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# Asymmetric Synthesis of α-Chloro-β-amino-*N*-sulfinyl Imidates as Chiral Building Blocks

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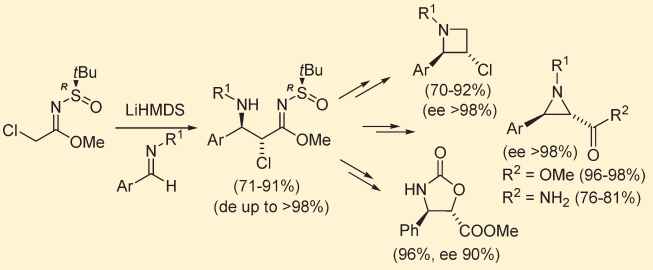
Supporting Information

**ABSTRACT:** New chiral α-chloro-β-amino-*N*-sulfinyl imidates were synthesized in high yield and excellent diastereomeric excess via highly *anti*-selective Mannich-type reactions of ($R_S$)-methyl *N*-*tert*-butanesulfinyl-2-chloroethanimidate with aromatic aldimines. The α-chloro-β-amino-*N*-sulfinylimidates proved to be excellent building blocks for the asymmetric synthesis of β-amino-α-chloro amides and esters, aziridine-2-carboxylic amides and esters, *trans*-2-aryl-3-chloroazetidines, and methyl 4-phenyloxazolidin-2-one-5-carboxylate. The obtained absolute *anti*-diastereoselectivity is the opposite of the stereochemical outcome observed for α-methyl-substituted imidates.




## INTRODUCTION

The Mannich reaction is a classic method for the preparation of β-amino carbonyl compounds and is therefore a very important carbon−carbon bond-forming reaction in organic synthesis as a key step in natural product synthesis as well as in medicinal chemistry.[1] The unique conformational and biological properties of β-peptides incorporating β-amino acids as monomers,[2] and the use of β-amino acid derivatives as building blocks for the preparation of pharmaceutical targets and natural products has prompted a tremendous amount of efforts in the development of asymmetric Mannich reactions to this class of amino acids.[3,4] Very recently, our group elaborated the asymmetric synthesis of new chiral β-(sulfonylamino)sulfinylimidates by highly *anti*-selective Mannich-type reactions of *N*-sulfinyl imidates across *N*-tosyl aldimines.[5] These imidates proved to be excellent intermediates for the synthesis of the corresponding enantiopure β-sulfonylamino amides and esters as new chiral β-amino acid derivatives. Therefore, we envisioned that the use of an α-chloro *N*-sulfinyl imidate in the addition reaction across aromatic aldimines would lead to the synthesis of new chiral β-aryl-α-chloro-substituted β-amino acid derivatives as potential building blocks of enantiopure functionalized aziridines, azetidines and oxazolidinones.

Among aziridines, chiral aziridine-2-carboxylic acid derivatives are of special importance because of their occurrence in natural products and synthetic pharmaceuticals and their versatility in the preparation of diverse chiral bioactive nitrogen-containing compounds, mainly via a range of regio- and stereoselective ring-opening reactions.[6−8] In contrast to oxirane-2-carboxylic acid derivatives,[9] the synthesis of optically active aziridine-2-carboxylates still remains challenging to synthetic chemists.[7c,8a,10]

Besides aziridines, azetidines are also an extraordinary class of strained azaheterocyclic compounds with a wide range of known biological activities.[11] In particular, 3-haloazetidines form an important subclass because of their potential physiological activities and their use as substrates toward the synthesis of 3-substituted azetidine derivatives.[12] Remarkably, however, no asymmetric synthesis of 3-haloazetidines was reported in the literature until now.

4,5-Disubstituted 2-oxazolidinones, like (−)-cytoxazone, i.e., (4*R*,5*R*)-5-(hydroxymethyl)-4-(4-methoxyphenyl)oxazolidin-2-one, and its analogues, have been the subject of numerous studies because of their potent cytokine-modulating activity and possible use as novel immunotherapeutic agents but also because the ring system provides an interesting objective for various asymmetric synthesis strategies.[13] Whereas in the literature the oxazolidinone ring is conveniently formed from amino alcohols,[13a] an alternative cyclization strategy of α-chloro-β-amino acid derivatives will be explored.

## RESULTS AND DISCUSSION

The synthesis of α-chloro-*N*-*tert*-butanesulfinyl imidate ($R_S$)-**3** from 2-chloro-1,1,1-trimethoxyethane **2** was optimized by systematically changing the reaction conditions. Using similar conditions as applied in the synthesis of nonhalogenated *N*-*tert*-butanesulfinyl imidates,[14] the condensation of ($R_S$)-*tert*-butanesulfinamide ($R_S$)-**1** and 3 equiv of 2-chloro-1,1,1-trimethoxyethane **2** in the presence of a catalytic amount of *p*-TsOH without solvent afforded after 3 h at 100 °C a mixture of the desired α-chloro-*N*-*tert*-butanesulfinyl imidate ($R_S$)-**3** and

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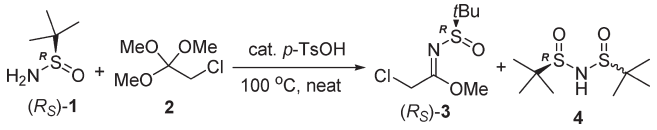
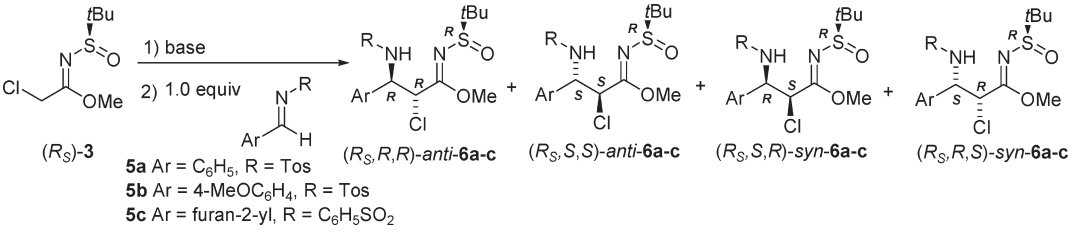
**Table 1. Synthesis of α-Chloro-*N*-*tert*-butanesulfinyl Imidate ($R_S$)-3**




| entry | 2 (equiv) | time (h) | conversion of ($R_S$)-1 to 3 and 4[a] (%) | ($R_S$)-3/4[a] | yield ($R_S$)-3 (%) |
|---|---|---|---|---|---|
| 1 | 3 | 3 | 72 | 72:28 | 31[b], 45[c] |
| 2 | 3 | 8 | 89 | 51:49 | |
| 3 | 7 | 3 | 97 | 86:14 | |
| 4 | 7 | 4 | 100 | 86:14 | 84[c,d] |
| 5 | 10 | 0.5 | 100 | 77:23 | 73[c] |

[a] Determined via GC analysis of the crude reaction mixture. [b] Yield after purification by distillation (74 °C/0.05 mmHg). [c] Yield after purification by flash chromatography. [d] *N*-(*tert*-Butanesulfinyl)-*tert*-butanesulfinimide **4** was isolated in 10% yield.

**Table 2. Addition Reaction of α-Chloro-*N*-*tert*-butanesulfinyl Imidate ($R_S$)-3 across Aldimines 5**




| entry | aldimine | ($R_S$)-3 (equiv) | base (equiv) | temp (°C)/ time (h) | conversion of 3 and 5 into 6 (%)[a] | ($R_S$,R,R)-6/ *minor*-6[a,b] | yield (%) |
|---|---|---|---|---|---|---|---|
| 1 | **5a** | 1.0 | DBU (cat.)[c] | 0/3 | 0 | | |
| 2 | **5a** | 1.0 | DBU (1.1)[c] | −78/1 | 42 | 63:37 | |
| 3 | **5a** | 1.0 | DBU (2.0)[c] | −78/2 | 68 | 69:31 | |
| 4 | **5a** | 1.0 | DBU (1.6)[c] | −40/2 | 92 | 56:44 | |
| 5 | **5a** | 1.2 | LiHMDS (1.2)[d] | −78/1 | 75 | 91:9 | ($R_S$,R,R)-**6a** (57) |
| 6 | **5a** | 1.2 | LiHMDS (1.2)[d,e] | −78/1 | 71 | 87:13 | |
| 7 | **5a** | 1.2 | KHMDS (1.2)[d] | −78/1 | 72 | 91:9 | |
| 8 | **5a** | 1.2 | NaHMDS (1.2)[d] | −78/1 | 70 | 92:8 | |
| 9 | **5a** | 1.2 | LDA (1.2)[d] | −78/1 | 26 | 85:15 | |
| 10 | **5a** | 1.2 | LiHMDS (1.2)[f] | −97/1 | 66 | 90:10 | |
| 11 | **5a** | 1.6 | LiHMDS (1.6)[d] | −78/1 | 91 | 91:9 | |
| 12 | **5a** | 1.8 | LiHMDS (1.8)[d] | −78/0.5 | 100 | 94:6 | ($R_S$,R,R)-**6a** (86) |
| 13 | **5b** | 1.8 | LiHMDS (1.8)[d] | −78/0.5 | 100 | 96:4 | ($R_S$,R,R)-**6b** (87) |
| 14 | **5c** | 1.8 | LiHMDS (1.8)[d] | −78/0.5 | 100 | 92:8 | ($R_S$,R,R)-**6c** (71) |

[a] Determined via $^1$H NMR analysis of the crude reaction mixture. [b] *minor*-**6** = ($R_S$,S,S)-*anti*-**6** + ($R_S$,S,R)-*syn*-**6** + ($R_S$,R,S)-*syn*-**6**. [c] DBU was added dropwise to a solution of ($R_S$)-**3** and **5a** in DMF (entry 1) or THF (entries 2−4). [d] Deprotonation was performed at −78 °C for 45 min in THF. [e] 1.2 equiv of $MgBr_2$ was added after deprotonation at −78 °C for 15 min at −78 °C. [f] Deprotonation was performed at −97 °C for 45 min in THF.

