Supporting Information for:

Conversion of aldoximes into nitriles and amides under mild conditions

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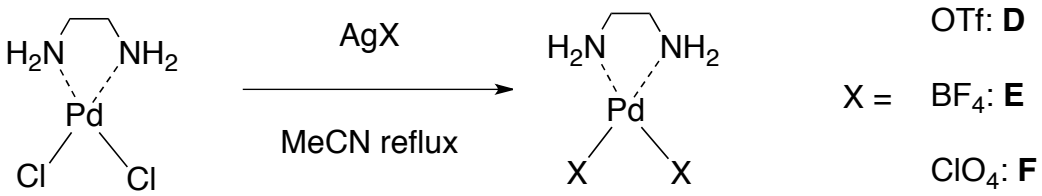
Experimental section

SYNTHESIS

Synthetic schemes for precursor the compounds

Scheme 1



Characterisation data

A

L-(+)-leucinol (874mg, 953µl, 7.458 mmol) was added to a suspension of naphthalene tetracarboxylic dianhydride (1g, 3.729 mmol) in DMF (6ml). The mixture was sonicated until it became transparent, and then heated under microwave irradiation for 5 minutes at 140°C. The reaction mixture was added dropwise into 1M HCl solution and the precipitated product was collected under filtration, and dried *in vacuo* to yield a light brown product (1.488g, 86%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 0.95 (12H, dd, J_1 = 6.6Hz, J_2 = 9.6Hz), 1.46 - 1.52 (2H, m), 1.63 - 1.69 (2H, m), 1.99 - 2.04 (2H, m), 3.96 (2H, dd, J_1 = 3.9Hz, J_2 = 11.7Hz), 4.25 (2H, dd, J_1 = 8.3Hz, J_2 = 11.7Hz), 5.35 - 5.40 (2H, m), 8.74 (4H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ(ppm): 22.5, 23.1, 25.6, 37.4, 54.7, 63.6, 126.7, 131.3, 164.0. Melting point = 189°C.
HRMS (ESI+) calcd. for $C_{26}H_{27}N_2O_6$ $[M+H]^+$ (m/z): 463.1869, found: 463.1889.

B

To a dichloromethane solution of **A** (0.8 g, 1.715 mmol), a dichloromethane solution of Dess-Martin periodinane (2.18 g, 5.144 mmol) was added along with potassium bicarbonate (3.4 g, 20 equivalents, 34 mmol). The reaction progress was monitored by LC-MS. The reaction mixture was diluted with diethyl ether and washed with saturated aqueous sodium bicarbonate/sodium thiosulfate solution. The organic layer was collected and dried (anhydrous magnesium sulfate) and concentrated *in vacuo* to yield the product as an orange powder (657mg, 83%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 0.96 (6H, d, J = 6.6Hz), 1.05 (6H, d, J = 6.6Hz), 1.62 - 1.69 (1H, m), 1.98 - 2.05 (2H, m), 2.23 - 2.30 (2H, m), 5.52 (2H, dd, J_1 = 4.8Hz, J_2 = 9.0Hz), 8.80 (4H, s), 9.70 (2H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ(ppm): 22.2, 23.1, 25.5, 36.6, 59.1, 126.6, 127.1, 131.8, 162.7, 196.8. Melting point = 141°C.
HRMS (ESI+) calcd. for $C_{26}H_{31}N_2O_6$ $[M+H]^+$ (m/z): 467.2182, found: 467.2208.

C

Hydroxylamine hydrochloride (107mg, 1.531 mmol), sodium carbonate (163mg, 1.531 mmol) and **B** (354mg, 0.765 mmol) were dissolved in absolute ethanol. Anhydrous magnesium was then added to the reaction mixture. The reaction progress was monitored by LC-MS. The ethanol was removed under reduced pressure and redissolved in dichloromethane. The organic phase was washed with water and dried with magnesium sulfate. Drying *in vacuo* yielded the product as a pale orange solid (291mg, 77%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 0.91 - 1.01 (12H, m), 1.51 - 1.62 (2H, m), 1.84 - 2.04 (4H, m), 5.84 - 5.86 (1H, α proton, *E* isomer, m), 6.16 (1H, α proton, *Z* isomer, br s), 7.16 (1H, C<u>H</u>=NOH, *Z* isomer, br s), 7.83 - 7.85 (1H, C<u>H</u>=NOH, *E* isomer, dd, J_1 = 2.3Hz, J_2 = 6.1Hz), 8.69 (4H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ(ppm): 22.5, 25.5, 39.8, 50.6, 126.6, 126.7, 131.4, 150.0, 150.7, 162.4. Melting point = 168°C.
HRMS (ESI+) calcd. for $C_{26}H_{29}N_4O_6$ $[M+H]^+$ (m/z): 493.2087, found: 493.2101.

