Supporting Information

for

Asymmetric synthesis of propargylamines as amino acid surrogates in peptidomimetics

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General methods and materials

If not mentioned differently, all reagents and solvents were purchased from commercial sources and applied without further purification. THF was kept over KOH before being dried with sodium/benzophenone under reflux and was freshly distilled before use. Toluene was predried over CaCl₂, then dried over sodium under reflux and distilled freshly before use. DCM used for synthesis was predried over CaCl₂, dried over CaH₂ under reflux and distilled freshly before use. DMSO was dried under reflux over CaH₂, distilled and stored over molecular sieves (4 Å) until use. DCM, EtOAc, PE and Et₂O used for aqueous work-ups or column chromatography were purchased in technical grade and distilled prior to application.

Schlenk conditions: If not mentioned differently, the reactions were carried out under exclusion of moisture and oxygen in dried glassware under argon atmosphere. The argon gas was supplied from Linde (quality 4.0) and passed through a column filled with phosphorpentoxide (sicapent®, Merck) before use.

Solvents were removed on a rotational evaporator at 40 °C and appropriately reduced pressure. Solvent residues were removed at rt and 0.001–0.1 mbar.

For column chromatography, Silica gel 60, 40–63 μm (Merck) was used. The eluents and their proportions are individually noted. Thin layer chromatography (TLC) was executed using silica gel 60 coated aluminium sheets with fluorescence indicator F254 (Merck). Spots were identified using different stains, such as KMnO₄, iodine, ninhydrin or UV light with a wavelength of λ = 254 nm or λ = 366 nm.

Preparative HPLC (Thermo Separation Products): Equipment: UV detector: UV1000; pump: Thermo Separation Products P4000; Method: column: Thermo Scientific Hypersil Gold (8 μm), 250 × 21.2 mm cartridge; flow rate: 10.00 mL min⁻¹; injection volume: 1.00 mL; detection at λ = 254 nm; solvents: A: water/acetonitrile/trifluoroacetic acid (94.9:5:0.1); B: water/acetonitrile/trifluoroacetic acid (5:94.9:0.1), gradient elution: (A %): 0–1 min: 100%, 1-30 min: gradient from 100% to 0%, 30–44 min: 0 %, 44–45 min: gradient from 100% to 0%.

Melting points: Melting points were determined using a Büchi 540 melting point apparatus and are uncorrected.

Optical rotation was measured on a DIP-360 (Jasco) polarimeter with a sodium vapour light source at a specific given temperature. A quartz cell with a path length of 10 cm was used. The average of ten single measurements divided by the concentration in units of g/mL and the
The sample concentration and solvent is given in $c = g/100 \text{mL}$ in parentheses.

Nuclear magnetic resonance (NMR) spectra were recorded on Bruker Avance 300 (300.13 MHz for $^1\text{H}$, 282.38 MHz for $^{19}\text{F}$, 75.48 MHz for $^{13}\text{C}$) or DRX 500 (499.87 MHz for $^1\text{H}$, 470.43 MHz for $^{19}\text{F}$, 125.70 MHz for $^{13}\text{C}$) or Avance 500 (500.01 MHz for $^1\text{H}$, 125.79 MHz for $^{13}\text{C}$) or Avance 600 (600.13 MHz for $^1\text{H}$, 564.63 MHz for $^{19}\text{F}$, 150.92 MHz for $^{13}\text{C}$). Chemical shifts ($\delta$), given in the experimental section, are reported in ppm relative to TMS ($\delta_{\text{TMS}} = 0$ ppm) and referenced to the solvent residue signals as internal standard: $\delta_{\text{ppm}}$: CHCl$_3$ ($\delta$ 7.26 ppm ($^1\text{H}$ NMR) and $\delta$ 77.2 ppm ($^{13}\text{C}$ NMR)) and CHD$_2$OD ($\delta$ 3.31 ppm ($^1\text{H}$ NMR) and $\delta$ 49.0 ppm ($^{13}\text{C}$ NMR)) and D$_2$HCSOCD$_3$ ($\delta$ 2.50 ppm ($^1\text{H}$ NMR) and $\delta$ 39.5 ppm ($^{13}\text{C}$ NMR)).

Coupling constants ($J$) are reported in Hertz (Hz) with 0.05 Hz resolution. Multiplicities are described as singlet (s), doublet (d), triplet (t) quartet (q) or multiplet (m). The assignments of $^{13}\text{C}$ and $^1\text{H}$ NMR signals were supported by 2D NMR techniques (COSY, HMQC, HMBC).

MS: Nano-ESI mass spectra were recorded using an Esquire 3000 ion trap mass spectrometer (Bruker Daltonik GmbH, Bremen, Germany) equipped with a standard nano-ESI source. Samples were introduced by static nano-ESI using in-house pulled glass emitters. Nitrogen served both as the nebuliser gas and the dry gas. Nitrogen was generated by a Bruker nitrogen generator NGM 11. Helium served as cooling gas for the ion trap and collision gas for MS$^n$ experiments.

ESI mass spectra were recorded using an Agilent 6220 time-of-flight mass spectrometer (Agilent Technologies, Santa Clara, CA, USA) in extended dynamic range mode equipped with a Dual-ESI source, operating with a nitrogen generator NGM 11. Samples were introduced with a 1200 HPLC system consisting of an autosampler, degasser, binary pump, column oven and diode array detector (Agilent Technologies, Santa Clara, CA, USA) using a C18 Hypersil Gold column (length: 50 mm, diameter: 2.1 mm particle size: 1.9 $\mu$m) with a short gradient (in 4 min from 0% B to 98% B, back to 0% B in 0.2 min, total run time 7.5 min) at a flow rate of 250 $\mu$L min$^{-1}$ and column oven temperature of 40 °C. HPLC solvent A consisted of water, acetonitrile and formic acid (94.9:5:0.1), solvent B of water, acetonitrile and formic acid (5:94.9:0.1). The mass axis was externally calibrated with ESI-L Tuning Mix (Agilent Technologies, Santa Clara, CA, USA) as calibration standard.

Elemental analyses were performed on an Element Analyser EURO EA.
IR spectra were recorded as neat samples on a FT-IR spectrophotometer Nicolet 380 (Thermo Scientific) equipped with ATR technique (smart orbit).

Analytical HPLC (Thermo Scientific Accela): Equipment; UV detector: Thermo Separation Products UV6000LP; pump: Thermo Separation Products P4000; autosampler: Thermo Separation Products AS100, Method: column: Jupiter 5 C18 Fa. Phenomenex, 250 × 4.60 mm cartridge; flow rate: 1.00 mL/min; injection volume: 0.2 µL; detection at λ = 254 nm; solvents: A: water/acetonitrile/trifluoroacetic acid (95.9:5:0.1); B: water/acetonitrile/trifluoroacetic acid (5:95.9:0.1). Gradient elution: (A, method 1): 0–9 min: gradient from 100% to 0%, 9–12 min: 0%, 12–13 min: gradient from 0% to 100%. (A, method 1): 0–4.5 min: gradient from 100% to 0%, 4.5–7 min: 0%, 7–8 min: gradient from 100% to 0%.

Crystal data were collected on an Agilent SuperNova diffractometer with Cu Kα radiation except for 12k and 10k, where Mo Kα radiation was used. The crystals were kept at 100.0(3) K during data collection. Using Olex2 [1] the structures were solved and refined with the ShelX program package [2] using direct methods and least-squares minimization. Details of the X-ray investigation are given in SI. CCDC 1566791 (7a), CCDC 1566792 (7c), CCDC 1566793 (7d), CCDC 1566794 (e), CCDC 1566795 (7i), CCDC 1566796 (7j), CCDC 1566797 (7k), CCDC 1566798 (7q), CCDC 1566799 (7s), CCDC 1566800 (10k), CCDC 1566801 (11i), CCDC 1566802 (12i), CCDC 1566803 (12k) and CCDC 1566804 (13w) contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.
### Abbreviations

| Abbreviation | Full Form | Description |
|--------------|-----------|-------------|
| ACN          | Acetonitrile |        |
| All          | Allyl     |             |
| ar           | Aryl      |             |
| Bn           | Benzyl    |             |
| Boc          | tert-Butyloxycarbonyl |          |
| Bu           | Butyl     |             |
| cy           | Cyclohexyl |             |
| d            | Doublet   |             |
| DCM          | Dichloromethane |         |
| DMSO         | Dimethylsulfoxide |        |
| dr           | Diastereomeric Ratio |       |
| ee           | Enantiomeric Excess |        |
| eq           | Equivalents |             |
| ESI          | Electrospray Ionization |       |
| Et           | Ethyl     |             |
| Et<sub>2</sub>O | Diethyl Ether |        |
| EtOAc        | Ethylacetate |         |
| FT           | Fourier Transform |         |
| h            | Hours     |             |
| HPLC         | High Performance Liquid Chromatography |         |

| Abbreviation | Full Form | Description |
|--------------|-----------|-------------|
| IR           | Infrared  |             |
| M            | Molar [mol L<sup>-1</sup>] |         |
| Me           | Methyl    |             |
| MeOH         | Methanol  |             |
| MHz          | Megahertz  |             |
| m            | Multiplet  |             |
| mp           | Melting Point |         |
| MS           | Mass Spectrometry |         |
| NMR          | Nuclear Magnetic Resonance |         |
| Ph           | Phenyl    |             |
| q            | Quartet    |             |
| rt           | Room Temperature |         |
| s            | Singlet    |             |
| TFA          | Trifluoroacetic Acid |         |
| THF          | Tetrahydrofuran |         |
| TLC          | Thin Layer Chromatography |         |
| TMS          | Trimethylsilyl |        |
| t            | Triplet    |             |
| UV           | Ultra Violet |         |
| Vis          | Visible    |             |
General Procedures

Condensation of aldehydes with Ellman’s chiral sulfinamide to form imines 5

GP-1: tert-Butylsulfinamide (S)-1 or (R)-1 (1 equiv) was dissolved in freshly distilled aldehyde (1 equiv) and Ti(OEt)$_4$ (2 equiv) was added in one portion. The slightly yellow suspension turned brightly orange upon heating for 40 min (approximately 60 °C) under reflux conditions. After cooling to rt, the suspension was diluted with EtOAc (40 mL) and brine (1 mL) was added dropwise leading to the formation of a colourless precipitate. The solid was filtered through a pad of celite and washed with EtOAc (200 mL). Evaporation of the solvent in vacuo yielded the aldimine ($5_{b,c,h,i,t}$) in pure form to be converted without further purification. Typical reactions were carried out on a scale of 1–3 g of tert-Butylsulfinamide (S)-1 or (R)-1. Analogous reaction conditions have already been described by Ellman et al. and Yus et al. [3–5].

GP-2: tert-Butylsulfinamide (S)-1 or (R)-1 (1 equiv) was dissolved in CH$_2$Cl$_2$ (1 M solution) and freshly prepared aldehyde (1.2 equiv), as well as dried CuSO$_4$ (1.5–2.0 equiv) was added in one portion. The colourless reaction mixture was stirred for 72 h at rt. After complete conversion of the sulfinamide (monitored by TLC), the suspension was diluted with a KHSO$_4$ solution (5%). The aqueous layer was separated, extracted twice with CH$_2$Cl$_2$ and the combined organic layers were dried over Na$_2$SO$_4$. Evaporation of the solvent in vacuo yielded the desired sulfinylimines ($5_{d-g, j-l, n-q, s, v, w}$). In some cases, purification by column chromatography was necessary. Typical reactions were carried out on a scale of 0.2–3 g of tert-Butylsulfinamide (S)-1 or (R)-1. Analogous reaction conditions have already been described by Ellman et al. [6].