*N*-(*tert*-butanesulfinyl)-*tert*-butanesulfinimide **4** in a ratio of 72:28 (Table 1, entry 1). After purification by distillation, pure α-chloro-*N*-*tert*-butanesulfinyl imidate ($R_S$)-**3** was obtained, but in a disappointing yield of only 31%, partly due to the incomplete conversion (72%) of starting compound ($R_S$)-**1** into ($R_S$)-**3** and **4**. Purification by flash chromatography resulted in a higher yield of 45% of ($R_S$)-**3**. In a second attempt, to obtain full conversion of starting compound ($R_S$)-**1**, the reaction time was increased to 8 h, resulting in a better conversion of 89% but also in a more extensive formation of the undesired sulfinimide **4** (entry 2). Subsequently, the condensation of ($R_S$)-*tert*-butanesulfinamide ($R_S$)-**1** with 7 equiv of 2-chloro-1,1,1-trimethoxyethane **2** gave almost full conversion (97%) after 3 h, and sulfinimide **4** was formed in minor amounts (entry 3). Repeating the reaction with 7 equiv of 2-chloro-1,1,1-trimethoxyethane **2** for 4 h led to a full conversion of starting compound ($R_S$)-**1** into reaction products ($R_S$)-**3** and **4**, and after flash chromatography, α-chloro-*N*-*tert*-butanesulfinyl imidate ($R_S$)-**3** and sulfinimide **4** were obtained in 84% and 10% yield, respectively (entry 4). In order to improve the yield of imidate ($R_S$)-**3** and to reduce the formation of sulfinimide **4**, a final reaction was performed with 10 equiv of ortho ester **2**, unfortunately providing α-chloro-*N*-*tert*-butanesulfinyl imidate ($R_S$)-**3** in a lower yield of 73% (entry 5). It is assumed that the formation of *N*-(*tert*-butanesulfinyl)-*tert*-butanesulfinimide **4** proceeds with partial inversion of stereochemistry at sulfur.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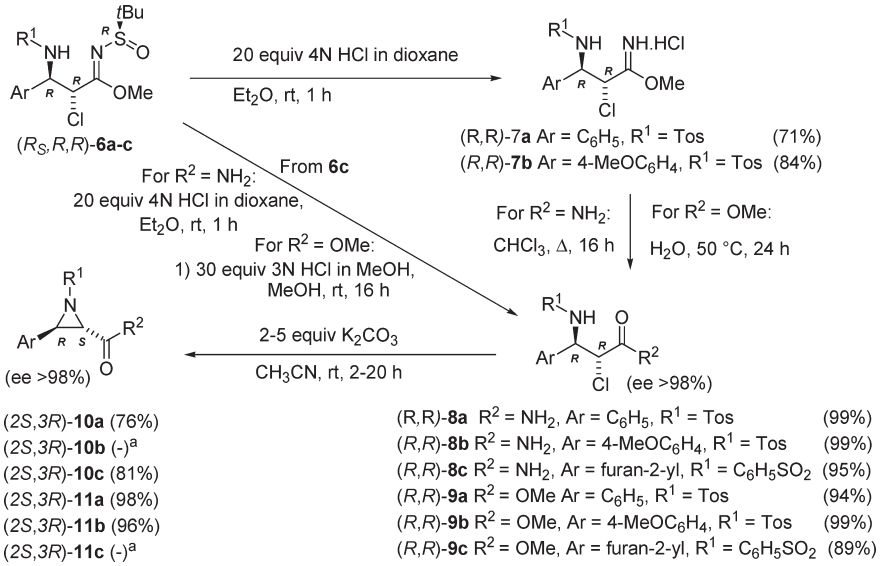
**Scheme 1. Synthesis of Chiral Imidate Hydrochlorides (*R*,*R*)-7, Amides (*R*,*R*)-8, Esters (*R*,*R*)-9, Aziridine-2-carboxylic Amides (2*S*,3*R*)-10, and Esters (2*S*,3*R*)-11**




[a] Compounds (2*S*,3*R*)-**10b** and (2*S*,3*R*)-**11c** could not be obtained in pure form due to their instability during purification with flash chromatography.

The addition reaction of imidate ($R_S$)-**3** across aldimine **5a** was optimized by systematically changing the reaction conditions in the synthesis of α-chloro-β-(sulfonylamino)sulfinylimidates **6a** (Table 2). An initial attempt using similar reaction conditions as applied by Kobayashi and co-workers in the synthesis of β-aminosulfonylimidates,[15] namely reaction of imidate ($R_S$)-**3** with aldimine **5a** in the presence of a catalytic amount of DBU in DMF, did not result in the formation of addition products (Table 2, entry 1). The use of more DBU (1.1−2 equiv) resulted in incomplete conversions to imidates **6a** with poor diastereoselectivity (Table 2, entries 2−4). In contrast, the use of 1.2 equiv of LiHMDS at −78 °C to deprotonate imidate ($R_S$)-**3** resulted after addition of aldimine **5a** in the formation of imidates **6a** with high diastereoselectivity, but with incomplete conversion of 75% (Table 2, entry 5). Four diastereomers could be detected by $^1$H NMR analysis of the crude reaction mixture, namely *major*-($R_S$,*R*,*R*)-**6a**/*minor*-**6a** = ($R_S$,*S*,*S*)-**6a** + ($R_S$,*S*,*R*)-**6a** + ($R_S$,*R*,*S*)-**6a** in a 91:9 ratio.

The use of other bases, such as LDA, KHMDS, and NaHMDS, addition of $MgBr_2$ as Lewis acid, or performing the reaction at −97 °C did not result in improved diastereomeric ratios and/or conversion (Table 2, entries 6−10). Subsequently, in order to obtain a full conversion of ($R_S$)-**3** and **5a** into **6a**, more equivalents of LiHMDS and ($R_S$)-**3** were applied (Table 2, entries 11 and 12), and finally, the use of 1.8 equiv of LiHMDS to deprotonate 1.8 equiv of ($R_S$)-**3** was sufficient to achieve a full conversion of ($R_S$)-**3** and **5a** into imidates **6a** in excellent diastereomeric ratio [($R_S$,*R*,*R*)-**6a**/*minor*-**6a** 94:6]. The optically pure ($R_S$,*R*,*R*)-**6a** was isolated in 86% yield after purification via flash chromatography (entry 12).

Analogously, new (hetero)aromatic chiral imidates **6b**,**c** were prepared with excellent diastereoselectivity [($R_S$,*R*,*R*)-**6**/*minor*-**6** 92:8 to 96:4] and good yields (71−87%) using the latter optimized reaction conditions (entries 13 and 14).

In a next step, the chiral ($R_S$,*R*,*R*)-*anti*-α-chloro-β-(sulfonylamino) sulfinylimidates ($R_S$,*R*,*R*)-**6a**,**b** were *N*-deprotected by simple treatment with a 4 N solution of anhydrous HCl in dioxane to the corresponding imidate hydrochlorides (*R*,*R*)-**7a**,**b** (Scheme 1).

Furthermore, these hydrochlorides (*R*,*R*)-**7** proved to be excellent intermediates for an easy transformation to new chiral α-chloro-β-sulfonylamino amides (*R*,*R*)-**8** and esters (*R*,*R*)-**9** in excellent yields (94−99%), upon simple heating in chloroform and hydrolysis, respectively (Scheme 1). It is noteworthy that the HCl-promoted *N*-deprotection of imidate (*R*,*R*)-**6c** (Ar = furan-2-yl, $R^1 = C_6H_5SO_2$) in dioxane led directly to the corresponding amide (*R*,*R*)-**8c** in 95% yield, whereas ester (*R*,*R*)-**9c** was formed in 89% yield via the addition of 30 equiv of 3 N HCl in MeOH to imidate ($R_S$,*R*,*R*)-**6c** (Scheme 1).

In the next step, amides (*R*,*R*)-**8** and esters (*R*,*R*)-**9** could be easily cyclized to the corresponding aziridine-2-carboxylic amides (2*S*,3*R*)-**10** and esters (2*S*,3*R*)-**11** via addition of $K_2CO_3$ in $CH_3CN$ (Scheme 1). Unfortunately, the formed aziridine-2-carboxylic amide (2*S*,3*R*)-**10b** and ester (2*S*,3*R*)-**11c** could not be obtained in pure form because of their instability during purification with flash chromatography.

An alternative important application of esters **9** involved reduction with $LiAlH_4$ to afford β-chloro-γ-sulfonylamino alcohols **12**. Initially, when 2.8 equiv of $LiAlH_4$ was added to ester (*R*,*R*)-**9a**, a mixture of alcohol (*R*,*R*)-**12a**, (*S*)-*N*-(3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*S*)-**13**, and (2*S*,3*R*)-2-hydroxymethyl-3-phenyl-1-(*p*-toluenesulfonyl)aziridine (2*S*,3*R*)-**14** was obtained, which could be isolated after flash chromatography in 42%, 25%, and 17% yield, respectively (Scheme 2).

Finally, when fewer equivalents of $LiAlH_4$ at lower temperature, were used in order to suppress the formation of alcohol (*S*)-**13** and aziridine (2*S*,3*R*)-**14**, β-chloro-γ-sulfonylamino alcohols (*R*,*R*)-**12** were obtained in good yields (84−88%) (Scheme 3). In a final step, these alcohols (*R*,*R*)-**12** were cyclized under Mitsunobu conditions, leading to the first asymmetric synthesis of *trans*-2-aryl-3-chloroazetidines (2*R*,3*S*)-**15** in good yields (Scheme 3).

Aziridine-2-carboxylic ester (2*S*,3*R*)-**11a** and the enantiomer of aziridine (2*S*,3*R*)-**14** are reported compounds in the literature and thus allowed a comparison of the optical rotations ($[\alpha]_D$ (2*S*,3*R*)-**11a** −34.6 (*c* 0.4, $CH_2Cl_2$) vs −29.4 (*c* 1.0, $CH_2Cl_2$) and (2*R*,3*S*)-**11a** +33.1 (*c* 1.0, $CH_2Cl_2$) in ref 16;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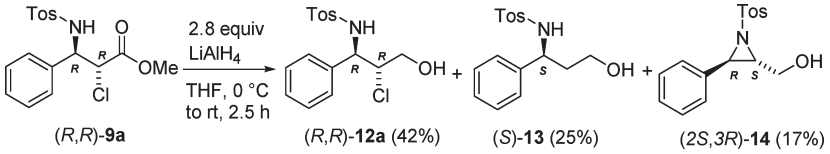
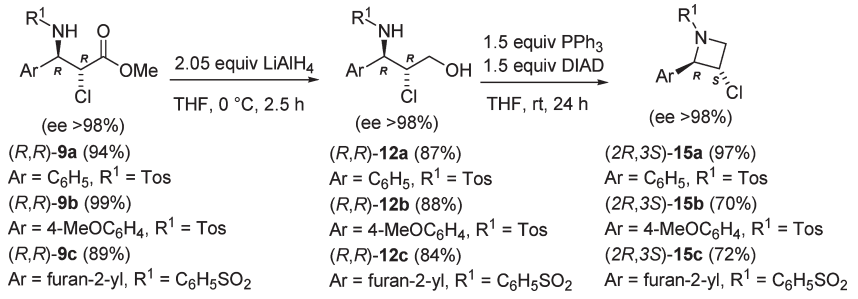
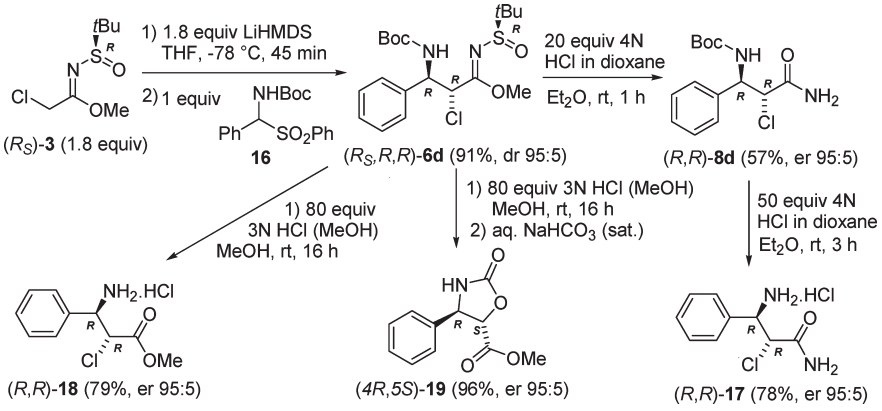
**Scheme 2. Reduction of (*R*,*R*)-Methyl 2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-9a with $LiAlH_4$**