D

Palladium(ethylenediamine)dichloride (200mg, 0.842 mmol) and silver (I) triflate (432mg, 1.685 mmol) were refluxed in acetonitrile under nitrogen for 2 days. After cooling the reaction mixture to room temperature, all solids (silver chloride) were filtered off. The mixture was concentrated under reduced pressure and recrystallised with diethyl ether to yield a pale yellow solid product (201mg, 51%).
Elemental analysis for $C_8H_{14}F_6N_4O_6PdS_2$•2MeCN, calcd: C 17.57%, H 2.58%, N 10.25%, found: C 17.32%, H 2.50%, N 9.82%. Melting point = 201°C.
HRMS (ESI+) calcd. for $C_4H_8F_6N_2O_6PdS_2Na$ $[M+Na]^+$ (m/z): 486.8655, found: 486.8649.

E

Palladium(ethylenediamine)dichloride (200mg, 0.842 mmol) and silver (I) tetrafluoroborate (328mg, 1.685 mmol) were refluxed in acetonitrile under nitrogen for 2 days. After cooling the reaction mixture to room temperature, all solids (silver chloride) were filtered off. The mixture was concentrated under reduced pressure and recrystallised with diethyl ether to yield a pale yellow solid product (182mg, 64%).
Elemental analysis for $C_2H_8B_2F_8N_4Pd$•2MeCN, calcd: C 17.07%, H 3.34%, N 13.27%, found: C 16.65%, H 3.25%, N 13.06%. Melting point = 196°C.
HRMS (ESI+) calcd. for $C_2H_8B_2F_8N_2PdNa$ $[M+Na]^+$ (m/z): 362.9673, found: 362.9020.

F

Palladium(ethylenediamine)dichloride (200mg, 0.842 mmol) and silver (I) perchlorate (349mg, 1.685 mmol) were refluxed in acetonitrile under nitrogen for 2 days. After cooling the reaction mixture to room temperature, all solids (silver chloride) were filtered off. The mixture was concentrated under reduced pressure and recrystallised with diethyl ether to yield a pale yellow solid product (197mg, 64%).
Elemental analysis for $C_6H_{14}Cl_2N_4O_8Pd$•2MeCN, calcd: C 16.10%, H 3.15%, N 12.52%, found: C 15.85%, H 3.02%, N 12.34%. Melting point = 199°C.
HRMS (ESI+) calcd. for $C_2H_8Cl_2N_2O_8PdNa$ $[M+Na]^+$ (m/z): 386.8585, found: 386.8577.

Table 1, Entry 1 (reactant): acetaldehyde oxime

The compound was purchased commercially and used without further purification.

Table 1, Entry 2 (reactant): propionaldehyde oxime

The compound was purchased commercially and used without further purification.

Table 1, Entry 3 (reactant): butyraldoxime

The compound was purchased commercially and used without further purification.

Table 1, Entry 4 (reactant): 3-phenylpropionaldoxime

3-phenylpropanal (1010mg, 7.527mmol) was dissolved in methanol and hydroxylamine hydrochloride (523mg, 7.527mmol) and sodium carbonate (798mg, 7.527mmol) and anhydrous magnesium sulfate were added. The reaction mixture was stirred for 2 hours at room temperature. All solids were filtered off and the methanol was evaporated from the filtrate under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with anhydrous magnesium sulfate to yield the crude product. Recrystallisation from dichloromethane/hexane yielded the pure product as a white solid (201mg, 18%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 2.63 - 2.67 (2H, m), 2.80 (2H, t, J = 7.6Hz), 6.66 (1H, t, J = 5.3Hz), 7.17 (1H, t, J = 7.1Hz), 7.22 (2H, d, J = 7.1Hz), 7.27 (2H, t, J = 7.1Hz). ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 27.6, 33.0, 127.1, 129.3, 129.5, 142.4, 152.0. Melting point = 107°C.
HRMS (EI+) calcd. for $C_9H_{11}NO$ $[M]^+$ (m/z): 149.0835, found: 149.0828.

Table 1, Entry 6 (reactant): *tert*-butyl ((4-hydroxyimino)methyl)piperidine-1-carboxylate

1-boc-piperidine-4-carboxaldehyde (500mg, 2.344mmol) was dissolved in methanol and hydroxylamine hydrochloride (163mg, 2.344mmol) and sodium carbonate (248mg, 2.344mmol) and anhydrous magnesium sulfate were added. The reaction mixture was stirred for 2 hours at room temperature. All solids were filtered off and the methanol was evaporated from the filtrate under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with anhydrous magnesium sulfate to yield the crude product. Recrystallisation from dichloromethane/hexane yielded the pure product as a white solid (350mg, 65%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 1.28 - 1.41 (2H, m), 1.46 (9H, s), 2.34 - 2.41 (1H, m), 2.86 (2H, s, br), 4.03 (2H, d, J_1 = 3.3Hz, J_2 = 13.3Hz), 6.50 (RC<u>H</u>=NOH, Z isomer, d, J = 6.8Hz), 7.29 (RC<u>H</u>=NOH, E isomer, d, J = 5.8Hz); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 28.7, 30.4, 33.3, 37.9, 81.0, 154.3, 154.7, 156.4. Melting point = 130°C.
HRMS (ESI+) calcd. for $C_{11}H_{20}N_2O_3Na$ $[M+Na]^+$ (m/z): 251.1372, found: 251.1363.