Diastereoselective nucleophilic addition of trimethylsilylthynyl lithium to chiral sulfinimines 5 to form TMS-protected alkynes 6.

GP-3: At −78 °C, n-BuLi (1.6 M in n-hexane, 1.6 equiv) was added dropwise to a 0.85 M solution of ethynyltrimethylsilane (1.5 equiv) in THF. After 2 h, a 0.35 M solution of aldimine 5 (1.0 equiv) and Ti(OiPr)$_4$ (0.5 equiv) in THF was added to the reaction mixture over a period of 30 min. After complete conversion (approximately 2 h, monitored by TLC), the reaction mixture was allowed to warm up to rt. Subsequently, a saturated aqueous solution
of NH₄Cl was added until no further precipitate was formed. The colourless solid was filtered through a pad of celite, and the pad was washed with EtOAc (200 mL). The filtrate was dried over Na₂SO₄ and the solvent evaporated under reduced pressure. The crude product was directly applied for desilylation. This method was applied for the synthesis of 6a-d, 6n and 6t. Typical reactions were carried out on a scale of 0.5–3 g of imine 5. Analogous reaction conditions have already been described by Ellman et al. and Tartakovski et al. [7–9].

GP-4: At −78 °C, n-BuLi (1.6 M in n-hexane, 1.6 equiv) was added dropwise to a 0.85 M solution of ethynyltrimethylsilane (1.5 equiv) in toluene. After 2 h, a solution of aldimine 5 (1.0 equiv) and AlMe₃ (0.5 equiv) in toluene (0.35 M sol.) was added to the reaction mixture over a period of 30 min. After complete conversion (approximately 2 h, monitored by TLC), the reaction mixture was allowed to warm up to rt. The reaction mixture was diluted with a solution of KHSO₄ (5%), the organic layer was separated and washed with another portion of KHSO₄ solution (5%). The combined aqueous layers were extracted with Et₂O (4 × 50 mL). The combined organic layers were dried over Na₂SO₄ and the solvent was evaporated under reduced pressure. The crude alkyne 6 was directly applied for desilylation. This method was used for the synthesis of 6e-j, 6p, 6o. Typical reactions were carried out on a scale of 0.2–5 g of imine 5. Analogous reaction conditions have already been described by Ellman et al., Yus et al., Tan et al., Lin et al. and Hou et al. [9–14].

Desilylation of alkynes to yield propargylamine 7

GP-5: In this procedure, no Schlenk-conditions were applied. TMS protected alkyne 6 (1.0 equiv) was dissolved in THF to give a 0.2 M solution and a 1 M solution of TBAF in THF (2 equiv) was added dropwise at 0 °C. The reaction mixture was stirred for 2 h at 0 °C and for another 2 h at rt. After complete conversion (monitored by TLC), the reaction mixture was diluted with a saturated NH₄Cl solution. The emulsion was extracted with Et₂O (4 × 50 mL) and the combined organic layers were dried over Na₂SO₄. After evaporation of the solvent, the crude product was purified by column chromatography (in most cases EtOAc/PE, 1:2 or 1:1). The diastereomerically pure propargylamines 7 were isolated by recrystallization. This reaction procedure was used for the synthesis of 7a-e, 7h, 7n-p and 7t. Typical reactions were carried out on a scale of 0.4-5 g of TMS protected alkyne 6. Analogous reaction conditions have already been described by Du Bois et al., Isobe et al. and Vasella et al. [15–17].
GP-6: In this procedure, no Schlenk-conditions were applied. TMS protected alkyne 6 (1.0 equiv) was dissolved in a mixture of THF/H$_2$O (98:2) to give a 0.1 M solution and a 0.3 M solution of KF (1.1 equiv) and 18-crown-6 (1.1 equiv) in THF/H$_2$O (98:2) was added dropwise at 0 °C. After complete conversion (monitored by TLC, about 2.5 h), the reaction mixture was diluted with a saturated aqueous solution of NH$_4$Cl and extracted with Et$_2$O (3 × 50 mL). The combined organic layers were dried over Na$_2$SO$_4$ and the solvent was evaporated. The crude product was purified by column chromatography (in most cases EtOAc/PE, 1:2). The diastereomerically pure propargylamines 7 were isolated by recrystallization. This reaction procedure was applied for the synthesis of 7g, 7j-l, 7q, 7s, 7vx and 7wx. Typical reactions were carried out on a scale of 0.4–5 g of TMS protected alkyne 6. Analogous reaction conditions have already been described by Vasella et al. [18].

GP-7: In this procedure, no Schlenk-conditions were applied. TMS protected alkyne 6 (8.27 mmol, 1.0 equiv) was dissolved in EtOH (80 mL) and a solution of AgNO$_3$ (22.3 mmol, 2.7 equiv) in EtOH/H$_2$O (60 mL, 58:42) was added dropwise at rt. After 20 min, a 4 M aqueous solution of KCN (99.2 mmol, 12.0 equiv) was added and the reaction mixture was neutralised with hydrochloric acid (1 M). After 2 h the mixture was concentrated up under reduced pressure and afterwards extracted with Et$_2$O (3 × 40 mL). The combined organic layers were dried over Na$_2$SO$_4$ and the solvent was evaporated. The crude product was purified by column chromatography (EtOAc/PE, 1:2). The diastereopure propargylamines 7 were isolated by recrystallization. These reaction conditions were only used for the synthesis of 7i (typically 0.3–3 g). Analogous reaction conditions have already been described by Vasella et al. [17].

**Swern Oxidation**

GP-8: DMSO (50 mmol) was added dropwise to a solution of oxalylchloride (25 mmol) in DCM (60 mL) at −78 °C. After 2 min, a solution of the alcohol (23 mmol) in DCM (30 mL) was added over a period of 5 min. The reaction mixture was stirred for 30 min, before NEt$_3$ (115 mmol) was added. The resulting slurry was stirred for further 30 min at −78 °C and then warmed up to rt. The suspension was washed with water (50 mL) and a solution of KH$_2$SO$_4$ (5 %, 30 mL). The aqueous layers were extracted with DCM (2 × 30 mL) and the combined organic layers were washed with brine (20 mL) and dried over Na$_2$SO$_4$ before the solvent was evaporated under reduced pressure. The prepared aldehyde was directly converted or purified
by column chromatography or distillation. Typical reactions were carried out on a scale of 0.5–10 g of alcohol. The synthesis was carried out as described by Swern et al. [19].

Sonogashira cross coupling of propargylamine 7 to peptidomimetic 11

GP-9: DIPEA (6 equiv) was added to a solution of propargylamine 7 (1 equiv) and the methyl iodo-benzoate derivative (1.6 equiv) in THF (THF/DIPEA = 3:1). The reaction mixture was degassed by freeze pump thaw method, until no more gas atmosphere could be detected by the manometer. The catalysts, Cl$_2$Pd(PPh$_3$)$_2$ (2 mol %) and CuI (1 mol %) were added to the frozen reaction mixture and the solution slowly warmed to room temperature. After 30-120 min, a colourless precipitate formed in the clear solution, indicating the progress of the reaction. At least 2-8 h later, the suspension was diluted with a saturated aqueous NH$_4$Cl solution and KHSO$_4$ (aq, 5 %) was added, until the organic layer started to turn faintly red (pH 5-6). The emulsion was diluted with Et$_2$O, the organic layer separated and the organic layer extracted to more times with Et$_2$O. The combined organic layers were dried over Na$_2$SO$_4$ and the solvent was evaporated in vacuum. The crude product was purified by column chromatography. Typical reactions were carried out on a scale of 0.1–0.5 g of propargylamine 7. Similar reactions have already been described by Hashmi [20], Ishida [21] and Wong et al. [22].
Synthesis

Ethyl (3-hydroxypropynyl)-benzoate derivatives 1

Ethyl 4-(3-hydroxyprop-1-yn-1-yl)benzoate (1a)

Synthesis: GP-9, reaction scale: 25.2 mmol of prop-2-yn-1-ol. Instead of DIPEA, 6 equivalent of piperidine were used. Isolation by column chromatography (PE/EtOAc, 4:1). Compound 1a has been first described by Soler et al. [23].

Colourless crystals, yield: 4.32 g, 21.2 mmol, 84 %. ¹H NMR (300 MHz, Chloroform-d) δ = 7.99 (d, 3J = 8.5 Hz, 2H, ar-2-H, ar-6-H), 7.49 (d, 3J = 8.5 Hz, 2H, ar-3-H, ar-5-H), 4.52 (s, 2H, CH₂OH), 4.38 (q, 3J = 7.1 Hz, 1H, OCH₂CH₃), 1.39 (t, 3J = 7.1 Hz, 2H, OCH₂CH₃).

C₁₂H₁₂O₃ (204.23 g mol⁻¹). TLC: Rf (EtOAc/PE, 1:4) = 0.28.

Ethyl 3-(3-hydroxyprop-1-yn-1-yl)benzoate (1b)

Synthesis: GP-9, reaction scale: 1.153 mmol of prop-2-yn-1-ol. Isolation by column chromatography (PE/EtOAc, 2:1). Compound 1b has been described first by Chuang, Gallucci and Hart [24].

Colourless crystals, yield: 209.6 mg, 1.026 mmol, 89 %. ¹H NMR (500 MHz, Chloroform-d) δ = 8.03 (dd, 4J = 1.8 Hz, 4J = 1.5 Hz, 1H, ar-2-H), 7.92 (dd, 4J = 7.8 Hz, 4J = 1.5 Hz, 1H, ar-6-H), 7.51 (dd, 4J = 7.7 Hz, 4J = 1.5 Hz, 1H, ar-4-H), 7.30 (dd, 4J = 7.8 Hz, 4J = 7.8 Hz, 1H, ar-5-H), 4.48 (s, 2H, CH₂OH), 4.32 (q, 3J = 7.1 Hz, 2H, OCH₂CH₃), 3.18 (s, 1H, CH₂OH), 1.33 (t, 3J = 7.2 Hz, 3H, OCH₂CH₃). C₁₂H₁₂O₃ (204.23 g mol⁻¹). TLC: Rf (EtOAc/PE, 1:4) = 0.28. Smp = 48.8 °C.

Ethyl (3-oxopropynyl)-benzoate derivatives 2

Ethyl 4-(3-oxoprop-1-yn-1-yl)benzoate (2a)

Synthesis: GP-8, reaction scale: 21.10 mmol of alcohol 1a. Isolation by column chromatography (PE/EtOAc, 10:1).
Compound 2a has been described by Moser, Lu, Patten, Wang, Kasar, Kaldor and Patterson [25].

