-), 5.42 (2H, s, ArCH₂O-), 6.68 (1H, d, $J = 8.1$, ArCH), 7.18 (1H, t, $J = 8.3$, ArCH), 7.28-7.36 (3H, m, ArCH), 7.46-7.55 (7H, m, ArCH), 7.54 (1H, s, ArCH), 7.55 (1H, s, ArCH), 7.71-7.73 (2H, singlet with buried doublet, ArCH), 7.87-7.92 (2H, m, ArCH), 8.05 (1H, m, ArCH), 8.63 (1H, d, $J = 8.5$, ArCH), 8.73 (1H, d, $J = 8.4$, ArCH), 8.78 (1H, br, NH), 8.88 (1H, br, NH); δ_{C} (75 MHz, CDCl₃) 22.2, 52.1, 69.3, 71.4, 71.9, 110.8, 111.2, 113.2, 113.5, 118.6, 118.7, 119.5, 121.0, 123.4, 123.7, 123.8, 125.0, 125.3, 126.1, 126.6, 127.4, 127.8, 128.7, 128.8, 128.9, 129.3, 129.5, 131.9, 132.3, 133.1, 133.8, 135.9, 141.0, 145.8, 145.9, 147.5, 164.5, 165.1, 166.8; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3481, 3450, 3358, 2977, 1712, 1662, 1594, 1515, 1438, 1250, 1204, 1130,

1006, 873, 796, 750, 618; ESI-HRMS found 710.2853 m/z $[M+H]^+$, $C_{43}H_{39}N_3O_9$ requires 710.2861.

Methyl-3-isopropoxy-4-(3-benzyloxy-4-(3-(2-naphthoxy-4-amino-benzoylamido)-benzoylamido)-benzoate 9ace

(Procedure D) **8ace** (185.5 mg, 0.25 mmol), $SnCl_2 \cdot H_2O$ (364.3 mg, 1.61 mmol) and ethyl acetate (60 mL) to yield a yellow oil the solidified upon cooling (128.6 mg, 72%); m.p. 148–150°C; R_f = 0.65 (30% Et_2O in CH_2Cl_2) δ_H (300 MHz, $CDCl_3$) 1.45 (6H, d, J = 6.1, $iPrCH_3$), 3.91 (3H, s, CO_2Me), 4.20 (2H, br, NH_2), 4.75 (1H, sept, J = 6.1, $iPrCH$), 5.18 (2H, s, Benzyl CH_2), 5.24 (2H, s, naphthyl- CH_2), 6.70 (1H, d, J = 8.1, ArCH), 7.25–7.54 (11H, m, ArCH), 7.60 (1H, s, ArCH), 7.70–7.74 (2H, m, ArCH), 7.85–7.90 (4H, m, ArCH), 8.62 (1H, d, J = 8.5, ArCH), 8.71 (1H, d, J = 8.5, ArCH), 8.73 (1H, br, NH), 8.87 (1H, br, NH). δ_C (75 MHz, $CDCl_3$) 22.6, 52.5, 71.1, 71.7, 72.3, 111.3, 111.6, 113.7, 113.9, 119.0, 119.1, 119.9, 121.3, 123.7, 124.2, 125.4, 126.0, 126.7, 126.8, 127.4, 128.2, 128.4, 128.9, 129.1, 129.3, 129.7, 132.6, 133.5, 133.7, 134.2, 136.4, 141.2, 146.2, 146.3, 147.8, 164.9, 165.4, 167.2. ν (cm^{-1} solid state) 3569, 3429, 2969, 1678, 1598, 1528, 1440, 1354, 1272, 1111, 994, 881, 849, 614; ESI-HRMS found 710.2853 m/z $[M+H]^+$, $C_{43}H_{39}N_3O_9$ requires 710.2861.