Table 1, Entry 8 (reactant): 4-trifluoromethylbenzaldoxime

4-(trifluoromethyl)benzaldehyde (1ml, 1275mg, 7.323 mmol), hydroxylamine hydrochloride (509mg, 7.323 mmol) and sodium carbonate (776mg, 7.323 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (562mg, 41%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.64 (2H, d, J = 8.5Hz), 7.70 (2H, d, J = 8.5Hz), 7.86 (1H, br s), 8.18 (1H, s).
^{13}C NMR (100 MHz, $CDCl_3$) δ(ppm): 122.9, 125.1, 125.9, 127.4, 135.4, 149.3.
HRMS (ESI+) calcd. for $C_8H_7F_3NO$ $[M+H]^+$ (m/z): 190.0480, found: 190.0476.

Table 1, Entry 9 (reactant): 4-nitrobenzaldoxime

4-nitrobenzaldehyde (1000mg, 6.617 mmol), hydroxylamine hydrochloride (460mg, 6.617 mmol) and sodium carbonate (702mg, 6.617 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a dark yellow powder (478mg, 43%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.75 (2H, d, J = 8.9Hz), 7.93 (1H, br s), 8.20 (1H, s), 8.25 (2H, d, J = 8.9Hz). ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 133.5, 136.8, 136.9, 149.0, 156.3, 157.0.
HRMS (ESI+) calcd. for $C_7H_7N_2O_3$ $[M+H]^+$ (m/z): 167.1415, found: 167.1038.

Table 1, Entry 10 (reactant): 4-(*tert*-butyl)benzaldoxime

4-(*tert*-butyl)benzaldehyde (500mg, 3.082 mmol), hydroxylamine hydrochloride (214mg, 3.082 mmol) and sodium carbonate (327mg, 3.082 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (305mg, 56%).
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 1.33 (9H, s), 7.41 (2H, d, J = 8.4Hz), 7.51 (2H, d, J = 8.4Hz), 7.80 (1H, br s), 8.13 (1H, s).
^{13}C NMR (100 MHz, $CDCl_3$) δ(ppm): 31.3, 35.0, 125.9, 127.0, 129.3, 150.3, 153.6.
HRMS (ESI+) calcd. for $C_{11}H_{16}NO$ $[M+H]^+$ (m/z): 178.1232, found: 178.1224.

Table 1, Entry 11 (reactant)

The compound was purchased commercially and used without further purification.

Table 1, Entry 12 (reactant): 3-chloroisonicotinaldehyde oxime

3-chloroisonicotinaldehyde (100mg, 0.706 mmol), hydroxylamine hydrochloride (50mg, 0.706 mmol) and sodium carbonate (75mg, 0.706 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (15mg, 14%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 6.67 (1H, dd, J_1 = 5.1Hz, J_2 = 7.9Hz), 7.53 (1H, dd, J_1 = 1.7Hz, J_2 = 7.9Hz), 7.90 (1H, dd, J_1 = 1.7Hz, J_2 = 5.1Hz), 8.15 (1H, s).
^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 112.8, 113.4, 141.1, 148.4, 150.7, 157.7.
HRMS (ESI+) calcd. for $C_6H_4ClN_2O$ [M-H$^+$] (m/z): 155.0018, found: 155.0015.

Table 1, Entry 13 (reactant): 4-methylthiazole-5-carbaldehyde oxime

4-methylthiazole-5-carbaldehyde (100mg, 0.786 mmol), hydroxylamine hydrochloride (55mg, 0.786 mmol) and sodium carbonate (84mg, 0.786 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (13mg, 12%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 2.56 (3H, s), 7.81 (1H, s), 8.86 (1H, s), 9.81 (1H, br s).
^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 15.4, 120.5, 138.6, 155.9, 157.2.
HRMS (ESI+) calcd. for $C_5H_5N_2OS$ [M-H$^+$] (m/z): 141.0128, found: 141.0125.

Table 1, Entry 14 (reactant): 1*H*-indole-5-carbaldehyde oxime

1*H*-indole-5-carbaldehyde (100mg, 0.689 mmol), hydroxylamine hydrochloride (48mg, 0.689 mmol) and sodium carbonate (73mg, 0.689 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (35mg, 32%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 6.47 (1H, dd, J_1 = 0.9Hz, J_2 = 3.2Hz), 7.24 (1H, d, J = 3.2Hz), 7.37 (1H, d, J = 8.5Hz), 7.45 (1H, dd, J_1 = 1.5Hz, J_2 = 8.5Hz), 7.70 (1H, s), 8.16 (1H, s).
^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 103.0, 112.6, 120.5, 121.5, 125.3, 126.5, 129.4, 138.5, 152.2.
HRMS (ESI+) calcd. for $C_9H_9N_2O$ [M+H]$^+$ (m/z): 161.0709, found: 161.0705.

