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Asymmetric synthesis of α-(heteroaryl)alkylamines and α-amino acids via nucleophilic 1,2-addition of lithiated heterocycles to aldehyde SAMP-hydrazones

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Abstract: The asymmetric synthesis of α-(heteroaryl)alkylamines was accomplished by employing a diastereoselective nucleophilic 1,2-addition of lithiated aromatic heterocycles to aldehyde SAMP-hydrazones, followed by BH_3·THF or SmI_2 promoted removal of the chiral auxiliary. The CBz or benzoyl-protected amines were obtained in good yields (40%–78%) and excellent enantiomeric excesses (*ee* = 88%–99%). The methodology can be applied to the synthesis of highly enantioenriched α-amino acids (*ee* = 90%–99%).

Key words: Amines, asymmetric synthesis, SAMP-hydrazone, nucleophilic addition, amino acids

1. Introduction

Highly enantiomerically enriched amines with a stereocenter in the α position are of paramount importance in organic chemistry.[1] In particular, α-(heteroaryl)alkylamines are often characteristic structural features of biologically active natural products and pharmaceuticals. For example, α-(2-furyl)alkylamines constitute the backbone of nuphar alkaloids, α-(3-pyridyl)-alkylamines are common subunits in the tobacco alkaloids, and the potent antineoplastic agents dolastatin 10[2] and virenamides[3] are both linear peptides containing α-(2-thiazolyl)ethylamine units (Figure 1). From a synthetic point of view, α-(heteroaryl)alkylamines are widely used as chiral ligands in metal complex catalysis[4] and as important starting materials. Particular attention has been focused on the various synthetic applications of α-(2-furyl)alkylamines. Oxidative cleavage of the furan ring under mild conditions allows the conversion into α-amino acids.[5] Moreover, the aza-Achmatovicz rearrangement[6] represents an easy and unique entry into the piperidine skeleton and has thus been applied in the synthesis of numerous alkaloids[7] and azasugars.[8]

The broad utility of α-(heteroaryl)alkylamine derivatives has stimulated a relentless pursuit of practical asymmetric routes to these valuable compounds. Since the pioneering work by Smith and co-workers,[9] which was based on classical resolution of the racemate with an optically active acid, there has been significant growth in this area and thus many reliable synthetic methods have been devised. To date, most approaches have been based on a nucleophilic attack of organometallic reagents on imines bearing a stereogenic *N*-substituent. Savoia et al. applied valine derivatives as chiral auxiliary in the asymmetric synthesis of (*S*)-1-(2-pyridyl)alkyl-amines. Although (*S*)-valinate[10] gave good results, *O*-trimethylsilyl valinol[11] proved to be a superior chiral auxiliary affording high yields and excellent diastereoselectivity (*de* = 40%–99%).

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In memory of Prof Dr Ayhan S. Demir, an outstanding alumnus and good friend.

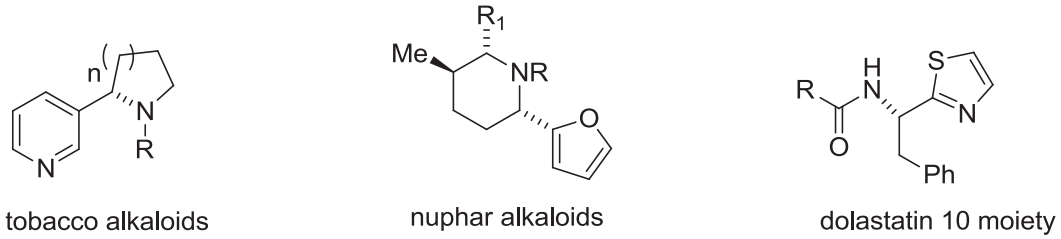
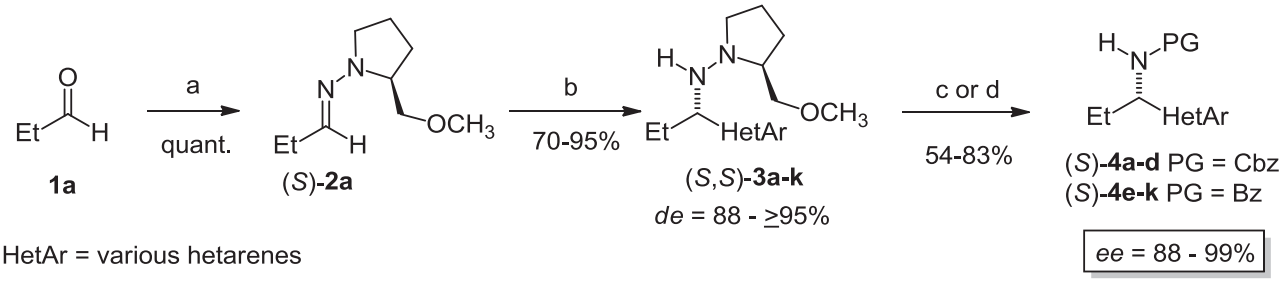


Figure 1. Typical biologically active compounds containing α-(heteroaryl)alkylamine units.

Zhou et al.[12] explored the addition of cerium derivatives to chiral imines derived by condensation of 2-furaldehyde and (1*S*,2*R*)-2-amino-1,2-diphenylethanol or its enantiomer (*de* = 84%–99%). Harwood and co-workers[13] used (*S*)-5-phenylmorpholin-2-one in the presence of a range of aliphatic aldehydes to form enantioenriched iminium intermediates, which underwent diastereoselective Mannich reactions with 2-furylboronic acid to afford the corresponding tertiary amines in moderate to good yields and high diastereoselectivities (*de* = 86%–98%). On the other hand, chiral oxime ethers were employed by Moody et al.[14] in an asymmetric synthesis of *N*-protected 1-(2-thiazolyl)alkylamines (*ee* = 83%–92%). More recently, a few cases have been reported using asymmetric catalytic nucleophilic 1,2-additions.[15] A conceptually different approach was presented by Shiori et al.[16] investigating the α-alkylation of chiral Schiff bases obtained by condensation of 1-(2-heteroaryl)methylamine and (+)-2-hydroxy-3-pinanone or (–)-3-hydroxy-2-caranone. The method was extremely efficient when pyridine and furan moieties were used, and after removal of the chiral auxiliary the corresponding amines were obtained in excellent enantioselectivities (*ee* = 88%–98%). Demir et al.[5a,d] studied the reduction of furyl ketone oxime ethers using chiral boron reagents[17] prepared from optically pure amino alcohol and BH_3·THF complex (*ee* = 87%–95%). Finally enzymatic[18] and chemical[19] resolution of racemic amines have been employed as well by different groups.



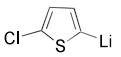
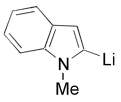
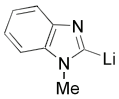
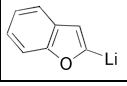
Scheme 1. Asymmetric synthesis of α-(heteroaryl)alkylamines: a) SAMP, Et_2O, rt; b) HetArLi, THF or Et_2O; c) BH_3·THF, THF, reflux and then CbzCl, K_2CO_3, THF/H_2O; d) DMAP, Et_3N, CH_2Cl_2, PhCOCl, rt, then SmI_2, THF, DMPU, rt.

We have briefly reported a very efficient asymmetric synthesis of α-(heteroaryl)alkylamines[20] by nucleophilic 1,2-addition of metallated hetarenes to aldehyde-SAMP-hydrazones. Herein we disclose the full account of this research and further applications of this protocol to the synthesis of α-amino acids.

Our general protocol exploring the use of easily accessible lithium hetarenes is depicted in Scheme 1. Preliminary studies were conducted treating the simple propanal-SAMP-hydrazone **2a**, dissolved in THF or alternatively in Et_2O, with 11 different lithiated heterocycles[21] prepared by modified literature procedures.[22] Due to the different nature, basicity, and reactivity of the heteroarenylithium species, optimal reaction conditions

had to be determined case by case. We found that either 2- or 3-thienyllithium (Table 1, Entries 1 and 2) reacted well using Et_2O as solvent. The highest conversions and selectivities were obtained by treating hydrazone **2a** with 3 equiv of organolithium compound at –78 °C for 30 min, after which the reactions were allowed to warm up to room temperature. The NMR spectra of the crude products showed only the desired hydrazines without the presence of starting material or eventual side products.

Table 1. Nucleophilic 1,2-addition of lithiated hetarenes to **2a** to form the hydrazines **3a**–**k** (Scheme 1).

Entry	Product 3	Li⁻HetAr	Equivalents	Solvent	T (°C)	Time (h)	Yield (%) [a]	de (%) [b]
1	**a**		3.2	Et_2O	–78 to rt	2	91	≥ 95
2	**b**		3.2	Et_2O	–78 to rt	5	86	94
3	**c**		3.2	Et_2O	–78 to rt	5	90	≥ 95
4	**d**		3.2	THF	–78 to rt	14	70 [c]	88
5	**e**		8.0	Et_2O	–100	54	82	≥ 95
6	**f**		5.0	Et_2O	–78	14	82	≥ 95
7	**g**		3.2	THF	–78 to rt	14	75 [c]	94%
8	**h**		3.2	THF	–78 to rt	14	95	≥ 95
9	**i**		3.2	THF	–78 to rt	14	87	92
10	**j**		3.2	THF	–78 to rt	2	91	≥ 95
11	**k**		3.2	Et_2O	–78 to rt	2	85	≥ 95

[a] Yield of crude product (≥95% purity as determined by ^1H and ^{13}C NMR spectroscopy).

[b] Determined by ^1H and ^{13}C NMR spectroscopy.

[c] Conversion (determined by ^1H and ^{13}C NMR spectroscopy).

The reactions turned out to be very efficient, even if a chloride atom was carried on the thiophene ring (Entry 3), affording the corresponding hydrazine in excellent yield as a single product. 2-(Pyridinyl)lithium and 3-(pyridinyl)litihum (Entries 5 and 6) showed the highest reactivities and thus a relatively high instability. Therefore, the reactions were carried out at low temperature and 8 and 5 equiv of organolithium species had to be used, respectively. It was noteworthy that employing THF as solvent in all the previous cases changed drastically the reactivity of the lithium hetarenes, affording only traces of products. On the other hand, THF was clearly a superior solvent in the cases of 1-methyl-2-lithiumpyrrole (Entry 4), 1-methyl-2-lithio-indole (Entry 7), 1-methyl-2-lithio-imidazole (Entry 8), and 1-methyl-2-lithio-benzoimidazole (Entry 9), providing excellent diastereoselectivities when the reactions were allowed to reach room temperature overnight. Finally, 1,2-nucleophilic addition using 2-(furyl)lithium (Entry 10) and 2-(benzofuryl)litihum (Entry 11) was conducted in THF for the former and in Et_2O for the latter.