Methyl-3-propoxy-4-(3-benzyloxy-4-(3-isopropoxy-4-amino-benzoylamido)-benzoylamido)-benzoate 9bca

(procedure C) **8bca** (70 mg, 0.1 mmol), $SnCl_2$ (126.5 mg, 0.6 mmol) afforded the product (62.3 mg, 94%) as a yellow solid; m.p. 208°C; δ_H (500 MHz, $CDCl_3$) 1.13 (3H, t, J 7.3, CH_3) 1.33 (6H, d, J 5.9, CH_3), 1.94 (2H, tq, J 7.2 and 6.9, CH_2), 3.92 (3H, s, CO_2Me), 4.14 (2H, t, J 6.3, CH_2), 4.53 (1H, hep, J 6.1, CH), 5.25 (2H, s, benzylic CH_2), 6.67 (1H, d, J 8.0, Ar CH), 8.86 (1H, s, NH), 7.42–7.20 (4H, m, ArCH), 7.43 (1H, s, ArCH), 7.49–7.46 (5H, m, ArCH), 7.56 (1H, s, NH), 7.74 (2H, d, J 8.4, NH_2), 8.62 (1H, d, J 8.4, ArCH), 8.71 (2H, d, J 5.4, ArCH); ν_{max}/cm^{-1} (solid state) 3433, 3378 (NH), 2977, 1701 (CO), 1603, 1520, 1272; ESI-HRMS found m/z 634.2524 $[M+Na]^+$, $C_{35}H_{37}N_3O_7 \cdot Na$ 634.2529.

3-Isopropoxy-4-(3-isopropoxy-4-(3-benzyloxy-4-amino-benzoylamido)-benzoylamido)-benzoic acid 10aac

(Procedure B) **9aac** (45mg, 0.07mmol). Target acid was recrystallised by slow cooling of a MeOH/THF/ H_2O mix and isolated (29 mg, 66%) as a yellow crystalline solid; m.p. 230–232°C; δ_H (300 MHz, MeOD: $CDCl_3$): 1.48 (d, 12H, J = 6.0, 2 x CH_3), 4.82 (m, 2H, CH), 5.31 (s, 2H, Benzylic CH_2), 7.43 (m, 8H, ArCH), 7.59 (d, 1H, J = 1.8, ArCH), 7.67 (dd, 2H J = 1.7 and 7.2, ArCH), 7.72 (dd, 1H, J = 8.5 and 1.8 Hz, ArCH), 8.48 (d, 1H, J = 7.3, ArCH), 8.52 (d, 1H, J = 7.3, ArCH); δ_C (75 MHz, $CDCl_3$): 22.1, 22.2, 59.6, 69.9, 71.8, 111.7, 112.7, 114.3, 120.4, 121.1, 121.7, 122.6, 127.0, 127.7, 128.1, 128.8, 129.9, 132.5,

132.9, 137.3, 145.7, 147.7, 148.0, 164.6, 164.7, 167.3; $\nu_{\max}/\text{cm}^{-1}$ (solid state) ~ 3200 (broad, COOH), 3434, 3357 (NH), 2968, 2924, 2850 (CH), 1670, 1597 (CO); ESI-HRMS found 620.2389 m/z $[\text{M}+\text{Na}]^+$, $\text{C}_{34}\text{H}_{35}\text{N}_3\text{NaO}_7$ requires 6120.2367.

3-Isopropoxy-4-(3-benzyloxy-4-(3-(1-naphthyl)oxy-4-amino-benzoylamido)-benzoylamido)-benzoic acid 10acd