Table 1, Entry 15 (reactant): 2-aminonicotinaldehyde oxime

2-aminonicotinaldehyde (100mg, 0.819 mmol), hydroxylamine hydrochloride (57mg, 0.819 mmol) and sodium carbonate (87mg, 0.819 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (21mg, 19%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 6.37 (2H, br s), 6.65 (1H, dd, J_1 = 4.9Hz, J_2 = 7.9Hz), 7.47 (1H, dd, J_1 = 1.9Hz, J_2 = 7.9Hz), 7.99 (1H, dd, J_1 = 1.9Hz, J_2 = 4.9Hz), 8.15 (1H, s), 9.06 (1H, s).
^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 112.8, 113.4, 141.1, 148.4, 150.7, 157.7.
HRMS (ESI+) calcd. for $C_6H_8N_3O$ $[M+H]^+$ (m/z): 138.0662, found: 138.0662.

Table 1, Entry 16 (reactant): Methyl 3-((hydroxyimino)methyl)benzoate

Methyl-3-formylbenzoate (100mg, 0.609 mmol), hydroxylamine hydrochloride (43mg, 0.609 mmol) and sodium carbonate (65mg, 0.609 mmol) were dissolved in methanol. Anhydrous magnesium sulfate was added and the reaction mixture stirred at room temperature. The reaction progress was monitored by LC-MS. All solids were filtered off and the methanol evaporated under reduced pressure. The residue was redissolved in dichloromethane and washed with water. The organic layer was collected and dried with magnesium sulfate. Removing the solvent *in vacuo* yielded the product as a white powder (25mg, 23%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 3.89 (3H, s), 7.51 (1H, t, J = 7.8Hz), 7.82 (1H, dt, J_1 = 1.3Hz, J_2 = 7.8Hz), 7.99 (1H, dt, J_1 = 1.3Hz, J_2 = 7.8Hz), 8.16 (1H, s), 8.18 (1H, t, J = 1.6Hz), 9.18 (1H, s).
^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 52.7, 128.56, 130.0, 131.1, 132.1, 135.2, 149.0, 168.1.
HRMS (ESI+) calcd. for $C_9H_9NO_3Na$ $[M+Na]^+$ (m/z): 202.0475, found: 202.0469.

Experiments conducted in acetonitrile

Table 1, Entry 1 (product)

Acetaldehyde oxime (4.07mg, 0.069mmol) and $Pd(en)(NO_3)_2$ (2mg, 0.0069 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.96 (3H, s). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 1.32, 118.34.
HRMS (EI+) calcd. for C_2H_3N $[M]^+$ (m/z): 41.0260, found: 41.0266.

Table 1, Entry 2 (product)

Propionaldehyde oxime (4.63mg, 0.063mmol) and $Pd(en)(NO_3)_2$ (1.84mg, 0.0063 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.20 (3H, t, J = 7.6Hz), 2.36 (2H, q, J = 7.6Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 10.8, 11.3, 118.3.
HRMS (ESI+) calcd. for C_3H_6N $[M+H]^+$ (m/z): 56.0495, found: 56.0450.

Table 1, Entry 3 (product)[1]

Butyraldoxime (3.00mg, 0.034mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
The experiment was repeated on a larger scale of butyraldoxime (200µl, 185mg, 2.119mmol) and $Pd(en)(NO_3)_2$ (62mg, 0.212 mmol). The starting materials were dissolved in acetonitrile and heated for 16 hours at 60°C. The acetonitrile was removed under reduced pressure without heating, and the residue was redissolved in dichloromethane. All solids were filtered off, and the solvent removed under reduced pressure without heating to yield the product as a colourless liquid (106mg, 72%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.02 (3H, t, J = 7.3Hz), 1.63 (2H, sestet, J = 7.3Hz), 2.35 (2H, t, J = 7.3Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 13.4, 19.2, 19.8, 121.2.
HRMS (EI+) calcd. for C_4H_8N $[M+H]^+$ (m/z): 70.0651, found: 70.0651.

Table 1, Entry 3 (product), catalyst D

^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.01 (3H, t, J = 7.3Hz), 1.63 (2H, sestet, J = 7.3Hz), 2.35 (2H, t, J = 7.3Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 13.4, 19.2, 19.8, 121.2.
HRMS (ESI+) calcd. for C_4H_8N $[M+H]^+$ (m/z): 70.0651, found: 70.0651.

Table 1, Entry 3 (product), catalyst E

^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.01 (3H, t, J = 7.3Hz), 1.63 (2H, sestet, J = 7.3Hz), 2.35 (2H, t, J = 7.3Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 13.4, 19.2, 19.8, 121.2.
HRMS (ESI+) calcd. for C_4H_8N $[M+H]^+$ (m/z): 70.0651, found: 70.0651.