**Scheme 3. Synthesis of Chiral β-Chloro-γ-sulfonylamino Alcohols (*R*,*R*)-12 and *trans*-2-Aryl-3-chloroazetidines (2*R*,3*S*)-15**




**Scheme 4. Synthesis of ($R_S$,*R*,*R*)-6d and Further Transformation to Chiral Amide (*R*,*R*)-8d, Hydrochlorides (*R*,*R*)-17 and (*R*,*R*)-18, and Oxazolidin-2-one (4*R*,5*S*)-19**




$[\alpha]_D$ (2*S*,3*R*)-**14** −50.5 (*c* 0.3, $CHCl_3$) vs (2*R*,3*S*)-**14** +48.4 (*c* 1.9, $CHCl_3$, > 98% ee) in ref 17) confirming the assigned absolute stereochemistry of all synthesized products **6**−**15**. In view of the strong correspondence of the optical rotations with literature data, and with an ee of >98% for the commercially available starting material ($R_S$)-*tert*-butanesulfinamide ($R_S$)-**1**, an ee of >98% can be concluded for all synthesized products **6**−**15**.

In order to expand the Mannich-type additions of α-chloro-*N*-sulfinyl imidate ($R_S$)-**3** across aromatic *N*-sulfonyl aldimines **5**, *N*-Boc-protected α-chloro-β-aminosulfinylimidate ($R_S$,*R*,*R*)-**6d** was synthesized via the Mannich-type reaction of imidate ($R_S$)-**3** across α-amido sulfone **16** (Scheme 4).[18] α-Amido sulfone **16** was prepared from benzaldehyde, sodium benzenesulfinate, and *tert*-butyl carbamate according to a literature procedure.[19] After flash chromatography, the major diastereomer ($R_S$,*R*,*R*)-**6d** could be obtained in 91% yield, containing still 5% of the inseparable diastereomer ($R_S$,*S*,*S*)-**6d**, leading to a diastereomeric excess of 90% (Scheme 4).

The treatment of imidate ($R_S$,*R*,*R*)-**6d** with 20 equiv of 4 N HCl in dioxane led to the selective formation of α-chloro-β-amino amide (*R*,*R*)-**8d** in 57% yield and an enantiomeric ratio of 95:5 (Scheme 4). Furthermore, *N*-Boc-deprotected hydrochlorides (*R*,*R*)-**17** and (*R*,*R*)-**18** were obtained upon treatment of amide (*R*,*R*)-**8d** and imidate ($R_S$,*R*,*R*)-**6d** with 50 equiv of 4 N HCl in dioxane and 80 equiv of 3 N HCl in MeOH, respectively.

Importantly, the 4,5-disubstituted oxazolidin-2-one (4*R*,5*S*)-**19** was obtained in 96% yield when the addition of the excess of HCl in MeOH to *N*-Boc-protected α-chloro-β-aminosulfinylimidate ($R_S$,*R*,*R*)-**6d** was followed by basic extraction with $NaHCO_3$. Similar syntheses of oxazolidin-2-ones via the condensation of β-chloroamines with $Na_2CO_3$ or $NaHCO_3$ have been reported.[20]

It is noteworthy that, whereas the high relative *anti*-diastereoselectivity of the Mannich-type reactions of α-chloro *N*-sulfinyl imidate ($R_S$)-**3** across aldimines **5** and α-amido sulfone **16** is in analogy with the previously mentioned *anti*-selective addition reactions of α-methyl-*N*-sulfinyl imidates across *N*-tosyl aldimines,[5] the absolute *anti*-diastereoselectivity is reversed. It is speculated that the nature of the α-substituent of the imidates influences the *E*/*Z* ratio and the coordination behavior of the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Li enolates, which influences the diastereoselectivity of the Mannich reactions.

## CONCLUSIONS

In conclusion, it was demonstrated that new chiral α-chloro-β-aminosulfinyl imidates are formed in high yield and excellent diastereomeric excess via highly *anti*-selective Mannich-type reactions of an α-chloro sulfinylimidate across aromatic *N*-sulfonyl-aldimines or α-amido sulfones. The absolute *anti*-diastereoselectivity obtained in the newly synthesized α-chloro-β-aminosulfinylimidates is the opposite of the stereochemical outcome observed for α-methyl-substituted imidates. Several transformations of the α-chloro-β-aminosulfinylimidates led to the synthesis of new chiral β-aryl-α-chloro-substituted β-amino acid and aziridine-2-carboxylic acid derivatives, the first entry to enantiopure *trans*-2-aryl-3-chloroazetidines and the cyclization to (4*R*,5*S*)-methyl 4-phenyloxazolidin-2-one-5-carboxylate.

## EXPERIMENTAL SECTION

**Synthesis of ($R_S$)-Methyl *N*-*tert*-Butanesulfinyl-2-chloroethanimidate ($R_S$)-3.** To a round-bottomed flask charged with ($R_S$)-*tert*-butanesulfinamide ($R_S$)-**1** (3.00 g, 24.79 mmol) were added 1-chloro-2,2,2-trimethoxyethane **2** (7 equiv, 26.80 g, 173.55 mmol) and *p*-toluenesulfonic acid monohydrate (0.005 equiv, 0.02 g, 0.12 mmol). The reaction mixture was stirred for 4 h at 100 °C, and the volatile materials were removed in vacuo. The crude oil was purified via flash chromatography to yield 4.40 g (20.83 mmol, 84% yield) of pure ($R_S$)-methyl *N*-*tert*-butanesulfinyl-2-chloroethanimidate ($R_S$)-**3** and 0.28 g (1.24 mmol, 10% yield) *N*-(*tert*-butanesulfinyl)-*tert*-butanesulfinimide **4** as byproduct.

**($R_S$)-Methyl *N*-*tert*-Butanesulfinyl-2-chloroethanimidate ($R_S$)-3.** $R_f$ = 0.11 (petroleum ether/$Et_2O$ 7:3). Yellow oil, 84%. $[\alpha]_D$ −247.8 (*c* 1.2, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 1076, 1294, 1634, 2949. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.24 (9H, s), 3.82 (3H, s), 4.30 (1H, d, *J* = 12.4 Hz), 4.60 (1H, d, *J* = 12.4 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 21.9, 37.6, 54.9, 56.0, 167.0. MS (ES, pos mode) *m*/*z*: 212/214 ($M + H^+$, 100). Anal. Calcd for $C_7H_{14}ClNO_2S$: C, 39.71; H, 6.67; N, 6.62. Found: C, 39.62; H, 6.74; N, 6.69.

***N*-(*tert*-Butanesulfinyl)-*tert*-butanesulfinimide 4.** $R_f$ = 0.61 (petroleum ether/$Et_2O$ 7:3). White crystals, yield 10%. $[\alpha]_D$ −21.9 (*c* 0.6, $CHCl_3$). Mp: 161.1−161.5 °C. IR ($cm^{-1}$): $\nu_{max}$ 884, 1124, 1296, 1362, 2979, 3233. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.32 (9H, s), 1.43 (9H, s), 5.44 (1H, br s). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 24.8, 28.2, 48.6, 61.3. MS (ES, neg. mode) *m*/*z*: 224 ($M - H^+$, 100). Anal. Calcd for $C_8H_{19}NO_2S_2$: C, 42.63; H, 8.50; N, 6.21. Found: C, 42.34; H, 8.73; N, 6.37.

**Synthesis of α-Chloro-β-amino-*N*-sulfinylimidates ($R_S$,*R*,*R*)-6.** The synthesis of ($R_S$,*R*,*R*)-α-chloro-β-(sulfonylamino)-*N*-sulfinylimidate ($R_S$,*R*,*R*)-**6a** is representative. A solution of ($R_S$)-methyl *N*-*tert*-butanesulfinyl-2-chloroethanimidate ($R_S$)-**3** (1.8 equiv, 3.00 g, 14.19 mmol) in THF (60 mL) was cooled to −78 °C. A 1 M solution of LiHMDS (1.8 equiv, 14.19 mL, 14.19 mmol) in THF was slowly added, and the resulting solution was stirred for 45 min at −78 °C. After deprotonation, a solution of *N*-benzylidene-4-methylbenzenesulfonamide **5a** (1 equiv, 2.04 g, 7.88 mmol) in THF (20 mL) was added dropwise, and the reaction mixture was stirred at −78 °C for 0.5 h. To the reaction mixture was added a saturated solution of $NH_4Cl$ (5 mL), followed by a 1.0 N aqueous solution of NaOH (40 mL). The aqueous phase was extracted with $Et_2O$ (3 × 40 mL). The combined organic phases were dried ($MgSO_4$), filtered, and evaporated in vacuo. The crude product was purified by flash chromatography to yield 3.18 g (6.77 mmol, 86% yield) of pure ($R_S$,*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)-*N*-*tert*-butanesulfinyl-propanimidate ($R_S$,*R*,*R*)-**6a**.

The synthesis of ($R_S$,*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*tert*-butoxycarbonylamino)-*N*-*tert*-butanesulfinyl propanimidate ($R_S$,*R*,*R*)-**6d** was performed via the addition reaction of ($R_S$)-methyl *N*-*tert*-butanesulfinyl-2-chloroethanimidate ($R_S$)-**3** with α-amido sulfone **16**.