(Procedure B) **9acd** (92.2 mg, 0.13 mmol), aqueous NaOH (1 mL), THF (4 mL), methanol (4 mL) afforded the product (76.3 mg, 84%) as a pale beige solid; m.p. 225–226°C; δ_{H} (300 MHz, DMSO- d_6) 1.36 (6H, d, $J = 6.0$, $i\text{PrCH}_3$), 4.76 (1H, hep, $J = 6$, $i\text{PrCH}$), 5.34 (2H, s, benzylic CH_2), 5.58 (2H, s, benzylic CH_2), 6.73 (1H, d, $J = 8.2$, ArCH), 7.18–7.40 (4H, m, ArCH), 7.51–7.75 (11H, m, ArCH), 7.93–8.01 (2H, m, ArCH), 8.13–8.25 (3H, m, ArCH), 9.20 (1H, s, NH), 9.33 (1H, s, NH); δ_{C} (75 MHz, DMSO- d_6) 22.09, 68.5, 70.6, 71.8, 111.5, 112.0, 112.9, 114.4, 120.5, 121.2, 121.7, 122.5, 124.1, 125.8, 126.3, 126.8, 127.8, 128.3, 128.8, 128.9, 131.4, 132.0, 132.8, 133.6, 137.1, 144.8, 148.1, 164.8, 164.9, 167.3; $\nu_{\max}/\text{cm}^{-1}$ (solid state) 3431, (NH), 2929, 1688 (CO), 1598, 1513, 1427, 1348, 1261, 1122, 1014, 872; ESI-HRMS found 696.2711 m/z $[\text{M}+\text{H}]^+$, $\text{C}_{42}\text{H}_{38}\text{N}_3\text{O}_7$ requires 696.2704.

3-propoxy-4-(3-benzyloxy-4-(3-isopropoxy-4-amino-benzoylamido)-benzoylamido)-benzoic acid 10bca

(Procedure B) **9bca** (53.2 mg, 0.087 mmol), aqueous NaOH (1 mL), THF (4 mL), methanol (4 mL) afforded the product (45.7 mg, 88%) as a pale beige solid; m.p. 231–232°C; δ_{H} (300 MHz, DMSO- d_6) 1.01 (3H, t, $J = 7.3$, PrCH_3), 1.25 (6H, d, $J = 6.0$, $i\text{PrCH}_3$), 1.80 (2H, m, PrCH_2), 4.03 (2H, t, $J = 6.3$, PrCH_2), 4.48 (1H, hep, $J = 6.0$, $i\text{PrCH}$), 5.30 (2H, s, benzylic CH_2), 5.41 (2H, s, NH_2), 6.68 (1H, d, $J = 8.3$, ArCH), 7.32–7.43 (5H, m, ArCH), 7.47–7.62 (5H, m, ArCH), 7.76 (1H, s, ArCH), 7.82 (1H, d, $J = 8.1$, ArCH), 8.18 (1H, d, $J = 8.3$, ArCH), 9.10 (1H, s, NH), 9.26 (1H, s, NH); δ_{C} (75 MHz, DMSO- d_6) 10.83, 22.2, 22.5, 70.0, 70.6, 70.7, 108.8, 111.9, 113.1, 113.2, 120.5, 121.2, 121.6, 121.7, 122.0, 122.1, 127.9, 128.4, 129.8, 130.4, 131.6, 137.1, 143.5, 143.7, 149.1, 149.6, 152.0, 157.3, 164.5, 164.9, 169.8; $\nu_{\max}/\text{cm}^{-1}$ (solid state) 3433, 2971, 1665, 1602, 1514, 1384, 1259, 1119; ESI-HRMS found 598.2560 m/z $[\text{M}+\text{H}]^+$, $\text{C}_{34}\text{H}_{36}\text{N}_3\text{O}_7$ requires 598.2548.

Tetramer 11aaaa

(Procedure C) **9aaa** (186.0 mg, 0.35 mmol), **4a** (115.4 mg, 0.51 mmol), Cl_2PPh_3 (553.4 mg, 1.71 mmol), and chloroform (40 mL) afforded product (185 mg, 73%) as a pale yellow solid; m.p. 225–226°C (Found: C, 62.3; H, 6.15; N, 6.85%. $\text{C}_{41}\text{H}_{46}\text{N}_4\text{O}_{11}$ requires: C, 62.43; H, 6.15; N, 7.10%); $R_f = 0.8$ (30% Et_2O in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 1.32–1.49 (24H, 4 different $i\text{Pr CH}_3$), 3.91 (3H, s, CO_2Me), 4.75–4.86 (4H, m, $i\text{PrCH}$), 7.32–7.46 (3H, m, ArCH), 7.60–7.63 (3H, m, ArCH), 7.68–7.74 (2H, m, ArCH), 7.87 (1H, d $J = 8.3$ Hz, ArCH), 8.60–8.70 (3H, nested doublets, ArCH), 8.78 (1H, br NH), 8.85 (1H, br,

