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Enantioselective synthesis of α,α-disubstituted amines from nitroalkenes

Mary-Lorène Leroux, Thierry Le Gall* and Charles Mioskowski*

CEA-Saclay, Service des Molécules Marquées, Bât. 547, 91191 Gif-sur-Yvette Cedex, France

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Abstract—Disubstituted nitroalkenes were converted into enantiomerically enriched amines (isolated as their hydrochloride salts) with enantiomeric excesses of 88 to >95% in three steps: (a) highly stereoselective conjugate addition of the potassium salt of 4-phenyloxazolidin-2-one; (b) radical-mediated removal of the nitro group; (c) cleavage of the oxazolidinone.

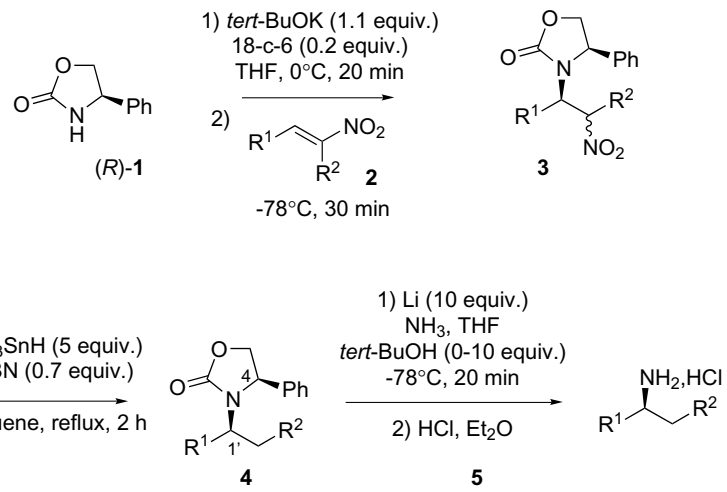
1. Introduction

Optically active primary amines, in which the nitrogen atom is attached to a stereogenic center, are important both as biologically active compounds and synthetic precursors. Asymmetric syntheses of these products have been reported, for example from compounds having a C=N double bond,[1] from alkenes via enantioselective hydroboration,[2] or from enamine derivatives via enantioselective hydrogenation.[3]

We have previously reported the highly stereoselective conjugate addition of the potassium salt of 4-phenyloxazolidin-2-one to monosubstituted nitroalkenes and the conversion of the adducts to enantiomerically pure 1,2-diamines and α-amino acids, owing to the conversion of the nitro group to other functionalities.[4] Herein, we present the enantioselective preparation of α,α-disubstituted amines from the conjugate adducts of 4-phenyloxazolidin-2-one to disubstituted nitroalkenes.

2. Results and discussion

Scheme 1 describes our general, three-step strategy to prepare optically active amines, isolated as their



Scheme 1.

* Corresponding authors. E-mail: legall@dsvidf.cea.fr; charles.mioskowski@cea.fr

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hydrochlorides **5**, from nitroalkenes **2**. The nitrogen atom present in the final products derives from oxazolidinone **1**, and the absolute configuration of the stereogenic center is established in the conjugate addition step. The nitro group necessary for this addition to occur is subsequently removed by a radical-mediated reaction.

The conjugate addition of the potassium salt of 4-phenyloxazolidin-2-one **1** to disubstituted nitroalkenes **2a**–**2e** (see Section 4 for their preparation) at −78°C in the presence of 18-crown-6 afforded the corresponding adducts **3a**–**3e** as mixtures of epimers (Table 1).

At this stage, the absolute configuration of the stereogenic center bound to the oxazolidinone was not known, although it was guessed to be (*R*) on the basis of previous results where a *like* configuration was observed for all adducts.[4]

Replacement of the nitro group of adducts **3** by a hydrogen atom to afford oxazolidinones **4** was realized according to the method developed by Ono et al.[5] Thus, a solution of **3** and AIBN (α,α′-azoisobutyronitrile) in toluene was slowly added (over 2 hours) to a refluxing solution of tributyltin hydride in toluene. Compounds **4a**–**4e** were obtained as diastereomerically pure products, hence confirming that a highly stereoselective conjugate addition had occurred in the preceding step (Table 2).

A procedure for the conversion of nitroalkanes to alkanes employing Bu_3SnH (0.1 equiv.) as catalyst and $PhSiH_3$ (1 equiv.) as stoichiometric reducing agent was recently reported by Fu et al.[6] These conditions were applied to the reduction of compound **3a**. However, the reaction was very sluggish. A better procedure involved reaction of **3a** with 1 equiv. Bu_3SnH and 2 equiv. $PhSiH_3$ for 6 hours in refluxing toluene, which afforded **4a** in 56% yield.

The Birch reduction of compounds **4a**–**4e** was then performed to cleave the oxazolidinone ring,[7] affording the corresponding amines which were isolated as their hydrochlorides **5a**–**5e** (Table 3).

The enantiomeric purity of the final products (from 88 to >95%) was assessed by analysis of either the ^1H or ^{19}F NMR spectra of the corresponding amides derived from the (*S*)- and (*R*)-enantiomers of Mosher's acid chloride. It was not possible to distinguish between the two diastereomeric Mosher's amides derived from compound **5d**. The fact that compounds **5a** and **5c** were not enantiomerically pure suggests that some racemization occurred during cleavage of the oxazolidinone moiety.[8]

Table 1. Yield and epimers ratio of conjugate adducts **3**

Product	R^1	R^2	Epimers ratio	(%) Yield
3a	CH_3	CH_3	80/20	73
3b	C_6H_{11}	CH_3	70/30	71
3c	CH_3	$PhCH_2CH_2$	90/10	69
3d	CH_3	CH_3-CH_2	80/20	91
3e	$PhCH_2CH_2$	CH_3	70/30	84

3. Conclusion

Products of the highly stereoselective conjugate addition of the potassium salt of 4-phenyloxazolidin-2-one to nitroalkenes are precursors to many enantioenriched, nitrogen-containing derivatives (Scheme 2). They have

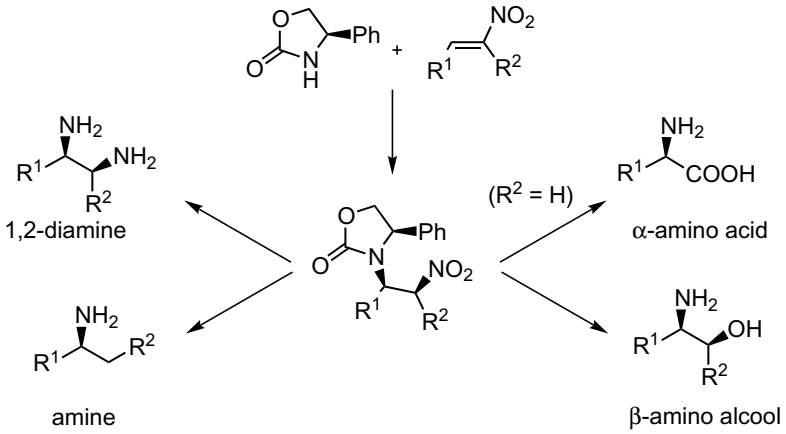
Table 2. Yield, configuration, optical rotation of oxazolidinones **4**