**($R_S$,*R*,*R*)-Methyl 2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-6a.** $R_f$ = 0.77 (petroleum ether/$Et_2O$ 3:7). White crystals, yield 86%. $[\alpha]_D$ −172.6 (*c* 0.3, $CHCl_3$). Mp: 53.7−54.1 °C. IR ($cm^{-1}$): $\nu_{max}$ 1067, 1160, 1298, 1615, 2948, 3161. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.35 (9H, s), 2.28 (3H, s), 3.86 (3H, s), 4.63 (1H, t, *J* = 9.9 Hz), 5.38 (1H, d, *J* = 9.9 Hz), 6.76 (1H, d, *J* = 9.9 Hz), 6.95 (2H, d, *J* = 8.3 Hz), 7.07−7.22 (3H, m), 7.24−7.28 (2H, m), 7.33 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 21.4, 22.1, 55.6, 57.2, 58.2, 60.4, 126.9 (2C), 127.7 (2C), 128.2, 128.4 (2C), 129.1 (2C), 137.1, 137.9, 142.7, 167.4. MS (ES, pos mode) *m*/*z*: 471/473 ($M + H^+$, 100). Anal. Calcd for $C_{21}H_{27}ClN_2O_4S_2$: C, 53.55; H, 5.78; N, 5.95. Found: C, 53.21; H, 5.53; N, 5.59.

**($R_S$,*R*,*R*)-Methyl 2-Chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-6b.** $R_f$ = 0.57 (petroleum ether/$Et_2O$ 25:75). White crystals, yield 87%. $[\alpha]_D$ −202.3 (*c* 0.3, $CHCl_3$). Mp: 55.7−56.0 °C. IR ($cm^{-1}$): $\nu_{max}$ 665, 1028, 1065, 1159, 1250, 1297, 1335, 1514, 1611, 2947, 3150. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.34 (9H, s), 2.29 (3H, s), 3.73 (3H, s), 3.87 (3H, s), 4.60 (1H, t, *J* = 9.9 Hz), 5.35 (1H, d, *J* = 9.9 Hz), 6.63 (2H, d, *J* = 8.3 Hz), 6.71 (1H, d, *J* = 9.9 Hz), 6.98 (2H, d, *J* = 8.3 Hz), 7.04 (2H, d, *J* = 8.3 Hz), 7.34 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 21.3, 22.0, 55.2, 55.5, 57.4, 58.1, 59.8, 113.8 (2C), 126.9 (2C), 128.8 (2C), 129.1 (2C), 129.2, 138.1, 142.5, 159.5, 167.5. MS (ES, pos mode) *m*/*z*: 501/503 ($M + H^+$, 100). Anal. Calcd for $C_{22}H_{29}ClN_2O_5S_2$: C, 52.74; H, 5.83; N, 5.59. Found: C, 53.02; H, 5.73; N, 5.66.

**($R_S$,*R*,*R*)-Methyl 3-(Benzenesulfonylamino)-2-chloro-3-furan-2-yl-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-6c.** $R_f$ = 0.19 (petroleum ether/$Et_2O$ 4:6). White crystals, yield 71%. $[\alpha]_D$ −236.2 (*c* 0.2, $CHCl_3$). Mp: 54.6−54.8 °C. IR ($cm^{-1}$): $\nu_{max}$ 742, 915, 1026, 1058, 1163, 1290, 1332, 1447, 1639, 2949, 3128. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.33 (9H, s), 3.86 (3H, s), 4.79 (1H, t, *J* = 9.6 Hz), 5.63 (1H, d, *J* = 9.6 Hz), 6.04−6.06 (2H, m), 6.62 (1H, d, *J* = 9.6 Hz), 7.09−7.12 (1H, m), 7.24−7.35 (2H, m), 7.38−7.44 (1H, m), 7.57−7.63 (2H, m). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 22.1, 53.8, 54.0, 58.0, 110.0, 110.2, 127.0 (2C), 128.6 (2C), 132.1, 140.5, 142.7, 148.2, 166.3. MS (ES, pos mode) *m*/*z*: 447/449 ($M + H^+$, 100). Anal. Calcd for $C_{18}H_{23}ClN_2O_5S_2$: C, 48.37; H, 5.19; N, 6.27. Found: C, 48.22; H, 5.33; N, 5.99.

**($R_S$,*R*,*R*)-Methyl 2-Chloro-3-phenyl-3-(*tert*-butoxycarbonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-6d.** $R_f$ = 0.54 (petroleum ether/$Et_2O$ 6:4). White crystals, yield 91%. dr 95:5. $[\alpha]_D$ −231.7 (*c* 0.4, $CHCl_3$). Mp: 107.0−107.3 °C. IR ($cm^{-1}$): $\nu_{max}$ 1159, 1243, 1301, 1510, 1619, 1722, 2969, 3324. $^1H$ NMR (300 MHz, $CDCl_3$): δ 1.30 (9H, s, *t*Bu), 1.36 (9H, s), 3.83 (3H, s), 5.01 (1H, t, *J* = 9.9 Hz), 5.51 (1H, d, *J* = 9.9 Hz), 6.29 (1H, d, *J* = 9.9 Hz), 7.25−7.46 (5H, m). $^{13}C$ NMR (75 MHz, $CDCl_3$): δ 22.0, 28.3, 55.0, 56.7, 57.3, 57.7, 79.4, 127.6 (2C), 128.2, 128.6 (2C), 139.0, 154.2, 167.7. MS (ES, pos mode) *m*/*z*: 417/419 ($M + H^+$, 20), 439/441 ($M + Na^+$, 100). Anal. Calcd for $C_{19}H_{29}ClN_2O_4S$: C, 54.73; H, 7.01; N, 6.72. Found: C, 54.89; H, 6.83; N, 6.59.

**Synthesis of α-Chloro-β-(sulfonylamino)midate Hydrochlorides (*R*,*R*)-7.** The synthesis of (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanimidate hydrochloride (*R*,*R*)-**7a** is representative. To a solution of ($R_S$,*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-**6a** (3.00 g, 6.38 mmol) in diethyl ether (60 mL) was added a 4 N solution of HCl in dioxane (20 equiv, 31.88 mL, 127.54 mmol) at room

temperature. The mixture was allowed to stir for 1 h at room temperature. Subsequently, the reaction mixture was concentrated in vacuo. Precipitation in diethyl ether afforded 1.82 g (4.53 mmol, 71% yield) of pure (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanimidate hydrochloride (*R*,*R*)-**7a**.

**(*R*,*R*)-Methyl 2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanimidate hydrochloride (*R*,*R*)-7a.** White crystals, yield 71%. $[\alpha]_D$ −33.6 (*c* 0.2, DMF). Mp: 214.9−215.2 °C. IR ($cm^{-1}$): $\nu_{max}$ 670, 701, 1066, 1087, 1159, 1334, 1402, 1460, 1649, 2871, 3044. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.26 (3H, s), 4.55 (3H, s), 4.69 (1H, t, *J* = 10.5 Hz), 5.56 (1H, d, *J* = 10.5 Hz), 6.97 (2H, d, *J* = 7.7 Hz), 7.05−7.17 (2H, m), 7.23 (2H, d, *J* = 7.2 Hz), 7.43 (2H, d, *J* = 8.3 Hz), 8.06 (1H, d, *J* = 10.5 Hz), 12.22 (1H, br s). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.4, 56.8, 61.1, 62.1, 126.9 (2C), 127.0, 127.9, 128.6 (2C), 129.2 (2C), 134.6, 136.9, 143.2, 175.0. MS (ES, pos mode) *m*/*z*: 367/369 ($M + H^+ -$ HCl, 100). Anal. Calcd for $C_{17}H_{20}Cl_2N_2O_3S$: C, 50.62; H, 5.00; N, 6.95. Found: C, 50.42; H, 5.13; N, 7.01.

**(*R*,*R*)-Methyl 2-Chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)propanimidate Hydrochloride (*R*,*R*)-7b.** White crystals, yield 84%. $[\alpha]_D$ −45.7 (*c* 0.2, DMF). Mp: 126.8−127.0 °C. IR ($cm^{-1}$): $\nu_{max}$ 688, 814, 1060, 1166, 1260, 1346, 1655, 2845, 3126. MS (ES, pos mode) *m*/*z*: 381/383 ($M + H^+ -$ HCl − 16, 100). Anal. Calcd for $C_{18}H_{22}Cl_2N_2O_4S$: C, 49.89; H, 5.12; N, 6.46. Found: C, 49.77; H, 5.02; N, 6.57. Imidate hydrochloride (*R*,*R*)-**7b** proved to be unstable in solvent leading to the formation of the corresponding amide (*R*,*R*)-**8b**. In order to obtain full characterization of hydrochloride (*R*,*R*)-**7b**, the salt (0.20 g, 0.46 mmol) was redissolved in $CH_2Cl_2$ (10 mL), followed by the addition of a saturated solution of $NaHCO_3$ (10 mL). The organic phase was dried ($MgSO_4$), filtered, and evaporated in vacuo to obtain 0.18 g (0.46 mmol) of pure (*R*,*R*)-methyl 2-chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)propanimidate.

**(*R*,*R*)-Methyl 2-Chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)propanimidate (*R*,*R*)-7b.** Colorless oil, quantitative yield. $[\alpha]_D$ −48.5 (*c* 0.2, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 665, 750, 1092, 1159, 1252, 1329, 1439, 1514, 1663, 3024, 3278. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.34 (3H, s), 3.71 (3H, s), 3.74 (3H, s), 4.73 (1H, d, *J* = 4.4 Hz), 5.02 (1H, d × d, *J* = 9.4, 4.4 Hz), 6.09 (1H, d, *J* = 9.4 Hz), 6.64 (2H, d, *J* = 8.3 Hz), 6.93 (2H, d, *J* = 7.4 Hz), 7.11 (2H, d, *J* = 8.3 Hz), 7.57 (2H, d, *J* = 7.4 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.4, 54.1, 55.2, 58.4, 64.9, 113.5 (2C), 126.7, 127.0 (2C), 128.6 (2C), 129.4 (2C), 137.2, 143.3, 159.4, 166.0. MS (ES, pos mode) *m*/*z*: 397/399 ($M + H^+$, 10), 290 (100). Anal. Calcd for $C_{18}H_{21}ClN_2O_4S$: C, 54.47; H, 5.33; N, 7.06. Found: C, 54.28; H, 5.61; N, 6.97.