NH), 8.86 (1H, br, NH). δ_{C} (75 MHz, CDCl_3) 22.1, 22.2, 22.6, 52.5, 72.2, 72.3, 72.4, 73.6, 112.2, 112.3, 113.6, 115.9, 116.9, 117.7, 118.9, 119.3, 119.6, 123.7, 125.4, 126.2, 130.3, 130.9, 131.8, 132.5, 133.5, 139.8, 143.4, 146.2, 146.9, 147.1, 152.0, 163.7, 167.8, 167.9, 167.2. $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3433, 2975, 2622, 1671, 1598, 1513, 1264, 1112, 986, 872, 794, 596; ESI-MS m/z 771 $[\text{M}+\text{H}]^+$, 794 $[\text{M}+\text{Na}]^+$.

Tetramer 11acde

(Procedure C) **9acd** (81.1 mg, 0.114 mmol), **4e** (86.5 mg, 0.26 mmol), Cl_2PPh_3 (318.4 mg, 0.98 mmol), and chloroform (40 mL) to yield product (75.2 mg, 65%) as a yellow solid; m.p. 256–257°C (Found: C, 70.45; H, 5.10; N, 5.35%. $\text{C}_{42}\text{H}_{47}\text{N}_3\text{O}_7$ requires: C, 70.92; H, 5.07; N, 5.35%); R_{f} = 0.8 (30% Et_2O in CH_2Cl_2); δ_{H} (500 MHz, CDCl_3) 1.47 (6H, d, J = 6.0, $i\text{PrCH}_3$), 3.92 (3H, s, CO_2Me), 4.78 (1H, sept, J = 6.0, $i\text{PrCH}$), 5.06 (2H, s, $\text{ArCH}_2\text{O}-$), 5.29 (2H, s, $\text{ArCH}_2\text{O}-$), 5.56 (2H, s, $\text{ArCH}_2\text{O}-$), 6.80 (1H, d, J = 8.3, ArCH), 7.28 (1H, t, J = 8.4 Hz, ArCH), 7.43–7.55 (16H, m, ArCH), 7.61 (1H, s, ArCH), 7.72–7.84 (3H, m, ArCH), 7.87–7.90 (6H, m, ArCH), 8.02 (1H, d, J = 8.3, ArCH), 8.57 (1H, br, NH), 8.59 (1H, d, J = 8.4 Hz, ArCH), 8.63 (1H, d, J = 8.5 Hz, ArCH), 8.74 (1H, d, J = 8.4, ArCH), 8.88 (1H, br, NH), 8.89 (1H, br, NH). δ_{C} (75 MHz, CDCl_3) 22.3, 52.1, 70.9, 71.3, 71.5, 71.9, 111.3, 111.5, 113.2, 114.0, 118.2, 118.7, 119.0, 119.2, 119.5, 120.3, 123.2, 123.3, 124.8, 125.4, 125.7, 126.3, 126.4, 127.0, 127.9, 128.1, 128.7, 129.0, 129.3, 130.0, 130.3, 131.4, 131.6, 133.3, 134.0, 138.9, 142.0, 146.1, 145.8, 151.8, 162.8, 164.3, 164.4, 166.8; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3432, 3068, 2971, 1728, 1688, 1596, 1516, 1426, 1349, 1194, 1123, 1025, 1000, 869, 747, 605. ESI-MS m/z 1015 $[\text{M}+\text{H}]^+$, 1037 $[\text{M}+\text{Na}]^+$.