Red solid, yield: 3.49 g, 17.3 mmol, 82 %. \(^1\)H NMR (600 MHz, Chloroform-\(d\)) \(\delta = 9.45\) (s, 1H, CHO), 8.08 (d, \(^3\)J = 8.4 Hz, 2H, ar-2-H, ar-6-H), 7.67 (d, \(^3\)J = 8.3 Hz, 2H, ar-3-H, ar-5-H), 4.40 (q, \(^3\)J = 7.1 Hz, 2H, OCH\(_2\)CH\(_3\)), 1.41 (t, \(^3\)J = 7.1 Hz, 3H, OCH\(_2\)CH\(_3\)). C\(_{12}\)H\(_{10}\)O\(_3\) (202.21 g mol\(^{-1}\)). TLC: R\(_f\) (EtOAc/PE, 1:1) = 0.78.

Ethyl 3-(3-oxoprop-1-yn-1-yl)benzoate (2b)

Synthesis: GP-8, reaction scale: 532 µmol of alcohol 1b. Isolation by column chromatography (PE/EtOAc, 10:1).

Dark red oil, yield: 91.3 mg, 452 µmol, 85 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)) \(\delta = 9.44\) (s, 1H, CHO), 8.28 (dd, \(^4\)J = 1.7 Hz, \(^4\)J = 1.4 Hz, 1H, ar-2-H), 8.16 (dd, \(^3\)J = 7.8 Hz, \(^4\)J = 1.4 Hz, 1H, ar-6-H), 7.77 (dd, \(^3\)J = 7.7 Hz, \(^4\)J = 1.4 Hz, 1H, ar-4-H), 7.50 (dd, \(^3\)J = 7.8 Hz, \(^3\)J = 7.7 Hz, 1H, ar-5-H), 4.40 (q, \(^3\)J = 7.2 Hz, 2H, OCH\(_2\)CH\(_3\)), 1.41 (t, \(^3\)J = 7.1 Hz, 3H, OCH\(_2\)CH\(_3\)). C\(_{12}\)H\(_{11}\)O\(_3\) (202.21 g mol\(^{-1}\)). TLC: R\(_f\) (EtOAc/PE, 1:1) = 0.77.

Ethyl (\(\text{tert}-\text{butylsulfanyl}\))imino)propynyl)benzoate derivatives 3

Ethyl (\(R,E\))-4-((\(\text{tert}-\text{butylsulfanyl}\))imino)prop-1-yn-1-yl)benzoate (3a)

Synthesis: GP-2, reaction scale: 17.1 mmol of alcohol 2a and 17.0 mmol of \(R\)-1. Isolation by column chromatography (PE/EtOAc, 4:1).

Yellow solid, yield: 1.72 g, 8.89 mmol, 52 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)) \(\delta = 8.06\) (d, \(^3\)J = 8.6 Hz, 2H, ar-2-H, ar-6-H), 8.04 (s, 1H, CHN), 7.64 (d, \(^3\)J = 8.6 Hz, 2H, ar-3-H, ar-5-H), 4.39 (q, \(^3\)J = 7.1 Hz, 2H, OCH\(_2\)CH\(_3\)), 1.40 (t, \(^3\)J = 7.1 Hz, 3H, OCH\(_2\)CH\(_3\)), 1.27 (s, 9H, SC(CH\(_3\))\(_3\)). \(^{13}\)C NMR (126 MHz, Chloroform-\(d\)) \(\delta = 165.8\) (CO\(_2\)CH\(_2\)CH\(_3\)), 147.9 (CHN), 132.6 (ar-C-3, ar-C-5), 131.9 (ar-C-1), 129.8 (ar-C-2, ar-C-6), 125.2 (ar-C-4), 98.9 (C\(^\equiv\)HC=Car), 87.4 (C\(^\equiv\)HC=Car), 61.6 (CO\(_2\)CH\(_2\)), 59.0 (SC(CH\(_3\))\(_3\)), 22.7 (SC(CH\(_3\))\(_3\)), 14.4 (CO\(_2\)CH\(_2\)CH\(_3\)). C\(_{16}\)H\(_{19}\)NO\(_3\)S (305.39 g mol\(^{-1}\)). MS(ESI): m/z = 328.103 (328.0983 [M+Na\(^+\)], [\(\alpha\)]\(_{22.8}^\text{D}\) = -149.1 (c = 0.92; CHCl\(_3\)). IR(ATR): \(\tilde{\nu}\) [cm\(^{-1}\)] = 2980-2868 (w, NH, C-H), 1717 (CO\(_2\)Et), 1220 (S=O). TLC: R\(_f\) (EtOAc/PE, 1:4) = 0.38.
Ethyl \((R,E)-3-((\text{tert-butylsulfanyl})\text{imino})\text{prop-1-yn-1-yl})\text{benzoate (3b)}

Red fluid liquid, yield: 110 mg, 359 \(\mu\)mol, 80 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)) \(\delta = 8.24\) (s, 1H, ar-2-\(H\)), 8.08 (d, \(^3J = 7.9\) Hz, 1H, ar-6-\(H\)), 8.01 (s, 1H, CHN), 7.73 (d, \(^3J = 7.7\) Hz, 1H, ar-4-\(H\)), 7.45 (dd, \(^3J = 7.8\) Hz, \(^3J = 7.8\) Hz, 1H, ar-5-\(H\)), 4.37 (q, \(^3J = 7.1\) Hz, 2H, OCH\(_2\)CH\(_3\)), 1.38 (t, \(^3J = 7.1\) Hz, 3H, OCH\(_2\)CH\(_3\)), 1.25 (s, 9H, SC(CH\(_3\))\(_3\)). C\(_{16}\)H\(_{19}\)NO\(_3\)S (305.39 g mol\(^{-1}\)).

**Ethyl benzoate substituted propargylamine derivatives 4**

Ethyl 4-((\text{tert-butylsulfanyl})\text{amido})\text{but-1-yn-1-yl})\text{benzoate (4a)}

Methyllithium (1.6 M in Et\(_2\)O, 3.0 mL, 2.1 g, 2.6 mmol, 3.5 equiv) or MeMgBr (3 M in Et\(_2\)O, 0.5 mL, 0.4 g, 1.4 mmol, 1.4 equiv) was added dropwise to a deeply purple solution of imine 3a (210 mg, 0.69 mmol, 1.0 equiv) and AlMe\(_3\) (25 % in \(n\)-hexane, 0.82 mL, 0.56 g, 1.9 mmol) at -70 °C. The reaction mixture was stirred for 4.5 h at -30 °C to -40 °C. Then, EtOH (15 mL) was added and the crude mixture washed with an aqueous NH\(_4\)Cl solution. The aqueous layer was extracted with Et\(_2\)O (3 \(\times\) 20 mL) and the combined organic layers were washed with brine and dried over Na\(_2\)SO\(_4\). After evaporation of the solvent, the crude product was purified by preparative HPLC to yield racemic propargylamine in form of a yellow solid.

Yellow solid, yield (nucleophile = MeLi): 8.6 mg, 4 %, \(dr = 52:48\). Yield (nucleophile = MeMgBr): 14.5 mg, 10 %, \(dr = 51:49\).

Ethyl 4-(((\text{S})-3-(((\text{R})-\text{tert-butylsulfanyl})\text{amido})\text{but-1-yn-1-yl})\text{benzoate:} \(^1\)H NMR (600 MHz, Chloroform-\(d\)) \(\delta = 7.96\) (d, \(^3J = 8.5\) Hz, 2H, ar-2-\(H\), ar-6-\(H\)), 7.68 (d, \(^3J = 8.6\) Hz, 1H, ar-3-\(H\), ar-5-\(H\)), 4.48 (q, \(^3J = 6.8\) Hz, 1H, C\(^\alpha\)H), 4.37 (q, \(^3J = 7.1\) Hz, 2H, OCH\(_2\)CH\(_3\)), 1.60 (dd, \(^3J = 6.8\) Hz, \(^4J = 1.0\) Hz, 3H, C\(^\alpha\)HCH\(_3\)), 1.39 (t, \(^3J = 7.2\) Hz, 3H, OCH\(_2\)CH\(_3\)), 1.25 (s, 9H, SC(CH\(_3\))\(_3\)). \(^{13}\)C NMR (151 MHz, Chloroform-\(d\)) \(\delta = 166.2\) (CO\(_2\)Et), 132.8 (ar-\(C\)-3, ar-\(C\)-5), 131.7 (ar-\(C\)-1), 129.5
The relation of vacuo and the crude product purified by preparative HPLC.

and the combined organic layers were dried over Na\textsubscript{2}O.  

Ethyl 4-((R)-3-(((R)-tert-butylsulfinyl)amido)but-1-yn-1-yl)benzoate: \textsuperscript{1}H NMR (600 MHz, Chloroform-\textit{d}) \( \delta = 7.96 \) (d, \( \textit{\delta} \textsuperscript{1}J = 8.3 \) Hz, 2H, ar-2-\textit{H}, ar-6-\textit{H}), 7.48 (d, \( \textit{\delta} \textsuperscript{1}J = 8.5 \) Hz, 2H, ar-3-\textit{H}, ar-5-\textit{H}), 4.41 (q, \( \textit{\delta} \textsuperscript{1}J = 6.6 \) Hz, 1H, C\textsuperscript{6}H), 4.37 (q, \( \textit{\delta} \textsuperscript{1}J = 7.1 \) Hz, 3H, OCH\textsubscript{2}CH\textsubscript{3}), 1.55 (d, \( \textit{\delta} \textsuperscript{1}J = 6.5 \) Hz, 3H, C\textsuperscript{6}HCH\textsubscript{3}), 1.39 (t, \( \textit{\delta} \textsuperscript{1}J = 7.2 \) Hz, 3H, OCH\textsubscript{2}CH\textsubscript{3}), 1.24 (s, 9H, SC(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{13}C NMR (151 MHz, Chloroform-\textit{d}) \( \delta = 147.6 \) (CO\textsubscript{2}Et), 131.8 (ar-C-3, ar-C-5), 130.2 (ar-C-1), 129.5 (ar-C-2, ar-C-6), 127.4 (ar-C-4), 92.8 (C\textsuperscript{6}C=Car), 87.8 (C\textsuperscript{6}C=Car), 58.8 (OCH\textsubscript{2}CH\textsubscript{3}), 56.2 (SC(CH\textsubscript{3})\textsubscript{3}), 43.6 (C\textsuperscript{6}), 26.9 (C\textsuperscript{6}HCH\textsubscript{3}), 22.7 (SC(CH\textsubscript{3})\textsubscript{3}), 14.4 (OCH\textsubscript{2}CH\textsubscript{3}). C\textsubscript{17}H\textsubscript{23}NO\textsubscript{3}S (321.44 g mol\textsuperscript{-1}). MS(ESI) \( m/z = 322.25 \) (322.44 [M+H]+). IR(ATR): \( \delta \) [cm\textsuperscript{-1}] = 3268-3195 (NH), 2980-2866 (CH), 1714 (CO\textsubscript{2}Et), 1290 (SO).

Ethyl 3-((R)-3-(((R)-tert-butylsulfinyl)amido)-4-methylpent-1-yn-1-yl)benzoate (4b)

Isopropylmagnesium bromide (2 M in THF, 4 equiv) was added dropwise to a solution of imine 3b and Ti(OiPr)\textsubscript{4} in THF at −78 °C. The reaction progress was monitored by analytical HPLC. After complete consumption of the starting material, the reaction was quenched by the addition of a saturated NH\textsubscript{2}Cl solution. Et\textsubscript{2}O was added, the layers separated and the organic layer was washed with a KHSO\textsubscript{4} (5%) solution. The aqueous layers were extracted with Et\textsubscript{2}O and the combined organic layers were dried over Na\textsubscript{2}SO\textsubscript{4}. The solvent was evaporated in vacuo and the crude product purified by preparative HPLC.