**Synthesis of Chiral α-Chloro-β-amino Amides (*R*,*R*)-8.** The synthesis of (*R*,*R*)-2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino) propanamide (*R*,*R*)-**8a** is representative. (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanimidate hydrochloride (*R*,*R*)-**7a** (0.50 g, 1.24 mmol) was dissolved in chloroform (20 mL). The reaction mixture was stirred for 16 h at reflux temperature and subsequently evaporated in vacuo. Recrystallization from diethyl ether afforded 0.44 g (1.23 mmol, 99% yield) of pure (*R*,*R*)-2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanamide (*R*,*R*)-**8a**.

(*R*,*R*)-3-(Benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanamide (*R*,*R*)-**8c** and (*R*,*R*)-2-chloro-3-phenyl-3-(*tert*-butoxycarbonylamino) propanamide (*R*,*R*)-**8d** were formed directly via the addition of HCl in the *N*-deprotection of the corresponding α-chloro-β-aminosulfinylimidates ($R_S$,*R*,*R*)-**6c** and ($R_S$,*R*,*R*)-**6d**. The synthesis of (*R*,*R*)-3-(benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanamide (*R*,*R*)-**8c** is representative. To a solution of ($R_S$,*R*,*R*)-methyl 3-(benzenesulfonylamino)-2-chloro-3-furan-2-yl-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-**6c** (1.00 g, 2.24 mmol) in diethyl ether (20 mL) was added a 4N solution of HCl in dioxane (20 equiv, 11.20 mL, 44.80 mmol) at room temperature. The mixture was allowed to stir for 1 h at room temperature. Subsequently, the reaction mixture was concentrated in vacuo. Precipitation in diethyl ether afforded 0.70 g (2.13 mmol, 95% yield) of pure (*R*,*R*)-3-(benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanamide (*R*,*R*)-**8c**.

**(*R*,*R*)-2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanamide (*R*,*R*)-8a.** White crystals, yield 99%. $[\alpha]_D$ −38.6 (*c* 0.3, DMF). Mp 214.2−214.4 °C. IR ($cm^{-1}$): $\nu_{max}$ 666, 1089, 1154, 1319, 1586, 1682, 3186, 3368, 3472. $^1H$ NMR (300 MHz, DMSO-$d_6$, int. ref 2.49): $\delta$ 2.23 (3H, s), 4.37 (1H, d, *J* = 8.3 Hz), 4.79 (1H, d, *J* = 8.3 Hz), 7.01−7.15 (7H, m), 7.35 (2H, d, *J* = 8.3 Hz), 7.45 (1H, br s), 7.68 (1H, br s), 8.40 (1H, br s). $^{13}C$ NMR (75 MHz, DMSO-$d_6$, int. ref 40.0): $\delta$ 21.4, 60.1, 60.7, 126.9 (2C), 127.9, 128.2 (2C), 128.3 (2C), 129.4 (2C), 137.5, 138.8, 142.5, 168.8. MS (ES, pos mode) *m*/*z* (%): 353/355 ($M + H^+$, 100). Anal. Calcd for $C_{16}H_{17}ClN_2O_3S$: C, 54.46; H, 4.86; N, 7.94. Found: C, 54.57; H, 5.03; N, 7.96.

**(*R*,*R*)-2-Chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)propanamide (*R*,*R*)-8b.** White crystals, yield 99%. $[\alpha]_D$ −45.3 (*c* 0.1, DMF). Mp: 176.8−177.0 °C. IR ($cm^{-1}$): $\nu_{max}$ 665, 1091, 1156, 1250, 1323, 1514, 1611, 1677, 3273. $^1H$ NMR (300 MHz, DMSO-$d_6$, int ref 2.49): $\delta$ 2.25 (3H, s), 3.65 (3H, s), 4.33 (1H, d, *J* = 8.8 Hz), 4.74 (1H, t, *J* = 8.8 Hz), 6.62 (2H, d, *J* = 8.8 Hz), 7.00 (2H, d, *J* = 8.8 Hz), 7.07 (2H, d, *J* = 8.0 Hz), 7.34 (2H, d, *J* = 8.0 Hz), 7.44 (1H, br s), 7.66 (1H, br s), 8.30 (1H, br s). $^{13}C$ NMR (75 MHz, DMSO-$d_6$, int ref 40.0): $\delta$ 21.3, 55.5, 59.5, 61.0, 113.6 (2C), 126.8, 126.9 (2C), 129.4 (2C), 129.5 (2C), 138.8, 142.4, 159.1, 168.8. MS (ES, neg. mode) *m*/*z*: 381/383 ($M - H^+$, 100). Anal. Calcd for $C_{17}H_{19}ClN_2O_4S$: C, 53.33; H, 5.00; N, 7.32. Found: C, 53.14; H, 4.93; N, 7.09.

**(*R*,*R*)-3-(Benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanamide (*R*,*R*)-8c.** White crystals, yield 95%. $[\alpha]_D$ −45.5 (*c* 0.2, DMF). Mp: 222.3−222.4 °C. IR ($cm^{-1}$): $\nu_{max}$ 686, 736, 1088, 1156, 1315, 1454, 1580, 1677, 3149, 3376. $^1H$ NMR (300 MHz, DMSO-$d_6$, int ref 2.49): $\delta$ 4.45 (1H, d, *J* = 9.0 Hz), 4.89 (1H, t, *J* = 9.0 Hz), 6.04−6.11 (2H, m), 7.31 (1H, br s), 7.35−7.41 (2H, m), 7.43−7.53 (2H, m), 7.58 (2H, d, *J* = 7.2 Hz), 7.78 (1H, br s), 8.59 (1H, d, *J* = 9.0 Hz). $^{13}C$ NMR (75 MHz, DMSO-$d_6$, int ref 40.0): $\delta$ 53.8, 59.0, 109.5, 110.6, 126.7 (2C), 129.1 (2C), 132.5, 141.5, 142.8, 150.0, 168.2. MS (ES, pos mode) *m*/*z*: 327/329 ($M + H^+$, 100). Anal. Calcd for $C_{18}H_{23}ClN_2O_5S_2$: C, 48.37; H, 5.19; N, 6.27. Found: C, 48.17; H, 5.23; N, 6.29.

**(*R*,*R*)-2-Chloro-3-phenyl-3-(*tert*-butoxycarbonylamino) propanamide (*R*,*R*)-8d.** White crystals, yield 57%. er 95:5. $[\alpha]_D$ −48.3 (*c* 0.2, DMF). Mp: 196.3−196.5 °C. IR ($cm^{-1}$): $\nu_{max}$ 1165, 1522, 1644, 1675, 3195, 3356, 3398. $^1H$ NMR (300 MHz, DMSO-$d_6$, int ref 2.49): $\delta$ 1.33 (9H, s), 4.49 (1H, d, *J* = 8.8 Hz), 4.97 (1H, t, *J* = 8.8 Hz), 7.22−7.37 (5H, m), 7.42 (1H, br s), 7.52 (1H, d, *J* = 8.8 Hz), 7.70 (1H, br s). $^{13}C$ NMR (75 MHz, DMSO-$d_6$, int ref 40.0): $\delta$ 28.6, 57.3, 59.0, 78.9, 128.0 (2C), 128.1, 128.7 (2C), 139.9, 155.0, 169.5. MS (ES, neg mode) *m*/*z*: 297/299 ($M - H^+$, 10), 187 (100). Anal. Calcd for $C_{14}H_{19}ClN_2O_3$: C, 56.28; H, 6.41; N, 9.38. Found: C, 56.46; H, 6.23; N, 9.65.

**Synthesis of Chiral *N*-Tosyl-α-chloro-β-amino Esters (*R*,*R*)-9a and (*R*,*R*)-9b.** The synthesis of (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-**9a** is representative. (*R*,*R*)-Methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanimidate hydrochloride (*R*,*R*)-**7a** (1.20 g, 2.98 mmol) was dissolved in $H_2O$ (50 mL). The reaction mixture was stirred for 24 h at 50 °C and subsequently poured into a saturated aqueous solution of $NaHCO_3$ (50 mL) and extracted with diethyl ether (3 × 50 mL). The combined organic phases were dried ($MgSO_4$), filtered, and evaporated in vacuo. The crude product was purified by flash chromatography to yield 1.03 g (2.80 mmol, 94% yield) of pure (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-**9a**.

**(*R*,*R*)-Methyl 2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-9a.** $R_f$ = 0.21 (petroleum ether/$Et_2O$ 5:5). White crystals, yield 94%. $[\alpha]_D$ −70.4 (*c* 0.3, $CHCl_3$). Mp: 121.9−122.0 °C. IR ($cm^{-1}$): $\nu_{max}$ 1088, 1152, 1326, 1433, 1766, 3252. $^1H$

NMR (300 MHz, $CDCl_3$): $\delta$ 2.34 (3H, s), 3.66 (3H, s), 4.56 (1H, d, $J$ = 5.7 Hz), 4.93 (1H, d × d, $J$ = 9.0, 5.7 Hz), 6.07 (1H, d, $J$ = 9.0 Hz), 7.06−7.25 (7H, m), 7.58 (2H, d, $J$ = 8.3 Hz). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 21.5, 53.2, 59.1, 59.8, 127.0 (2C), 127.1 (2C), 128.5, 128.6 (2C), 129.4 (2C), 135.6, 137.2, 143.4, 167.9. MS (ES, pos mode) $m/z$: 368/370 ($M + H^+$, 100). Anal. Calcd for $C_{17}H_{18}ClNO_4S$: C, 55.51; H, 4.93; N, 3.81. Found: C, 55.24; H, 5.03; N, 3.67.

**(*R*,*R*)-Methyl 2-Chloro-3-(4-methoxyphenyl)-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-9b.** $R_f$ = 0.13 (petroleum ether/$Et_2O$ 5:5). Yellow oil, yield 99%. $[\alpha]_D$ −73.2 ($c$ 0.4, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 663, 1029, 1158, 1251, 1329, 1438, 1514, 1747, 3274. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 2.34 (3H, s), 3.67 (3H, s), 3.73 (3H, s), 4.55 (1H, d, $J$ = 6.3 Hz), 4.88 (1H, d × d, $J$ = 8.8, 6.3 Hz), 6.22 (1H, d, $J$ = 8.8 Hz), 6.68 (2H, d, $J$ = 8.8 Hz), 7.01 (2H, d, $J$ = 8.8 Hz), 7.11 (2H, d, $J$ = 8.0 Hz), 7.57 (2H, d, $J$ = 8.0 Hz). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 21.5, 53.2, 55.2, 59.4, 59.5, 113.8 (2C), 127.1 (2C), 127.6, 128.4 (2C), 129.3 (2C), 137.3, 143.3, 159.5, 168.1. MS (ES, pos mode) $m/z$: 415/417 ($M + NH_4^+$, 20), 290 (90), 227/229 (100). Anal. Calcd for $C_{18}H_{20}ClNO_5S$: C, 54.34; H, 5.07; N, 3.52. Found: C, 54.32; H, 5.10; N, 3.78.