Tetramer 12aaaa

(Procedure D) **11aaaa** (111.8 mg, 0.15 mmol), $\text{SnCl}_2\cdot\text{H}_2\text{O}$ (371.4 mg, 1.65 mmol), ethyl acetate (30 mL) and methanol (1 mL) afforded a pale yellow oil (98.7 mg, 92%) that solidified upon standing; m.p. 206–207°C; R_{f} = 0.65 (30% Et_2O in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 1.40–1.49 (24H, m, 4 x $i\text{PrCH}_3$), 3.1 (2H, br, NH_2), 3.92 (3H, s, CO_2Me), 4.67–4.85 (4H, m, 4 x $i\text{PrCH}$), 6.75 (1H, d, J = 8.1, ArCH), 7.28 (1H, d, ArCH), 7.40–7.47 (3H, nested doublets, ArCH), 7.60–7.62 (3H, overlapping singlets, ArCH), 7.73 (1H, d, J = 8.5, ArCH), 8.63 (1H, d, J = 8.5, ArCH), 8.67–8.71 (2H, overlapped doublets, ArCH), 8.74 (1H, br, NH), 8.85 (1H, br, NH), 8.87 (1H, br, NH). δ_{C} (75 MHz, CDCl_3) 22.6, 52.5, 71.3, 72.2, 72.3, 112.2, 112.8, 113.6, 114.0, 119.0, 119.1, 119.2, 119.3, 119.4, 120.4, 123.7, 124.4, 125.3, 129.5, 130.0, 132.8, 1333.2, 133.5, 141.9, 145.3, 146.2, 146.8, 146.9, 165.0, 165.2, 165.6, 167.2; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3434, 3358, 3199, 2976, 1710, 1672, 1598, 1514, 1348, 1266, 1112, 985, 872, 750, 598; ESI-HRMS found 741.3505 m/z $[\text{M}+\text{H}]^+$, $\text{C}_{41}\text{H}_{48}\text{N}_4\text{O}_9$ requires 741.3494.

Pentamer 13aaaaa

(Procedure C), **12aaaa** (38.7 mg, 0.054 mmol), **4a** (35.3 mg, 0.156 mmol), Cl_2PPh_3 (214.5 mg, 0.66 mmol), and chloroform (30 mL), to yield product (33.5 mg, 68%) as a pale yellow solid; m.p. 248–249°C; $R_f = 0.8$ (30% Et_2O in CH_2Cl_2); δ_{H} (300 MHz, CDCl_3) 1.44–1.53 (30H, nested doublets, $i\text{PrCH}_3$), 3.91 (3H, s, CO_2Me), 4.75–4.87 (5H, nested septuplets, $i\text{PrCH}$), 7.32–7.46 (4H, m, ArCH), 7.60–7.65 (4H, m, ArCH), 7.70 (1H, s, ArCH), 7.72 (1H, d, $J = 8.8$, ArCH), 7.88 (1H, d $J = 8.3$, ArCH), 8.63 (1H, d, $J = 8.5$, ArCH), 8.65–8.71 (3H, m, ArCH), 8.78 (1H, br, NH), 8.85–8.87 (3H, br, NH). δ_{C} (75 MHz, CDCl_3) 22.1, 22.2, 22.6, 52.5, 72.3, 72.4, 73.6, 112.3, 113.6, 115.9, 116.7, 119.0, 119.2, 119.3, 119.4, 119.6, 123.7, 125.4, 126.2, 130.1, 130.2, 130.9, 131.9, 132.6, 132.7, 133.5, 146.2, 147.0, 147.1, 152.0, 163.7, 164.8, 164.9, 165.0, 167.2; $\nu_{\text{max}}/\text{cm}^{-1}$ (solid state) 3434, 2978, 1673, 1595, 1519, 1266, 1111, 986, 874, 746, 602. ESI-HRMS found 948.4004 m/z $[\text{M}+\text{H}]^+$, $\text{C}_{51}\text{H}_{57}\text{N}_5\text{O}_{13}$ requires 948.4026.