Table 1, Entry 3 (product), catalyst F

^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.01 (3H, t, J = 7.3Hz), 1.63 (2H, sestet, J = 7.3Hz), 2.35 (2H, t, J = 7.3Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 13.4, 19.2, 19.8, 121.2. HRMS (ESI+) calcd. for C_4H_8N $[M+H]^+$ (m/z): 70.0651, found: 70.0651.
Table 1, Entry 6 (product)

[1] For reactions of Entry 3 using catalysts C, D, and E, the following general protocol was used: Butyraldoxime (5µl, 4.6mg, 0.053mmol) and the respective catalyst (0.0053 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.

tert-butyl ((4-hydroxyimino)methyl)piperidine-1-carboxylate (7.86mg, 0.034mmol) and Pd(en)$(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.42 (9H, s), 1.67 (2H, m), 1.85 (2H, m), 2.87 (1H, m), 3.19 (2H, m), 3.63 (2H, m). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 26.9, 28.5, 29.2, 80.2, 122.7, 155.2.
HRMS (ESI+) calcd. for $C_{11}H_{19}N_2O_2$ $[M+H]^+$ (m/z): 211.1441, found: 211.1432.

Table 1, Entry 7 (product)

S-3,7-dimethyloct-6-enal oxime (5.83mg, 0.034 mmol) and Pd(en)$(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.01 (3H, d, J = 6.7Hz), 1.29 (1H, m), 1.40 (1H, m), 1.61 (3H, s), 1.67 (3H, s), 1.82 (1H, sestet, J = 6.7Hz), 2.00 (2H, q, J = 7.6Hz), 2.30 (1H, dd, J_1 = 6.9Hz, J_2 = 17.1Hz), 2.38 (1H, dd, J_1 = 5.8Hz, J_2 = 17.1Hz), 5.11 (1H, m). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 17.6, 19.4, 24.5, 25.7, 25.9, 30.6, 36.5, 120.2, 124.7, 132.7.

Table 1, Entry 8 (product)

4-trifluoromethylbenzaldoxime (6.51mg, 0.034 mmol) and Pd(en)$(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
The experiment was repeated on a larger scale of 4-(trifluoromethyl)benzaldehyde (100mg, 0.529mmol) and Pd(en)$(NO_3)_2$ (16mg, 0.0529 mmol). The starting materials were dissolved in acetonitrile and heated for 16 hours at 60°C. The acetonitrile was removed under reduced pressure, and the residue was redissolved in dichloromethane. All solids were filtered off, and the solvent removed under reduced pressure to yield the product as an off-white powder (63mg, 70%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 7.86 (2H, d, J = 8.2Hz), 7.93 (2H, d, J = 8.2Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 117.0, 123.1, 125.8, 128.8, 131.0, 134.2.

Table 1, Entry 9 (product)

4-nitrobenzaldoxime (5.72mg, 0.034 mmol) and Pd(en)$(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
The experiment was repeated on a larger scale of 4-nitrobenzaldoxime (100mg, 0.602mmol) and Pd(en)$(NO_3)_2$ (18mg, 0.0602 mmol). The starting materials were dissolved in acetonitrile and heated for 16 hours at 60°C. The acetonitrile was removed under reduced pressure, and the residue was redissolved in dichloromethane. All solids were filtered off, and the solvent removed under reduced pressure. The product was purified by flash column chromatography (eluent: 3:1 mixture of DCM:hexane, product R_f = 0.45) to yield the product as a white powder (44mg, 51%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 7.98 (2H, d, J = 9.0Hz), 8.33 (2H, d, J = 9.0Hz). ^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 118.1, 118.9, 125.2, 129.3, 134.9.

HRMS (EI) calcd. for $C_7H_4N_2O_2$ $[M]^+$ (m/z): 148.0267, found: 148.0266. Elemental Analysis for $3C_7H_4N_2O_2 \bullet 1H_2O$, calcd: C 54.55%, H 3.05%, N 18.18%, found: C 54.68%, H 2.84%, N 18.20%.

Table 1, Entry 10 (product)

4-(*tert*-butyl)benzaldoxime (5.72mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
The experiment was repeated on a larger scale of 4-(*tert*-butyl)benzaldoxime (100mg, 0.564mmol) and $Pd(en)(NO_3)_2$ (17mg, 0.0564 mmol). The starting materials were dissolved in acetonitrile and heated for 16 hours at 60°C. The acetonitrile was removed under reduced pressure, and the residue was redissolved in dichloromethane. All solids were filtered off, and the solvent removed under reduced pressure. The product was purified by flash column chromatography (eluent: DCM, product R_f = 0.75) to yield the product as a white powder (21mg, 23%).
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 1.32 (9H, s), 7.58 (2H, dt, J_1 = 2.1Hz, J_2 = 8.7Hz), 7.66 (2H, dt, J_1 = 2.1Hz, J_2 = 8.7Hz).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 31.0, 35.9, 110.0, 119.9, 127.3, 132.9, 157.8. HRMS (ESI+) calcd. for $C_{11}H_{14}N$ $[M+H^+]$ (m/z): 160.1126, found: 160.1126.