Due to the sensitivity of the obtained hydrazines, cleavage of the chiral auxiliary was performed using the crude products without any purification. We were pleased to find that the chiral auxiliary group could be removed smoothly without detectable racemization when hydrazines **3a–d** were refluxed with a large excess of BH_3•THF[23] complex for 6–18 h. The corresponding polar amines were not isolated but directly treated with CbzCl to give the corresponding carbamates **4a–d**, which could be purified by flash chromatography on silica gel (Table 2). Unfortunately, when the hydrazines **3e–k** were reacted with an excess of BH_3•THF only poor results were obtained. Attempts to overcome the problem using Zn in acetic acid met the same fate. In an effort to find a suitable method for removing the chiral auxiliary, we decided to examine the SmI_2 promoted N-N bond cleavage.[24] For this purpose, the tertiary hydrazines had to be activated by conversion to the corresponding benzoyl derivatives. The desired reaction was performed treating **3e–k** with an excess of benzoyl chloride in the presence of a stoichiometric amount of Et_3N and a catalytic amount of DMAP. The obtained N-benzoyl hydrazines could be isolated after purification as a mixture of amide rotamers in high yields. We were delighted to find that when treating the *N*-protected hydrazines with 2–3 equiv of SmI_2 in the presence of an equimolar

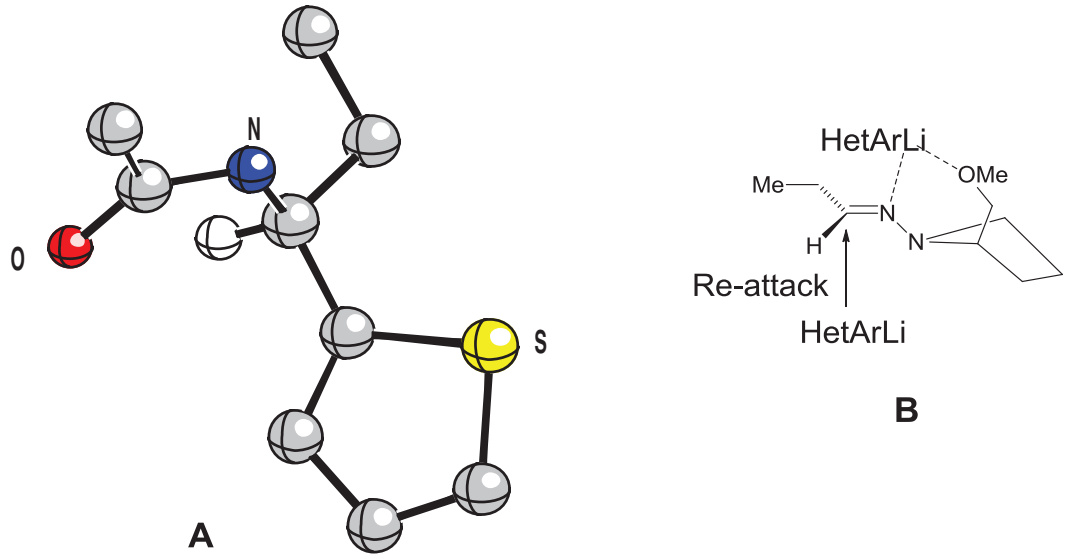
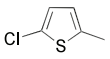
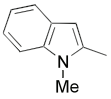
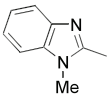
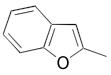


Figure 2. X-ray crystal structure and absolute configuration of **4l** and proposed mechanism for the nucleophilic 1,2-addition of lithiated heteroarenes to the aldehyde-SAMP-hydrazones.

amount of DMPU a smooth cleavage of the chiral auxiliary took place. After purification, the corresponding benzoyl amines **4**–**k** (Table 2) were obtained in a very good overall yield. Furthermore, determination of the *ee* value by HPLC analysis using a chiral stationary phase by comparison with the racemate showed that the cleavage proceeded without any detectable epimerization or racemization.

Table 2. Asymmetric synthesis of N-protected α-(heteroaryl)alkylamines **4** (Scheme 1).

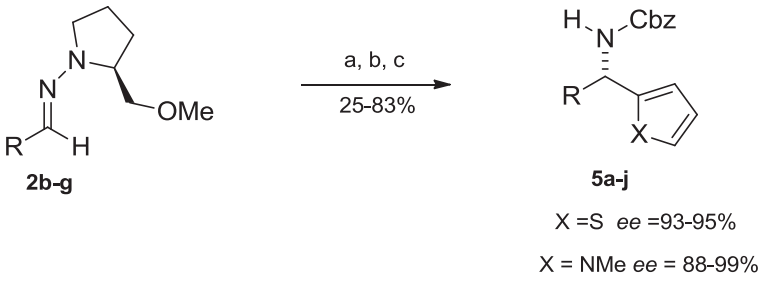
4	HetAr	Cleavage	Yield (%) [a]	ee (%) [b]
a		BH_3·THF	83	99
b		BH_3·THF	70	93
c		BH_3·THF	80	96
d		BH_3·THF	64	88
e		SmI_2	71	96
f		SmI_2	73	99
g		SmI_2	54	94
h		SmI_2	82	99 [c]
i		SmI_2	85	92
j		SmI_2	68	98
k		SmI_2	81	97

[a] Yield of isolated product over 2 steps.
[b] Determined by HPLC on a chiral stationary phase.
[c] Determined by GC on a chiral stationary phase.

The absolute configuration of the protected amines **4** was determined to be *S* by single crystal X-ray analysis (Figure 2, **A**)[25] on the N-acetyl protected 1-(thiophen-2-yl)propan-1-amine synthesized according to an analogous procedure (see Experimental). This stereochemical outcome is in agreement with the relative topicity observed for all 1,2-additions of nucleophiles to the CN bond of aldehyde SAMP-hydrazones.[26] The preferential formation of the *S* isomer can be explained considering an initial complexation of a first equivalent of lithio hetarene with the chiral auxiliary to give the chelate structure **B**. This should allow a low-energy pathway for the subsequent nucleophilic addition and moreover should result in the complete shielding of the *Si*-face of

the imine double bond. The relative topicity of the nucleophilic attack is then directed by steric interactions, resulting in a *Re*-face attack by a second equivalent of organometallic reagent.

In order to demonstrate the generality of our approach, we performed the nucleophilic 1,2-additions on a range of different aldehyde hydrazones. First experiments were conducted using 2-(thienyl)lithium as a nucleophile.



Scheme 2. Screening of different aldehyde SAMP-hydrazones: a) 2-(thienyl)lithium Et_2O or 1-methyl-2-lithiopyrrole, THF; b) THF, $BH_3 \cdot THF$, reflux; c) CbzCl, K_2CO_3, THF/H_2O.

As depicted in Scheme 2, the application of our established 3-step protocol afforded in all cases the desired carbamates **5a**–**f** in high overall yields and excellent enantiomeric excesses (Table 3). In particular, it is remarkable that in the addition steps the rates of formation of the tertiary hydrazines as well as the selectivities were not significantly altered by the presence of bulky groups on the hydrazone. A second series of experiments were conducted with 1-methyl-2-lithiopyrrole. In agreement with the observation made in our trial system, we found that although the desired carbamates **5g**–**j** could be obtained with good to excellent selectivities, the overall yields were moderate. The decreased level of efficiency was mainly due to the insufficient conversion obtained in the first step, confirming the lower reactivity of 1-methyl-2-lithiopyrrole compared with 2-(thienyl)lithium.

Having demonstrated the generality and efficiency of our methodology, we turned our attention to exploring possible synthetic applications. For this purpose, as disclosed in the introduction, α-(2-furyl)alkylamines represented a straightforward entry into the synthesis of α-amino acids as the furan moiety is a synthetic equivalent of the carboxylic acid functionality. Intrigued by this possibility and confident that our methodology could provide a flexible solution, we decided to embark on an asymmetric synthesis of α-amino acids.

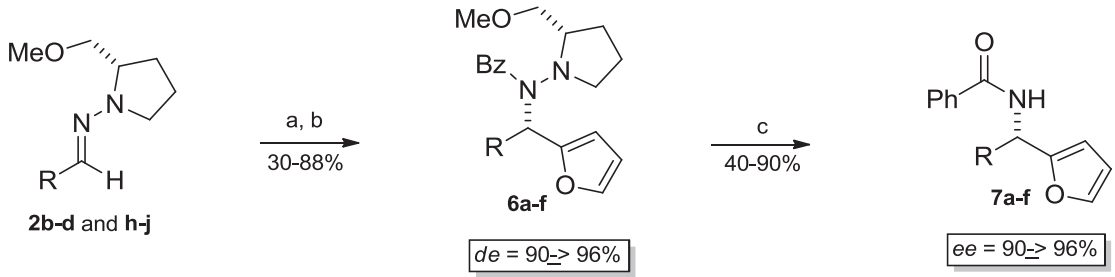
The reaction sequence to synthesize the benzoyl protected 2-furylalkylamines **7** is outlined in Scheme 3. The SAMP-hydrazones **2** were treated with 3.2 equiv of 2-(furyl)lithium in THF at –78 °C. NMR analysis of the crude products showed that the corresponding hydrazines were obtained with perfect stereocontrol. Although some of them were stable during flash chromatography and hence could be isolated, we found it more practical and efficient to carry out the protection on the crude hydrazine and to isolate the corresponding *N*-benzoyl hydrazines (Table 4).

Surprisingly, hydrazine **6e** was obtained in very poor yield. Therefore, we chose to adopt a different pathway to introduce the methyl group by reacting hydrazone **2k** with MeLi. When the reaction was performed in Et_2O, an excellent diastereoselectivity and high yield was obtained. Moreover, as expected, NMR analysis showed that (S,S)-**6e** and (S,R)-**6e** are epimers.

Table 3. Screening of different aldehyde SAMP-hydrazones **2** using 2-thienyllitihum and 2-lithio-N-methylpyrrole as nucleophiles to form the amines **5** (see Scheme 2).

5	HetAr	R	Yield (%)	ee (%)[a]
a		n-Bu	70	94
b		$Ph(CH_2)_2$	83	95
c		t-Bu	57	93
d		i-Pr	73	93
e		Et_2CHCH_2	78	94
f		Ferrocenyl	49	≥95[b]
g		n-Bu	35	92
h		$Ph(CH_2)_2$	36	99
i		t-Bu	25	88
j		Et_2CHCH_2	53	90

[a] Determined by chiral stationary phase HPLC.
[b] Determined by ^1H and ^{13}C NMR on the corresponding hydrazine.

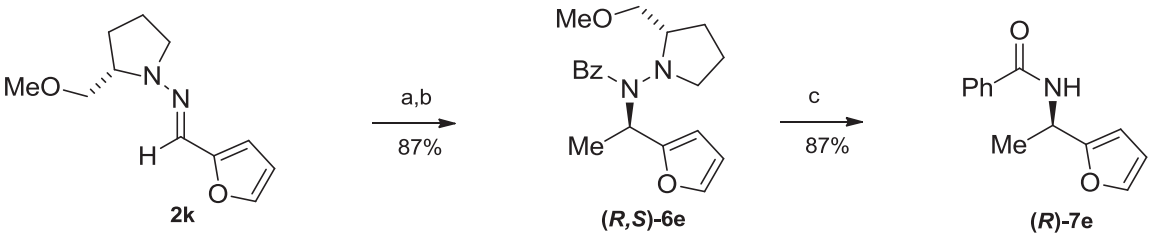


Scheme 3. Asymmetric synthesis of α-amino acids: a) 2-furyllithium, THF, –78 °C to rt 2–18 h; b) BzCl, CH_2Cl_2, Et_3N, DMAP, rt, 12–48 h; c) SmI_2, DMPU, THF, rt, 1 h.

Table 4. Asymmetric synthesis of N-protected α-(2-furyl)alkyl-ydrazines **6** (see Scheme 3).

6	R	Yield (%)	*de* (%)[a]	Confg.
a	n-Bu	75	≥ 96	S,S
b	$Ph(CH_2)_2$	75	≥ 96	S,S
c	t-Bu	72	≥ 96	S,S
d	$CH_3(CH_2)_2CH(CH_3)$	88	≥ 96	S,R,S
e	Me	30	≥ 96	S,S
f	$TBDMSO(CH_2)_3$	45	90	S,S

[a]Determined by ^{1}H and ^{13}C NMR spectroscopy.



Scheme 4. Screening of different aldehyde SAMP-hydrazones: a) methyllithium, Et_2O, –78 °C; b) BzCl, CH_2Cl_2, Et_3N, DMAP, rt, 12 h; c) SmI_2, DMPU, THF, rt, 1 h.

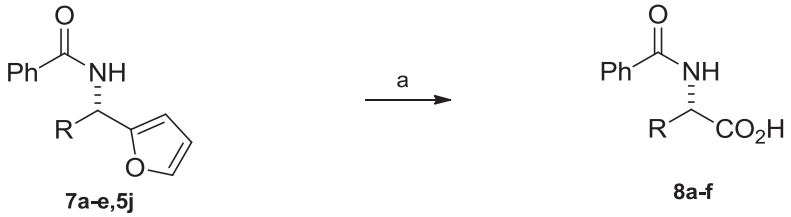
Thus we were able to confirm that by using only the SAMP chiral auxiliary we have access to both the enantiomers of α-(2-furyl)alkylamines.The N-N bond cleavage was achieved using the above-reported SmI_2-method, affording the N-protected amines in good to excellent yield and enantiomeric purity[27] greater than 96% (Table 5). It is noteworthy that when compound **6f** was used as substrate the corresponding amine **7f** was obtained in 40% yield together with 20% of O-deprotected compound.