Additional Structural Data

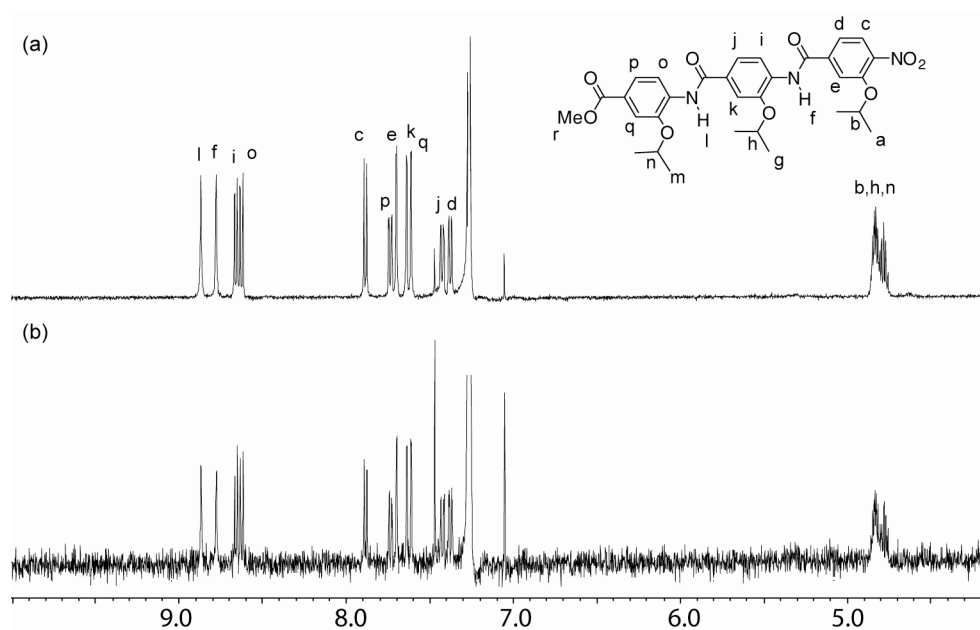


Fig. S1. ^1H NMR spectrum (500 MHz, CDCl_3) of trimer **8aaa** (a) at 3 mM (b) at 0.3 mM.

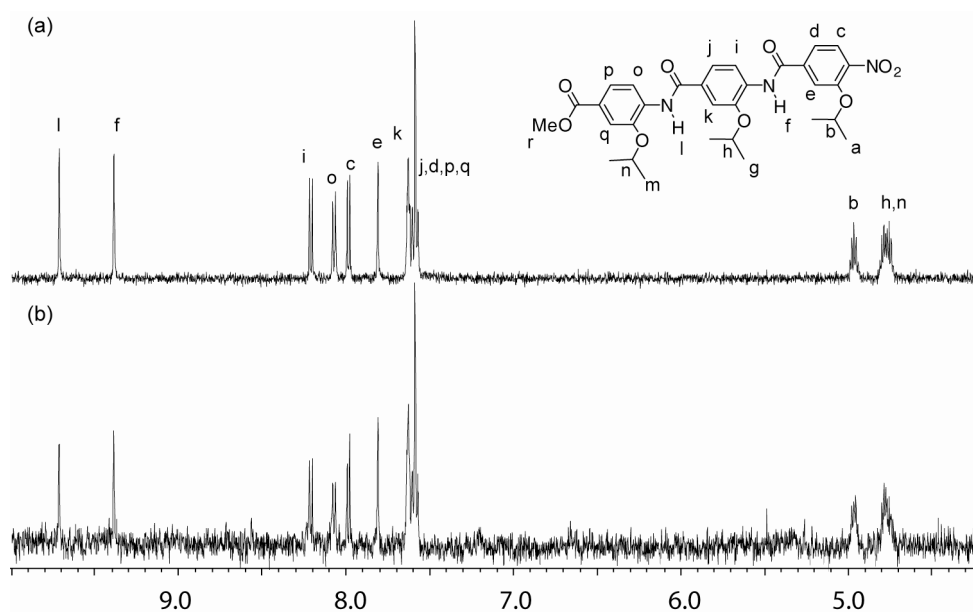


Fig. S2. ^1H NMR spectrum (500 MHz, DMSO-d_6) of trimer **8aaa** (a) at 2 mM (b) at 0.2 mM.