Table 1, Entry 11 (product)

Methyl 3-((hydroxyimino)methyl)benzoate (6.17mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 7.66 (1H, t, J = 7.8Hz), 7.95 (1H, dt, J_1 = 1.2Hz, J_2 = 7.8Hz), 8.25 (1H, dt, J_1 = 1.5Hz, J_2 = 7.8Hz), 8.32 (1H, t, J = 1.5Hz).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 53.3, 113.7, 118.9, 130.8, 132.5, 133.9, 134.5, 137.3, 166.1.
HRMS (ESI+) calcd. for $C_9H_8NO_2$ $[M+H^+]$ (m/z): 162.0550, found: 162.0546.

Table 1, Entry 13 (product)

1*H*-indole-5-carbaldehyde oxime (5.51mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 6.59 - 6.61 (1H, m), 7.41 – 7.43 (1H, m), 7.57 (1H, dt, J_1 = 0.8Hz, J_2 = 8.5Hz), 8.01 – 8.02 (1H, m), 8.70 (1H, s).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 103.6, 104.0, 114.1, 122.3, 126.0, 127.6, 129.2, 129.4, 129.6, 139.4.
HRMS (EI) calcd. for $C_9H_6N_2$ $[M]^+$ (m/z): 142.0525, found: 142.0528.

Table 1, Entry 14 (product)

2-aminonicotinaldehyde oxime (4.72mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.

^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 6.57 (2H, br s), 6.68 (1H, dd, J_1 = 5.0Hz, J_2 = 7.8Hz), 7.52 (1H, dd, J_1 = 1.8Hz, J_2 = 7.8Hz), 7.98 (1H, dd, J_1 = 1.8Hz, J_2 = 5.0Hz).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 111.6, 113.4, 141.1, 148.5, 151.3, 157.0.
HRMS (ESI+) calcd. for $C_6H_6N_3$ $[M+H]^+$ (m/z): 120.0556, found: 120.0556.

Table 1, Entry 15 (product)

3-chloroisonicotinaldehyde oxime (5.39mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 7.72 (1H, d, J = 4.9Hz), 8.69 (1H, d, J = 4.9Hz), 8.83 (1H, s).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 115.0, 121.1, 127.9, 133.5, 149.5, 151.0.
HRMS (EI) calcd. for $C_6H_3N_2Cl$ $[M]^+$ (m/z): 137.9979, found: 137.9979.

Table 1, Entry 16 (product)

4-methylthiazole-5-carbaldehyde oxime (4.89mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_3-acetonitrile (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_3-MeCN) δ(ppm): 2.60 (3H, s), 9.02 (1H, s).
^{13}C NMR (100 MHz, d_3-MeCN) δ(ppm): 17.0, 102.2, 113.7, 159.1, 165.5.
HRMS (EI) calcd. for $C_5H_4N_2S$ $[M]^+$ (m/z): 124.0090, found: 124.0092.

Experiments conducted in methanol

All experiments carried out on NMR tube-scale were used to determine the conversion rates. Isolated yields were calculated through experiments on larger scales and have been described concurrently.

Table 2, Entry 1 (product)

Acetaldehyde oxime (4.07mg, 0.069mmol) and $Pd(en)(NO_3)_2$ (2mg, 0.0069 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 1.94 (3H, s); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 22.1, 176.4.
HRMS (EI+) calcd. for C_2H_5NO $[M]^+$ (m/z): 59.0366, found: 59.0367.

Table 2, Entry 2 (product)

Propionaldehyde oxime (4.63mg, 0.063mmol) and $Pd(en)(NO_3)_2$ (1.84mg, 0.0063 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
The experiment was repeated on a larger scale of propionaldoxime (200µl, 185mg, 2.534mmol) and $Pd(en)(NO_3)_2$ (74mg, 0.253 mmol). The starting materials were dissolved in methanol and heated for 16 hours at 60°C. The methanol was removed under reduced pressure, and the residue was redissolved in dichloromethane. All

solids were filtered off, and the solvent removed under reduced pressure to yield the product as a white powder (112mg, 60%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 1.13 (3H, t, J = 7.6Hz), 2.22 (2H, q, J = 7.6Hz); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 10.3, 29.6, 180.1.
HRMS (ESI+) calcd. for C_3H_7NO $[M]^+$ (m/z): 73.0522, found: 73.0523. Elemental Analysis for $7C_3H_7NO•1H_2O$, calcd: C 47.62%, H 9.71%, N 18.51%, found: C 47.92%, H 9.44%, N 18.68%.

For reactions of **Table 2,** Entry 3 using catalysts C, D, and E, the following general protocol was used: Butyraldoxime (5µl, 4.6mg, 0.053mmol) and the respective catalyst (0.0053 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.

Table 2, Entry 3 (product), catalyst C

^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 0.96 (3H, t, J = 7.4Hz), 1.56 - 1.66 (2H, m, J = 7.4Hz), 2.18 (2H, t, J = 7.4Hz); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 14.0, 20.2, 38.4, 179.2.
HRMS (ESI+) calcd. for $C_4H_{10}NO$ $[M+H]^+$ (m/z): 88.0756, found: 88.0757.