Table 5. SmI_2 promoted N-N bond cleavage to form **7** (see Scheme 3).

7	R	Yield (%)	*ee* (%)[a]	Confg.
a	n-Bu	84	96	S
b	$Ph(CH_2)_2$	80	96	S
c	t-Bu	76	98	S
d	$CH_3(CH_2)_2CH(CH_3)$	80	99	S,R[b]
e	Me	90	98	S
f	$TBDMSO(CH_2)_3$	40	90	S

[a]Determined by chiral stationary phase HPLC.
[b]*de* $\geq$ 96% determined by ^{1}H and ^{13}C NMR spectroscopy.

Finally, conversion into α-amino acids was carried out by treatment of **7a**–**e**, **4j** with a catalytic amount of $RuCl_3 \cdot H_2O$ in the presence of a large excess of $NaIO_4$ in a mixture of $H_2O/CH_2Cl_2/CH_3CN$ (Scheme 5).[5b]



Scheme 5. Synthesis of α-amino acids: a) $RuCl_3 \cdot H_2O$, $NaIO_4$, $H_2O/CH_2Cl_2/CH_3CN$, rt, 2 h.

After 2 h at room temperature the reaction was complete. Work-up and subsequent purification either by recrystallization or flash chromatography provided the α-amino acids as virtually enantiomerically pure products in excellent overall yields (Table 6).

Table 6. Synthesis of α-amino acids **8** by oxidation with $RuCl_3 \cdot H_2O$ and $NaIO_4$ (see Scheme 5).

8	R	Yield (%)	*ee* (%)[a]	Confg.
a	*n*-Bu	70	96	*S*
b	$Ph(CH_2)_2$	90	96	*S*
c	*t*-Bu	77	98	*S*
d	$CH_3(CH_2)_2CH(CH_3)$	82	99	*S*, *R*
e	Me	86	98	*S*
f	Et	79	99	*S*

[a]Determined by chiral stationary phase HPLC.

Notably, product **8d** demonstrated that our methodology is compatible with the SAMP-α-alkylation, allowing us to generate α-amino acids with 2 stereocenters.

A final detail should be addressed: regardless of the extensive experimentation we were not able to synthesize aromatic α-amino acids. Even by changing the solvent, temperature, and aromatic substituents the reaction between aromatic hydrazones and 2-furyllithium did not take place.

In summary, we have achieved a highly efficient asymmetric synthesis of α-(heteroaryl)alkylamines based on the nucleophilic 1,2-addition of lithiated aromatic heterocycles to aldehyde SAMP-/RAMP-hydrazones.[28] In addition, oxidative furan to carboxylic acid conversion allowed the asymmetric synthesis of α-amino acids of high enantiomeric purities.

2. Experimental

Preparative column chromatography: Merck silica gel 60, particle size 0.040–063 mm (230–240 mesh, flash). Analytical TLC: silica gel 60 F254 plates from Merck, Darmstadt, Germany. Optical rotation values were measured on a PerkinElmer P241 polarimeter. Microanalyses were obtained with a Vario EL element analyzer. Mass spectra were acquired on a Finnigan SSQ7000 (CI 100 eV; EI 70 eV) spectrometer. IR spectra were taken on a PerkinElmer FT/IR 1760. ^1H and ^{13}C NMR spectra were recorded on Varian Gemini 300 or Inova 400 spectrometers and all measurements were performed with tetramethylsilane as internal standard. Melting points were determined on a Tottoli melting point apparatus and are uncorrected. Gas chromatography: Lipodex A (Macherey-Nagel) or Chirasil-L-Val (25 m $\times$ 0.25 mm, 1 bar H_2, Chrompak) columns. ee-Determination with HPLC: Chiralpak AD or OD (250 $\times$ 4.4 mm, n-heptane: isopropanol = 95:5).

2.1. General procedure 1 (GP1): preparation of the lithiated heteroarenes

2-(Furyl)lithium: *n*-(butyl)lithium (6.4 mmol) was added to a solution of furan (462 mg, 6.8 mmol) in 20 mL of dry THF at 0 °C. The ice bath was removed and the mixture warmed up to 50–60 °C for 60–90 min.

2-(Thienyl)lithium, 2-(benzothienyl)lithium and *2-(benzofuryl)lithium*: *n*-(butyl)lithium (6.4 mmol) was added to a solution of thiophene, benzothiophene, or benzofuran (6.8 mmol) in dry Et_2O (20 mL) at 0 °C. After 5 min the ice bath was removed and the mixture was stirred for 1 h at rt (90 min for benzothiophene).

2-Lithio-1-methyl pyrrole and *2-lithio-1-methylindole*: *n*-(butyl)lithium (6.4 mmol) was added to a

solution of *N*-methylpyrrole or *N*-methylindole (6.8 mmol) in dry THF (20 mL) at rt. The mixture was warmed up to 60 °C for 1 h or alternatively stirred at rt overnight.

2.2. GP2: synthesis of 1-(2-thienyl)alkylcarbamates

To a solution of 2-(thienyl)lithium in Et_2O cooled to –78 °C was added dropwise hydrazone **2** (2 mmol) dissolved in dry Et_2O (2 mL). After 30 min the cooling bath was removed, the temperature allowed to warm to room temperature, and the reaction mixture stirred for an additional 2–9 h. The mixture was quenched with saturated aqueous NH_4Cl and extracted 3 times with Et_2O. The organic layer was then washed twice with brine, dried over $MgSO_4$, and evaporated in vacuo. The crude hydrazine was dissolved in dry THF (10 mL pro mmol of hydrazine) and heated up to reflux with 10 or 20 equiv of $BH_3 \cdot THF$ (1.0 mol in THF) for 9–36 h. The reaction was cooled to room temperature, acidified with aqueous HCl (1N), and stirred for 1 h. The THF was evaporated under reduced pressure and the aqueous solution was basified with a saturated solution of K_2CO_3 and extracted with methylene chloride. The organic layers were concentrated in vacuo and the residue was dissolved in a mixture of H_2O and THF (1:1). Then 2 equiv of potassium carbonate were added, followed by 1.8 equiv of benzyl chloroformate, and the heterogeneous solution was stirred at room temperature overnight. Et_2O was added to the mixture, the layers were separated and the aqueous layer was washed with 2 further portions of Et_2O. The combined organic extracts were dried ($MgSO_4$) and evaporated. The crude product was purified by column chromatography.

2.3. GP3: preparation of furfuryl hydrazines

To a solution of 2-(furyl)lithium (GP1) cooled to –78 °C was added dropwise hydrazone **2** (2 mmol) dissolved in dry THF (2 mL). After 30 min the cooling bath was removed and the temperature allowed to warm to rt, followed by stirring for an additional 2–18 h. The mixture was hydrolyzed with saturated aqueous NH_4Cl and extracted 3 times with Et_2O. The organic layer was then washed twice with brine, dried with $MgSO_4$, and evaporated in vacuo. The crude product was either purified via column chromatography or used as crude product in the next step.

2.4. GP4: SmI_2 promoted cleavage

To a solution of protected hydrazine in dry THF (strict anaerobic conditions are required) (10 mL pro mmol of hydrazine) were added 2 equiv of DMPU followed by 2–3 equiv of SmI_2. After 2 h at rt the reaction mixture was quenched with a mixture of $NaHCO_3$ solution and CH_2Cl_2 (5:2), extracted with CH_2Cl_2, dried over $MgSO_4$, and concentrated in vacuo. The crude product was purified by column chromatography.

2.5. GP5: oxidation of furfuryl amides to *N*-protected α-amino acids

$RuCl_3 \cdot H_2O$ (2 mol%) was added to a mixture of $NaIO_4$ (15 equiv) in CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) and the mixture was stirred for 0.5 h. A solution of furfuryl amide in CH_2Cl_2 was rapidly added to the mixture via cannula. Upon completion of the reaction after 2 h, the organic phase was separated and the aqueous phase was washed with CH_2Cl_2. The collected organic layers were washed with saturated aqueous $NaHSO_3$ and brine, dried ($MgSO_4$), and concentrated in vacuo. The crude product was purified by column chromatography or recrystallization.

2.6. (1*S*)-(1-Thiophen-2-yl-propyl)-carbamic acid benzyl ester (4a)

Prepared according to GP 2 from 2-lithio-thiophene (6.4 mmol) and hydrazone **2a** (340 mg, 2.0 mmol). After N,N-cleavage and protection purification by column chromatography (Et_2O:pentane 1:2) gave **4a** (420 mg, 75%) as a colorless solid. *ee* $\geq$ 99%; mp 69–70 °C; $[\alpha]_D^{26}$ –57.8 (c = 1.4, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3309, 2971, 2934, 2878, 1685, 1535, 1499, 1467, 1454, 1443, 1327, 1298, 1266, 1238, 1081, 1045, 1029, 974, 752 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.96 (t, 3H, J = 7.4 Hz, CH_3CH_2), 1.85–1.96 (m, 2H, CH_3CH_2), 4.91–5.14 (m, 4H, N*H*, C*H*NH, $CH_2OC{=}O$), 6.93–6.97 (m, 2H, arom C*H*), 7.18–7.20 (m, 1H, arom C*H*), 7.29–7.34 (m, 5H, arom C*H*) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 10.97 (*C*H_3), 30.49 (CH_3*C*H_2), 52.80 (*C*HN), 67.15 (*C*$H_2OC{=}O$), 124.31, 124.47, 126.98, 128.34, 128.73, (arom *C*H), 136.58, 146.18 (arom *C*), 155.83 (*C* =O) ppm.

MS (EI, 70 eV): m/z (%) = 275 (1) [$M^{+\bullet}$], 246 (6), 202 (9), 185 (5), 184 (50), 140 (11), 97 (6), 92 (9), 91 (100), 85 (5), 65 (9), 56 (10).

Anal. Calcd for $C_{15}H_{17}NO_2S$: C, 65.43; H, 6.22; N, 5.09; Found: C, 65.50; H, 6.16; N, 4.99.

2.7. (1*S*)-(1-Thiophen-3-yl-propyl)-carbamic acid benzyl ester (4b)

To a solution of 3-bromothiophene (1.127 g, 7 mmol) in ether (20 mL) was added *n*-BuLi (6.4 mmol) dropwise at –78 °C and the obtained mixture was stirred for 90 min. A solution of hydrazone **2a** (340 mg, 2.0 mmol) in Et_2O (4 mL) was added to the mixture according to GP2. After N,N-cleavage and protection purification by column chromatography (Et_2O:pentane 1:2) gave **4b** (385 mg, 70%) as a colorless solid. *ee* $\geq$ 93%; mp 76–77 °C; $[\alpha]_D^{22}$ – 47.4 (c = 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3341, 1683, 1533, 1268, 1239, 1083, 776 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.87 (t, 3H, J = 7.4 Hz, C*H*$_3$), 1.70–1.83 (m, 2H, CH_3CH_2), 4.68–4.80 (m, 1H, C*H*NH), 5.02 (d, 1H, J = 12.4 Hz C*H*HOC=O), 5.08 (d, 1H, J = 12.4 Hz CH*H*OC=O), 5.35 (d, 1H, J = 8.7 Hz, N*H*), 6.96 (d, 1H, J = 4.2 Hz, arom C*H*), 7.03–7.06 (m, 1H, arom C*H*), 7.20 (dd, 1H, J = 3.0, 5.2 Hz, arom C*H*), 7.22–7.30 (m, 5H, arom C*H*) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 10.72 (*C*H_3), 29.21 (CH_3*C*H_2), 52.70 (*C*HN), 66.79 (*C*$H_2OC{=}O$), 120.98, 126.15, 126.28, 128.18, 128.62 (arom *C*H), 136.74, 143.78 (arom *C*), 156.12 (*C* =O) ppm.

MS (EI, 70 eV): m/z (%) = 275 (7) [$M^{+\bullet}$], 246 (24), 202 (15), 184 (16), 140 (6), 97 (5), 92 (8), 91 (100), 65 (6).

Anal. Calcd for $C_{15}H_{17}NO_2S$: C, 65.43; H, 6.22; N, 5.09; Found: C, 65.54; H, 6.09; N, 5.04.