The relation of 4b/4c was 6:4. In 4c, ester and imine were both substituted. So, the chemoselectivity of imine/ester was 71:29.
Ethyl 3-((R)-3-(((R)-tert-butylsulfinyl)amido)-4-methylpent-1-yn-1-yl)benzoate (4b):

Yellow oil, yield: 8.0 mg, 23 μmol, 13 %. \( dr = 99:1. \)
\(^1\)H NMR (600 MHz, Chloroform-\(d\)) \( \delta = 8.08 \) (dd, \( ^4\text{J} = 1.5 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-2-\text{H}), 7.98 \) (ddd, \( ^3\text{J} = 7.9 \text{ Hz}, ^4\text{J} = 1.5 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-6-\text{H}), 7.60 \) (ddd, \( ^3\text{J} = 7.7 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-4-\text{H}), 7.39 \) (td, \( ^3\text{J} = 7.8 \text{ Hz}, ^4\text{J} = 7.8 \text{ Hz}, ^4\text{J} = 0.6 \text{ Hz}, 1\text{H}, \text{ar}-5-\text{H}), 4.39 \) (q, \( ^3\text{J} = 7.2 \text{ Hz}, 2\text{H}, \text{OCH}_2\text{CH}_3\)), 4.25 \) (t, \( ^3\text{J} = 4.2 \text{ Hz}, 1\text{H}, \text{C}^\alpha\text{H})), 3.39 \) (m, 1H, \( \text{C}^\alpha\text{HNH})\)), 2.05 \) (pd, \( ^3\text{J} = 6.7 \text{ Hz}, ^3\text{J} = 4.9 \text{ Hz}, 1\text{H}, \text{C}^\alpha\text{CH(CH}_3)_2\)), 1.40 \) (t, \( ^3\text{J} = 7.1 \text{ Hz}, 3\text{H}, \text{OCH}_2\text{CH}_3\)), 1.26 \) (s, 9H, \( \text{SC(CH}_3)_3\)), 1.10 \) (d, \( ^3\text{J} = 6.7 \text{ Hz}, 3\text{H}, \text{C}^\alpha\text{HCHCH}_3\)), 1.09 \) (d, \( ^3\text{J} = 6.7 \text{ Hz}, 3\text{H}, \text{C}^\alpha\text{HCHCH}_3\)). \(^{13}\)C NMR (126 MHz, Chloroform-\(d\)) \( \delta = 166.1 \) (\( \text{CO}_2\text{CH}_2\text{CH}_3\)), 136.0 \) (ar-C-2), 132.9 \) (ar-C-6), 130.9 \) (ar-C-1), 129.4 \) (ar-C-4), 128.5 \) (ar-C-5), 123.3 \) (ar-C-3), 87.7 \) (\( \text{C}^\alpha\text{C} = \text{C-ar})\), 85.2 \) (\( \text{C}^\alpha\text{C} = \text{C-ar})\), 61.4 \) (\( \text{OCH}_2\text{CH}_3\)), 56.3 \) (\( \text{SC(CH}_3)_3\)), 54.7 \) (\( \text{C}_9\)), 34.4 \) (\( \text{C}^\alpha\text{CH(CH}_3)_2\)), 22.7 \) (\( \text{SC(CH}_3)_3\)), 19.6 \) (\( \text{CH}_3\text{CHCH}_3\)), 17.4 \) (\( \text{CH}_3\text{CHCH}_3\)), 14.5 \) (\( \text{OCH}_2\text{CH}_3\)). \( \text{C}_{19}\text{H}_{27}\text{NO}_3\text{S} \) (349.49 g mol\(^{-1}\)). MS(ESI): \( \text{m/z} = 372.3 \) (372.16 \([\text{M+Na}]^+\)), \([\text{a}]^{23}_{\text{D}}\) = 27.7 (c = 0.4; \( \text{CHCl}_3\)). IR(ATR): \( \tilde{\nu} \) [\( \text{cm}^{-1}\)] = 3255 (NH), 2961- 2872 (C-H), 1717 (\( \text{CO}_2\text{Et}\)), 1292 (S=O).

Side-product:

(R)-N-((S)-1-(3-isobutylphenyl)-4-methylpent-1-yn-3-yl)-tert-butylsulfinamide (4c):

Yellow oil, yield: 5.5 mg, 16 μmol, 9 %. \(^1\)H NMR (600 MHz, Chloroform-\(d\)) \( \delta = 8.07 \) (dd, \( ^4\text{J} = 1.4 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-2-\text{H}), 7.97 \) (ddd, \( ^3\text{J} = 7.9 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-6-\text{H}), 7.59 \) (dd, \( ^3\text{J} = 7.7 \text{ Hz}, ^4\text{J} = 1.4 \text{ Hz}, 1\text{H}, \text{ar}-4-\text{H}), 7.38 \) (dd, \( ^3\text{J} = 8.2 \text{ Hz}, ^3\text{J} = 7.2 \text{ Hz}, 1\text{H}, \text{ar}-5-\text{H}), 5.26 \) (sept, \( ^3\text{J} = 6.3 \text{ Hz}, 1\text{H}, \text{COCH(CH}_3)_2\)), 4.38 \) (m, 1H, \( \text{C}^\alpha\text{H})), 4.25 \) (d, \( ^3\text{J} = 4.2 \text{ Hz}, 1\text{H}, \text{C}^\alpha\text{HNH})\)), 2.05 \) (m, 1H, \( \text{C}^\alpha\text{CH(CH}_3)_2\)), 1.38 \) (d, \( ^3\text{J} = 6.2 \text{ Hz}, 3\text{H}, \text{COCH(CH}_3)_2\)), 1.36 \) (d, \( ^3\text{J} = 6.2 \text{ Hz}, 3\text{H}, \text{COCH(CH}_3)_2\)), 1.27 \) (s, 9H, \( \text{SC(CH}_3)_3\)), 1.10 \) (d, \( ^3\text{J} = 6.6 \text{ Hz}, 3\text{H}, \text{C}^\alpha\text{HCHCH}_3\)), 1.09 \) (d, \( ^3\text{J} = 6.7 \text{ Hz}, 3\text{H}, \text{C}^\alpha\text{HCHCH}_3\)). \( \text{C}_{20}\text{H}_{29}\text{NO}_2\text{S} \) (347.52 g mol\(^{-1}\)). MS(ESI): \( \text{m/z} = 348.41 \) (348.20 \([\text{M+H}]^+\)). IR(ATR): \( \tilde{\nu} \) [\( \text{cm}^{-1}\)] = 3395- 3275 (NH), 2962- 2870 (C-H), 1673 (\( \text{CO}_2\text{Pr}\)), 1201 (SO).
Chiral aldimines 5

(S,E)-N-Ethylidene-2-tert-butylsulfinamide (5a)

Synthesis: GP-1, reaction scale: 16.4 mmol of sulfinamide (S)-1. In contrast to other imine condensations, five equivalents of the acetaldehyde are necessary due to its low boiling point. The Lewis acid Ti(OEt)₄ was replaced by MgSO₄ (5 equiv) and the reaction was carried out at 30 °C overnight. Purification by column chromatography (PE/EtOAc, 4:1 or Et₂O). Compound 5a has been first described by Ferreira, Audouin and Chemla [26].

Colourless, viscous oil, yield: 1.95 g, 13.3 mmol, 81 %. ¹H NMR (500 MHz, Chloroform-d) δ = 8.08 (q, ³J = 5.1 Hz, 1H, CHN), 2.23 (d, ³J = 5.1 Hz, 3H, CNCH₃), 1.19 (s, 9H, C(CH₃)₃).

¹³C NMR (126 MHz, Chloroform-d) δ = 166.1 (CHN), 56.7 (CMe₃), 22.5 (C(CH₃)₃).

C₆H₁₃NOS (147.24 gmol⁻¹). MS(ESI): m/z = 170.0 (170.06 [M+Na⁺]). TLC: Rf (PE/EtOAc, 4:1) = 0.3.

(S,E)-N-(2-Methylpropyldiene)-tert-butylsulfinamide (5b)

Synthesis: GP-1, reaction scale: 1.7 mmol of sulfinamide (S)-1. In contrast to other imine condensations, two equivalents of the isobutyaldehyde are necessary due to its low boiling point. Imine 5b was achieved in pure form and not further purified. Compound 5b was first described by Tang and Ellman [27].

Yellow viscous oil, yield: 0.27 g, 1.5 mmol, 90 %. ¹H NMR (600 MHz, Chloroform-d): δ = 7.98 ppm (d, ³J = 4.4 Hz, 1H, CHN), 2.71 (m, 1H, CH(CH₃)₂), 1.18 (s, 9H, C(CH₃)₃), 1.17 (d, ³J = 6.9 Hz, 3H, CH(CH₃)₂), 1.16 (d, ³J = 6.8 Hz, 3H, CH(CH₃)₂).

¹³C NMR (126 MHz, Chloroform-d) δ = 173.7 (C=N), 56.6 (SC(CH₃)₃), 35.0 (CH(CH₃)₂), 22.4 (SC(CH₃)₃), 19.0 ((CH₃)HC(CH₃)), 19.0 ((CH₃)HC(CH₃)). C₈H₁₇NOS (175.29 gmol⁻¹). [α]D²⁰ = 230.2 (c = 2.28; CHCl₃). TLC: Rf (PE/EtOAc, 2:1) = 0.28.

(S,E)-N-(3-Methylbutyldiene)-tert-butylsulfinamide (5c)

Synthesis: GP-1, reaction scale: 8.36 mmol of sulfinamide (S)-1 and 10.0 mmol of isovaleraldehyde. No further purification of the crude...
product was necessary. Compound 5c was first described by Staas, Savage, Homnick, Tsou and Ball [28], as well as Ye, He and Zhang [29].

Colourless, viscous oil, yield: 1.46 g, 7.69 mmol, 92 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)\): \(\delta = 8.02\) (t, \(^3 J = 5.2\) Hz, 1H, CHN), 2.43-2.36 (m, 2H, CNCH\(_2\)), 2.03 (m, 1H, (H\(_3\)C)\(_2\)CH), 1.17 (s, 9H, S(C(CH\(_3\)))\(_3\)), 0.98 (d, \(^3 J = 6.9\) Hz, 3H, (CH\(_3\))HC(CH\(_3\))), 0.95 (d, \(^3 J = 7.3\) Hz, 3H, (CH\(_3\))CH(CH\(_3\))). C\(_9\)H\(_{10}\)NOS (189.32 g mol\(^{-1}\)). \([\alpha]^{20}_{D89} = 276.3\) (c = 2.09; CHCl\(_3\)). TLC: \(R_f\) (PE/EtOAc, 2:1) = 0.67.

\((S,E)-N-(Cyclohexylmethylene)-tert-butylsulfinamide (5d)\)

Synthesis: GP-2, reaction scale: 12.66 mmol of sulfinamide (S)-1 and 13.9 mmol of cyclohexanecarbaldehyde. Isolation by column chromatography (PE/EtOAc, 4:1). Compound 5d has been first described by Prakash, Mandal and Olah [30].