Product	R^1	R^2	Configuration	$[\alpha]_D$ (*c*, $CHCl_3$)	(%) Yield
4a	CH_3	CH_3	(4*R*,1′*R*)	−52 (0.53)	79
4b	C_6H_{11}	CH_3	(4*R*,1′*S*)	+2.2 (1.15)	82
4c	CH_3	$PhCH_2CH_2$	(4*R*,1′*R*)	−56.9 (1.10)	79
4d	CH_3	CH_3–CH_2	(4*R*,1′*R*)	−49.8 (1.54)	70
4e	$PhCH_2CH_2$	CH_3	(4*R*,1′*S*)	+22.3 (1.21)	57

Table 3. Yield, configuration, optical rotation, enantiomeric excess of amines hydrochlorides **5**

Product	R^1	R^2	Configuration	$[\alpha]_D$ (*c*, EtOH)	E.e. (%)[a]	Yield (%)
5a	CH_3	CH_3	(*R*)	+1.0 (1.04)	88	54
5b	C_6H_{11}	CH_3	(*S*)	−7.7 (1.00)	>95[b]	65
5c	CH_3	$PhCH_2CH_2$	(*R*)	+3.0 (0.63)	92	70
5d	CH_3	CH_3–CH_2	(*R*)	+6.1 (0.40)	[c]	79
5e	$PhCH_2CH_2$	CH_3	(*S*)	−0.4 (0.68)	>95[b]	77

[a] E.e.: Determined by ^1H NMR or ^{19}F NMR analysis of the corresponding Mosher's amides.
[b] Only one diastereomeric Mosher's amide seen.
[c] E.e. not determined, the two diastereomeric Mosher's amides were not distinguishable.



Scheme 2.

previously been converted to 1,2-diamines and α-amino acids of high enantiomeric purity. We have demonstrated that representative chiral, α,α-disubstituted amines can be prepared asymmetrically, with very good e.e., in three steps from disubstituted nitroalkenes. The synthesis of chiral, enantiopure nitrogen-containing compounds such as alkaloids using this procedure is now envisaged.

4. Experimental

4.1. General

THF was distilled from sodium benzophenone ketyl directly before use. TLC analysis was performed on Silica Gel $60F_{254}$ plates (Merck), with detection by UV light or with an acidic solution of ninhydrine in *tert*-BuOH or with an acidic solution of *p*-anisaldehyde in EtOH. Column chromatography was performed using 40–63 μm Merck Silica Gel. IR spectra were recorded using a Perkin–Elmer 2000 spectrophotometer. Optical rotations were obtained using a Perkin–Elmer 341 micropolarimeter. Melting points (uncorrected) were obtained using a Büchi 535 melting point apparatus. NMR spectra were recorded on a Bruker AM 300 (300.13, 75.47 and 282.40 MHz for ^{1}H, ^{13}C and ^{19}F, respectively); Chemical shifts (δ) are reported in ppm, coupling constants (J) are reported in Hz. Mass spectra were obtained on a Finnegan-Mat 4600 (70 eV).

4.2. General procedure for the preparation of amino alcohols precursors of nitroalkenes 2

To a stirred solution of nitroalkane (1.0 equiv.) in methanol (50 mL) cooled at 0°C was added a solution of potassium hydroxide (0.1 equiv.) in methanol (20 mL/mmol). After stirring the mixture for 20 min at 0°C, a solution of aldehyde (1.2 equiv.) in methanol was added. The reaction mixture was then stirred at room temperature for 48 h. Acetic acid (0.3 equiv.) was added. After concentration in vacuo, brine was added and the mixture was extracted twice with ether. The combined organic phases were then dried over magnesium sulfate, filtered and concentrated in vacuo, to yield the nitroalcohol as a mixture of two diastereomers. The product was not purified but employed directly in the next step.

4.2.1. 1-Cyclohexyl-2-nitropropan-1-ol. Yield of crude product: quantitative, yellow oil; two diastereomers (1:1); ^{1}H NMR ($CDCl_3$): δ 0.75–1.40 (m, 6H, $CH_2CH_2CH_2CH_2CH_2$), 1.60–1.81 (m, 6H, CH_2CHCH_2, OH), 1.52 and 1.55 (two d, 3H, CH_3, $J=5.5$ Hz), 3.63 and 3.93 (two m, 1H, CHOH), 4.59–4.74 (m, 1H, $CHNO_2$).

4.2.2. 3-Nitro-5-phenylpentan-2-ol. Yield of crude product: quantitative, yellow oil; two diastereomers (1:1); ^{1}H NMR ($CDCl_3$): δ 1.21 (d, 3H, CH_3, $J=6.7$ Hz), 2.08–2.47 (m, 2H, CH_2CH_2Ph), 2.54–2.79 (m, 2H, CH_2Ph), 4.11 and 4.16 (two m, 1H, CHOH), 4.35–4.50 (m, 1H, $CHNO_2$), 7.15–7.35 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 18.73 and 19.38 (CH_3), 30.12 and 31.61, 31.70 and 31.80 (CH_2CH_2Ph), 68.32 and 68.39 (CHOH), 92.07 and 93.40 ($CHNO_2$), 126.30, 126.36, 128.27, 128.50 (Ph-C), 139.59 and 139.79 (*ipso*-Ph-C).

4.2.3. 4-Nitro-1-phenylpentan-3-ol. Yield of crude product: quantitative, yellow oil; two diastereomers (1:1); ^{1}H NMR ($CDCl_3$): δ 1.26 and 1.32 (two d, 3H, CH_3, $J=6.7$ Hz), 2.43–2.57 (m, 2H, CH_2CH_2Ph), 2.66–2.75 (m, 2H, CH_2Ph), 3.75 and 3.99 (two m, 1H, CHOH), 4.20–4.45 (m, 1H, $CHNO_2$), 6.95–7.15 (m, 5H, Ph-H).

4.3. General procedure for the preparation of nitroalkenes 2

To a solution of nitroalcohol (1.0 equiv.) in anhydrous ether (1 mL/mmol) under an argon atmosphere was added (4-*N*,*N*-dimethylamino)pyridine (DMAP), (0.5 equiv.) in acetic anhydride (1.25 equiv.). After stirring for 48–60 h at room temperature, saturated aqueous sodium hydrogen carbonate (30 mL) was added. The phases were separated and the aqueous phase was extracted with ether (twice). The combined organic extracts were then washed successively with saturated aqueous sodium hydrogen carbonate, brine and water, then dried over magnesium sulfate, filtered and concen-

trated in vacuo, the crude product was purified by chromatography on silica gel, to afford the (*E*)-nitroalkene **2**.