2.8. (1*S*)-[1-(5-Chloro-thiophen-2-yl-propyl)]-carbamic acid benzyl ester (4c)

To a solution of 2-bromo-5-chloro-thiophene (1.365 g, 7 mmol) in Et_2O (20 mL) was added *n*-BuLi (6.4 mmol) dropwise at –78 °C and the obtained mixture was stirred for an additional 90 min. A solution of hydrazone **2a** (340 mg, 2.0 mmol) in Et_2O (4 mL) was added to the mixture according to GP2. After N,N-cleavage and protection purification by column chromatography (Et_2O:pentane 1:2) gave **4c** (495 mg, 80%) as a colorless solid. *ee* = 96%; mp 65–66 °C; $[\alpha]_D^{22}$ – 49.7 (*c* 1.4, $CHCl_3$).

IR ($CHCl_3$): $\tilde{u}$ = 3446, 1684, 1536, 1263, 700 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.95 (t, 3H, J = 7.4 Hz, CH_3), 1.74–1.86 (m, 2H, CH_3CH_2), 4.76–4.78 (m, 1H, CHNH), 5.05–5.13 (m, 3H, NH, CH_2CO=O), 6.70–6.73 (m, 2H, arom CH), 7.27–7.36 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 10.71 (CH$_3$), 29.79 (CH_3CH$_2$), 52.86 (CHN), 67.09 (CH$_2$OC=O), 123.61, 125.77, 128.12, 128.21, 128.55 (arom CH), 136.29, 145.14 (arom C), 155.61 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 309 (7) [M$^{+\bullet}$], 220 (23), 219 (6), 218 (61), 174 (10), 92 (7), 91 (100), 65 (5), 56 (14).

Anal. Calcd for $C_{15}H_{16}ClNO_2S$: C, 58.15; H, 5.21; N, 4.52. Found: C, 57.84; H, 5.53; N, 4.46

2.9. (1*S*)-[1-(1-Methyl-1*H*-pyrrol-2-yl)-propyl]-carbamic acid benzyl ester (4d)

Prepared according to GP2 from 2-lithio-1-methylpyrrole (6.4 mmol) and hydrazone **2a** (340 mg, 2.0 mmol). After N,N-cleavage and protection purification by column chromatography (Et_2O:pentane 1:3) gave **4d** (245 mg, 45%) as a colorless solid. *ee* = 88%; mp 70–71 °C; $[\alpha]_D^{22}$ – 62.4 (c 1.8, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3309, 1684, 1540, 1305, 1266, 1248, 1077, 718, 696 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.98 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 1.80–1.95 (m, 2H, CH_3CH_2), 3.54 (s, 3H, NCH_3), 4.67–4.76 (m, 2H, CHN, NH), 5.09 (s, 2H, CH_2OC=O), 6.00–6.49 (m, 2H, arom CH), 6.54–6.55 (m, 1H, arom CH), 7.27–7.35 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.36 (CH$_3$CH$_2$), 28.51 (CH_3CH$_2$), 34.15 (NCH_3), 48.90 (CHN), 66.98 (CH$_2$OC=O), 105.89, 106.95, 122.79, 128.22, 128.32, 128.73 (arom CH), 133.19, 136.81, (arom C), 155.86 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 273 (6) [M$^{+\bullet}$+1], 272 (36) [M$^{+\bullet}$], 243 (28), 199 (25), 181 (16), 172 (7), 137 (9), 122 (7), 107 (8), 92 (7), 91 (100), 82 (14), 65 (5).

Anal. Calcd for $C_{16}H_{20}N_2O_2$: C, 70.56; H, 7.41; N, 10.28. Found: C, 70.49; H, 7.35; N, 10.10.

2.10. (1*S*)-*N*-(1-pyridin-2-yl-propyl)-benzamide (4e)

A solution of benzoyl protected hydrazine **3e** (355 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 95:5) **4e** was obtained as a colorless solid (185 mg, 77%); *ee* = 96%; mp 69–70 °C; $[\alpha]_D^{22}$ –16.0 (c 1.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3325, 1634, 1588, 1576, 1525, 1487, 1467, 1433, 1309, 695, 664 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.76 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 1.78–1.96 (m, 2H, CH_3CH_2), 5.09–5.16 (m, 1H, CHN), 7.07 (ddd, J = 1.4, 4.9, 7.7 Hz, 1H, arom CH), 7.15–7.17 (m, 1H, arom CH), 7.26–7.39 (m, 3H, arom CH), 7.54 (dt, 1H, J = 1.7, 8.7 Hz, arom CH) 7.63 (d, 1H, J = 7.4 Hz, NH), 7.57–7.78 (m, 2H, arom CH), 8.44–8.46 (m, 1H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 10.12 (CH$_3$CH$_2$), 29.70 (CH$_2$CHN), 55.52 (CHN), 122.58, 127.28, 128.67, 131.54 (arom CH), 134.92 (arom C), 136.84, 149.32 (arom CH), 160.01 (arom C), 166.93 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 240 (12) [M$^{+\bullet}$], 212 (13), 211 (44), 135 (13), 120 (6), 118 (6), 107 (7), 106 (8), 105 (100), 78 (5), 77 (40), 51 (9).

Anal. Calcd for $C_{15}H_{16}N_2O$: C, 74.93; H, 6.71; N, 11.66. Found: C, 74.86; H, 6.88; N, 11.59.

2.11. (1*S*)-*N*-(1-pyridin-3-yl-propyl)-benzamide (4f)

A solution of benzoyl protected hydrazine **3f** (355 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O) **4f** was obtained as a colorless solid (200 mg, 83%). *ee* = 99%; mp 72–73 °C; $[\alpha]_D^{22}$ +11.7 (*c* 1.4, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3319, 2966, 1639, 1603, 1578, 1533, 1480, 1459, 1325, 1334, 1001, 795, 715, 690 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.84 (t, 3H, *J* = 7.3 Hz, CH_3CH_2), 1.73–1.86 (m, 2H, CH_3CH_2), 4.95 (q, 1H, *J* = 7.7 Hz, CHN), 7.10 (dd, *J* = 4.9, 8.0 Hz, 1H, arom CH), 7.21–7.25 (m, 2H, arom CH), 7.31–7.35 (m, 2H, NH, arom CH), 7.54 (dt, 1H, *J* = 1.7, 8.7 Hz, arom CH) 7.66–7.68 (m, 2H, arom CH), 8.33 (dd, 1H, *J* = 1.7, 4.8 Hz, arom CH), 8.44 (d, 1H, *J* = 1.9 Hz, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.11 (CH_3CH_2), 29.04 (CH_2CHN), 53.66 (CHN), 123.71, 127.35, 128.65, 131.70 (arom CH), 134.52 (arom *C*), 134.71 (arom CH), 138.37 (arom *C*), 148.56, 148.59 (arom CH), 167.63 (C=O) ppm.

MS (EI, 70 eV): *m/z* (%) = 240 (15) [$M^{+\bullet}$], 211 (17), 106 (8), 105 (100), 77 (33), 51 (7).

Anal. Calcd for $C_{15}H_{16}N_2O$: C, 74.93; H, 6.71; N, 11.66. Found: C, 74.72; H, 6.58; N, 11.46.

2.12. (1*S*)-*N*-[1-(1-Methyl-1H-indol-2-yl)-propyl]-benz-amide (4g)

A solution of benzoyl protected hydrazine **3g** (405 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 3:2) **4g** was obtained as a colorless solid (210 mg, 72%). *ee* = 94%; mp 165–166 °C; $[\alpha]_D^{22}$ –120.2 (*c* 1.6, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3286, 2929, 1632, 1457, 1385, 1338, 1314, 1295, 1272, 1152, 783, 748, 731, 712, 696 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.02 (t, 3H, *J* = 7.4 Hz, CH_3CH_2), 1.95–2.12 (m, 2H, CH_3CH_2), 3.64 (s, 3H, NCH_3), 5.39 (q, 1H, *J* = 7.4 Hz, CHN), 6.14–6.16 (br, 1H, NH), 6.41 (s, 1H, arom CH), 7.00–7.04 (m, 1H, arom CH), 7.11–7.42 (m, 5H, arom CH), 7.50 (d, 1H, *J* = 7.7 Hz, arom CH), 7.49–7.66 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.42 (CH_3CH_2), 28.10 (CH_2CHN), 30.16 (NCH_3), 47.44 (CHN), 99.23, 109.52, 119.88, 120.67, 122.04, 127.10 (arom CH), 127.45 (arom *C*), 128.83, 131.87 (arom CH), 134.30, 137.83, 140.48 (arom *C*), 166.61 (C=O) ppm.

MS (EI, 70 eV): *m/z* (%) = 293 (15) [$M^{+\bullet}$+1], 292 (72) [$M^{+\bullet}$], 264 (14), 263 (75), 187 (13), 171 (10), 160 (8), 157 (8), 156 (6), 132 (24), 130 (6), 106 (7), 105 (100), 77 (33).

Anal. Calcd for $C_{19}H_{20}N_2O$: C, 78.05; H, 6.89; N, 9.58. Found: C, 77.71; H, 6.84; N, 9.53.

2.13. (1*S*)-*N*-[1-(1-Methyl-1H-imidazol-2-yl)-propyl]-benzamide (4h)

A solution of hydrazine **3h** (356 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (AcOEt) **4h** was obtained as a colorless solid (210 mg, 87%). *ee* = 99%; mp 115–116 °C; $[\alpha]_D^{22}$ –25.0 (*c* 1.2, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3212, 3042, 2966, 2932, 2873, 1651, 1600, 1577, 1540, 1491, 1458, 1381, 1334, 1295, 750, 715 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.86 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 1.90–2.00 (m, 2H, CH$_3$CH_2), 3.61 (s, 3H, NCH_3), 5.25 (q, 1H, J = 7.2 Hz, CHN), 6.68 (d, 1H, J = 1.1 Hz, CH =CHN), 6.78 (d, 1H, J = 1.1 Hz, CH=CHN), 7.22–7.36 (m, 3H, arom CH), 7.72–7.75 (m, 3H, NH, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 9.35 (CH$_3$CH$_2$), 26.86 (CH$_2$CHN), 31.69 (NCH_3), 45.56 (CHN), 119.85, 125.94, 126.18, 127.34, 130.43 (arom CH), 132.85, 147.08 (arom C), 165.73 (C =O) ppm.

MS (EI, 70 eV): m/z (%) = 244 (6) [M$^{+\bullet}$+1], 243 (29) [M$^{+\bullet}$], 214 (14), 138 (75), 123 (6), 121 (12), 106 (8), 105 (100), 83 (5), 77 (41), 51 (7).

Anal. Calcd for $C_{14}H_{17}N_3O$: C, 69.11; H, 7.04; N, 17.27. Found: C, 68.81; H, 6.79; N, 17.08.

2.14. (1*S*)-*N*-[1-(1-Methyl-1H-benzoimidazol-2-yl)-pro pyl]-benzamide (4i)

A solution of benzoyl protected hydrazine **3i** (406 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 in THF (0.1 in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (AcOEt) **4i** was obtained as a colorless solid (230 mg, 78%). *ee* = 92%; mp 163–164 °C; $[\alpha]_D^{22}$ –32.5 (c 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3291, 3054, 2966, 2932, 2872, 1654, 1528, 1488, 1332, 1290, 1236, 842, 741, 700, 655 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.02 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 2.08–2.32 (m, 2H, CH$_3$CH_2), 3.85 (s, 3H, NCH_3), 5.58 (dt, 1H, J = 6.9, 8.4 Hz, CHN), 7.21–7.30 (m, 3H, arom CH), 7.39–7.55 (m, 4H, arom CH, NH), 7.62–7.66 (m, 1H, arom CH), 7.87–7.90 (m, 2H, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 10.21 (CH$_3$CH$_2$), 28.03 (CH$_2$CHN), 29.98 (NCH_3), 47.09 (CHN), 109.56, 119.13, 122.31, 122.82, 127.23, 128.58, 131.76 (arom CH), 133.80, 135.50, 139.96 (arom C), 166.85 (C =O) ppm.

MS (EI, 70 eV): m/z (%) = 294 (12) [M$^{+\bullet}$+1], 293 (59) [M$^{+\bullet}$], 278 (8), 264 (8), 189 (12), 188 (100), 171 (5), 160 (7), 133 (8), 131 (6), 106 (6), 105 (75), 77 (40).