Colourless crystalline solid, yield: 2.616 g, 12.15 mmol 96 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)\): \(\delta = 7.91\) (d, \(^3 J = 4.5\) Hz, 1H, CHN), 2.41 (m, 1H, cy-1-H), 1.83 (ddd, \(^2 J = 9.6\) Hz, \(^3 J = 4.7\) Hz, \(^3 J = 4.2\) Hz, 2H, cy-2-H, cy-6-H), 1.78-1.69 (m, 2H, cy-3-H, cy-5-H), 1.62 (m, 1H, cy-4-H), 1.37-1.17 (m, 5H, cy-5-H, cy-3-H, cy-4-H, cy-6-H, cy-2-H), 1.13 (s, 9H, C(CH\(_3\)))\(_3\)). \(^1\)C NMR (75 MHz, Chloroform-\(d\)\): \(\delta = 172.7\) (CHN), 56.5 (C(CH\(_3\)))\(_3\)), 44.1 (cy-C-1), 29.4 (cy-C-2, cy-C-6), 25.9 (cy-C-4), 25.4 (cy-C-3), 25.4 (cy-C-5), 22.4 (C(CH\(_3\)))\(_3\)). C\(_{11}\)H\(_{21}\)NOS (215.36 g mol\(^{-1}\)). MS(El): \(m/z = 238.0\) (238.12 [M+Na]). IR(ATR): \(\tilde{\nu}[\text{cm}^{-1}] = 2924\) (C-H), 2851 (C-H), 1613 (CN), 1606 (SO), 1451, 1359, 1185, 1076 (SC), 967, 584.

\((S,E)-N-(2,2-Dimethylpropylidene)-tert-butylsulfinamide (5e)\)

Synthesis: GP-2, reaction scale: 36.5 mmol of sulfinamide (S)-1 and 36.5 mmol of pivalaldehyde. Reaction was monitored by TLC. Reaction time was increased to 7 d, due to the low reactivity of tert-butanal. Purification by column chromatography (EtOAc/PE, 1:4). Compound 5e has been first described by Liu, Cogan, Owens, Tang and Ellman [3].

Colourless oil, yield: 1.245 g, 6.575 mmol, 18 %. \(^1\)H NMR (500 MHz, Chloroform-\(d\)\): \(\delta = 7.87\) (s, 1H, CHN), 1.13 (s, 9H, SC(CH\(_3\)))\(_3\)), 1.10 (s, 9H, C\(_6\)H(C\(_3\)))\(_3\)). \(^1\)C NMR (126 MHz,
Chloroform-\(d\) \(\delta = 175.7\) (CHN), 56.6 (SC(CH\(_3\))\(_3\)), 38.0 (C\(^\alpha\)SC(CH\(_3\))\(_3\)), 26.7 (C\(^\alpha\)C(CH\(_3\))\(_3\)), 22.4 (SC(CH\(_3\))\(_3\)). C\(_{19}\)H\(_{19}\)NOS (189.32 g mol\(^{-1}\)), MS(ESI): 190.1264 (190.12601 [M+H]\(^+\)). TLC: R\(_f\) (PE/EtOAc, 4:1) = 0.63.

(S)-\(N\)-((E)-((3S,5S,7S)-Adamantan-1-yl)methylene)-\(\alpha\)-butylsulfinamide (5f)

Synthesis: GP-2, reaction scale: 4.20 mmol of sulfinamide \((S)\)-1 and 4.06 mmol of adamantyl-1-carbaldehyde. Purification by column chromatography (PE/EtOAc, 4:1).

Colourless crystalline solid, yield: 456 mg, 1.70 mmol, 42 %. \(^1\)H NMR (500 MHz, Chloroform-\(d\)) \(\delta = 7.64\) (s, 1H, CHN), 1.90 (d, \(^2\)J = 25.1 Hz, 3H, CNC(CH\(_2\)CHCH\(_2\))\(_3\)), 1.64 (d, \(^2\)J = 15.1 Hz, 13H, CNC(CH\(_2\)CHCH\(_2\))\(_3\)), 1.57 (d, \(^2\)J = 11.8 Hz, 3H, CNC(CH\(_2\)CHCH\(_2\))\(_3\)), 1.04 (s, 9H, SC(CH\(_3\))\(_3\)). \(^{13}\)C NMR (126 MHz, Chloroform-\(d\)) \(\delta = 174.9\) (CHN), 56.2 (SC(CH\(_3\))\(_3\)), 39.9 (CNC(CH\(_2\)CHCH\(_2\))\(_3\)), 39.0 (CNC(CH\(_2\)CHCH\(_2\))\(_3\)), 36.4 (C\(^\alpha\)C(CH\(_2\)CHCH\(_2\))\(_3\)), 27.7 (C\(^\alpha\)C(CH\(_2\)CHCH\(_2\))\(_3\)), 22.1 (SC(CH\(_3\))\(_3\)). C\(_{15}\)H\(_{25}\)NOS (267.43 g mol\(^{-1}\)), MS(ESI): \(m/\varepsilon = 268.1733\) (268.1730 [M+H]\(^+\)). TLC: R\(_f\) (PE/EtOAc, 10:1) = 0.24.

(R,E)-\(N\)-(3-(Methylthio)propylidene)-\(\alpha\)-butylsulfinamide (5g)

Synthesis: GP-2, reaction scale: 36.5 mmol of sulfinamide \((R)\)-1 and 19.85 mmol of 3-(methylthio)propanal. The crude product was purified by column chromatography (EtOAc/PE, 1:4). Compound 5g has been first described by Gross, Heuser, Ammer, Heckmann and Bach [31] and Yao and Yuan [32].

Slightly yellow oil, yield: 3.663 g, 17.67 mmol, 89 %. \(^1\)H NMR (300 MHz, Chloroform-\(d\)) \(\delta = 8.03\) (t, \(^3\)J = 3.4 Hz, 1H, CHN), 2.80-2.73 (m, 4H, SCH\(_2\)CH\(_2\)), 2.07 (s, 3H, SCH\(_3\)), 1.15 (s, 9H, SC(CH\(_3\))\(_3\)). \(^{13}\)C NMR (75 MHz, Chloroform-\(d\)) \(\delta = 167.5\) (CHN), 56.9 (SC(CH\(_3\))\(_3\)), 35.7 (CNCH\(_2\)), 29.6 (CH\(_2\)SCH\(_3\)), 22.4 (SC(CH\(_3\))\(_3\)), 15.7 (SCH\(_3\)). C\(_8\)H\(_{17}\)NOS\(_2\) (207.35 g mol\(^{-1}\)).
(S)-N-(2-Phenylethylidene)- tert-butyrsulfamidine (5h)

Synthesis: GP-2, reaction scale: 4.16 mmol of sulfamidine (S)-1 and 5.40 mmol of phenylacetaldehyde. Purification of 5h by column chromatography (DCM). Compound 5h has been first described by Liu, Cogan, Owens, Tang and Ellman [3].

Yellow oil, yield: 593 mg, 2.66 mmol, 64 %. 1H NMR (500 MHz, Chloroform-d): δ = 8.13 (t, 3J = 5.2 Hz, 1H, CHN), 7.31 (m, 2H, ar-2-H, ar-6-H), 7.28-7.20 (m, 3H, ar-3-H, ar-4-H, ar-5-H), 3.85 (dd, 2J = 15.1 Hz, 3J = 5.2 Hz, 1H, CNCH2), 3.80 (dd, 2J = 15.1 Hz, 3J = 5.2 Hz, 1H, CNCH2), 1.18 (s, 9H, SC(CH3)3). C_{12}H_{17}NOS (223.33 g mol⁻¹). TLC: Rf (DCM) = 0.28. [α]_{589}^{20} = 271.0 (c = 1.0; CHCl₃).

(S)-N-(Benzyldiene)- tert-butyrsulfamidine (5i)

Synthesis: GP-1, reaction scale: 8.31 mmol of sulfamidine (S)-1 and 12.5 mmol of benzaldehyde. The crude product was obtained in pure form. No further purification was necessary for the further conversions. Compound 5i was first described by Ruano, Fernández, Catalina and Cruz [33].

Yellow oil, yield: 1.72 g, 8.23 mmol, 99 %. 1H NMR (500 MHz, Chloroform-d): δ = 8.59 (s, 1H, N=CH), 7.86-7.85 (m, 2H, ar-2-H, ar-6-H), 7.54-7.46 (m, 3H, ar-3-H, ar-4-H, ar-5-H), 1.27 (s, 9H, SC(CH3)3). C_{11}H_{15}NOS (209.31 g mol⁻¹). [α]_{589}^{20} = 124.4 (c = 1.0; CHCl₃).

(S,Z)-N-((Pentafluorophenyl)methylene)- tert-butyrsulfamidine (5j)

Synthesis: GP-2, reaction scale: 9.0 mmol of sulfamidine (S)-1 and 9.0 mmol of pentafluorobenzaldehyde. Compound 5j was purified by column chromatography (PE/EtOAc, 4:1).

Colourless highly viscous oil, yield: 2.37 g, 7.92 mmol, 88 %. 1H NMR (300 MHz, Chloroform-d) δ = 8.72 (s, 1H, CHN), 1.28 (s, 9H, SC(CH3)3). 19F NMR (282 MHz, Chloroform-d) δ = -139.9 (dt, 3J_{FF} = 19.0 Hz, 4J_{FF} = 6.3 Hz, 2F, ar-2-F, ar-6-F), -147.2 (tt, 3J = 20.8 Hz, 4J_{FF} = 4.9 Hz, ar-4-F), -160.8 (dd, 3J = 20.7 Hz, 3J_{FF} = 12.7 Hz, ar-3-F, ar-5-F). 13C NMR (126 MHz, Chloroform-d) δ = 151.4 (d, 3J_{CF} = 2.7 Hz, CHN), 146.4 (d, 1J_{CF} =
260.9 Hz, ar-C-3, ar-C-5), 143.6 (d, $^1J_{CF} = 261.2$ Hz, ar-C-4), 138.0 (d, $^1J_{CF} = 255.2$ Hz, ar-C-2, ar-C-6), 109.7 (dd, $^2J_{CF} = 11.0$ Hz, $^2J = 7.0$ Hz, ar-C-1), 58.7 (C(CH$_3$)$_3$), 22.7 (SC(CH$_3$)$_3$). C$_{11}$H$_{16}$F$_5$NOS (299.26 g mol$^{-1}$). ESI: $m/z$ = 322.0306 (322.0301 [M+Na]$^+$). TLC: $R_f$(PE/EtOAc, 6:1) = 0.56.

(S,E)-N-(2,2,2-Trifluoroethylidene)-tert-butylsulfinamide (5k)

The preparation of 2,2,2-trifluoroacetaldehyde was carried out as described in the dissertation of Gerhard Greier [34]: Fluoral hydrate (75 %, 55.9 mmol) was placed under argon atmosphere in a closed vessel, which is linked by a Claisen condenser to a vessel with molecular sieves (3 Å), cooled to −78 °C. Concentrated sulfuric acid (10 mL) was added dropwise to the fluoral hydrate (6 mL) via dropping funnel and the solution was heated to 70 °C. The developing 2,2,2-trifluoroacetaldehyde was condensed in the cooled flask, where its mass was determined (2.08 g, 21.2 mmol).