4.3.1. (*E*)-2-Nitrobut-2-ene 2a. Yield from 5.0 mL of 3-nitrobutan-2-ol: 2.41 g (52%), yellow oil; ^{1}H NMR ($CDCl_3$): δ 1.87 (d, 3H, CH_3CH, $J=7.3$ Hz), 2.15 (s, 3H, CH_3CNO$_2$), 7.19 (q, 1H, CHCH$_3$, $J=7.3$ Hz); ^{13}C NMR ($CDCl_3$): δ 11.81 (C_4), 13.27 (C_1), 131.18 (C_3), 148.13 (C_2); IR (neat) 3000 ($\nu_{=C-H}$), 1655 ($\nu_{C=C}$), 1561 ($\nu_{as\ NO}$), 1390 ($\nu_{s\ NO}$), 1172 (ν_{C-N}) cm^{-1}.

4.3.2. (*E*)-1-Cyclohexyl-2-nitroprop-1-ene 2b. Yield from 1.67 g of 1-cyclohexyl-2-nitropropan-1-ol: 950 mg (63%), yellow oil; ^{1}H NMR ($CDCl_3$): δ 1.17–1.36 (m, 6H, CH$_2$CH_2CH_2CH_2CH$_2$), 1.57 (s, 1H, CH$_3$), 1.68–1.80 (m, 5H, CH$_2$CHCH$_2$), 6.97 (d, 1H, -CH=, $J=10.0$ Hz); ^{13}C NMR ($CDCl_3$): δ 12.46 (CH$_3$), 25.18, 25.47, 31.61 (CH$_2$), 37.47 (*C*HCH=), 140.70 (CH=), 146.10 (CNO$_2$); IR (neat) 2929 ($\nu_{=C-H}$), 2853 (ν_{C-C} cyclohexyl), 1670 ($\nu_{C=C}$), 1518 ($\nu_{as\ NO}$), 1330 ($\nu_{s\ NO}$), 1112 (ν_{C-N}) cm^{-1}.

4.3.3. (*E*)-3-Nitro-5-phenylpent-2-ene 2c. Yield from 1.27 g of 3-nitro-5-phenylpentan-2-ol: 480 mg (48%), yellow oil; ^{1}H NMR ($CDCl_3$): δ 1.56 (d, 3H, CH$_3$, $J=7.3$ Hz), 2.86 (m, 4H, CH$_2$CH$_2$), 7.18 (q, 1H, CHCH$_3$, $J=7.3$ Hz), 7.19–7.32 (m, 5H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 12.78 (CH$_3$), 28.02 (*C*H$_2$CH$_2$Ph), 33.39 (*C*H$_2$Ph), 126.07, 128.18, 128.39 (Ph-C), 132.64 (CH$_2$*C*H=), 139.95 (*ipso*-Ph-C), 150.85 (CNO$_2$); IR (neat) 3085, 3063, 3027 ($\nu_{=C-H\ arom.}$), 2933, 2865 ($\nu_{=C-H\ aliph.}$), 1670 ($\nu_{C=C}$), 1518 ($\nu_{as\ NO}$), 1355 ($\nu_{s\ NO}$), 1135 (ν_{C-N}) cm^{-1}.

4.3.4. (*E*)-3-Nitropent-2-ene 2d. Yield from 6.0 mL of 3-nitropentan-2-ol: 3.84 g (69%), yellow oil; ^{1}H NMR ($CDCl_3$): δ 1.02 (t, 3H, CH_3CH$_2$, $J=7.3$ Hz), 1.81 (d, 3H, CH_3CH, $J=7.3$ Hz), 2.53 (q, 2H, CH$_2$, $J=7.3$ Hz), 7.05 (q, 1H, CHCH$_3$, $J=7.3$ Hz); ^{13}C NMR ($CDCl_3$): δ 11.71 (C_5), 13.62 (C_1), 19.12 (C_4), 130.50 (C_2), 153.53 (C_3); IR (neat) 2986, 2946 ($\nu_{=C-H\ aliph.}$), 1643 ($\nu_{C=C}$), 1560 ($\nu_{as\ NO}$), 1355 ($\nu_{s\ NO}$), 1092 (ν_{C-N}) cm^{-1}.

4.3.5. (*E*)-2-Nitro-5-phenylpent-2-ene 2e. Yield from 10.2 g of 4-nitro-1-phenylpentan-2-ol: 5.1 g (54%), yellow oil; ^{1}H NMR ($CDCl_3$): δ 2.04 (s, 3H, CH$_3$), 2.53 (m, 2H, CH_2CH), 2.81 (m, 2H, CH$_2$Ph), 7.15 (t, 1H, CHCH$_2$, $J=6.7$ Hz), 7.20–7.37 (m, 5H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 12.00 (CH$_3$), 29.67 (*C*H$_2$CH$_2$Ph), 34.03 (*C*H$_2$Ph), 126.23, 128.27, 128.46 (Ph-C), 134.84 (CH$_2$*C*H=), 140.17 (*ipso*-Ph-C), 148.00 (CNO$_2$); IR (neat) 3086, 3063, 3028 ($\nu_{=C-H\ arom.}$), 2933, 2861 ($\nu_{=C-H\ aliph.}$), 1673 ($\nu_{C=C}$), 1522 ($\nu_{as\ NO}$), 1334 ($\nu_{s\ NO}$), 1085 (ν_{C-N}) cm^{-1}.

4.4. General procedure for the conjugate addition of (*R*)-4-phenyloxazolidin-2-one potassium salt to nitroalkenes 2

A mixture of (*R*)-4-phenyloxazolidin-2-one (1.1 equiv.), potassium *tert*-butoxide (1.1 equiv.) and 18-crown-6 (0.2 equiv.) in THF (7.5 mL/mmol) was stirred under argon at 0°C for 20 min and then cooled to −78°C. A solution of nitroalkene **2** (1.0 equiv.) in THF (0.5 mL/mmol) was added dropwise. The reaction mixture was stirred at −78°C for 30 min, then saturated aqueous ammonium chloride was added, and the aqueous phase was extracted with ether (three times). The combined organic phases were washed with brine, then dried over magnesium sulfate. After filtration and concentration in vacuo, the crude product was chromatographed on silica gel, to afford nitro compound **3**, as a mixture of two diastereomers.

4.4.1. (4*R*,1′*R*,2′*RS*)-3-(1′-Methyl-2′-nitropropyl)-4-phenyloxazolidin-2-one 3a. Yield from 563 mg of (*E*)-2-nitrobut-2-ene **2a**: 1.08 g (73%), colorless oil; two diastereomers (4/1).