Table 2, Entry 3 (product), catalyst D

^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 0.96 (3H, t, J = 7.4Hz), 1.56 - 1.66 (2H, m, J = 7.4Hz), 2.18 (2H, t, J = 7.4Hz); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 14.0, 20.2, 38.4, 179.2.
HRMS (ESI+) calcd. for $C_4H_{10}NO$ $[M+H]^+$ (m/z): 88.0756, found: 88.0757.

Table 2, Entry 3 (product), catalyst E

^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 0.96 (3H, t, J = 7.4Hz), 1.56 - 1.66 (2H, m, J = 7.4Hz), 2.18 (2H, t, J = 7.4Hz); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 14.0, 20.2, 38.4, 179.2.
HRMS (ESI+) calcd. for $C_4H_{10}NO$ $[M+H]^+$ (m/z): 88.0756, found: 88.0757.

Table 2, Entry 4 (product)

3-phenylpropionaldoxime (5mg, 0.034mmol) and $Pd(en)(NO_3)_2$ (0.97mg, 0.0034 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 2.50 (2H, t, J = 7.6Hz), 2.91 (2H, t, J = 7.6Hz), 7.15 - 7.28 (5H, m); ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 32.8, 38.4, 127.2, 129.3, 129.5, 142.2, 178.2. ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 22.8, 38.4, 127.2, 129.3, 129.5, 142.2, 178.2.
HRMS (ESI+) calcd. for $C_9H_{11}NO$ $[M+H]^+$ (m/z): 149.0835, found: 149.0828.

Table 2, Entry 5 (product)

C (8.48mg, 0.017 mmol) and $Pd(en)(NO_3)_2$ (0.5mg, 0.0017 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.

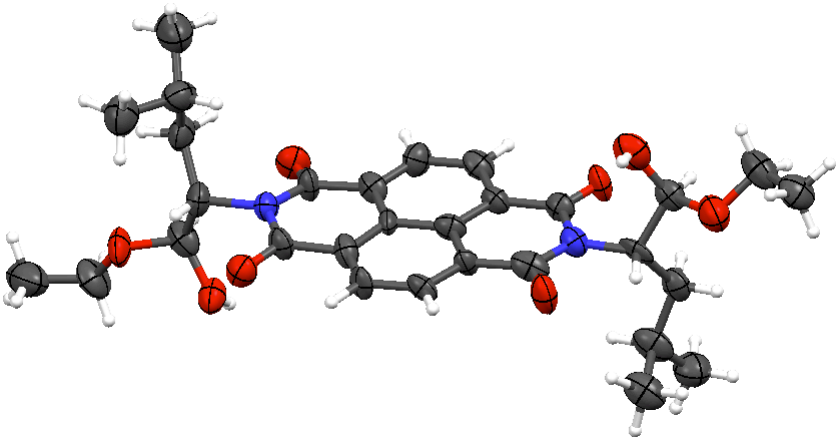
The experiment was repeated on a larger scale of **5** (100mg, 0.203mmol) and $Pd(en)(NO_3)_2$ (6mg, 0.0203 mmol). The starting materials were dissolved in methanol and heated for 16 hours at 60°C. The methanol was removed under reduced pressure, and the residue was redissolved in dichloromethane. All solids were filtered off, and the solvent removed under reduced pressure to yield the product as a brown powder (58mg, 58%).
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 0.92 (6H, d, J = 6.6Hz), 0.99 (6H, d, J = 6.6Hz), 1.46 - 1.52 (1H, m), 2.09 - 2.15 (2H, m), 2.19 - 2.25 (2H, m), 5.72 (2H, dd, J_1 = 4.8Hz, J_2 = 9.8Hz), 8.77 (4H, s). ^{13}C NMR (100 MHz, d_4-MeOD) δ(ppm): 22.2, 23.8, 26.6, 38.6, 47.3, 54.4, 128.2, 132.0, 164.4, 175.0.
HRMS (ESI+) calcd. for $C_{26}H_{29}N_4O_6$ $[M+H]^+$ (m/z): 493.2087, found: 493.2098.

Table 2, Entry 7 (product)

S-3,7-dimethyloct-6-enal oxime (5.83mg, 0.034 mmol) and $Pd(en)(NO_3)_2$ (1mg, 0.0034 mmol) were dissolved in an NMR tube in d_4-methanol (1 ml, with 10% d_6-acetone additive v/v) under nitrogen. The reaction mixture was then heated for 16 hours at 60°C.
^{1}H NMR (400 MHz, d_4-MeOD) δ(ppm): 0.92 - 0.96 (3H, m), 1.18 - 1.23 (2H, m), 1.33 - 1.37 (2H, m), 1.61 (3H, s), 1.68 (3H, s), 1.96 - 2.03 (2H, m), 5.08 - 5.13 (1H, m).
HRMS (ESI+) calcd. for $C_{10}H_{20}NO$ $[M+H]^+$ (m/z): 170.1545, found: 170.1549.