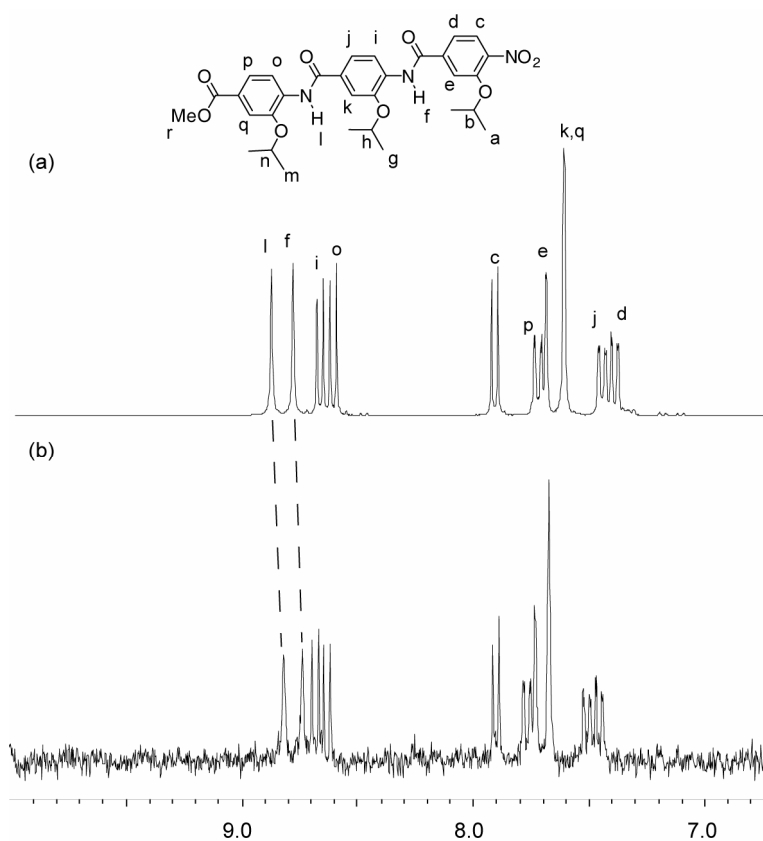


Fig. S3. ^1H NMR spectrum (300 MHz, $\text{C}_2\text{D}_2\text{Cl}_4$) of trimer **8aaa** (a) at 303 K (b) at 373 K

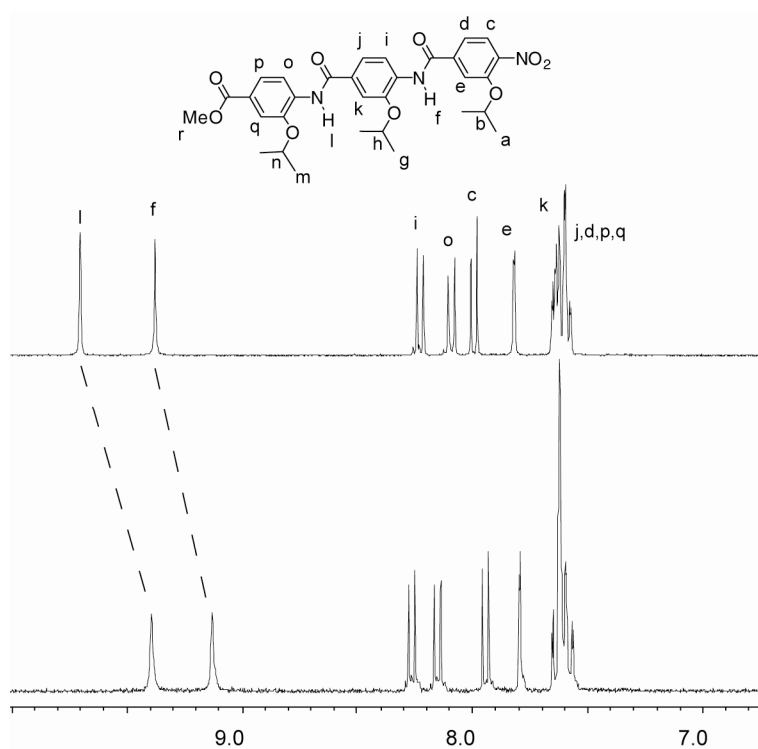


Fig. S4. ^1H NMR spectrum (300 MHz, DMSO-d_6) of trimer **8aaa** (a) at 303 K (b) at 373 K