To the condensed 2,2,2-trifluoroacetaldehyde, an equimolar amount of (S)-tert-butyl sulfinamide (S)-1 (2.57 g, 21.2 mmol) was added in one portion. The mixture was diluted with dry toluene (20 mL) and stirred for 48 h at rt. The suspension was filtered under argon atmosphere through a frit and the solution of imine 5k was stored under argon atmosphere for subsequent reactions.

Imine 5k is formed as intermediate without isolation, as first described by Truong, Menard and Dion [35].

(S,Z)-N-(2,2,2-Trichloroethylidene)-tert-butylsulfinamide (5l)

Chloral hydrate was converted to the aldehyde, chloral, following the description of Ullman’s Encyclopedia of Industrial Chemistry [36]: Chloral hydrate (5.00 g, 30.25 mmol, 1 equiv) was placed in a two neck flask with a column, filled with CaCl$_2$ and which is attached to a claisen condenser, leading to another flask, cooled to −78 °C. P$_2$O$_5$ (4.29 g, 15.1 mmol, 0.5 equiv) was added to the chloral hydrate in one portion through the second neck. The mixture was melted at 80 °C and then heated up to 120 °C. The developing gas was lead through the CaCl$_2$ and distilled (T =
approximately 100 °C) into the precooled flask, where the chloral was quantified (4.46 g, 30.25 mmol). Molecular sieves (4 Å, 15 g) and an equimolar amount of Ellman’s chiral sulfonamide (S)-I (3.65 g, 30.0 mmol) was added and the reaction mixture was suspended in toluene (30 mL). After full conversion (7 d, monitored by TLC), the solid components were filtered through a pad of silica gel (PE/EtOAc, 10:1) and the solvent was evaporated under reduced pressure to yield imine 5l in pure form.

Slightly yellow oil, yield: 6.56 g, 26.2 mmol, 87 %. 1H NMR (500 MHz, Chloroform-d) δ = 7.98 (s, 1H, C\textsubscript{H}N), 1.25 (s, 9H, SC\textsubscript{(CH\textsubscript{3})\textsubscript{3}}). 13C NMR (126 MHz, Chloroform-d) δ = 159.6 (CHN), 93.0 (Cl\textsubscript{3}C), 59.3 (SC\textsubscript{(CH\textsubscript{3})\textsubscript{3}}), 22.6 (SC(\textsubscript{CH\textsubscript{3}})\textsubscript{3}). C\textsubscript{21}H\textsubscript{20}O\textsubscript{2} (304.39 g mol\textsuperscript{-1}). MS (ESI): m/z = 327.2 (327.14 [M+Na]+). IR (ATR): \tilde{\nu} [cm\textsuperscript{-1}] = 3383 (OH), 3057 (a\textsubscript{r}-CH), 2946 (CH\textsubscript{2}), 1448 (C\textsubscript{H}2), 1100 (C-O-C). Smp: 99 °C. TLC: R\textsubscript{f} (PE/EtOAc, 1:1) = 0.72.

(S,E)-N-(2-(Trityloxy)ethylenidene)-\textit{tert}-butylsulfonamide (5m)

2-(Trityloxy)ethane-1-ol

A solution of tritylchloride (5.01 g, 18.0 mmol, 1 equiv) in DCM (20 mL) was added dropwise to a solution of ethane-1,2-diol (3.02 mL, 54.0 mmol, 3 equiv), DMAP (0.22 mL, 1.8 mmol, 0.1 equiv) and Et\textsubscript{3}N (5.05 mL, 18.0 mmol, 1 equiv) in DCM (120 mL). The reaction mixture was stirred for 48 h at rt. Then, H\textsubscript{2}O (100 mL) was added. The phases were separated and the aqueous layer was extracted with DCM (2 × 100 mL). The combined organic layers were washed with brine, dried over \textsubscript{Na\textsubscript{2}}SO\textsubscript{4} and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography (PE/EtOAc, 4:1).

Colourless crystalline solid, yield: 4.73 g, 15.5 mmol, 86 %. 1H NMR (500 MHz, Chloroform-d) δ = 7.45 (d, \textit{J} = 7.2 Hz, 6H, ar-2-H, ar-6-H), 7.31 (t, \textit{J} = 7.5 Hz, 6H, ar-3-H, ar-5-H), 7.25 (t, \textit{J} = 6.7 Hz, 3H, ar-4-H), 3.78-3.72 (m, 2H, CH\textsubscript{2}CH\textsubscript{2}OH), 3.27 (t, \textit{J} = 4.8 Hz, 2H, OCH\textsubscript{2}), 1.93 (t, \textit{J} = 6.2 Hz, 1H, –OH). 13C NMR (126 MHz, Chloroform-d) δ = 143.9 (ar-C-1), 128.7 (ar-C-2, ar-C-6), 127.9 (ar-C-3, ar-C-5), 127.1 (ar-C-4), 86.7 (Ph\textsubscript{3}C), 64.8 (Ph\textsubscript{2}COCH\textsubscript{2}), 62.4 (CH\textsubscript{2}OH). C\textsubscript{21}H\textsubscript{20}O\textsubscript{2} (304.39 g mol\textsuperscript{-1}). MS(ESI): m/z = 327.2 (327.14 [M+Na]+). IR (ATR): \tilde{\nu} [cm\textsuperscript{-1}] = 3383 (OH), 3057 (ar-CH), 2946 (CH\textsubscript{2}), 1448 (CH\textsubscript{2}), 1100 (C-O-C). Smp: 99 °C. TLC: R\textsubscript{f} (PE/EtOAc, 1:1) = 0.44.
2-(Trityloxy)acetaldehyde

Synthesis: GP-8, reaction scale: 15.7 mmol of 2-(trityloxy)ethan-1-ol. The crude product was purified by filtration through a pad of silica gel (PE/EtOAc, 10:1).

Yellow oil, yield: 3.16 g, 10.5 mmol, 67 %. $^1$H NMR (500 MHz, Chloroform-$d$) δ = 9.50 (t, $^3J = 1.2$ Hz, 1H, CHO), 7.47 (m, 6H, ar-2-H, ar-6-H), 7.33 (m, 6H, ar-3-H, ar-5-H), 7.27 (m, 3H, ar-4-H), 3.86 (d, $^3J = 1.2$ Hz, 2H, CH$_2$). C$_{21}$H$_{18}$O$_2$ (302.37 g mol$^{-1}$).

IR (ATR): $\tilde{\nu}$ [cm$^{-1}$] = 3056 (ar, CH), 2974 (CH$_2$), 1729 (CHO), 1451 (ar, C=C).

TLC: $R_f$ (PE/EtOAc, 10:1) = 0.67.

(S,E)-N-(2-(Trityloxy)ethylidene)-tert-butylsulfinamide (5m)

Synthesis: GP-2, reaction scale: 7.2 mmol of sulfinamide (S)-1 and 7.13 mmol of 2-(trityloxy)acetaldehyde. Purification of the crude product by filtration through a short pad of silica gel (PE/EtOAc, 4:1).

Colourless, crystalline solid, yield: 1.36 g, 3.35 mmol, 47 %. $^1$H NMR (500 MHz, Chloroform-$d$) δ = 8.19 (t, $^3J = 3.3$ Hz, 1H, CHN), 7.58 (d, $^3J = 8.0$ Hz, 6H, ar-2-H, ar-6-H), 7.38 (t, $^3J = 7.6$ Hz, 6H, ar-3-H, ar-5-H), 7.32 (t, $^3J = 7.4$ Hz, 3H, ar-4-H), 4.17 (t, $^3J = 3.7$ Hz, 2H, CH$_2$), 1.28 (s, 9H, SC(CH$_3$)$_3$). $^{13}$C NMR (126 MHz, Chloroform-$d$) δ = 166.9 (CHN), 143.4 (ar-C-1), 128.6 (ar-C-2, ar-C-6), 128.0 (ar-C-3, ar-C-5), 127.3 (ar-C-4), 87.4 (Ph$_3$C), 66.4 (C(CH$_3$)$_3$), 60.4 (CH$_2$), 22.4 (SC(CH$_3$)$_3$). C$_{25}$H$_{27}$NO$_2$S (405.56 g mol$^{-1}$), MS(ESI): $m/z$ = 428.2 (428.17 [M+Na]$^+$). TLC: $R_f$ (PE/EtOAc, 4:1) = 0.65.

(R,E)-N-(2-(Benzyloxy)ethylidene)-tert-butylsulfinamide (5n)

Synthesis: GP-2, reaction scale: 4.23 mmol of sulfinamide (R)-1 and 4.3 mmol of 2-(benzyloxy)acetaldehyde. Purification by column chromatography (EtOAc/PE, 1:4). Decomposition was observed via $^1$H NMR spectroscopy after 1 d. Compound 5n has been first described by Tang, Volkman and Ellman [37].
Slightly yellow oil, yield: 869 mg, 3.43 mmol, 81%. $^1$H NMR (300 MHz, Chloroform-$d$) δ = 8.12 (t, $^3J = 3.2$ Hz, 1H, CHN), 7.38-7.29 (m, 5H, ar-H), 4.63 (s, 2H, PhCH$_2$), 4.40 (d, $^3J = 3.2$ Hz, 2H, CNCH$_2$), 1.21 (s, 9H, SC(CH$_3$)$_3$). C$_{13}$H$_{19}$NO$_2$S (253.36 g mol$^{-1}$). TLC: $R_f$ (EtOAc/PE, 1:4) = 0.34. $[\alpha]$$^\text{D}_{589}$ = 180.5 (c = 1.43; CHCl$_3$).

(S)-N-(2-(Allyloxy)ethylidene)-tert-butylsulfinamide (5o)

2-(Allyloxy)acetaldehyde

Silica gel adsorbed Sodium periodate was prepared according to the description of Roth and Stark [38]: Under stirring, Silica gel (5 g) was added to a solution of NaIO$_4$ (1.29 g, 6.03 mmol) in H$_2$O (2.5 mL) at 70 °C. The water was evaporated in vacuo and the crude product was dried in an desiccator over P$_2$O$_5$.

2-(Allyloxy)acetaldehyde was prepared as described by Karmann and Kazmaier [39]: To a suspension of silica gel adsorbed NaIO$_4$ (3 g, 2.88 mmol) in absolute DCM (7.5 mL), a solution of allyloxy-1,2-propanediol (220 mg, 1.64 mmol) in absolute DCM (6 mL) was added dropwise. The reaction mixture was stirred for 2 h at rt and then filtered through a pad of silica gel. The silica gel was washed with DCM and the solvent was evaporated under reduced pressure to yield alloxycacetaldehyde in pure form.

Yellow oil (crude product), yield: quant. $^1$H NMR (500 MHz, Chloroform-$d$): δ [ppm] = 9.74 (s, 1H, CHO), 5.92 (m, 1H, CH=CH$_2$), 5.32 (dddd, $^4J = 1.6$ Hz, $^4J = 1.4$ Hz, $^2J = 1.4$ Hz, $^3J = 17.2$ Hz, 1H, CH=H$_2$CH$_2$), 5.26 (dddd, $^4J = 1.4$ Hz, $^4J = 1.3$ Hz, $^2J = 1.2$ Hz, $^3J = 10.4$ Hz, 1H, CH=H$_2$CH$_2$), 4.11-4.09 (m, 4H, CH$_2$-O-CH$_2$). C$_5$H$_8$O$_2$ (100.12 g mol$^{-1}$).