Crystallographic data

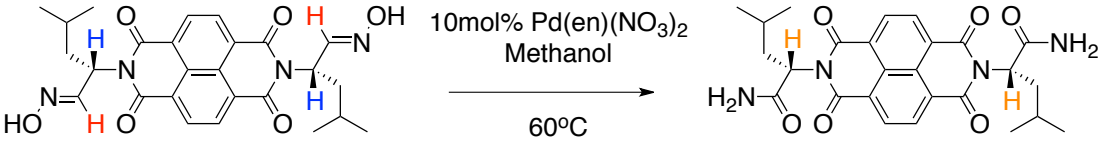
Single crystal x-ray structure of NDI dialdehyde in its hemiacetal form (crystal grown from the slow evaporation of ethanol solution. Atom colours: C: grey, N: blue, O: red, H: white).



Crystallographic data and structure refinement details.

Compound	**1**
Chemical formula	$C_{30}H_{38}N_2O_8$
M/g mol^{-1}	554.62
Crystal system	Triclinic
Space group	P$\bar{1}$
a/Å	5.7769(9)
b/Å	8.856(2)
c/Å	14.249(3)
α/°	84.286(8)
β/°	79.600(6)
γ/°	76.235(8)
V/ Å^3	695.2(2)
Z	1
D_{calc}/g cm^{-3}	1.325
μ/mm^{-1}	0.096
F(000)	296
T/K	180(2)
Reflections collected	2923
Independent reflections	1631
"Observed" reflections ($I>2\sigma(I)$)	1428
R_{int}	0.0371
Parameters refined	367
R_1	0.0934
wR_2	0.2715
S	1.066

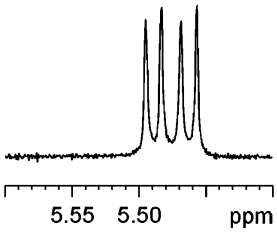
^{1}H NMR kinetics study for the oxime-amide conversion of Entry 5 (The colour scheme of the protons highlighted in the reaction scheme correspond to the peaks monitored during the reaction; *E* and *Z* refer to the geometrical isomers of the oxime moiety).

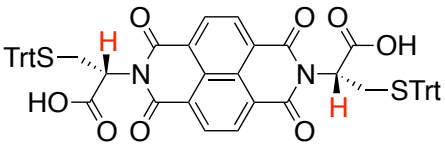


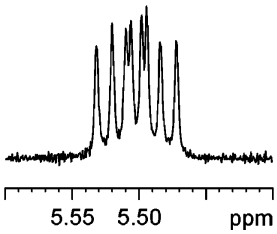
Time (min)	*E* integral	*Z* integral
0	1.28	1
30	0.69	1
90	0.51	1
150	0.49	1
210	0.32	1
270	0.25	1

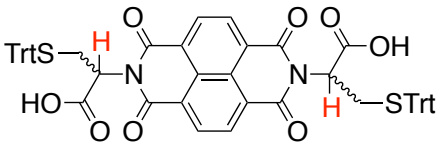
Retention of chirality

The effect of racemisation at the α-proton on the ^{1}H NMR spectrum has been reported previously by Sanders *et al.*[2] The α-proton peaks for both the NDI derived from enantiopure H-*L*-Cys(Trt)-OH (top) and racemic H-(*D*,*L*)-Cys(Trt)-OH (bottom) are shown below.

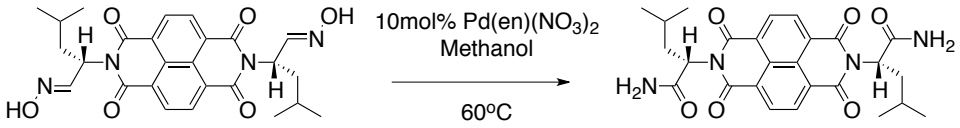


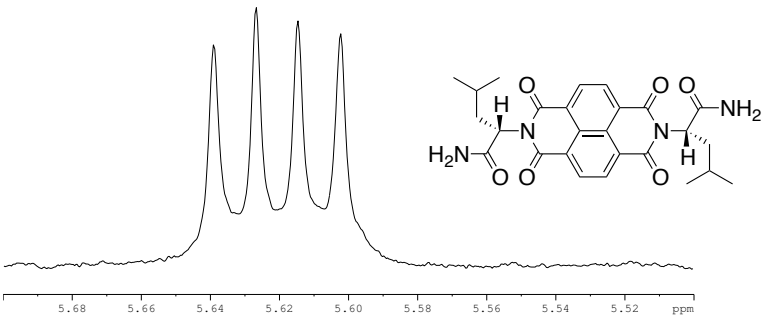






For the conversion of Entry 5 shown below, the α-proton peak in the ^{1}H NMR spectrum of the product is shown. The presence of a single AB quartet indicates that the product is enantiopure, thus reflecting the retention of chirality in the product.





[2] P. Pengo, G. D. Pantoş, S. Otto, J. K. M. Sanders, *J. Org. Chem.*, 2006, **71**, 7063-7066.

Furthermore, a comparison of the CD signals of both the reactant and the product show no evidence of inversion, thereby illustrating that the original absolute chirality of the reactant has been retained in the product.