Anal. Calcd for $C_{18}H_{19}N_3O$: C, 73.69; H, 6.53; N, 14.32. Found: C, 74.07; H, 6.64; N, 14.31.

2.15. (*S*)-*N*-(1-Furan-2-yl-propyl)-benzamide (4j)

A solution of benzoyl protected hydrazine **3j** (342 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:2) **4j** was obtained as a colorless solid (190 mg, 83%). *ee* = 99%; mp 86–88 °C; $[\alpha]_D^{22}$ –62.4 (c 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3291, 2968, 1635, 1534, 1339, 1301, 1153, 1011, 803, 697 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.86 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 1.77–1.94 (m, 2H, CH$_3$CH_2), 5.12–5.18 (m, 1H, CHNH), 6.14 (d, 1H, J = 3.0 Hz, CHCO), 6.23 (dd, 1H, J = 1.6, 3.0 Hz, CHCHO), 6.44–6.48 (br, 1H, NH), 7.25–7.26 (m, 1H, arom CH), 7.29–7.33 (m, 2H, arom CH), 7.37–7.41 (m, 1H, arom CH), 7.68–7.71 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 10.84 (CH$_3$CH$_2$), 27.56 (CH$_3C$H$_2$), 49.37 (CHN), 106.79, 110.42,

127.22, 128.73, 131.69 (arom *C*H), 134.64 (arom *C*), 142.03 (arom *C*H), 154.38 (arom *C*), 166.87 (*C* =O) ppm.

MS (EI, 70 eV): m/z (%) = 230 (5) [$M^{+\bullet}$+1], 229 (31) [$M^{+\bullet}$], 200 (34), 106 (8), 105 (42), 77 (27).

Anal. Calcd for $C_{14}H_{15}NO_2$: C, 73.34; H, 6.59; N, 6.11. Found: C, 73.11; H, 6.79; N, 6.03.

2.16. (1*S*)-*N*-(1-benzofuran-2-yl-propyl)-benzamide (4k)

A solution of benzoyl protected hydrazine **3k** (392 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:3) **4k** was obtained as a colorless solid (238 mg, 85%). *ee* = 97%; mp 132–134 °C; $[\alpha]_D^{22}$ −85.4 (*c* 0.9, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3291, 1633, 1600, 1578, 1527, 1487, 1452, 1341, 1290, 1255, 1157, 805, 754, 695 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.89 (t, 3H, J = 7.4 Hz, CH_3CH_2), 1.83–2.00 (m, 2H, CH_3CH_2), 5.23–5.29 (m, 1H, CHN), 6.50 (s, 3H, arom CH), 6.71 (d, 1H, J = 8.8 Hz, NH), 7.07–7.16 (m, 2H, arom CH), 7.24–7.41 (m, 3H, arom CH) 7.69–7.71 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 10.76 (CH_3CH_2), 27.26 (CH_2CHN), 49.73 (*C*HN), 103.69, 111.36, 121.24, 123.06, 124.27, 127.34 (arom *C*H), 128.42 (arom *C*), 128.79, 131.85 (arom *C*H), 134.52, 155.00, 157.16 (arom *C*), 167.20 (*C* =O) ppm.

MS (EI, 70 eV): m/z (%) = 280 (7) [$M^{+\bullet}$+1], 279 (33) [$M^{+\bullet}$], 251 (5), 250 (34), 158 (5), 106 (8), 105 (100), 77 (33).

Anal. Calcd for $C_{18}H_{17}NO_2$: C, 77.40; H, 6.13; N, 5.01. Found: C, 77.29; H, 6.08; N, 4.93.

2.17. (1*S*)-*N*-(1-Thiophen-2-yl-propyl)-acetamide (4l)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et_2O (20 mL) was added hydrazone **2a** (340 mg, 2.0 mmol) dissolved in Et_2O (4 mL) according to GP2. After cleavage of the chiral auxiliary, the crude amine was dissolved in CH_2Cl_2 (10 mL) in the presence of 2 equiv of Et_3N and a catalytic amount of DMAP. The resulting mixture was cooled to 0 °C and 2 mmol of acetylchloride was added dropwise and the reaction was allowed to reach rt. After stirring for 12 h at rt, the reaction mixture was poured in water (10 mL) and extracted with CH_2Cl_2 (3 times); the organic layer was dried over $MgSO_4$ and evaporated under reduced pressure. Crystallization from Et_2O afforded **4l** (275 mg, 75%) as a colorless solid. *ee* = 99%; mp 126–127 °C; $[\alpha]_D^{22}$ –149.8 (*c* 0.2, $CHCl_3$), lit.[15d] $[\alpha]_D^{22}$ –148.0 (*c* 0.14, $CHCl_3$). The rest of the analytical data are in agreement with those reported in the literature.[15d]

2.18. (1*S*)-(1-Thiophen-2-yl-pentyl)-carbamic acid benzyl ester (5a)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et_2O (20 mL) was added hydrazone **2b** (396 mg, 2.0 mmol) dissolved in Et_2O (4 mL) according to GP2. After cleavage of the chiral auxiliary, purification by column chromatography (Et_2O:pentane 1:4) gave **5a** (425 mg, 70%) as a colorless solid. *ee* = 94%; mp 56–57 °C; $[\alpha]_D^{22}$ –48.0 (*c* 2.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3336, 2951, 2936, 2885, 2857, 1688, 1527, 1465, 1455, 1433, 1333, 1300, 1286, 1248, 1225, 1140, 1123, 1102, 1045, 1028, 1011, 749, 701, 650 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.12 (t, 3H, J = 7.0 Hz, CH_3CH$_2$), 1.50–1.66 (m, 4H, CH$_3$CH_2CH_2), 2.08–2.13 (m, 2H, CH_2CH), 5.21–5.39 (m, 4H, CHN, NH, CH_2OC=O), 7.16–7.19 (m, 2H, arom CH), 7.42–7.44 (m, 1H, arom CH), 7.51–7.57 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.46 (CH$_3$), 22.84 (CH$_3$CH_2), 28.71 (CH$_3$CH$_2C$H$_2$), 37.37 (CH$_2$CH), 51.53 (CHN), 67.35 (CH$_2$OC=O), 124.57, 124.70, 127.28, 128.64, 129.03, (arom CH), 136.92, 147.17 (arom C), 156.14 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 303 (1) [M$^{+\bullet}$], 246 (12), 212 (65), 202 (20), 168 (11), 97 (7), 92 (8), 91 (100), 84 (5), 65 (6).

Anal. Calcd for $C_{17}H_{21}NO_2S$: C, 67.29; H, 6.97; N, 4.61. Found: C, 67.21; H, 6.82; N, 4.56.

2.19. (1*S*)-(3-Phenyl-1-thiophen-2-yl-propyl)-carbamic acid benzyl ester (5b)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et$_2$O (20 mL) was added hydrazone **2c** (492 mg, 2.0 mmol) dissolved in Et$_2$O (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et$_2$O:pentane 1:2) gave **5b** (585 mg, 83%) as a colorless solid. *ee* = 95%; mp 56–57 °C; $[\alpha]_D^{22}$ –36.5 (c 1.4, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3312, 3029, 2944, 1684, 1538, 1497, 1453, 1436, 1326, 1282, 1261, 1250, 1134, 1051, 1028, 750, 698, 657, 575 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.10–2.22 (m, 2H, CH$_2$CH_2), 2.60–2.73 (m, 2H, PhCH_2), 5.03–5.28 (m, 4H, NH, CHNH, CH_2OC=O), 6.93–6.96 (m, 2H, arom CH), 7.14–7.35 (m, 11H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 32.78 (PhCH$_2$), 39.13 (CH$_2C$H$_2$), 51.09 (CHN), 67.23 (CH$_2$OC=O), 124.56, 124.74, 126.32, 127.09, 128.40, 128.61, 128.71, 128.76 (arom CH), 136.54, 141.23, 146.02 (arom C), 155.74 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 351 (1) [M$^{+\bullet}$], 260 (28), 202 (7), 199 (14), 156 (6), 92 (8), 91 (100), 65 (6).

Anal. Calcd for $C_{21}H_{21}NO_2S$: C, 71.76; H, 6.03; N, 3.99. Found: C, 71.72; H, 6.00; N, 3.76.

2.20. (1S)-(2,2-Dimethyl-1-thiophen-2-yl-propyl)-carbamic acid benzyl ester (5c)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et$_2$O (20 mL) was added hydrazone **2d** (396 mg, 2.0 mmol) dissolved in Et$_2$O (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et$_2$O:pentane 1:3) gave **5c** (345 mg, 57%) as a colorless solid. *ee* = 93%; mp 59–60 °C; $[\alpha]_D^{22}$ –8.1 (c 1.5, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3331, 2965, 2869, 1707, 1526, 1510, 1477, 1465, 1455, 1398, 1367, 1332, 1239, 1110, 1055, 1007, 777, 736, 697 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.23 (s, 9H, CH_3C), 5.10 (d, 1H, J = 9.9 Hz, CHNH), 5.28 (d, 1H, J = 12 Hz CHHOC=O), 5.35 (d, 1H, J = 12 Hz CHHOC=O), 5.45–5.48 (br, 1H, NH), 7.15–7.20 (m, 2H, arom. CH), 7.42 (dd, 1H, J = 1.4, 5.0 Hz, arom CH), 7.57–7.69 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 27.13 (CH$_3$), 35.67 (CH$_3C$), 60.71 (CHN), 67.49 (CH$_2$OC=O), 124.27, 126.45, 126.85, 128.74, 129.06, (arom CH), 136.84, 144.09 (arom C), 156.41 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 303 (4) [M$^{+\bullet}$], 247 (7), 246 (46), 202 (23), 92 (8), 91 (100), 65 (5).

Anal. Calcd for $C_{17}H_{21}NO_2S$: C, 67.29; H, 6.97; N, 4.61. Found: C, 67.29; H, 7.16; N, 4.59.

2.21. (1*S*)-(2-Methyl-1-thiophen-2-yl-propyl)-carbamic acid benzyl ester (5d)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et_2O (20 mL) was added hydrazone **2e** (368 mg, 2.0 mmol) dissolved in Et_2O (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et_2O:pentane 1:2) gave **5d** (422 mg, 73%) as a colorless oil. *ee* = 93%; $[\alpha]_D^{22}$ –43.3 (*c* 1.2, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3321, 2957, 2934, 2870, 1688, 1540, 1466, 1455, 1331, 1309, 1273, 1242, 1024, 747, 697 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.19 (t, 6H, *J* = 7.7 Hz, CH_3CH), 2.29–2.35 (m, 1H, CH_3CH), 5.06–5.11 (m, 1H, CHN), 5.30–5.41 (m, 3H, NH, CH_2OC=O), 7.15–7.20 (m, 2H, arom CH), 7.43 (dd, 1H, *J* = 1.1, 5.0 Hz, arom CH), 7.51–7.58 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 18.78, 20.17 (CH_3), 34.87 (CH_3CH), 57.41 (*C*HN), 67.43 (CH_2OC=O), 124.42, 125.02, 127.23, 128.67, 129.05, (arom *C*H), 136.92, 146.12 (arom *C*), 156.45 (*C* =O) ppm.

MS (EI, 70 eV): *m*/*z* (%) = 289 (3) [$M^{+\bullet}$], 246 (53), 202 (27), 198 (9), 92 (8), 91 (100).

Anal. Calcd for $C_{16}H_{19}NO_2S$: C, 66.41; H, 6.62; N, 4.84. Found: C, 66.16; H, 6.98; N, 4.77.