(S)-N-(2-(Allyloxy)ethylidene)-tert-butylsulfinamide (5o)

Synthesis: GP-1, reaction scale: 2.7 mmol of sulfinamide (S)-1 and 2.58 mmol of 2-(allyloxy)acetaldehyde. The reaction mixture was dissolved in THF (4 mL) and the reaction time was stretched to 8 h. Purification by column chromatography (PE/EtOAc, 4:1).
Yellow oil, yield: 0.125 g, 0.620 mmol, 24 %. $^1$H NMR (500 MHz, Chloroform-d): $\delta$ [ppm] = 8.10 (t, $^3J = 3.2$ Hz, 1H, CHN), 5.91 (m, 1H, CH=CH$_2$), 5.30 (dddd, $^4J = 1.6$ Hz, $^4J = 1.5$ Hz, $^3J = 17.2$ Hz, $^2J = 1.6$ Hz, 1H, C=H$_2$CH$_2$), 5.23 (dddd, $^4J = 1.6$ Hz, $^4J = 1.5$ Hz, $^3J = 10.5$ Hz, $^2J = 1.4$ Hz, 1H, CHNCH$_2$O), 4.39 (dd, $^3J = 3.1$ Hz, $^2J = 16.4$ Hz, 1H, C=H$_2$O), 4.36 (dd, $^3J = 3.2$ Hz, $^2J = 16.3$ Hz, 1H, CHNCH$_2$O), 4.10-4.08 (m, 2H, C$_2$H$_2$CH=), 1.20 (s, 9H, SC(C$_3$H$_7$)$_3$).

$^{13}$C NMR (125 MHz, Chloroform-d): $\delta$ [ppm] = 166.9 (C=HN), 133.9 (C=H$_2$C$_2$), 118.2 (CH=CH$_2$), 72.4 (CH$_2$CH=), 71.4 (CH$_2$O), 57.1 (SCMe$_3$), 22.5 (SC(C$_3$H$_7$)$_3$).

C$_9$H$_{17}$NO$_2$S (203.30 g mol$^{-1}$).

MS (ESI): $m/z$ = 204.0 (204.31 [M+H]$^+$). TLC: R$_f$ (PE/EtOAc, 4:1) = 0.34. $[\alpha]_{D}^{20}$ = 232.3 (c = 1.2; CHCl$_3$).

(R,E)-N-(2-(Benzylthio)ethylidene)-tert-butylsulfinamide (5p)

The synthesis of all precursors of 5p was carried out as described by Zhdanko, Gulevich and Nenajdenko [40].

Phenylmethanethiol was synthesised as described by Zhdanko, Gulevich and Nenajdenko [40]. Brown fluid, yield: 9.106 g, 73 mmol, 56 %. $^1$H NMR (300 MHz, Chloroform-d) $\delta$ = 7.45-7.43 (m, 4H, ar-2-H, ar-3-H, ar-5-H, ar-6-H), 7.34 (m, 1H, ar-4-H), 3.80 (s, 2H, CH$_2$), 2.00 (s, 1H, SH). $^{13}$C NMR (75 MHz, Chloroform-d) $\delta$ = 141.1 (ar-C-1), 128.6 (ar-C-3, ar-C-5), 128.0 (ar-C-4), 126.9 (ar-C-2, ar-C-6), 28.9 (CH$_2$). C$_7$H$_8$S (124.20 g mol$^{-1}$).

Benzyl(2,2-dimethoxyethyl)sulfane

Sodium (1.76 g, 73.3 mmol, 1 equiv) was dissolved in a solution of phenylmethylthiol (9.12 g, 73.3 mmol, 1 equiv) in EtOH (38 mL). Afterwards, KI (372 mg, 2.24 mmol, 3 mol %) and chloroacetaldehyde dimethyl acetal (8.4 mL, 73.3 mmol, 1 equiv) were added and the reaction mixture was heated for 6 h to 80 °C. After cooling down to rt, the suspension was filtered, the residue washed with EtOH and the filtrate concentrated up under vacuum. The residue was diluted with water (45 mL) and washed with DCM (3 × 50 mL). The combined organic layers were washed with brine, dried over Na$_2$SO$_4$ and the solvent was evaporated. Purification of the crude product by column chromatography (PE/EtOAc, 10:1) yielded benzyl(2,2-dimethoxyethyl)sulfane in pure
form. The synthesis of the title compound has been first described by Zhdanko, Gulevich and Nenajdenko [40].

Deeply yellow oil, yield: 9.39 g, 44.2 mmol, 60 %. $^1$H NMR (300 MHz, Chloroform-$d$) $\delta = 7.38-7.30$ (m, 4H, ar-2-H, ar-3-H, ar-5-H, ar-6-H), 7.25 (m, 1H, ar-4-H), 4.43 (t, $^3J = 5.5$ Hz, 1H, CH(OCH$_3$)$_2$), 3.80 (s, 2H, ar-CH$_2$), 3.36 (s, 6H, CH(OCH$_3$)$_2$), 2.61 (d, $^3J = 5.5$ Hz, 2H, SCH$_2$CH(OCH$_3$)$_2$). C$_{11}$H$_{16}$O$_2$S (212.31 g mol$^{-1}$).

Benzyl(2,2-dimethoxyethyl)sulfane (5.00 g, 23.5 mmol, 1 equiv) was dissolved in H$_2$SO$_4$ (0.5 M, 21 mL) and the solution was heated for 5.5 h to 60 °C. After cooling down to rt, a solution of saturated NaHCO$_3$ was added until the pH was neutral. Afterwards, the solution was extracted with DCM (4 × 15 mL). The combined organic layers were dried over Na$_2$SO$_4$ and the solvent was evaporated under reduced pressure to yield 2-(benzylthio)acetaldehyde in pure form. The synthesis of the title compound has been first described by Zhdanko, Gulevich and Nenajdenko [40].

Deeply yellow oil, yield: 3.875 g, 23.31 mmol, 99 %. $^1$H NMR (300 MHz, Chloroform-$d$) $\delta = 9.43$ (t, $^3J = 3.4$ Hz, 1H, CHO), 7.37-7.27 (m, 5H, C$_6$H$_5$), 3.64 (s, 2H, ar-CH$_2$), 3.09 (d, $^3J = 3.4$ Hz, 2H, SCH$_2$CHO). C$_9$H$_{10}$OS (166.24 g mol$^{-1}$).

(R,E)-N-(2-(Benzylthio)ethylidene)-tert-butylsulfinamide (5p)

Synthesis: GP-2, reaction scale: 24.0 mmol of sulfinamide (R)-1 and 23.34 mmol of 2-(benzylthio)acetaldehyde. Purification by column chromatography (PE/EtOAc, 4:1). Compound 5p has been first described by Yao and Yuan [32].

Brown oil, yield: 5.212 g, 19.37 mmol, 83 %. $^1$H NMR (300 MHz, Chloroform-$d$): $\delta$ (ppm) = 7.98 (t, $^3J = 5.6$ Hz, 1H, CHN), 7.38-7.26 (m, 5H, C$_6$H$_5$), 3.70 (s, 2H, Ph-CH$_2$), 3.34 (d, $^3J = 2.8$ Hz, 2H, SCH$_2$), 1.23 (s, 9H, C(CH$_3$)$_3$). C$_{13}$H$_{19}$NOS$_2$ (269.42 g mol$^{-1}$).
(S,E)-N-(4-Cyanobutyliden)-tert-butylsulfinamide (5q)

4-Iodobutan-1-ol

4-Iodobutan-1-ol was prepared as described by Sasano, Nagasawa, Yamazaki, Shibuya, Park, Iwabuchi [41].

\[
\text{HO} \quad \rightarrow \\
\text{I} \\
\text{CN}
\]

A solution of iodine (7.650 g, 30.14 mmol) in THF (50 mL) was added dropwise at 0 °C to a rigorously stirred suspension of NaBH₄ (0.568 g, 15.01 mmol) in THF (80 mL) over a period of 2 h. The reaction mixture was allowed to warm up to rt overnight. The deep purple solution was diluted with an aqueous Na₂SO₃ solution until it turned completely colourless. The organic layer was separated, the aqueous layer extracted with Et₂O (3 × 75 mL) and the combined organic layers dried over Na₂SO₄. Evaporation of the solvent yielded the title compound, which had to be used quickly in further conversions because it was observed to reform THF or polymerise. When the title compound perishes, it starts to turn brown or red.

Colourless oil, yield: 8.141 g, 40.70 mmol, 68 %. ¹H NMR (300 MHz, Chloroform-d) δ (ppm) = 3.66-3.60 (m, 2H, HO(CH₂)₂), 3.19 (t, ³J = 6.9 Hz, 2H, ICH₂), 1.90-1.83 (m, 2H, HOCH₂CH₂), 1.69-1.59 (m, 2H, ICH₂CH₂). C₄H₉IO (200.02 g mol⁻¹).

5-Hydroxypentanenitrile

\[
\text{HO} \quad \rightarrow \\
\text{CN}
\]

To a solution of 5-iodobutan-1-ol (16.5 g, 82.5 mmol, 1 equiv) in dry DMSO (75 mL), solid NaCN (6.06 g, 124 mmol, 1.5 equiv) was added in small portions at 0 °C. The reaction progress was surveilled by NMR spectroscopy. It is instant and the title compound as well as THF (6:5) are formed. After complete conversion, the reaction mixture was diluted with water (75 mL) and extracted with Et₂O (5 × 100 mL). The combined organic layers were washed with brine and dried over Na₂SO₄. Evaporation of the solvent yielded the title compound in pure form.

Slightly yellow oil, yield 3.596 g, 36.3 mmol, 52 %. ¹H NMR (600 MHz, DMSO-d₆) δ = 3.35 (t, ³J = 6.2 Hz, 2H, HOCH₂), 2.47 (t, ³J = 7.0 Hz, 2H, N≡CCH₂), 1.56-1.50 (m, 2H, N≡CCH₂CH₂), 1.50-1.40 (m, 2H, HOCH₂CH₂). ¹³C NMR (151 MHz, DMSO-d₆) δ = 120.8 (C≡N), 59.6 (HOCH₂), 31.3 (HOCH₂CH₂), 21.7 (HO(CH₂)₂CH₂), 16.2 (N≡CCH₂). C₅H₉NO (99.13 g mol⁻¹).
5-Oxopentanenitrile

Synthesis: GP-8, reaction scale: 43.2 mmol of 5-hydroxypentanenitrile. Purification by filtration through a pad of silica gel (PE/EtOAc, 10:1).

Red oil, yield 2.434 g, 25.06 mmol, 58 %. \( ^1H \) NMR (300 MHz, Chloroform-\( \text{d} \)) \( \delta = 9.81 \) (s, 1H, CHO), 2.70 (t, \( ^3J = 6.9 \) Hz, 2H, HCOCH\(_2\)), 2.46 (t, \( ^3J = 7.0 \) Hz, 2H, N=CCH\(_2\)), 1.98 (p, \( ^3J = 6.9 \) Hz, 2H, N=CCH\(_2\)). C\(_5\)H\(_7\)NO (97.13 g mol\(^{-1}\)).