Major diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.15 (d, 3H, CH$_3$NCO, $J=6.7$ Hz), 1.43 (d, 3H, CH$_3$NO$_2$, $J=6.7$ Hz), 3.54–3.64 (m, 1H, CHNCO), 4.22 (dd, 1H, CHHO, $J=6.7$, 8.5 Hz), 4.72 (t, 1H, CHHO, $J=8.5$ Hz), 4.76 (dd, 1H, CHPh, $J=6.7$, 8.5 Hz), 5.24–5.33 (m, 1H, CHNO$_2$), 7.32–7.44 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 12.91 (*C*H$_3$CNO$_2$), 17.15 (*C*H$_3$CHNCO), 52.41 (*C*HNCO), 59.95 (CHPh), 70.33 (CH$_2$O), 84.86 (CHNO$_2$), 127.30, 129.28, 129.44 (Ph-C), 137.43 (*ipso*-Ph-C), 157.36 (C=O); IR (neat) 3066, 3035 ($\nu_{=C-H\ arom.}$), 1761 ($\nu_{C=O}$), 1554 ($\nu_{as\ NO}$), 1391 ($\nu_{s\ NO}$), 1249 (ν_{C-O}), 1086, 1040 (ν_{C-N}) cm^{-1}.

Minor diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.11 (d, 3H, CH$_3$NCO, $J=6.7$ Hz), 1.44 (d, 3H, CH$_3$NO$_2$, $J=6.7$ Hz), 3.54–3.64 (m, 1H, CHNCO), 4.15 (dd, 1H, CHHO, $J=6.7$, 8.5 Hz), 4.62 (t, 1H, CHHO, $J=8.5$ Hz), 4.77 (dd, 1H, CHPh, $J=6.7$, 8.5 Hz), 5.24–5.33 (m, 1H, CHNO$_2$), 7.32–7.44 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 13.43 (*C*H$_3$CNO$_2$), 16.70 (*C*H$_3$CHNCO), 53.32 (*C*HNCO), 59.63 (CHPh), 70.17 (CH$_2$O), 83.60 (CHNO$_2$), 127.30, 129.08, 129.63 (Ph-C), 137.17 (*ipso*-Ph-C); IR (neat) 3066, 3035 ($\nu_{=C-H\ arom.}$), 1761 ($\nu_{C=O}$), 1554 ($\nu_{as\ NO}$), 1391 ($\nu_{s\ NO}$), 1249 (ν_{C-O}), 1086, 1040 (ν_{C-N}) cm^{-1}.

4.4.2. (4*R*,1′*S*,2′*RS*)-3-(1′-Cyclohexyl-2′-nitropropyl)-4-phenyloxazolidin-2-one 3b. Yield from 837 mg of (*E*)-1-cyclohexyl-2-nitroprop-1-ene **2b**: 1.32 g (71%), white solid; two diastereomers (7/3); mp 99.6–100.1°C.

Major diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.18 (d, 1H, CH$_3$, $J=6.7$ Hz), 1.0–2.0 (m, 11H, cyclohexyl-H), 3.32 (dd, 1H, CHNCO, $J=4.6$, 9.2 Hz), 4.43 (dd, 1H, CHHO, $J=6.1$, 9.1 Hz), 4.72 (dd, 1H, CHHO, $J=8.5$, 9.1 Hz), 4.78 (dd, 1H, CHPh, $J=6.1$, 8.5 Hz), 5.39 (q, 1H, CHNO$_2$, $J=6.7$ Hz), 7.25–7.45 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 18.16 (*C*H$_3$CNO$_2$), 25.91, 25.98, 26.31, 28.96, 31.58, (cyclohexyl-CH$_2$), 41.16 (*C*HCHNCO), 60.66 (CHPh), 63.44 (*C*HNCO), 69.62 (CH$_2$O), 82.85 (CHNO$_2$), 128.21, 129.37 (Ph-C), 137.01 (*ipso*-Ph-C), 157.16 (C=O); IR (neat) 3035 ($\nu_{=C-H\ arom.}$), 1737 ($\nu_{C=O}$), 1549 ($\nu_{as\ NO}$), 1354 ($\nu_{s\ NO}$), 1240 (ν_{C-O}), 1086 (ν_{C-N}) cm^{-1}.

Minor diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.50 (d, 1H, CH_3, $J=6.7$ Hz), 1.0–2.0 (m, 11H, cyclohexyl-H), 3.50 (dd, 1H, CHNCO, $J=9.2$, 4.6 Hz), 4.27 (dd, 1H, C*H*HO, $J=6.1$, 9.1 Hz), 4.62 (dd, 1H, CH*H*O, $J=8.5$, 9.1 Hz), 4.83 (dd, 1H, CHPh, $J=6.1$, 8.5 Hz), 5.40 (q, 1H, $CHNO_2$, $J=6.7$ Hz), 7.25–7.45 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 16.76 (CH_3CNO_2), 25.92, 25.98, 26.31, 29.35, 31.51 (cyclohexyl-CH_2), 39.54 (*C*HCH-NCO), 61.76 (CHPh), 62.12 (*C*HNCO), 70.11 (CH_2O), 81.66 ($CHNO_2$), 127.98, 129.12, 129.80 (Ph-C), 137.40 (*ipso*-Ph-C), 157.91 (C=O); IR (neat) 3035 ($\nu_{=C\text{-}H\ arom.}$), 1737 ($\nu_{C=O}$), 1549 ($\nu_{as\ NO}$), 1354 ($\nu_{s\ NO}$), 1240 ($\nu_{C\text{-}O}$), 1086 ($\nu_{C\text{-}N}$) cm^{-1}.

4.4.3. (4*R*,1′*S*,2′*RS*)-3-(1′-Methyl-2′-nitro-4′-phenylbutyl)-4-phenyloxazolidin-2-one 3c. Yield from 329 mg of (*E*)-3-nitro-5-phenylpent-2-ene **2c**: 514 mg (69%), yellow oil; two diastereomers (9/1).

Major diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.04 (d, 3H, CH_3, $J=6.7$ Hz), 1.97–2.05 (m, 2H, CH_2CH_2Ph), 2.46–2.65 (m, 2H, CH_2Ph), 3.70–3.84 (m, 1H, $CHCH_3$), 4.15 (dd, 1H, C*H*HO, $J=7.3$, 8.5 Hz), 4.56 (t, 1H, CH*H*O, $J=8.5$, 9.1 Hz), 4.53 (dd, 1H, CHPh, $J=7.3$, 9.1 Hz), 5.10 (td, 1H, $CHNO_2$, $J=3.7$, 9.1 Hz), 7.12–7.35 (m, 10H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 13.66 (CH_3), 31.68, 32.71 (CH_2CH_2Ph), 51.99 (*C*HNCO), 59.59 (CHPh), 70.40 (CH_2O), 89.42 ($CHNO_2$), 127.27, 128.40, 128.63, 129.37 (Ph-C), 137.78, 139.63 (*ipso*-Ph-C), 157.45 (C=O); IR (neat) 3063, 3031 ($\nu_{=C\text{-}H\ arom.}$), 1751 ($\nu_{C=O}$), 1552 ($\nu_{as\ NO}$), 1360 ($\nu_{s\ NO}$), 1242 ($\nu_{C\text{-}O}$), 1037 ($\nu_{C\text{-}N}$) cm^{-1}.