**Synthesis of (*R*,*R*)-3-(Benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanoate (*R*,*R*)-9c.** To a solution of ($R_S$,*R*,*R*)-methyl 2-chloro-3-(benzenesulfonylamino)-3-furan-2-yl-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-**6c** (1.23 g, 2.76 mmol) in methanol (50 mL) was added a 3 N solution of HCl in MeOH (30 equiv, 27.55 mL, 82.65 mmol) at room temperature. The mixture was stirred for 24 h at room temperature and subsequently poured into a saturated aqueous solution of $NaHCO_3$ (50 mL) and extracted with dichloromethane (3 × 50 mL). The combined organic phases were dried ($MgSO_4$), filtered, and evaporated in vacuo. The crude product was purified by flash chromatography to yield 0.84 g (2.45 mmol, 89% yield) of pure (*R*,*R*)-3-(benzenesulfonylamino)-2-chloro-3-furan-2-ylpropanoate (*R*,*R*)-**9c**. $R_f$ = 0.38 (petroleum ether/$Et_2O$ 3:7). White crystals, yield 89%. $[\alpha]_D$ −63.6 ($c$ 0.2, $CHCl_3$). Mp: 99.3−99.5 °C. IR ($cm^{-1}$): $\nu_{max}$ 752, 1047, 1164, 1309, 1343, 1434, 1743, 3268. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 3.74 (3H, s), 4.62 (1H, d, $J$ = 5.5 Hz), 5.08 (1H, d × d, $J$ = 9.9, 5.5 Hz), 5.64 (1H, d, $J$ = 9.9 Hz), 6.08 (1H, d, $J$ = 3.3 Hz), 6.17 (1H, d × d, $J$ = 3.3, 1.7 Hz), 7.20 (1H, d, $J$ = 1.7 Hz), 7.40−7.47 (2H, m), 7.49−7.56 (1H, m), 7.76−7.81 (2H, m). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 53.4, 54.3, 57.7, 109.3, 110.5, 127.0 (2C), 129.0 (2C), 132.8, 140.1, 142.8, 148.4, 167.5. MS (ES, neg. mode) $m/z$: 342/344 ($M - H^+$, 100). Anal. Calcd for $C_{14}H_{14}ClNO_5S$: C, 48.91; H, 4.10; N, 4.07. Found: C, 48.63; H, 3.98; N, 4.26.

**Synthesis of Chiral *N*-Sulfonyl 3-Arylaziridine-2-carboxylic Amides (2*S*,3*R*)-10.** The synthesis of (2*S*,3*R*)-3-phenyl-1-(*p*-toluenesulfonyl)aziridine-2-carboxylic amide (2*S*,3*R*)-**10a** is representative. (*R*,*R*)-2-Chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanamide (*R*,*R*)-**8a** (0.25 g, 0.71 mmol) was dissolved in acetonitrile (20 mL), and $K_2CO_3$ (2 equiv, 0.196 g, 1.42 mmol) was added in one portion. The reaction mixture was stirred for 5 h at room temperature and subsequently evaporated in vacuo. The reaction mixture was dissolved in $CH_2Cl_2$ (20 mL), washed with brine (20 mL), dried ($MgSO_4$), filtered, and evaporated in vacuo. Purification via flash chromatography and recrystallization from diethyl ether afforded 0.17 g (0.54 mmol, 76% yield) of pure (2*S*,3*R*)-3-phenyl-1-(*p*-toluenesulfonyl)aziridine-2-carboxylic amide (2*S*,3*R*)-**10a**. In the synthesis of (2*S*,3*R*)-1-benzenesulfonyl-3-furan-2-ylaziridine-2-carboxylic amide (2*S*,3*R*)-**10c**, 3 equiv of $K_2CO_3$ was used, and the reaction mixture was stirred for 20 h at room temperature. The obtained (2*S*,3*R*)-1-benzenesulfonyl-3-furan-2-ylaziridine-2-carboxylic amide (2*S*,3*R*)-**10c** was purified by recrystallization from $Et_2O$.

**(2*S*,3*R*)-3-Phenyl-1-(*p*-toluenesulfonyl)aziridine-2-carboxylic amide (2*S*,3*R*)-10a.** $R_f$ = 0.23 ($CH_2Cl_2$ + 3% MeOH). White crystals, yield 76%. $[\alpha]_D$ +28.3 ($c$ 0.2, DMF). Mp: 167.0−167.2 °C. IR ($cm^{-1}$): $\nu_{max}$ 684, 762, 909, 1165, 1334, 1656, 3182, 3385. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 2.42 (3H, s), 3.90 (1H, d, $J$ = 4.4 Hz), 4.09 (1H, d, $J$ = 4.4 Hz), 5.52 (1H, br s), 6.25 (1H, br s), 7.21−7.41 (7H, m), 7.59 (2H, d, $J$ = 8.3 Hz). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 21.7, 44.1, 50.9, 127.7 (2C), 128.4 (2C), 129.3 (2C), 129.4, 129.7 (2C), 135.7, 144.8, 145.2, 168.0. MS (ES, pos mode) $m/z$: 317 ($M + H^+$, 100). Anal. Calcd for $C_{16}H_{16}N_2O_3S$: C, 60.74; H, 5.10; N, 8.85. Found: C, 60.81; H, 5.23; N, 9.02.

**(2*S*,3*R*)-1-Benzenesulfonyl-3-furan-2-ylaziridine-2-carboxylic Amide (2*S*,3*R*)-10c.** White crystals, yield 81%. $[\alpha]_D$ +24.3 ($c$ 0.1, DMF). Mp 128.7−128.9 °C. IR ($cm^{-1}$): $\nu_{max}$ 1090, 1165, 1323, 1672, 3319, 3432. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 3.66 (1H, d, $J$ = 7.7 Hz), 4.07 (1H, d, $J$ = 7.7 Hz), 5.73 (1H, br s), 6.17 (1H, br s), 6.27−6.31 (1H, m), 6.33−6.38 (1H, m), 7.33 (1H, br s), 7.56−7.65 (2H, m), 7.68−7.76 (1H, m), 7.99 (2H, d, $J$ = 8.3 Hz). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 40.3, 43.5, 110.7, 110.9, 128.1 (2C), 129.5 (2C), 134.5, 136.4, 143.7, 144.9, 166.3. MS (ES, pos mode) $m/z$: 293 ($M + H^+$, 100). Anal. Calcd for $C_{13}H_{12}N_2O_4S$: C, 53.42; H, 4.14; N, 9.58. Found: C, 53.53; H, 4.29; N, 9.38.

**Synthesis of Chiral *N*-Tosyl-3-arylaziridine-2-carboxylic Esters (2*S*,3*R*)-11.** The synthesis of (2*S*,3*R*)-methyl 3-phenyl-1-(*p*-toluenesulfonyl)aziridine-2-carboxylate (2*S*,3*R*)-**11a** is representative. (*R*,*R*)-Methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-**9a** (0.25 g, 0.68 mmol) was dissolved in acetonitrile (20 mL), and $K_2CO_3$ (2 equiv, 0.188 g, 1.36 mmol) was added in one portion. The reaction mixture was stirred for 2 h at room temperature and subsequently evaporated in vacuo. The reaction mixture was dissolved in $CH_2Cl_2$ (20 mL), washed with brine (20 mL), dried ($MgSO_4$), filtered, and evaporated in vacuo. Purification via flash chromatography afforded 0.22 g (0.67 mmol, 98% yield) of pure (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (2*S*,3*R*)-**11a**. In the synthesis of (2*S*,3*R*)-methyl 3-(4-methoxyphenyl)-1-(*p*-toluenesulfonyl)aziridine-2-carboxylate (2*S*,3*R*)-**11b** 5 equiv of $K_2CO_3$ was used, and the reaction mixture was stirred for 2 h at room temperature. (2*S*,3*R*)-Methyl 3-(4-methoxyphenyl)-1-(*p*-toluenesulfonyl)aziridine-2-carboxylate (2*S*,3*R*)-**11b** was obtained in analytically pure form after extraction, without the need of purification via flash chromatography.

**(2*S*,3*R*)-Methyl 3-Phenyl-1-(*p*-toluenesulfonyl)aziridine-2-carboxylate (2*S*,3*R*)-11a.** $R_f$ = 0.32 (petroleum ether/EtOAc 8:2). Colorless oil, yield 98%. $[\alpha]_D$ −34.6 ($c$ 0.4, $CH_2Cl_2$) vs −29.4 ($c$ 1.0, $CH_2Cl_2$) and (2*R*,3*S*)-**11a** +33.1 ($c$ 1.0, $CH_2Cl_2$) in ref 16. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 2.41 (3H, s), 3.53 (1H, d, $J$ = 3.9 Hz), 3.86 (3H, s), 4.44 (1H, d, $J$ = 3.9 Hz), 7.21−7.36 (7H, m), 7.78 (2H, d, $J$ = 8.3 Hz). Anal. Calcd for $C_{17}H_{17}NO_4S$: C, 61.61; H, 5.17; N, 4.23. Found: C, 61.41; H, 4.95; N, 4.07. All spectroscopic data were in good agreement with reported data.[16]

**(2*S*,3*R*)-Methyl 3-(4-Methoxyphenyl)-1-(*p*-toluenesulfonyl)aziridine-2-carboxylate (2*S*,3*R*)-11b.** $R_f$ = 0.23 (hexane/$Et_2O$ 7:3). Colorless oil, yield 96%. $[\alpha]_D$ −19.4 ($c$ 0.2, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 790, 1160, 1251, 1333, 1517, 1746, 2954. $^1$H NMR (300 MHz, $CDCl_3$): $\delta$ 2.42 (3H, s), 3.60 (1H, d, $J$ = 4.1 Hz), 3.79 (3H, s), 3.84 (3H, s), 4.35 (1H, d, $J$ = 4.1 Hz), 6.83 (2H, d, $J$ = 8.3 Hz), 7.19 (2H, d, $J$ = 8.3 Hz), 7.28 (2H, d, $J$ = 7.7 Hz), 7.75 (2H, d, $J$ = 8.3 Hz). $^{13}$C NMR (75 MHz, $CDCl_3$): $\delta$ 21.6, 46.0, 48.0, 53.1, 55.3, 114.0 (2C), 123.9, 127.5 (2C), 129.0 (2C), 129.6 (2C), 137.0, 144.3, 160.1, 166.6. MS (ES, pos mode) $m/z$: 362 ($M + H^+$, 100). Anal. Calcd for $C_{18}H_{19}NO_5S$: C, 59.82; H, 5.30; N, 3.88. Found: C, 60.11; H, 5.02; N, 3.68.