2.22. (1*S*)-(2-Ethyl-1-thiophen-2-yl-butyl)-carbamic acid benzyl ester (5e)

To a solution of 2-lithio-thiophene (6.4 mmol) in Et_2O (20 mL) was added hydrazone **2f** (424 mg, 2.0 mmol) dissolved in Et_2O (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et_2O:pentane 3:7) gave **5e** (495 mg, 78%) as a colorless solid. *ee* = 94%; mp 59–60 °C; $[\alpha]_D^{22}$ –43.7 (*c* 2.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3361, 2965, 2939, 2875, 1690, 1522, 1456, 1316, 1267, 1252, 1227, 1134, 1022, 746, 712, 699 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.86–0.95 (m, 6H, CH_3CH_2), 1.19–1.49 (m, 4H, CH_3CH_2), 1.58–1.63 (m, 1H, CHCHN), 5.00–5.17 (m, 4H, NH, CHNH, CH_2OC=O), 6.90–6.93 (m, 1H, arom CH), 6.94 (dd, 1H, *J* = 3.5, 5.0 Hz, arom CH), 7.18 (dd, 1H, *J* = 1.1, 5.0 Hz, arom CH) 7.26–7.35 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.67, 11.70 (CH_3), 21.93, 22.74 (CH_3CH_2), 47.43 (*C*HCHN), 53.40 (*C*HN), 67.13 (CH_2OC=O), 124.12, 126.63, 127.02, 128.37, 128.78, (arom *C*H), 136.82, 146.62 (arom *C*), 156.30 (*C* =O) ppm.

MS (EI, 70 eV): *m*/*z* (%) = 317 (4) [$M^{+\bullet}$], 247 (5), 246 (32), 226 (6), 202 (24), 92 (8), 91 (100).

Anal. Calcd for $C_{18}H_{23}NO_2S$: C, 68.10; H, 7.30; N, 4.41. Found: C, 67.96; H, 7.45; N, 4.45.

2.23. (1*S*)-(Ferrocenyl-thiophen-2-yl-methyl)-carbamic acid benzyl ester (5f)

To a solution of 2-lithio-thiophene (3.2 mmol) in Et_2O (10 mL) was added hydrazone **2g** (326 mg, 1.0 mmol) dissolved in Et_2O (2 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et_2O:pentane 1:6) gave **5f** (210 mg, 49%) as an orange solid. *ee* ≥ 95% (based on ^1H NMR of the corresponding hydrazine); mp 85–87 °C; $[\alpha]_D^{22}$ –38.8 (*c* 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3355, 1693, 1514, 1227, 1019, 819, 751, 698, 485 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 4.10–4.56 (m, 9H, CH Fc), 5.16 (d, 1H, *J* = 12.3 Hz, CHHOC=O),

5.24 (d, 1H, J = 12.3 Hz CHHOC=O), 5.56–5.59 (br 1H, CHN), 5.97–6.00 (br, 1H, NH), 6.95–6.98 (m, 2H, arom CH), 7.23–7.28 (m, 1H, arom CH), 7.38–7.42 (m, 5H, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 50.26 (CHN), 66.89 (CH, Fc), 67.13 (CH$_2$O), 67.29, 68.10, 68.16, 69.03 (CH, Fc), 90.34 (C, Fc), 124.31, 125.05, 126.43, 128.17, 128.54 (arom CH), 136.45, 146.15 (arom C), 155.25 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 433 (9) [M$^{+\bullet}$+2], 432 [M$^{+\bullet}$+1], 431 (100) [M$^{+\bullet}$], 429 (7), 296 (12), 230 (8), 226 (11), 217 (9), 212 (19), 160 (7), 121 (11), 91 (13), 56 (6).

Anal. Calcd for $C_{23}H_{21}FeNO_2S$: C, 64.04; H, 4.91; N, 3.25. Found: C, 64.34; H, 5.21; N, 3.16.

2.24. (1*S*)-[1-(1-Methyl-1*H*-pyrrol-2-yl)-pentyl]-carbamic acid benzyl ester (5g)

To a solution of 2-lithio-1-methylpyrrole (6.4 mmol) in THF (20 mL) was added hydrazone **2b** (396 mg, 2.0 mmol) dissolved in THF (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et$_2$O:pentane 1:2) gave **5g** (210 mg, 35%) as a colorless solid. *ee* = 92%; mp 67–68 °C; $[\alpha]_D^{22}$ –65.3 (c 1.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3313, 2950, 2925, 2869, 2858, 1682, 1532, 1466, 1412, 1335, 1298, 1247, 1231, 1100, 1047, 1009, 750, 721, 697, 669 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.89 (t, 3H, J = 7.4 Hz, CH_3CH$_2$), 1.32–1.40 (m, 4H, CH$_3$CH_2CH_2), 1.78–1.95 (m, 2H, CH_2CHN), 3.55 (s, 3H, NCH_3), 4.69–4.82 (m, 2H, CHN, NH), 5.09 (s, 2H, CH_2OC=O), 6.02–6.05 (m, 2H, arom CH,), 6.56–6.57 (m, 1H, arom CH), 7.27–7.33 (m, 5H, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 14.28 (CH$_3$CH$_2$), 22.76 (CH$_3$$CH_2$), 28.73 (CH$_3CH_2$$CH_2$), 34.07 (N$CH_3$), 35.14 ($CH_2$CHN), 47.27 ($C$HN), 66.92 ($CH_2$OC=O), 105.86, 106.93, 122.79, 128.26, 128.36, 128.76 (arom CH), 133.45, 136.85, (arom C), 155.90 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 301 (7) [M$^{+\bullet}$+1], 300 (36) [M$^{+\bullet}$], 244 (6), 243 (40), 209 (13), 199 (30), 165 (12), 107 (8), 94 (8), 92 (8), 91 (100), 82 (15).

Anal. Calcd for $C_{18}H_{24}N_2O_2$: C, 71.97; H, 8.05; N, 9.32. Found: C, 71.72; H, 7.69; N, 9.08.

2.25. (1*S*)-[1-(1-Methyl-1*H*-pyrrol-2-yl)-3-phenyl-propyl]-carbamic acid benzylester (5h)

To a solution of 2-lithio-1-methylpyrrole (6.4 mmol) in THF (20 mL) was added hydrazone **2c** (492 mg, 2.0 mmol) dissolved in THF (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et$_2$O:pentane 1:2) gave **5h** (250 mg, 36%) as a colorless solid. *ee* = 99%; mp 92–93 °C; $[\alpha]_D^{22}$ –48.1 (c 2.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3309, 1681, 1535, 1495, 1454, 1331, 1297, 1255, 1244, 1045, 1029, 754, 720, 699 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.12–2.29 (m, 2H, CH$_2$CH_2CH), 2.80 (t, 2H, J = 8.3 Hz, PhCH_2), 3.57 (s, 3H, NCH_3), 4.89–4.93 (m, 2H, CHN, NH), 5.19 (s, 2H, CH_2OC=O), 6.13–6.15 (m, 2H, arom CH), 6.63–6.64 (m, 1H, arom CH), 7.18–7.44 (m, 10 H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 33.13 (PhCH$_2$), 34.19 (NCH$_3$), 37.26 (CH$_2$CH), 47.14 (CHN), 67.11 (CH$_2$OC=O), 106.14, 107.16, 122.95, 126.28, 128.33, 128.44, 128.73, 128.82 (arom CH), 132.92, 136.83, 141.76 (arom C), 155.84 (C=O) ppm.

MS (EI, 70 eV): m/z (%) = 349 (11) [M$^{+\bullet}$+1], 348 (46) [M$^{+\bullet}$], 257 (11), 243 (33), 213 (11), 199 (29),

107 (6), 92 (7), 91 (100), 82 (8), 65 (5).

Anal. Calcd for $C_{22}H_{24}N_2O_2$: C, 75.83; H, 6.94; N, 8.04. Found: C, 75.41; H, 6.72; N, 7.86.

2.26. (1*S*)-[2,2-Dimethyl-1-(1-methyl-1*H*-Pyrrol-2-yl)-propyl]-carbamic acid benzyl ester (5i)

To a solution of 2-lithio-1-methylpyrrole (6.4 mmol) in THF (20 mL) was added hydrazone **2d** (396 mg, 2.0 mmol) dissolved THF (in 4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et_2O:pentane 1:2) gave **5i** (150 mg, 25%) as a colorless oil. *ee* = 88%; $[\alpha]_D^{22}$ –18.6 (*c* 1.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3332, 3032, 2958, 2871, 1713, 1511, 1455, 1419, 1394, 1365, 1325, 1304, 1234, 1125, 1091, 1050, 1028, 1007, 915, 774, 753, 698, 678, 610 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.96 (s, 9H, $(CH_3)_3C$), 3.64 (s, 3H, NCH_3), 4.65 (d, 1H, *J* = 9.6 Hz, CHN), 5.01–5.15 (m, 3H, NH, $CH_2OC{=}O$), 5.97 (dd, 1H, *J* = 1.6, 3.6 Hz, arom CH,), 6.06 (t, 1H, *J* = 3.6 Hz arom CH), 6.50–6.52 (m, 1H, arom CH), 7.27–7.33 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 26.79 (CH_3C), 34.79 (NCH_3), 36.57 ($CCHN$), 55.50 (CHN), 67.19 ($CH_2OC{=}O$), 106.14, 106.95, 121.59, 128.37, 128.41, 128.75 (arom CH), 132.92, 136.61, (arom *C*), 156.33 ($C{=}O$) ppm.

MS (EI, 70 eV): *m/z* (%) = 300 (10) [$M^{+\bullet}$], 244 (14), 243 (90), 200 (5), 199 (39), 172 (12), 135 (7), 107 (7), 92 (9), 91 (100).

Anal. Calcd for $C_{18}H_{24}N_2O_2$: C, 71.97; H, 8.05; N, 9.32. Found: C, 71.74; H, 8.16; N, 9.01.

2.27. (1*S*)-[2-Ethyl-1-(1-methyl-1*H*-pyrrol-2-yl)-butyl]-carbamic acid benzyl ester (5j)

To a solution of 2-lithio-1-methylpyrrole (6.4 mmol) in THF (20 mL) was added hydrazone **2e** (424 mg, 2.0 mmol) dissolved in THF (4 mL) according to GP2. After cleavage of the chiral auxiliary purification by column chromatography (Et_2O:pentane 1:2) gave **5j** (333 mg, 53%) as a colorless oil. *ee* = 90%; $[\alpha]_D^{22}$ –27.7 (*c* 1.5, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3338, 2961, 2933, 2875, 1702, 1530, 1456, 1329, 1298, 1253, 1136, 1092, 1021, 736, 698 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.89 (t, 6H, *J* = 7.4 Hz, CH_3CH_2), 1.69–1.86 (m, 4H, CH_3CH_2), 3.44 (s, 3H, NCH_3), 4.58–4.72 (m, 2H, CHN, NH), 4.99 (s, 2H, $CH_2OC{=}O$), 5.91–5.95 (m, 2H, arom CH), 6.44–6.45 (m, 1H, arom CH), 7.17–7.26 (m, 5H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.40 (CH_3CH_2), 28.51 (CH_3CH_2), 34.16 (NCH_3), 48.91 (CHN), 66.98 ($CH_2OC{=}O$), 105.94, 106.97, 122.80, 128.24, 128.33, 128.74 (arom CH), 133.17, 136.86, (arom *C*), 155.92 ($C{=}O$) ppm.

MS (EI, 70 eV): *m/z* (%) = 314 (14) [$M^{+\bullet}$], 244 (16), 243 (99), 199 (41), 172 (10), 107 (7), 94 (5), 92 (8), 91 (100).

Anal. Calcd for $C_{19}H_{26}N_2O_2$: C, 72.58; H, 8.33; N, 8.91. Found: C, 73.03; H, 8.55; N, 8.90.

2.28. (*S*)-*N*-(1-Furan-2-yl-pentyl)-benzamide (7a)

A solution of hydrazine **6a** (370 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 2:3) **7a** was obtained as a colorless solid (215 mg, 84%). *ee* = 96%; mp 95–96 °C; $[\alpha]_D^{22}$ –60.0 (*c* 1.2, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3297, 2954, 2932, 2856, 1635, 1579, 1537, 1465, 1382, 1340, 1308, 1222, 1183, 1151, 1077, 1008, 802, 731, 696 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.81 (t, 3H, *J* = 7.0 Hz, C*H*$_3$CH$_2$), 1.21–1.31 (m, 4H, CH$_3$C*H*$_2$C*H*$_2$), 1.81–1.89 (C*H*$_2$CHN), 5.20–5.27 (m, 1H, C*H*N), 6.10 (dt, 1H, *J* = 0.8, 3.0 Hz, C*H*CHCO), 6.21 (dd, 1H, *J* = 1.6, 3.0 Hz, C*H*CHO), 6.40–6.44 (br, 1H, N*H*), 7.27 (dd, 1H, *J* = 0.8, 1.6 Hz, arom C*H*), 7.31–7.36 (m, 2H, arom C*H*), 7.39–7.43 (m, 1H, arom C*H*), 7.69–7.71 (m, 2H, arom C*H*) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.33 (*C*H$_3$CH$_2$), 22.74 (CH$_3$*C*H$_2$), 28.44 (CH$_3$CH$_2$*C*H$_2$), 34.16 (*C*H$_2$CHN), 47.96 (*C*HN), 106.55, 110.41, 127.20, 128.72, 131.69 (arom *C*H), 134.64 (arom *C*), 141.97 (arom *C*H), 154.63 (arom *C*), 166.74 (*C*=O) ppm.