Minor diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.05 (d, 3H, CH_3, $J=6.7$ Hz), 1.97–2.05 (m, 2H, CH_2CH_2Ph), 2.46–2.65 (m, 2H, CH_2Ph), 3.70–3.84 (m, 1H, $CHCH_3$), 4.12 (dd, 1H, C*H*HO, $J=7.3$, 8.5 Hz), 4.71 (t, 1H, CH*H*O, $J=8.5$, 9.1 Hz), 4.76 (dd, 1H, CHPh, $J=7.3$, 9.1 Hz), 5.22 (td, 1H, $CHNO_2$, $J=3.7$, 9.1 Hz), 7.12–7.35 (m, 10H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 14.05 (CH_3), 31.68, 31.84 (CH_2CH_2Ph), 52.74 (*C*HNCO), 59.59 (CHPh), 70.40 (CH_2O), 88.90 ($CHNO_2$), 126.56, 127.46, 129.24, 129.54 (Ph-C), 137.78, 139.43 (*ipso*-Ph-C), 157.45 (C=O); IR (neat) 3063, 3031 ($\nu_{=C\text{-}H\ arom.}$), 1751 ($\nu_{C=O}$), 1552 ($\nu_{as\ NO}$), 1360 ($\nu_{s\ NO}$), 1242 ($\nu_{C\text{-}O}$), 1037 ($\nu_{C\text{-}N}$) cm^{-1}.

4.4.4. (4*R*,1′*S*,2′*RS*)-3-(1′-Methyl-2′-nitrobutyl)-4-phenyloxazolidin-2-one 3d. Yield from 1.28 g of (*E*)-3-nitropent-2-ene **2d**: 2.72 g (91%), yellow oil; two diastereomers (4/1).

Major diastereomer: ^{1}H NMR ($CDCl_3$): δ 0.87 (t, 3H, CH_3CH_2, $J=7.3$ Hz), 1.13 (d, 1H, CH_3CHN, $J=6.7$ Hz), 1.54–1.94 (m, 2H, CH_2CH_3), 3.61 (qd, 1H, $CHCH_3$, $J=6.7$, 7.3 Hz), 4.21 (dd, 1H, C*H*HO, $J=7.3$, 8.5 Hz), 4.63 (t, 1H, CH*H*O, $J=8.5$ Hz), 4.71 (dd, 1H, CHPh, $J=7.3$, 8.5 Hz), 5.08–5.18 (td, 1H, $CHNO_2$, $J=3.0$, 8.5 Hz), 7.25–7.44 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 9.84 (CH_3CH_2), 12.91 (CH_3CHNCO), 24.14 (CH_2CH_3), 51.63 (*C*HNCO), 59.88 (CHPh), 70.23 (CH_2O), 91.46 ($CHNO_2$), 127.17, 129.24, 129.40 (Ph-C), 137.36 (*ipso*-Ph-C), 157.25 (C=O); IR (neat) 3085, 3043 ($\nu_{=C\text{-}H\ arom.}$), 1752 ($\nu_{C=O}$), 1551 ($\nu_{as\ NO}$), 1362 ($\nu_{s\ NO}$), 1243 ($\nu_{C\text{-}O}$), 1061, 1038 ($\nu_{C\text{-}N}$) cm^{-1}.

Minor diastereomer: ^{1}H NMR ($CDCl_3$): δ 0.90 (t, 3H, CH_3CH_2, $J=7.3$ Hz), 1.10 (d, 1H, CH_3CHN, $J=6.7$ Hz), 1.54–1.94 (m, 2H, CH_2CH_3), 3.77 (qd, 1H, $CHCH_3$, $J=6.7$, 7.3 Hz), 4.13 (dd, 1H, C*H*HO, $J=7.3$, 8.5 Hz), 4.54 (t, 1H, CH*H*O, $J=8.5$ Hz), 4.76 (dd, 1H, CHPh, $J=7.3$, 8.5 Hz), 5.08–5.18 (td, 1H, $CHNO_2$, $J=3.0$, 8.5 Hz), 7.25–7.44 (m, 5H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 13.62 (CH_3CH_2), 13.94 (CH_3CHNCO), 24.04 (CH_2CH_3), 52.51 (*C*HNCO), 59.66 (CHPh), 70.07 (CH_2O), 90.6 1($CHNO_2$), 127.30, 129.01 (Ph-C), 137.04 (*ipso*-Ph-C), 157.38 (C=O); IR (neat) 3085, 3043 ($\nu_{=C\text{-}H\ arom.}$), 1752 ($\nu_{C=O}$), 1551 ($\nu_{as\ NO}$), 1362 ($\nu_{s\ NO}$), 1243 ($\nu_{C\text{-}O}$), 1061, 1038 ($\nu_{C\text{-}N}$) cm^{-1}.

4.4.5. (4*R*,1′*S*,2′*RS*)-3-[2′-Nitro-1′-(2-phenylethyl)propyl]-4-phenyloxazolidin-2-one 3e. Yield from 2.13 g of (*E*)-2-nitro-5-phenylpent-2-ene **2e**: 3.33 g (84%), yellow oil; two diastereomers (7/3).

Major diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.21 (d, 3H, CH_3, $J=6.7$ Hz), 1.62–1.84 (m, 1H, C*H*HCH_2Ph), 2.06–2.19 (m, 1H, CH*H*CH_2Ph), 2.54–2.72 (m, 2H, CH_2Ph), 3.60–3.93 (td, 1H, CHNCO, $J=3.7$, 9.1 Hz), 4.34 (dd, 1H, C*H*HO, $J=6.1$, 9.1 Hz), 4.58 (t, 1H, CH*H*O, $J=9.1$ Hz), 4.59 (dd, 1H, CHPh, $J=6.1$, 9.1 Hz), 5.07 (m, 1H, $CHNO_2$), 7.00–7.40 (m, 10H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 17.50 (CH_3), 30.05 (CH_2CH_2Ph), 32.09 (CH_2Ph), 55.90 (*C*HNCO), 60.85 (CHPh), 69.85 (CH_2O), 84.47 ($CHNO_2$), 126.20, 127.82, 128.01, 128.46, 129.18 (Ph-C), 137.17, 139.79 (*ipso*-Ph-C), 157.13 (C=O); IR (neat) 3031 ($\nu_{=C\text{-}H\ arom.}$), 1750 ($\nu_{C=O}$), 1548 ($\nu_{as\ NO}$), 1364 ($\nu_{s\ NO}$), 1219 ($\nu_{C\text{-}O}$), 1036 ($\nu_{C\text{-}N}$) cm^{-1}.