**Synthesis of Chiral $\beta$-Chloro-$\gamma$-sulfonylamino Alcohols (*R*,*R*)-12, (*S*)-*N*-(3-Hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*S*)-13, and (2*S*,3*R*)-2-Hydroxymethyl-3-phenyl-1-(*p*-toluenesulfonyl)aziridine (2*S*,3*R*)-14.** The synthesis of (*R*,*R*)-*N*-(2-chloro-3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*R*,*R*)-**12a** is representative. Lithium aluminum hydride (2.05 equiv, 0.106 g, 2.79 mmol) was suspended in tetrahydrofuran (10 mL) at 0 °C. A solution of (*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*p*-toluenesulfonylamino)propanoate (*R*,*R*)-**9a** (0.50 g, 1.36 mmol) in tetrahydrofuran

(10 mL) was added dropwise to the $LiAlH_4$ suspension under $N_2$. The reaction mixture was stirred for 2.5 h at 0 °C. Subsequently, the reaction was quenched with $H_2O$ (1 mL), diluted with $CH_2Cl_2$ (40 mL), and filtered through a short pad of Celite. The Celite pad was washed exhaustively with excess $CH_2Cl_2$. The collected solvent was dried ($MgSO_4$), filtered again and evaporated in vacuo. Purification via flash chromatography afforded 0.40 g (1.18 mmol, 87% yield) of pure (1*R*,2*R*)-*N*-(2-chloro-3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*R*,*R*)-**12a**. When the reaction was performed with 2.8 equiv of $LiAlH_4$ at 0 °C for 2.5 h upon which the reaction was slowly warmed to room temperature, a mixture was obtained of (1*R*,2*R*)-*N*-(2-chloro-3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*R*,*R*)-**12a**, (*S*)-*N*-(3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*S*)-**13**, and (2*S*,3*R*)-2-hydroxymethyl-3-phenyl-1-(*p*-toluenesulfonyl)aziridine (2*S*,3*R*)-**14**, which were purified and isolated via flash chromatography in respectively 42%, 17%, and 25% yield (Scheme 2).

**(*R*,*R*)-*N*-(2-Chloro-3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*R*,*R*)-12a.** $R_f$ = 0.40 (petroleum ether/$Et_2O$ 25:75). White crystals, yield 87%. $[\alpha]_D$ −71.0 (*c* 0.4, $CHCl_3$). Mp: 124.0−124.2 °C. IR ($cm^{-1}$): $\nu_{max}$ 702, 1091, 1159, 1325, 2948, 3271, 3465, 3524. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.34 (3H, s), 2.75 (1H, t, *J* = 6.6 Hz), 3.65−3.78 and 3.88−4.02 (2H, m), 4.18−4.25 (1H, m), 4.71 (1H, d × d, *J* = 8.8, 6.6 Hz), 5.99 (1H, d, *J* = 8.8 Hz), 6.98−7.22 (7H, m), 7.54 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.5, 59.6, 63.4, 64.4, 127.2 (2C), 127.3 (2C), 128.1, 128.4 (2C), 129.4 (2C), 136.6, 136.8, 143.5. MS (ES, neg mode) *m*/*z*: 338/340 ($M - H^+$, 100). Anal. Calcd for $C_{16}H_{18}ClNO_3S$: C, 56.55; H, 5.34; N, 4.12. Found: C, 56.29; H, 5.21; N, 4.01.

**(*R*,*R*)-*N*-[2-Chloro-3-hydroxy-1-(4-methoxyphenyl)propyl]-4-methylbenzenesulfonamide (*R*,*R*)-12b.** White crystals, yield 88%. $[\alpha]_D$ −69.6 (*c* 0.3, $CHCl_3$). Mp: 113.3−113.4 °C. IR ($cm^{-1}$): $\nu_{max}$ 666, 752, 1031, 1156, 1250, 1321, 1514, 2934, 3278, 3496. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.35 (3H, s), 2.92 (1H, d × d, *J* = 7.2, 6.3 Hz), 3.64−3.77 and 3.89−3.99 (2H, m), 3.73 (3H, s), 4.20 (1H, t × d, *J* = 6.3, 4.4 Hz), 4.66 (1H, d × d, *J* = 8.5, 6.3 Hz), 6.04 (1H, d, *J* = 8.5 Hz), 6.65 (2H, d, *J* = 8.8 Hz), 6.95 (2H, d, *J* = 8.8 Hz), 7.11 (2H, d, *J* = 8.3 Hz), 7.53 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.5, 55.2, 59.0, 63.5, 64.7, 113.7 (2C), 127.1 (2C), 128.5 (2C), 128.6, 129.4 (2C), 136.9, 143.4, 159.3. MS (ES, neg. mode) *m*/*z*: 368/370 ($M - H^+$, 100). Anal. Calcd for $C_{17}H_{20}ClNO_4S$: C, 55.20; H, 5.45; N, 3.79. Found: C, 54.91; H, 5.56; N, 3.69.

**(*R*,*R*)-*N*-(2-Chloro-1-furan-2-yl-3-hydroxypropyl)-4-methylbenzenesulfonamide (*R*,*R*)-12c.** White crystals, yield 84%. $[\alpha]_D$ −71.2 (*c* 0.3, $CHCl_3$). Mp: 99.0−99.3 °C. IR ($cm^{-1}$): $\nu_{max}$ 746, 1022, 1163, 1321, 1451, 2941, 3215, 3485. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.56 (1H, t, *J* = 6.1 Hz), 3.75−3.87 and 4.01−4.12 (2H, m), 4.24 (1H, t × d, *J* = 6.9, 4.4 Hz), 4.81 (1H, d × d, *J* = 9.4, 6.9 Hz), 5.60 (1H, d, *J* = 9.4 Hz), 5.90 (1H, d, *J* = 3.3 Hz), 6.13 (1H, d × d, *J* = 3.3, 1.7 Hz), 7.19 (1H, d, *J* = 1.7 Hz), 7.38−7.47 (2H, m), 7.49−7.56 (1H, m), 7.70−7.77 (2H, m). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 53.5, 62.7, 63.4, 109.0, 110.3, 127.0 (2C), 129.0 (2C), 132.9, 139.6, 142.5, 149.1. MS (ES, neg. mode) *m*/*z*: 314/316 ($M - H^+$, 100). Anal. Calcd for $C_{13}H_{14}ClNO_4S$: C, 49.45; H, 4.47; N, 4.44. Found: C, 49.66; H, 4.26; N, 4.24.

**(*S*)-*N*-(3-Hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*S*)-13.** $R_f$ = 0.14 (petroleum ether/$Et_2O$ 25:75). White crystals, yield 25%. $[\alpha]_D$ −74.9 (*c* 0.1, $CHCl_3$). Mp: 140.6−140.7 °C. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 1.88−2.00 (2H, m), 2.35 (3H, s), 2.47 (1H, t, *J* = 5.1 Hz), 3.57−3.69 and 3.74−3.85 (2H, m), 4.52 (1H, q, *J* = 7.4 Hz), 5.98 (1H, d, *J* = 7.4 Hz), 6.98−7.18 (7H, m), 7.56 (2H, d, *J* = 8.3 Hz). Anal. Calcd for $C_{16}H_{19}NO_3S$: C, 62.93; H, 6.27; N, 4.59. Found: C, 62.71; H, 6.11; N, 4.37. All spectroscopic data were in good agreement with reported data.[21]

**(2*S*,3*R*)-2-Hydroxymethyl-3-phenyl-1-(*p*-toluenesulfonyl) aziridine (2*S*,3*R*)-14.** $R_f$ = 0.72 (petroleum ether/$Et_2O$ 25:75). Colorless oil, yield 17%. $[\alpha]_D$ −50.5 (*c* 0.3, $CHCl_3$) vs (2*R*,3*S*)-**14** +48.4 (*c* 1.9, $CHCl_3$, > 98% ee) in ref 17. IR ($cm^{-1}$): $\nu_{max}$ 687, 696, 906, 1153, 1303, 1318, 2920, 3518. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.41 (3H, s), 3.12−3.23 (2H, m), 4.03 (1H, d, *J* = 4.4 Hz), 4.18 (1H, d × d × d, *J* = 13.6, 8.5, 4.4 Hz), 4.32 (1H, d × d × d, *J* = 13.6, 9.9, 3.2 Hz), 7.10−7.34 (7H, m), 7.83 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.6, 46.3, 54.7, 60.6, 126.4 (2C), 127.1 (2C), 128.4, 128.6 (2C), 129.7 (2C), 134.5, 137.0, 144.4. MS (ES, pos mode) *m*/*z*: 304 ($M + H^+$, 100). Anal. Calcd for $C_{16}H_{17}NO_3S$: C, 63.34; H, 5.65; N, 4.62. Found: C, 63.06; H, 5.39; N, 4.76. All spectroscopic data were in good agreement with reported data for the (2*R*,3*S*)-enantiomer of (2*S*,3*R*)-**14**.[17]

**Synthesis of Chiral *N*-Sulfonyl *trans*-2-Aryl-3-chloroazetidines (2*R*,3*S*)-15.** The synthesis of (2*R*,3*S*)-3-chloro-2-phenyl-1-tosylazetidine (2*R*,3*S*)-**15a** is representative. (1*R*,2*R*)-*N*-(2-Chloro-3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*R*,*R*)-**12a** (0.25 g, 0.74 mmol) and triphenylphosphine (1.5 equiv, 0.29 g, 1.11 mmol) were dissolved in tetrahydrofuran (20 mL). Diisopropyl azodicarboxylate (1.5 equiv, 0.22 g, 1.11 mmol) was slowly added, and the mixture was stirred for 24 h at room temperature. The reaction mixture was rinsed through a pad of silica gel with diethyl ether and evaporated in vacuo. Purification via flash chromatography afforded 0.23 g (0.71 mmol, 97% yield) of pure (2*R*,3*S*)-3-chloro-2-phenyl-1-tosylazetidine (2*R*,3*S*)-**15a**.

**(2*R*,3*S*)-3-Chloro-2-phenyl-1-tosylazetidine (2*R*,3*S*)-15a.** $R_f$ = 0.04 (petroleum ether/$Et_2O$ 7:3). White crystals, yield 97%. Mp: 137.4−137.5 °C. $[\alpha]_D$ −175.3 (*c* 0.4, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 656, 695, 1102, 1157, 1346, 2923. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.43 (3H, s), 3.72−3.82 (1H, m), 4.12−4.24 (2H, m), 4.75−4.82 (1H, m), 7.23−7.45 (7H, m), 7.67 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.6, 51.3, 57.0, 75.8, 126.3 (2C), 128.4 (2C), 128.7 (2C), 128.9, 129.8 (2C), 131.3, 136.9, 144.6. MS (ES, pos mode) *m*/*z*: 344/346 ($M + Na^+$, 10), 184 (100). Anal. Calcd for $C_{16}H_{16}ClNO_2S$: C, 59.71; H, 5.01; N, 4.35. Found: C, 59.91; H, 5.19; N, 4.23.