MS (EI, 70 eV) *m*/*z* (%) = 257 (7) [$M^{+\bullet}$], 200 (14), 106 (8), 105 (100), 77 (28).

Anal. Calcd for $C_{16}H_{19}NO_2$: C, 74.68; H, 7.44; N, 5.44. Found: C, 74.41; H, 7.42; N, 5.42.

2.29. (*S*)-*N*-(1-Furan-2-yl-3-phenyl-propyl)-benzamide (7b)

A solution of hydrazine **6b** (420 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:2) **7b** was obtained as a colorless solid (245 mg, 80%). *ee* = 96%; mp 120–121 °C; $[\alpha]_D^{22}$ –34.8 (*c* 1.2, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3309, 1631, 1577, 1523, 1488, 1341, 1283, 744, 697 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.12–2.20 (m, 2H, C*H*$_2$CHN), 2.50–2.63 (m, 2H, PhC*H*$_2$), 5.24–5.31 (m, 1H, C*H*NH), 6.12 (d, 1H, *J* = 3.3 Hz, C*H*CHCO), 6.21 (dd, 1H, *J* = 1.9, 3.3 Hz, C*H*CHO), 6.60–6.63 (br, 1H, N*H*), 7.05–7.08 (m, 3H, arom C*H*), 7.14–7.17 (m, 2H, arom C*H*), 7.22–7.28 (m, 3H, arom CH), 7.33–7.37 (m, 1H, arom C*H*), 7.61–7.63 (m, 2H, arom C*H*) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 32.68 (PhC*H*$_2$CH$_2$), 35.88 (CH$_2$*C*H$_2$), 47.88 (*C*HN), 106.86, 110.51, 126.24, 127.29, 128.62, 128.69, 128.71, 131.72 (arom *C*H), 134.52, 141.50 (arom *C*), 142.13 (arom *C*H), 154.31 (arom *C*), 166.88 (*C*=O) ppm.

MS (EI, 70 eV) *m*/*z* (%) = 306 (8) [$M^{+\bullet}$+1], 305 (37) [$M^{+\bullet}$], 214 (18), 201 (12), 200 (16), 184 (5), 105 (100), 91 (8), 77 (24).

Anal. Calcd for $C_{20}H_{19}NO_2$: C, 78.66; H, 6.27; N, 4.58. Found: C, 78.56; H, 6.11; N, 4.50.

2.30. (*S*)-*N*-(1-Furan-2-yl-2,2-dimethyl-propyl)-benzami de (7c)

A solution of hydrazine **6c** (370 mg, 1 mmol) in THF (5 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:3) **7c** was obtained as a colorless solid (195 mg, 76%). *ee* = 99%, mp 87–89 °C; $[\alpha]_D^{22}$ –43.1 (*c* 1.3, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3325, 2966, 1638, 1603, 1578, 1544, 1503, 1448, 1473, 1334, 1148, 1010, 725, 691, 658 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (s, 9H, C*H*$_3$C), 5.08 (d, *J* = 9.9 Hz, 1H, C*H*N), 6.10 (d, 1H,

J = 3.3 Hz, CHCHCO), 6.21 (dd, 1H, J = 1.9, 3.3 Hz, CHCHO), 6.62–6.64 (br, 1H, NH), 7.23–7.24 (m, 1H, arom CH), 7.29–7.33 (m, 2H, arom CH), 7.35–7.40 (m, 1H, arom CH), 7.67–7.70 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 27.07 (CH$_3$C), 36.27 (CH$_3$$C$), 56.04 ($C$HN), 107.80, 110.28, 127.19, 128.78, 131.69 (arom CH), 134.90 (arom C), 141.61 (arom CH), 153.28 (arom C), 166.86 (C=O) ppm.

MS (EI, 70 eV) m/z (%) = 257 (8) [M$^{+\bullet}$], 201 (22), 200 (87), 106 (7), 105 (100), 77 (22), 50 (5).

Anal. Calcd for $C_{16}H_{19}NO_2$: C, 74.68; H, 7.44; N, 5.44. Found: C, 74.54; H, 7.67; N, 5.42.

2.31. (1*S*,2*R*)-*N*-(1-Furan-2-yl-2-methyl-pentyl)-benzami de (7d)

A solution of hydrazine **6d** (384 mg, 1.0 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:4) **7d** was obtained as a colorless solid (217 mg, 80%). *ee* = 99%, *de* $\geq$ 96%; mp 95–96 °C; $[\alpha]_D^{22}$ –45.3 (c 1.0, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3350, 2957, 2930, 2871, 1634, 1579, 1524, 1487, 1463, 1329, 1289, 1148, 1013, 805, 736, 716, 691 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.79 (t, 3H, J = 6.9 Hz, CH_3CH$_2$), 0.90 (d, 2H, J = 6.9 Hz, CH_3CH), 1.00–1.35 (m, 4H, CH$_3$CH_2CH_2), 2.01–2.08 (m, 1H, CHCH$_3$), 5.23 (dd, 1H, J = 6.7, 9.4 Hz, CHN), 6.12 (dt, 1H, J = 0.7, 3.2 Hz, CHCHCO), 6.23 (dd, 1H, J = 1.7, 3.2 Hz, CHCHO), 6.39 (d, 1H, J = 9.4 Hz, NH), 7.26 (dd, 1H, J = 0.7, 1.7 Hz, arom CH), 7.32–7.44 (m, 3H, arom CH), 7.69–7.72 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.62 (CH$_3$CH$_2$), 16.03 (CH$_3$CH), 20.59 (CH$_3$$CH_2$), 35.89 (CH$_3CH_2$$CH_2$), 37.25 ($CHCH_3$), 52.34 ($C$HN), 106.93, 110.02, 127.17, 128.81, 131.74 (arom CH), 134.80 (arom C), 141.80 (arom CH), 154.06 (arom C), 166.88 (C=O) ppm.

MS (EI, 70 eV) m/z (%) = 271 (11) [M$^{+\bullet}$], 233 (10), 201 (10), 200 (77), 106 (7), 105 (100), 77 (23).

Anal. Calcd for $C_{17}H_{21}NO_2$: C, 75.25; H, 7.80; N, 5.16. Found: C, 75.00; H, 7.99; N, 5.07.

2.32. (1*S*)-*N*-(1-Furan-2-yl-ethyl)-benzamide (7e)

A solution of hydrazine **6e** (328 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:1) **7e** was obtained as a colorless solid (195 mg, 90 %). *ee* = 98%; mp 105–106; $[\alpha]_D^{22}$ –53.4 (c 1.3, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3339, 1636, 1578, 1520, 1485, 1316, 1151, 1008, 925, 813, 740, 720, 695 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.51 (d, 3H, J = 6.9 Hz, CH_3CH), 5.30–5.42 (m, 1H, CHN), 6.16 (dt, 1H, J = 0.7, 3.2 Hz, CHCHCO), 6.25 (dd, 1H, J = 1.7, 3.2 Hz, CHCHO), 6.31–6.34 (br, 1H, NH), 7.29 (dd, 1H, J = 0.7, 1.7 Hz, arom CH), 7.30–7.44 (m, 3H, arom CH), 7.68–7.71 (m, 2H, arom CH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.10 (CH$_3$CH), 43.78 (CHN), 106.05, 110.50, 127.18, 128.76, 131.74 (arom CH), 134.59 (arom C), 142.18 (arom CH), 155.45 (arom C), 166.40 (C=O) ppm.

MS (EI, 70 eV) m/z (%) = 216 (6) [M$^{+\bullet}$+1], 215 (40) [M$^{+\bullet}$], 189 (5), 106 (8), 105 (100), 95 (11), 94 (10), 77 (29), 50 (12).

Anal. Calcd for $C_{13}H_{13}NO_2$: C, 72.54; H, 6.09; N, 6.51. Found: C, 72.54; H, 6.26; N, 6.46.

2.33. (*S*)-*N*-[4-(*tert*-Butyl-dimethyl-silanyloxy)-1-furan-2-yl-butyl]-benzamide (7f)

A solution of hydrazine **6f** (486 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 3:7, then AcOEt) 2 products were obtained: **7f** (150 mg, 40%) and **7f1** (52 mg, 20%) as colorless solids. *ee* = 90%; mp 102–104 °C; $[\alpha]_D^{22}$ –40.0 (*c* 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3316, 2953, 2931, 2886, 2859, 1635, 1604, 1580, 1538, 1492, 1470, 1304, 1254, 1098, 1008, 838, 776, 733, 695 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 0.01 (s, 6H, CH_3Si), 0.89 (s, 9H, $(CH_3)_3CSi$), 1.53–1.71 (m, 2H, CH_2CH_2OSi), 1.95–2.07 (m, 2H. CH_2CHNH), 3.66 (dt, 2H, *J* = 1.4, 6.3 Hz, CH_2OSi), 5.30–5.38 (m, 1H, CHN), 6.25 (d, 1H, *J* = 3.3 Hz, $CHCHCO$), 6.30 (dd, 1H, *J* = 1.9, 3.3 Hz, $CHCHO$), 6.49 (d, 1H, *J* = 8.2 Hz, NH), 7.36–7.52 (m, 4H, arom CH), 7.76–7.79 (m, 2H, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = –5.29, –5.27 (CH_3Si), 18.35 (CSi), 25.98 (CH_3CSi), 29.17 (CH_2CH_2OSi), 30.55 (CH_2CHNH), 47.52 (CHN), 62.69 (CH_2OSi), 106.39, 110.23, 127.02, 128.56, 131.51 (arom *C*H), 134.55 (arom *C*), 141.86 (arom *C*H), 154.44 (arom *C*), 166.65 (*C*=O) ppm.

MS (EI, 70 eV) *m*/*z* (%) = 373 (2) [$M^{+\bullet}$], 316 (19), 269 (12), 268 (59), 195 (12), 180 (5), 179 (15), 178 (100), 165 (13), 136 (30), 135 (7), 121 (8), 105 (40), 77 (17), 75 (18).

Anal. Calcd for $C_{21}H_{31}NO_3Si$: C, 67.52; H, 8.36; N, 3.75. Found: C, 67.63; H, 8.36; N, 3.77.

2.34. (*S*)-*N*-(1-Furan-2-yl-4-hydroxy-butyl)-benzamide (7f1)

ee = 90%; mp 100–102 °C; $[\alpha]_D^{22}$ –48.8 (*c* 0.8, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3292, 3058, 2946, 2924, 1632, 1530, 1488, 1055, 1007 741, 700 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.55–1.68 (m, 2H, CH_2CH_2OH), 2.01 (q, 2H, *J* = 7.4 Hz, CH_2CHNH), 2.80–2.90 (br, 1H, OH), 3.64 (t, 2H, *J* = 6.2 Hz, CH_2OH), 5.28–5.37 (m, 1H, CHN), 6.21 (d, 1H, *J* = 3.2 Hz, $CHCHCO$), 6.29 (dd, 1H, *J* = 2.0, 3.2 Hz, $CHCHO$), 6.90–6.95 (br, 1H, NH), 7.32–7.48 (m, 4H, arom CH), 7.74–7.78 (m, 2H, arom CH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 28.67 (CH_2CH_2OH), 30.52 (CH_2CHNH), 47.49 (CHN), 62.06 (CH_2OSi), 106.46, 110.25, 127.08, 128.51, 131.57 (arom *C*H), 134.22 (arom *C*), 141.89 (arom *C*H), 154.23 (arom *C*), 167.04 (*C*=O) ppm.