Minor diastereomer: ^{1}H NMR ($CDCl_3$): δ 1.46 (d, 3H, CH_3, $J=6.7$ Hz), 1.62–1.84 (m, 1H, C*H*HCH_2Ph), 2.06–2.19 (m, 1H, CH*H*CH_2Ph), 2.54–2.72 (m, 2H, CH_2Ph), 3.60–3.93 (td, 1H, CHNCO, $J=3.7$, 9.1 Hz), 4.23 (dd, 1H, C*H*HO, $J=6.1$, 9.1 Hz), 4.55 (t, 1H, CH*H*O, $J=9.1$ Hz), 4.79 (dd, 1H, CHPh, $J=6.1$, 9.1 Hz), 5.23 (m, 1H, $CHNO_2$), 6.90–7.40 (m, 10H, Ph-H); ^{13}C NMR ($CDCl_3$): δ 16.73 (CH_3), 29.93 (CH_2CH_2Ph), 32.22 (CH_2Ph), 57.42 (*C*HNCO), 59.66 (CHPh), 70.27 (CH_2O), 83.46 ($CHNO_2$), 126.13, 127.46, 128.37, 129.34, 129.53 (Ph-C), 137.78, 139.98 (*ipso*-Ph-C), 157.58 (C=O); IR (neat) 3031 ($\nu_{=C\text{-}H\ arom.}$), 1750 ($\nu_{C=O}$), 1548 ($\nu_{as\ NO}$), 1364 ($\nu_{s\ NO}$), 1219 ($\nu_{C\text{-}O}$), 1036 ($\nu_{C\text{-}N}$) cm^{-1}.

4.5. General procedure for the reduction of nitro compounds 3

A solution of nitro compound **3** (1.0 equiv.) and AIBN (0.7 equiv.) in toluene (5 mL/mmol) was added dropwise over 2 h to a refluxing solution of tributyltin hydride (5.0 equiv.) in toluene (0.7 mL/mmol), under an argon atmosphere. The mixture was cooled to room temperature and concentrated in vacuo. The crude product was purified by chromatography on silica gel, to afford the oxazolidinone **4** in pure form.

4.5.1. (4*R*,1′*R*)-3-(1′-Methylpropyl)-4-phenyloxazolidin-2-one 4a. Yield from 300 mg of nitro compound **3a**: 198 mg (79%), colorless oil; $[\alpha]_D^{30}=-52.0$ (*c* 0.53, $CHCl_3$); ^{1}H NMR ($CDCl_3$): δ 0.85 (t, 3H, CH_3CH$_2$, $J=6.7$ Hz), 0.87 (d, 3H, CH_3CHN, $J=7.3$ Hz), 1.43–1.81 (m, 1H, CH_2CH$_3$), 3.52–3.64 (m, 1H, CH$_3$CHN), 4.11 (dd, 1H, CHHO, $J=6.1$, 8.5 Hz), 4.56 (t, 1H, CHHO, $J=8.5$ Hz), 4.72 (dd, 1H, CHPh, $J=6.1$, 8.5 Hz), 7.33–7.37 (m, 5H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 11.27 (*C*H$_3$CH$_2$), 18.68 (*C*H$_3$CHN), 26.70 (*C*H$_2$CH$_3$), 52.29 (CH$_3$*C*HN), 58.57 (CHPh), 70.28 (CH$_2$O), 127.28, 128.93, 129.06 (Ph-C), 140.15 (*ipso*-Ph-C), 158.17 (C=O); IR (neat) 3063, 3034 ($\nu_{=C\text{-}H\ arom.}$), 1747 ($\nu_{C=O}$), 1224 ($\nu_{C\text{-}O}$), 1053, 1043 ($\nu_{C\text{-}N}$) cm^{-1}; HRMS (EI): [M]$^+$, found 219.1265. $C_{13}H_{17}NO_2$ requires 219.1259.

4.5.2. (4*R*,1′*S*)-3-(1′-Cyclohexylpropyl)-4-phenyloxazolidin-2-one 4b. Yield from 600 mg of nitro compound **3b**: 425 mg (82%), white solid; mp 94.0–95.0°C; $[\alpha]_D^{30}=+2.2$ (*c* 1.15, $CHCl_3$); NMR ^{1}H ($CDCl_3$, δ ppm, *J* Hz) 0.79 (t, 3H, CH$_3$, $J=7.3$ Hz), 0.70–1.07 (m, 6H, CH$_2$CH_2CH_2CH_2CH$_2$), 1.45–1.73 (m, 7H, CH$_2$CHCH$_2$, CH_2CH$_3$), 3.10 (m, 1H, CHCHN), 4.22 (dd, 1H, CHHO, $J=6.1$, 8.5 Hz), 4.61 (dd, 1H, CHHO, $J=8.5$, 9.1 Hz), 4.75 (dd, 1H, CHPh, $J=6.1$, 9.1 Hz), 7.36 (m, 5H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 10.90 (CH$_3$), 20.80 (*C*H$_2$CH$_3$), 25.30, 25.66, 25.82, 29.73, 30.38 (cyclohexyl-CH$_2$), 39.99 (*C*HCHN), 58.81 (CHPh), 61.76 (CHEt), 69.36 (CH$_2$O), 127.56, 128.43 (Ph-C), 139.20 (*ipso*-Ph-C), 158.26 (C=O); IR (neat) 3067, 3032 ($\nu_{=C\text{-}H\ arom.}$), 1732 ($\nu_{C=O}$), 1224 ($\nu_{C\text{-}O}$), 1058, 1040 ($\nu_{C\text{-}N}$) cm^{-1}; HRMS (EI): [M]$^+$, found 287.1870. $C_{18}H_{25}NO_2$ requires 287.1885.

4.5.3. (4*R*,1′*R*)-3-(1′-Methyl-4′-phenylbutyl)-4-phenyloxazolidin-2-one 4c. Yield from 460 mg of nitro compound **3c**: 317 mg (79%), colorless oil; $[\alpha]_D^{29}=-56.9$ (*c* 1.10, $CHCl_3$); ^{1}H NMR ($CDCl_3$): δ 0.82 (d, 3H, CH$_3$, $J=6.7$ Hz), 1.42–1.79 (m, 4H, CH_2CH_2CHN), 2.44–2.70 (m, 2H, CH$_2$Ph), 3.67–3.79 (m, 1H, CH$_3$CHN), 4.09 (dd, 1H, CHHO, $J=6.7$, 8.5 Hz), 4.51 (t, 1H, CHHO, $J=8.5$, 9.1 Hz), 4.54 (dd, 1H, CHPh, $J=6.7$, 9.1 Hz), 7.15–7.35 (m, 10H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 19.09 (CH$_3$), 28.15 (*C*H$_2$CHCH$_3$), 32.68, 35.20 (*C*H$_2$*C*H$_2$Ph), 50.31 (*C*HCH$_3$), 58.27 (CHPh), 70.04 (CH$_2$O), 125.75, 127.14, 128.21, 128.34, 128.76, 128.89 (Ph-C), 139.82, 141.89 (*ipso*-Ph-C), 157.97 (C=O); IR (neat) 3061, 3028 ($\nu_{=C\text{-}H\ arom.}$), 1748 ($\nu_{C=O}$), 1224 ($\nu_{C\text{-}O}$), 1043 ($\nu_{C\text{-}N}$) cm^{-1}; HRMS (EI): [M]$^+$, found 309.1727. $C_{20}H_{23}NO_2$ requires 309.1729.