**(2*R*,3*S*)-3-Chloro-2-(4-methoxyphenyl)-1-tosylazetidine (2*R*,3*S*)-15b.** $R_f$ = 0.34 (hexane/$Et_2O$ 5:5). White crystals, yield 70%. Mp: 91.6−91.7 °C. $[\alpha]_D$ −192.8 (*c* 0.2, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 1025, 1102, 1162, 1252, 1294, 1348, 3209, 3480. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 2.46 (3H, s), 3.68−3.78 (1H, m), 3.81 (3H, s), 4.12−4.22 (2H, m), 4.66−4.73 (1H, m), 6.89 (2H, d, *J* = 8.8 Hz), 7.33 (2H, d, *J* = 8.8 Hz), 7.34 (2H, d, *J* = 8.3 Hz), 7.66 (2H, d, *J* = 8.3 Hz). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 21.7, 51.6, 55.3, 56.8, 75.7, 114.1 (2C), 127.9 (2C), 128.4 (2C), 129.1, 129.8 (2C), 131.4, 144.6, 160.1. MS (ES, pos mode) *m*/*z*: 374/376 ($M + Na^+$, 20), 184 (100). Anal. Calcd for $C_{17}H_{18}ClNO_3S$: C, 58.03; H, 5.16; N, 3.98. Found: C, 57.88; H, 5.08; N, 3.97.

**(2*R*,3*S*)-1-Benzenesulfonyl-3-chloro-2-furan-2-ylazetidine (2*R*,3*S*)-15c.** $R_f$ = 0.33 (petroleum ether/$Et_2O$ 7:3). White crystals, yield 72%. Mp: 84.9−85.1 °C. $[\alpha]_D$ −102.6 (*c* 0.2, $CHCl_3$). IR ($cm^{-1}$): $\nu_{max}$ 738, 1020, 1090, 1160, 1341. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 3.83 (1H, t, *J* = 7.7 Hz), 4.18 (1H, t, *J* = 7.7 Hz), 4.63 (1H, t × d, *J* = 7.7, 6.6 Hz), 4.89 (1H, d, *J* = 6.6 Hz), 6.33 (1H, d × d, *J* = 3.3, 1.7 Hz), 6.41 (1H, d, *J* = 3.3 Hz), 7.39 (1H, d, *J* = 1.7 Hz), 7.48−7.56 (2H, m), 7.59−7.65 (1H, m), 7.75−7.80 (2H, m). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 48.1, 56.6, 68.2, 110.7, 110.8, 128.1 (2C), 129.2 (2C), 133.5, 135.4, 143.8, 148.7. MS (ES, neg mode) *m*/*z*: 296/298 ($M - H^+$, 10), 278 (100). Anal. Calcd for $C_{13}H_{12}ClNO_3S$: C, 52.44; H, 4.06; N, 4.70. Found: C, 52.24; H, 3.93; N, 4.49.

**Synthesis of (*R*,*R*)-3-Amino-2-chloro-3-phenylpropanamide Hydrochloride (*R*,*R*)-17.** To a solution of (*R*,*R*)-2-chloro-3-phenyl-3-(*tert*-butoxycarbonylamino)propanamide (*R*,*R*)-**8d** (0.20 g, 0.67 mmol) in diethyl ether (6 mL) was added a 4 N solution of HCl in dioxane (50 equiv, 11.17 mL, 33.51 mmol) at room temperature. The mixture was allowed to stir for 3 h at room temperature. Subsequently, the reaction mixture was concentrated in vacuo. Precipitation in diethyl ether afforded 0.10 g (0.52 mmol, 78% yield) of pure (*R*,*R*)-3-amino-2-chloro-3-phenylpropanamide hydrochloride (*R*,*R*)-**17** (er 95:5). White

crystals, yield 78%. er 95:5. $[\alpha]_D$ +7.4 (*c* 0.2, DMF). Mp: 209.2−209.9 °C. IR ($cm^{-1}$): $\nu_{max}$ 701, 1412, 1512, 1578, 1685, 2774, 3038, 3394. $^1H$ NMR (300 MHz, $D_2O$, int. ref $CH_3CN$): $\delta$ 5.09 (1H, d, $J$ = 4.4 Hz), 5.14 (1H, d, $J$ = 4.4 Hz), 7.46−7.62 (5H, m). $^{13}C$ NMR (75 MHz, $D_2O$, int ref $CH_3CN$): $\delta$ 56.7, 57.8, 127.6 (2C), 129.3 (2C), 130.2, 131.2, 170.3. MS (ES, pos mode) $m/z$: 199/201 ($M + H^+ - HCl$, 100). Anal. Calcd for $C_9H_{12}Cl_2N_2O$: C, 45.98; H, 5.14; N, 11.91. Found: C, 46.19; H, 5.00; N, 11.77.

**Synthesis of (*R*,*R*)-Methyl 3-Amino-2-chloro-3-phenylpropanoate Hydrochloride (*R*,*R*)-18.** To a solution of ($R_S$,*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*tert*-butoxycarbonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-**6d** (0.40 g, 0.96 mmol) in methanol (15 mL) was added a 3 N solution of HCl in MeOH (80 equiv, 25.61 mL, 76.84 mmol) at room temperature. The mixture was stirred for 16 h at room temperature. Subsequently, the reaction mixture was concentrated in vacuo. Precipitation in diethyl ether afforded 0.19 g (0.76 mmol, 79% yield) of pure (*R*,*R*)-methyl 3-amino-2-chloro-3-phenylpropanoate hydrochloride (*R*,*R*)-**18** (er 95:5). White crystals, yield 79%. er 95:5. $[\alpha]_D$ +19.0 (*c* 0.1, DMF). Mp: 198.4−198.9 °C. IR ($cm^{-1}$): $\nu_{max}$ 700, 1168, 1511, 1746, 2849. $^1H$ NMR (300 MHz, $D_2O$, int. ref $CH_3CN$): $\delta$ 3.83 (3H, s), 5.26 (1H, d, $J$ = 4.7 Hz), 5.36 (1H, d, $J$ = 4.7 Hz), 7.48−7.59 (5H, m). $^{13}C$ NMR (75 MHz, $D_2O$, int. ref $CH_3CN$): $\delta$ 54.2, 56.0, 58.7, 127.6 (2C), 129.3 (2C), 130.4, 131.0, 168.1. MS (ES, pos mode) $m/z$: 214/216 ($M + H^+ - HCl$, 100). Anal. Calcd for $C_{10}H_{13}Cl_2NO_2$: C, 48.02; H, 5.24; N, 5.60. Found: C, 47.91; H, 5.23; N, 5.57.

**Synthesis of (4*R*,5*S*)-Methyl 4-Phenyloxazolidin-2-one-5-carboxylate (4*R*,5*S*)-19.** To a solution of ($R_S$,*R*,*R*)-methyl 2-chloro-3-phenyl-3-(*tert*-butoxycarbonylamino)-*N*-*tert*-butanesulfinylpropanimidate ($R_S$,*R*,*R*)-**6d** (0.40 g, 0.96 mmol) in methanol (15 mL) was added a 3N solution of HCl in MeOH (80 equiv, 25.61 mL, 76.84 mmol) at room temperature. The mixture stirred for 16 h at room temperature and subsequently poured in a saturated aqueous solution of $NaHCO_3$ (40 mL) and extracted with dichloromethane (3 × 40 mL). The combined organic phases were dried ($MgSO_4$), filtered and evaporated in vacuo. The crude product was purified by recrystallization from diethyl ether to yield 0.20 g (0.92 mmol, 96% yield) of pure (4*R*,5*S*)-methyl 4-phenyloxazolidin-2-one-5-carboxylate (4*R*,5*S*)-**19** (er 95:5). White crystals, yield 96%. er 95:5. $[\alpha]_D$ +47.4 (*c* 0.1, $CHCl_3$). Mp: 156.6−156.7 °C. IR ($cm^{-1}$): $\nu_{max}$ 699, 1076, 1211, 1722, 1760, 2849, 3261. $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ 3.88 (3H, s), 4.78 (1H, d, $J$ = 5.0 Hz), 4.99 (1H, d, $J$ = 5.0 Hz), 6.14 (1H, br s), 7.35−7.48 (5H, m). $^{13}C$ NMR (75 MHz, $CDCl_3$): $\delta$ 53.2, 59.1, 80.3, 125.9 (2C), 129.2, 129.4 (2C), 138.8, 157.7, 168.8. MS (ES, neg. mode) $m/z$: 220 ($M - H^+$, 100). Anal. Calcd for $C_{11}H_{11}NO_4$: C, 59.73; H, 5.01; N, 6.33. Found: C, 59.52; H, 4.86; N, 6.13. All spectroscopic data were in good agreement with reported data of the racemate of **19**.[22]

## ■ ASSOCIATED CONTENT

**Supporting Information.** General experimental conditions and copies of $^1H$ NMR and $^{13}C$ NMR spectra for ($R_S$)-methyl *N*-*tert*-butanesulfinyl-2-chloroethanimidate ($R_S$)-**3**, *N*-(*tert*-butanesulfinyl)-*tert*-butanesulfinimide **4**, α-chloro-β-amino-*N*-sulfinylimidates ($R_S$,*R*,*R*)-**6**, α-chloro-β-sulfonylamino imidate hydrochlorides (*R*,*R*)-**7**, α-chloro-β-amino amides (*R*,*R*)-**8**, α-chloro-β-amino esters (*R*,*R*)-**9**, aziridine-2-carboxylic amides (2*S*,3*R*)-**10**, aziridine-2-carboxylic esters (2*S*,3*R*)-**11**, β-chloro-γ-sulfonylamino alcohols (*R*,*R*)-**12**, (*S*)-*N*-(3-hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide (*S*)-**13**, (2*S*,3*R*)-2-hydroxymethyl-3-phenyl-1-(*p*-toluenesulfonyl)aziridine (2*S*,3*R*)-**14**, *trans*-2-aryl-3-chloroazetidines (2*R*,3*S*)-**15**, hydrochlorides (*R*,*R*)-**17** and (*R*,*R*)-**18**, and oxazolidin-2-one (4*R*,5*S*)-**19**. This material is available free of charge via the Internet at http://pubs.acs.org.

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### Notes

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