MS (EI, 70 eV) *m*/*z* (%) = 259 (4) [$M^{+\bullet}$], 200 (16), 155 (5), 154 (60), 138 (6), 106 (8), 105 (100), 77 (26).

Anal. Calcd for $C_{15}H_{17}NO_3$: C, 69.48; H, 6.61; N, 5.40. Found: C, 69.11; H, 6.57; N, 5.40.

2.35. (1*R*)-*N*-(1-Furan-2-yl-ethyl)-benzamide [(*R*)-7e]

A solution of hydrazine **6g** (328 mg, 1 mmol) in THF (10 mL) was treated with 2 equiv of SmI_2 (0.1 M in THF) and an equimolar amount of DMPU according to GP4. After work-up and flash chromatography (Et_2O:pentane 1:1) **7g** was obtained as a colorless solid (175 mg, 81%). *ee* = 98%; mp 105–106 °C; $[\alpha]_D^{22}$ –52.9 (*c* 0.8, $CHCl_3$).

Anal. Calcd for $C_{13}H_{13}NO_2$: C, 72.54; H, 6.09; N, 6.51. Found: C, 72.36; H, 6.18; N, 6.45.

2.36. (*S*)-2-Benzoylamino-hexanoic acid (8a)

Benzamide **7a** (150 mg, 0.58 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (2.6 mg, 2 mol %) and $NaIO_4$ (1.87 g, 8.75 mmol) in 20 mL of a CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) mixture, according to GP5. After work-up and purification by flash chromatography (CH_2Cl_2:MeOH 9:1), **8a** (96 mg, 70%) was obtained as a colorless solid. *ee* = 96%; mp 95–96; $[\alpha]_D^{22}$ –26.3 (*c* 1.4, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3427, 3322, 3065, 2974, 1727, 1647, 1577, 1531, 1489, 1345, 1215, 1161, 1074, 758, 714, 692, 667 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.88 (t, 3H, J = 7.1 Hz, CH_3CH$_2$), 1.30–1.43 (m, 4H, CH$_3$CH_2CH_2), 1.76–1.86 (m, 1H, CHHCHN), 1.95–2.06 (m, 1H, CHHCHN), 4.79 (dt, 1H, J = 5.2, 7.4 Hz, CHN), 7.03 (d, 1H, J = 7.4 Hz, NH), 7.38–7.47 (m, 2H, arom CH), 7.47–7.51 (m, 1H, arom CH), 7.77–7.80 (m, 2H, arom CH), 9.75–9.85 (br, 1H, OH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 14.23 (CH$_3$CH$_2$), 22.69 (CH$_3C$H$_2$), 27.71 (CH$_3$CH$_2C$H$_2$), 32.21 (CH$_2$CHN), 53.18 (CHN), 127.41, 128.83, 132.20 (arom CH), 133.67 (arom C), 168.24 (C =O), 175.99 (COOH) ppm.

MS (EI, 70 eV) m/z (%) = 235 (2) [$M^{+\bullet}$], 190 (15), 179 (26), 161 (11), 148 (5), 106 (8), 105 (100), 77 (29), 51 (10), 45 (6).

HRMS: m/z calcd for $C_{13}H_{17}NO_3$: 235.1208. Found: 235.1299.

2.37. (*S*)-2-Benzoylamino-4-phenyl-butyric acid (8b)

Benzamide **7b** (200 mg, 0.65 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (2.9 mg, 2 mol %) and $NaIO_4$ (2.0 g, 9.75 mmol) in 20 mL of a CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) mixture according to GP5. After work-up and crystallization (CH_2Cl_2), **8b** was obtained as a colorless solid (167 mg, 90%). *ee* = 96%; mp 160–161 °C; $[\alpha]_D^{22}$ +29.5 (*c* 1.8, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3395, 1742, 1634, 1577, 1526, 1452, 1397, 1246, 1206, 753, 695 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.04–2.33 (m, 2H, CH_2CHN), 2.67 (t, 2H, J = 8.0 Hz, PhCH_2), 4.75–4.82 (m, 1H, CHNH), 6.78 (d, 1H, J = 7.7 Hz, NH), 7.09–7.43 (m, 8H, arom CH), 7.54–7.60 (m, 2H, arom CH), 9.90–10.21 (br, 1H, OH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 32.00 (PhCH$_2$CH$_2$), 33.71 (CH$_2C$H$_2$), 53.08 (CHN), 126.53, 127.43, 128.72, 128.89, 133.82 (arom CH), 133.55, 140.91 (arom C), 168.25 (C =O), 176.02 (COOH) ppm.

MS (EI, 70 eV) m/z (%) = 283 (2) [$M^{+\bullet}$], 180 (8), 179 (78), 162 (6), 161 (59), 148 (5), 133 (8), 122 (6), 106 (9), 105 (100), 91 (10), 77 (39), 57 (6), 51 (13).

HRMS: m/z calcd for $C_{17}H_{17}NO_3$ (M^+): 283.1208. Found: 283.1208.

2.38. (*S*)-2-Benzoylamino-3,3-dimethyl-butyric acid (8c)

Benzamide **7c** (150 mg, 0.58 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (2.6 mg, 2 mol %) and $NaIO_4$ (1.87 g, 8.75 mmol) in 20 mL of a CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) mixture, according to GP5. After work-up and crystallization (CH_2Cl_2), **8c** was obtained as a colorless solid (105 mg, 77%). *ee* = 98%; mp 128–130 °C; $[\alpha]_D^{22}$ +32.0 (*c* 1.4, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3425, 3361, 3065, 2967, 1724, 1643, 1578, 1527, 1488, 1371, 1337, 1218, 1174, 1088, 757, 714, 693 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.01 (s, 9H, CH_3C), 4.64 (d, 1H, J = 9.3 Hz, CHN), 6.71 (d, 1H, J = 9.3 Hz, NH), 7.34–7.38 (m, 2H, arom CH), 7.42–7.46 (m, 1H, arom CH), 7.70–7.73 (m, 2H, arom CH), 8.24–8.44 (br, 1H, OH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 26.88 (CH$_3$C), 35.28 (CH$_3$$C$), 60.67 ($C$HN), 127.35, 128.93, 132.18 (arom CH), 134.11 (arom C), 168.15 (C=O), 175.37 (COOH) ppm.

MS (EI, 70 eV) m/z (%) = 220 (1) [$M^{+\bullet}$–CH_3], 180 (9), 179 (89), 162 (10), 161 (100), 133 (10), 106 (9), 105 (91), 77 (29), 57 (20), 51 (7).

HRMS: m/z calcd for $C_{12}H_{14}NO_3$ (M^+–CH_3): 220.0974. Found: 220.0973.

2.39. (2*S*,3*R*)-2-Benzoylamino-3-methyl-hexanoic-acid (8d)

Benzamide **7d** (180 mg, 0.66 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (3 mg, 2 mol %) and $NaIO_4$ (2.13 g, 9.96 mmol) in 20 mL of a CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) mixture, according to GP5. After work-up and crystallization (CH_2Cl_2), **8d** (135 mg, 82%) was obtained as a colorless solid. *ee* = 99%, *de* ≥ 96%; mp 117–119 °C; $[\alpha]_D^{22}$ +39.5 (c 1.3, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3314, 3228, 3065, 2960, 2928, 2871, 1729, 1642, 1603, 1543, 1352, 1232, 1199, 1075, 862, 836, 737, 722, 691 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.82 (t, 3H, J = 7.1 Hz, CH_3CH$_2$), 0.90 (d, 2H, J = 6.9 Hz, CH_3CH), 1.08–1.45 (m, 4H, CH$_3$CH_2CH_2), 2.11–2.24 (m, 1H, CHCH$_3$), 4.82 (dd, 1H, J = 3.9, 8.7 Hz, CHN), 6.63 (d, 1H, J = 8.7 Hz, NH), 7.34–7.47 (m, 3H, arom CH), 7.70–7.74 (m, 2H, arom CH), 8.31–8.49 (br, 1H, OH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 14.30 (CH$_3$CH$_2$), 15.26 (CH$_3$CH), 20.52 (CH$_3$$CH_2$), 35.78 (CH$_3CH_2$$CH_2$), 35.96 ($CHCH_3$), 56.48 ($C$HN), 127.38, 128.89, 132.11 (arom CH), 134.26 (arom C), 168.19 (C=O), 176.35 (COOH) ppm.

MS (EI, 70 eV) m/z (%) = 249 (3) [$M^{+\bullet}$], 204 (15), 179 (37), 162 (8), 161 (42), 133 (5), 122 (16), 106 (8), 105 (100), 77 (35), 57 (7), 55 (5), 51 (15).

HRMS: m/z calcd for $C_{14}H_{19}NO_3$: 249.1364. Found: 249.1365.

2.40. (*S*)-*N*-Benzoylalanine (8e)

Benzamide **7e** (140 mg, 0.65 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (2.9 mg, 2 mol %) and $NaIO_4$ (2.09 g, 9.76 mmol) in 20 mL of CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) according to GP5. After work-up and crystallization (CH_2Cl_2), **8e** (108 mg, 86%) was obtained as a colorless solid. *ee* = 98%; mp 148–149 °C, $[\alpha]_D^{22}$ +29.1 (c 1.0, $CHCl_3$).

IR (KBr $\tilde{u}$ = 3409, 1727, 1632, 1576, 1550, 1491, 1460, 1411, 1338, 1218, 1171, 1129, 904, 707, 689, 624 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.54 (d, 3H, J = 7.1 Hz, CH_3CH), 4.72–4.79 (m, 1H, CHN), 6.91 (d, 1H, J = 6.9 Hz, NH), 7.38–7.53 (m, 3H, arom CH), 7.75–7.78 (m, 2H, arom CH), 8.42–8.50 (br, 1H, OH) ppm.

^{13}C NMR (75 MHz, $CDCl_3$): δ = 18.43 (CH_3CH), 48.96 (CHN), 127.40, 128.92, 132.30 (arom CH), 133.62 (arom C), 168.04 (C=O), 176.56 ($COOH$) ppm.

MS (EI, 70 eV) m/z (%) = 193 (8) [$M^{+\bullet}$], 149 (15), 148 (44), 106 (8), 105 (100), 77 (37), 51 (15), 45 (5).

HRMS: m/z calcd for $C_{10}H_{11}NO_3$: 193.0739. Found: 193.0739.

2.41. (*S*)-2-Benzoylamino-butyric acid (8f)

Benzamide **4j** (150 mg, 0.65 mmol) was added to a stirred solution of $RuCl_3 \cdot H_2O$ (2.9 mg, 2 mol %) and $NaIO_4$ (2.0 g, 9.75 mmol) in 20 mL of a CH_2Cl_2/MeCN/H_2O (1.0:0.04:0.7) mixture according to GP5. After work-up and flash chromatography (CH_2Cl_2:MeOH 9:1), **8f** was obtained as a colorless solid (117 mg, 86%). *ee* = 99%; mp 140–142 °C; $[\alpha]_D^{22}$ +20.5 (*c* 1.1, $CHCl_3$).

IR (KBr): $\tilde{u}$ = 3340, 2959, 2931, 2864, 1726, 1643, 1536, 1489, 758, 715 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.98 (t, 3H, J = 7.4 Hz, CH_3CH_2), 1.80–1.93 (m, 1H, CH_3CHH), 2.00–2.09 (m, 1H, CH_3CHH), 4.74–4.79 (m, 1H, $CHNH$), 6.99 (d, 1H, J = 7.7 Hz, NH), 7.39–7.43 (m, 2H, arom CH), 7.48–7.52 (m, 1H, arom CH), 7.78–7.80 (m, 2H, arom CH), 8.90–9.16 (br, 1H, OH) ppm.

^{13}C NMR (100 MHz, $CDCl_3$): δ = 9.92 (CH_3CH_2), 25.68 (CH_3CH_2), 54.22 (CHN), 127.38 128.85, 132.22 (arom CH), 133.68 (arom C), 168.24 (NHC=O), 175.72 ($COOH$).

MS (EI, 70 eV) m/z (%) = 207 (7) [$M^{+\bullet}$], 179 (8), 163 (5), 162 (19), 106 (8), 105 (100), 77 (32), 51 (14), 45 (10).

HRMS: m/z calcd for $C_{11}H_{13}NO_3$ (M^+): 207.0895. Found: 207.0896.

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