4.5.4. (4*R*,1′*R*)-3-(1′-Methylbutyl)-4-phenyloxazolidin-2-one 4d. Yield from 500 mg of nitro compound **3d**: 300 mg (70%), colorless oil; $[\alpha]_D^{31}=-49.8$ (*c* 1.54, $CHCl_3$); ^{1}H NMR ($CDCl_3$): δ 0.73 (d, 3H, CH_3CHN, $J=6.7$ Hz), 0.76 (t, 3H, CH_3CH$_2$, $J=7.3$ Hz), 1.06–1.23 (m, 2H, CH_2CH$_3$), 1.30–1.42 (m, 1H, CHHCHN), 1.56–1.68 (m, 1H, CHHCHN), 3.51–3.63 (qd, 1H, CH$_3$CHN, $J=6.7$, 8.5 Hz), 3.98 (dd, 1H, CHHO, $J=6.1$, 8.5 Hz), 4.46 (t, 1H, CHHO, $J=8.5$ Hz), 4.66 (dd, 1H, CHPh, $J=6.1$, 8.5 Hz), 7.25 (m, 5H, Ph-*H*); ^{13}C NMR ($CDCl_3$): δ 13.46 (*C*H$_3$CH$_2$), 18.64, 19.44 (*C*H$_3$CHN, *C*H$_2$CH$_3$), 35.52 (CH$_2$Et), 50.01 (CH$_3$*C*HN), 58.26 (CHPh), 69.94 (CH$_2$O), 126.98, 128.72 (Ph-C), 139.92 (*ipso*-Ph-C), 157.77 (C=O); IR (neat) 3033 ($\nu_{=C\text{-}H\ arom.}$) 2961, 2932, 2873 ($\nu_{C\text{-}H\ aliph.}$), 1752 ($\nu_{C=O}$), 1221 ($\nu_{C\text{-}O}$), 1044 ($\nu_{C\text{-}N}$) cm^{-1}; HRMS (EI): [M]$^+$, found 233.1424. $C_{14}H_{19}NO_2$ requires 233.1416.

4.5.5. (4*R*,1′*S*)-3-(1′-Ethyl-3′-phenylpropyl)-4-phenyloxazolidin-2-one 4e. Yield from 500 mg of nitro compound **3d**: 250 mg (57%), colorless oil; $[\alpha]_D^{31}=+22.3$ (*c* 1.21, $CHCl_3$); ^{1}H NMR ($CDCl_3$): δ 0.88 (t, 3H, CH$_3$, $J=7.3$ Hz), 1.46 (m, 2H, CH_2CH$_3$), 1.52–1.67 (m, 1H, CHHCH$_2$Ph), 1.67–1.82 (m, 1H, CHHCH$_2$Ph), 2.54 (t, 2H, CH$_2$Ph, $J=7.9$ Hz), 3.56 (m, 1H, CHNCH$_2$CH$_3$), 4.22 (dd, 1H, CHHO, $J=5.5$, 8.5 Hz), 4.51 (t, 1H, CHHO, $J=8.5$ Hz), 4.54 (dd, 1H, CHPh, $J=5.5$, 8.5 Hz), 6.92 (d, 2H, *ortho*-*H*-PhCH$_2$, $J=8.5$ Hz), 7.09–7.25 (m, 3H, *meta*,*para*-*H*-PhCH$_2$), 7.38 (m, 5H, *H*-PhCHN); ^{13}C NMR ($CDCl_3$): δ 19.09 (CH$_3$), 28.15 (*C*H$_2$CH$_3$), 32.71 (*C*H$_2$CH$_2$Ph), 34.52 (CH$_2$Ph), 56.81 (*C*HEt), 58.39 (CHPh), 69.98 (CH$_2$O), 125.55, 127.40, 127.98, 128.04, 128.88, 128.95 (Ph-C), 139.62, 141.47 (*ipso*-Ph-C), 158.48 (C=O); IR (neat) 3062, 3029 ($\nu_{=C\text{-}H\ arom.}$)1746 ($\nu_{C=O}$), 1603 ($\nu_{C\text{-}C}$), 1228 ($\nu_{C\text{-}O}$), 1042 ($\nu_{C\text{-}N}$) cm^{-1}; HRMS (EI): [M]$^+$, found 309.1723. $C_{20}H_{23}NO_2$ requires 309.1729.

4.6. Reduction of nitro compound 3a by tributyltin hydride in the presence of phenylsilane

A solution of nitro compound **3a** (300 mg, 1.1 mmol, 1.0 equiv.), tributyltin hydride (0.3 mL, 1.1 mmol, 1.0 equiv.), phenylsilane (0.3 mL, 2.3 mmol, 2.0 equiv.) and AIBN (130 mg, 0.8 mmol, 0.7 equiv.) in toluene (6.5 mL) was stirred under reflux for 6 h under an argon atmosphere. The mixture was cooled to room temperature and concentrated in vacuo, the crude product was purified by chromatography on silica gel (49:1 CH_2Cl_2:Et_2O) to afford oxazolidinone **4a** (140 mg, 56%).

4.7. General procedure for the preparation of amine hydrochlorides 5

Ammonia was transferred into a flask cooled at −78°C and equipped with a cold-finger condenser. Small pieces of lithium (10 equiv.) were added. A solution of oxazolidinone **4** (1.0 equiv.) in THF (75 mL), containing either *tert*-butanol (1.0 mL/mmol, reduction of **4a**, **4b**, **4d**) or not (reduction of **4c**, **4d**) was then added via syringe to the deep-blue solution. After stirring for 20 min at −78°C, solid ammonium chloride (11.0 equiv.) was added. The reaction mixture was allowed to warm to room temperature, the residual ammonia was blown off under a nitrogen stream. Water was added, then 4N HCl was added until the mixture was acidic, pH <6. The aqueous phase was extracted with ether, and the organic phase was discarded. Dichloromethane was added to the aqueous phase and 2N NaOH was added until the mixture had basic pH. The phases were separated and the aqueous phase was extracted with dichloromethane. The combined organic phases were dried over magnesium sulfate, filtered and partially concentrated in vacuo. A solution of hydrogen chloride

in ether was added, the precipitated amine hydrochloride **5** was filtered and dried in a dessiccator.

4.7.1. (*R*)-2-Aminobutane hydrochloride 5a. Yield from 123 mg of oxazolidinone **4a**: 33 mg (54%), white solid; $[\alpha]_D^{37}=+1.0$ (*c* 1.04, EtOH); lit.:[9] $[\alpha]_D^{20}=+1.12$ (*c* 13.51, H_2O); ^{1}H NMR (CD_3OD): δ 0.95 (t, 3H, CH_3CH$_2$, $J=7.3$ Hz), 1.24 (d, 3H, CH_3CHN, $J=6.1$ Hz), 1.45–1.75 (m, 2H, CH_2CH$_3$), 3.14 (m, 1H, CHN); ^{13}C NMR (CD_3OD): δ 10.14 (C_4), 18.23 (C_1), 28.72 (C_3), 50.39 (C_2); IR (KBr pellet) 2968, 2005 ($\nu_{NH_3^+}$), 1505 ($\delta_{NH_3^+}$), 1011 ($\nu_{C\text{-}N}$) cm^{-1}; MS (CI/NH_3, *m*/*z*) 74 [M+H$^+$−HCl], 91 [M+NH_4^+−HCl].

4.7.2. (*S*)-1-Amino-1-cyclohexylpropane hydrochloride 5b. Yield from 250 mg of oxazolidinone **4b**: 100 mg (65%), white solid; mp 266.0–267.8°C; lit.:[10] 275–276°C (EtOH, Et_2O); $[\alpha]_D^{30}=-7.7$ (*c* 1.00, EtOH); lit.:[10] $[\alpha]_D^{22}=-7.2$ (*c* 2.6, EtOH); ^{1}H NMR ($CDCl_3$): δ 1.04 (t, 3H, CH_3, $J=7.3$ Hz), 1.10–1.26 (m, 6H, $CH_2CH_2CH_2$-CH_2CH_2), 1.62–1.82 (m, 7H, CH_2CH_3, CH_2CHCH_2), 2.93 (broad m, 1H, CHN), 8.29 (broad m, 3H, NH_3^+); ^{13}C NMR ($CDCl_3$): δ 10.30 (CH_3), 23.14 (CH_2CH_3), 26.15, 28.22, 29.00 (cyclohexyl-CH_2), 39.45 (*C*HCHN), 58.86 (CHN); IR (KBr pellet) 2929, 2027 ($\nu_{NH_3^+}$), 1519 ($\delta_{NH_3^+}$), 1032 ($\nu_{C\text{-}N}$) cm^{-1}; MS (CI/NH_3, *m*/*z*) 142 [M+H$^+$−HCl], 159 [M+NH_4^+−HCl], 283 [2M+H$^+$−HCl].

4.7.3. (*R*)-2-Amino-5-phenylpentane hydrochloride 5c[11]. Yield from 200 mg of oxazolidinone **4c**: 90 mg (70%), white solid; mp 129.3–129.9°C; $[\alpha]_D^{30}=+3.0$ (*c* 0.63, EtOH); ^{1}H NMR ($CDCl_3$): δ 1.38 (d, 3H, CH_3, $J=6.7$ Hz), 1.60–1.88 (m, 4H, $CH_2CH_2CH_2Ph$), 2.62 (m, 2H, CH_2Ph), 3.32 (m, 1H, CHN), 7.14–7.28 (m, 5H, Ph-H), 8.35 (broad m, 3H, NH_3^+); ^{13}C NMR ($CDCl_3$): δ 18.47 (CH_3), 27.01 (CH_2CH_2Ph), 34.33, 35.10 (CH_2CHN, CH_2Ph), 48.17 (CHN), 125.75, 128.11, 128.17 (Ph-C), 141.21 (*ipso*-Ph-C); IR (KBr pellet) 2893, 2049 ($\nu_{NH_3^+}$), 1518 ($\delta_{NH_3^+}$), 1030 ($\nu_{C\text{-}N}$) cmc^{-1}; MS (CI/NH_3, *m*/*z*) 164 [M+H$^+$−HCl], 181 [M+NH_4^+−HCl], 327 [2M+H$^+$−HCl]; HRMS (EI): [M]$^+$, found 163.1355. $C_{11}H_{17}N$ requires 163.1361.

4.7.4. (*R*)-2-Aminopentane hydrochloride 5d[11]. Yield from 250 mg of oxazolidinone **4d**: 105 mg (79%), white solid; mp 161.6–162.5°C; $[\alpha]_D^{37}=+6.1$ (*c* 0.40, EtOH); ^{1}H NMR ($CDCl_3$): δ 0.93 (t, 3H, CH_3CH$_2$, $J=7.3$ Hz), 1.38 (d, 3H, CH_3CHN, $J=6.7$ Hz), 1.45 (q, 2H, CH_2CH$_3$, $J=7.3$ Hz), 1.52–1.67 (m, 1H, C*H*HCHN), 1.72–1.84 (m, 1H, CH*H*CHN), 3.32 (m, 1H, CHN), 8.35 (broad m, 3H, NH_3^+); ^{13}C NMR ($CDCl_3$): δ 13.39 (C_5), 18.44, 18.60 (C_1, C_4), 36.69 (C_3), 48.11 (C_2); IR (KBr pellet) 2931, 2553 ($\nu_{NH_3^+}$), 1513 ($\delta_{NH_3^+}$), 1202,1147 ($\nu_{C\text{-}N}$) cm^{-1}; MS (CI/NH_3, *m*/*z*) 164 [M+H$^+$−HCl], 181 [M+NH_4^+−HCl]; HRMS (EI): [M−H]$^+$, found 86.0963. $C_5H_{12}N$ requires 86.0970.

4.7.5. (*S*)-3-Amino-1-phenylpentane hydrochloride 5e. Yield from 220 mg of oxazolidinone **4e**: 110 mg (77%), white solid; mp 177.3–179.6°C; $[\alpha]_D^{30}=-0.4$ (*c* 0.68, EtOH); ^{1}H NMR ($CDCl_3$): δ 1.00 (t, 3H, CH_3, $J=7.3$ Hz), 1.74–1.84 (m, 2H, CH_2CH$_3$), 1.93–2.15 (m, 2H, CH_2CH$_2$Ph), 2.69–2.88 (m, 2H, CH_2Ph), 3.15 (broad m, 1H, H_3), 7.11–7.30 (m, 5H, Ph-H), 8.41 (broad m, 3H, NH_3^+); ^{13}C NMR ($CDCl_3$): δ 9.51 (CH_3), 25.53 (CH_2CH_3), 31.19 (CH_2CH_2Ph), 33.71 (CH_2Ph), 53.18 (CHN), 125.97, 128.20, 128.30, 128.43 (Ph-C), 140.17 (*ipso*-Ph-C); IR (KBr pellet) 3031 ($\nu_{=C\text{-}H\ arom.}$), 2919, 2634, 2025 ($\nu_{NH_3^+}$), 1515 ($\delta_{NH_3^+}$), 1024 ($\nu_{C\text{-}N}$) cm^{-1}; MS (CI/NH_3, *m*/*z*) 164 [M+H$^+$−HCl], 181 [M+NH_4^+−HCl], 327 [2M+H$^+$−HCl]; HRMS (EI): [M]$^+$, found 163.1339. $C_{11}H_{17}N$ requires 163.1361.

4.8. General procedure for the preparation of Mosher amides

A suspension of amine hydrochloride **5** (1.0 equiv.) in anhydrous dichloromethane (3 mL/mmol) under an argon atmosphere was treated sequentially with anhydrous pyridine (6 mL/mmol) and then either (*R*)- or (*S*)-α-methoxy-α-trifluoromethylphenylacetic acid chloride (Mosher's acid chloride, 1.0 equiv.). The reaction mixture was stirred under reflux for 1 h. After cooling to room temperature, ether was added, and the organic phase was successively washed with aqueous HCl, aqueous 10% sodium bicarbonate and water, then dried over magnesium sulfate. The crude product obtained after filtration and concentration in vacuo was analyzed by ^{1}H and ^{19}F NMR.

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