\((S,E)-N\)-(4-Cyanobutylidene)-\text{\textit{\textup{tert}}}\)-butylsulfinamide (5q)

Synthesis: GP-2, reaction scale: 25.1 mmol of sulfinamide (S)-1 and 26.0 mmol of 5-oxopentanenitrile. The crude product was purified by column chromatography.

Orange oil, yield 4.02 g, 20.1 mmol, 80 %. \( ^1H \) NMR (500 MHz, Chloroform-\( \text{d} \)) \( \delta \) [ppm] = 8.10 (t, \( ^3J = 3.7 \) Hz, 1H, CH\(_{\text{N}}\)), 2.71 (td, \( ^3J = 6.8 \) Hz, \( ^3J = 3.5 \) Hz, 2H, CHNCH\(_2\)), 2.51 (ddd, \( ^3J = 17.0 \) Hz, \( ^3J = 7.3 \) Hz, \( ^3J = 4.1 \) Hz, 1H, CH\(_2\)CH\(_2\)CN), 2.48 (ddd, \( ^3J = 17.0 \) Hz, \( ^3J = 7.1 \) Hz, \( ^3J = 3.8 \) Hz, 1H, CH\(_2\)CH\(_2\)CN), 2.09-2.01 (m, 2H, CH\(_2\)-CN), 1.2 (s, 9H, C(CH\(_3\))\(_3\)). \(^{13}C\) NMR (126 MHz, Chloroform-\( \text{d} \)) \( \delta \) [ppm] = 167.3 (CH\(_{\text{N}}\)), 119.1 (CN), 56.9 (C(CH\(_3\))\(_3\)), 34.7 (HC\(=\text{N}\)CH\(_2\)), 22.8 (C(CH\(_3\))\(_3\)), 21.4 (CH\(_2\)CN), 17.1 (CH\(_2\)CH\(_2\)CN), C\(_9\)H\(_{16}\)N\(_2\)OS (200.30 g mol\(^{-1}\)). TLC: \( R_f \) (PE/EtOAc, 1:1) = 0.3. IR(ATR): \( \bar{\nu} \) [cm\(^{-1}\)] = 3501 (CH), 2962 (CH), 2927 (CH), 2901 (CH), 2243 (CN), 1625 (C=N), 1477 (SO), 1458, 1423, 1363, 1179, 1093 (SC), 102, 584.

Benzyl (S,E)-4-((\text{\textit{\textup{tert}}}\)-butylsulfinyl)imino)butanoate (5r)

Synthesis: GP-2, reaction scale: 1.3 mmol of sulfinamide (S)-1 and 1.14 mmol of benzyl-5-oxobutanoate. Purification by column chromatography (PE/EtOAc, 4:1).

Yellow oil, yield: 267 mg, 904 \( \mu \)mol, 79 %. \( ^1H \) NMR (500 MHz, Chloroform-\( \text{d} \)) \( \delta = 8.12 \) (t, \( ^3J = 3.0 \) Hz, 1H, CH\(_{\text{N}}\)), 7.37-7.31 (m, 5H, C\(_6\)H\(_5\)), 5.12-5.08 (m, 2H, arCH\(_2\)O), 2.87-2.83 (m, 2H,
CHNCH₂), 2.77 (m, 1H, CH₂CO₂), 2.68 (m, 1H, CH₂CO₂), 1.14 (s, 9H, SC(CH₃)₃). ¹³C NMR (125 MHz, Chloroform-δ) δ = 172.2 (CO₂), 167.2 (CHN), 135.8 (ar-C-1), 128.7 (ar-C-3, ar-C-5), 128.4 (ar-C-4), 128.2 (ar-C-2, ar-C-6), 66.6 (ar-CH₂O), 56.8 (SC(CH₃)₃), 31.0 (CHNCH₂), 29.3 (CH₂CO₂), 22.3 (SC(CH₃)₃). C₁₃H₂₁NO₃S (294.40 g mol⁻¹). MS(ESI): m/z = 318.11341 (318.11344 [M+Na⁺]). [α]²⁰⁺ = 143.3 (c = 1.1; CHCl₃). TLC: Rᵣ (PE/EtOAc, 4:1) = 0.28.

tert-Butyl (S,E)-4-((tert-butylsulfinyl)imino)butanoate (5s)

4-(tert-Butoxy)-4-oxobutanoic Acid

The monoester of succinate was prepared as described by Srinivasan, Uttamchandani and Yao [42]: Tert-butanol (10 mL) was added to a solution of succinic anhydride (6.04 g, 60.40 mmol), N-hydroxysuccinimide (2.53g, 22.01 mmol) and DMAP (0.88 g, 7.23 mmol) in toluene (100 mL) and the solution was heated for 48 h under reflux conditions. After cooling down to rt, two layers formed in the reaction vessel (brown oil and clear, colourless solution). The crude solution was diluted with EtOAc (50 mL) and washed with citric acid (10 %, 2 × 50 mL) and brine. The organic layer was dried over Na₂SO₄, the solvent evaporated and the crude product was recrystallized from Et₂O/PE (1:3, 25 mL) to yield the title compound in quantitative yield.

Colourless crystals, yield: 10.52 g, 60.40 mmol, quant. ¹H NMR (500 MHz, Chloroform-d) δ = 2.63 (t, J = 6.2 Hz, 2H, CO₂CH₂H₂), 2.55 (t, J = 6.8 Hz, 2H, HO₂CH₂CH₂H₂), 1.45 (s, 9H, CO₂C(CH₃)₃), ¹³C NMR (126 MHz, Chloroform-d) δ = 177.0 (CO₂H), 171.4 (CO₂C(CH₃)₃), 81.03 (C(CH₃)₃), 30.10 (CH₂CO₂C(CH₃)₃), 29.07 (CH₂CO₂H), 28.03 (C(CH₃)₃). C₈H₁₄O₄ (174.20 g mol⁻¹). Smp: 49 °C (44-45 °C, [42]).

tert-Butyl 4-hydroxybutanoate

The title compound was prepared as described by Chen, Zhao, Chen, Chen, Kuznetsova, Wong and Ojima [43].

A solution of BH₃ × Me₂S (2M in THF, 11.4 mL, 22.76 mmol) was added dropwise to a heavily stirred solution of mono tert-butyl succinate (3.69 g, 21.17 mmol) in THF (35 mL) and the solution was stirred at ambient temperature for 17 h. The reaction mixture was diluted in EtOAc (150 mL) and the organic layer was washed with H₂O (30 mL) and brine (10 mL).
Drying over Na₂SO₄ and evaporation of the solvent yielded quantitatively tert-butyl-4-hydroxybutanoate.

Viscous oil, yield: 3.71 g, 18.5 mmol, 80 %. ¹H NMR (500 MHz, Chloroform-d) δ = 3.65 (t, 3J = 6.2 Hz, 2H, CH₂OH), 2.37-2.29 (t, 3J = 7.1 Hz, 2H, CH₂CO₂), 1.89-1.78 (m, 2H, CH₂-CH₂-CH₂), 1.43 (s, 9H, CO₂C(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 173.4 (CO₂), 80.6 (C(CH₃)₃), 62.3 (HOCH₂), 32.6 (CH₂CO₂), 28.2 (C(CH₃)₃), 28.0 (CH₂-CH₂-CH₂). C₃H₁₄O₃ (158.20 g mol⁻¹).

**tert-Butyl 4-oxobutanoate**

![Chemical structure of tert-Butyl 4-oxobutanoate](image)

Synthesis: GP-8, reaction scale: 18.1 mmol of tert-butyl 4-hydroxybutanoate. The crude product was filtered through a pad of silica gel to yield the title compound in pure form.

Colourless oil, yield: 2.1 g, 13 mmol, 72 %. ¹H NMR (500 MHz, Chloroform-d) δ = 9.80 (s, 1H, CHO), 2.73 (t, 3J = 6.6 Hz, 2H, CHOCH₂CH₂), 2.55 (t, 3J = 6.6 Hz, 2H, CHOCH₂), 1.44 (s, 9H, CO₂C(CH₃)₃). C₈H₁₄O₃ (158.20 g mol⁻¹) MS(ESI): m/z = 181.0 (181.1 [M+Na]⁺), 339.3 (339.2 [2M+Na]⁺), 497.3 (497.3 [3M+Na]⁺). IR(ATR): ν [cm⁻¹] = 2977 (CH₃), 2930 (CH₂), 1727 (CHO). TLC: Rf (PE/EtOAc, 4:1) = 0.52.

**tert-Butyl (S,E)-4-((tert-butylsulfinyl)imino)butanoate (5s)**

![Chemical structure of tert-Butyl (S,E)-4-((tert-butylsulfinyl)imino)butanoate](image)

Synthesis: GP-2, reaction scale: 6.31 mmol of sulfinamide (S)-1. Isolation of title compound by column chromatography (PE/EtOAc, 4:1).

Colourless crystalline solid, yield: 1.06 g, 4.04 mmol, 64 %. ¹H NMR (500 MHz, Chloroform-d) δ = 8.12 (t, 3J = 3.3 Hz, 1H, CHN), 2.79 (ddd, 3J = 7.2 Hz, 3J = 6.7 Hz, 3J = 3.5 Hz, 2H, CO₂CH₂), 2.63 (ddd, 3J = 16.8 Hz, 3J = 7.2 Hz, 1H, CH₂CHN), 2.55 (dt, 2J = 16.8 Hz, 3J = 6.7 Hz, 1H, CH₂CHN), 1.44 (s, 9H, CO₂C(CH₃)₃), 1.18 (s, 9H, SC(CH₃)₃)). ¹³C NMR (126 MHz, Chloroform-d) δ = 171.5 (CO₂), 167.6 (CHN), 80.7 (CO₂C(CH₃)₃), 56.7 (SC(CH₃)₃), 31.1 (CH₂CHN), 30.5 (CO₂CH₂), 28.1 (CO₂C(CH₃)₃), 22.3 (SC(CH₃)₃). C₁₂H₂₃NO₃S (261.38 g mol⁻¹). MS(ESI): m/z = 262.1 (262.1 [M+H]⁺), 284.1 (284.1 [M+Na]⁺). TLC: Rf (PE/EtOAc, 4:1) = 0.26. IR(ATR): ν [cm⁻¹] = 2984 (CH₃), 2863 (CH₂), 1727 (C=O), 1622 (C=O), 1087 (S=O).
(S,E)-N-(4-((tert-Butyldimethylsilyl)oxy)butylidene)-tert-butylsulfinamide (5t)

4-((tert-Butyldimethylsilyl)oxy)butanal

Synthesis: GP-8, reaction scale: 4.127 mmol of 4-((tert-butyldimethylsilyl)oxy)butanol-1-ol. The title compound was obtained in pure form without further purification. The title compound has been first described by Asano and Matsubara [44].

Brightly yellow oil, yield: quant. $^1$H NMR (500 MHz, Chloroform-d) $\delta = 9.78$ (t, $^3J = 1.6$ Hz, 1H, CHO), 3.65 (t, $^3J = 6.0$ Hz, 2H, SiOCH$_2$), 2.50 (td, $^3J = 7.1$ Hz, $^3J = 1.6$ Hz, 2H, CHOCH$_2$), 1.86 (p, $^3J = 6.5$ Hz, 2H, CH$_2$CH$_2$CH$_2$), 0.88 (s, 9H, C(CH$_3$)$_3$), 0.04 (s, 6H, Si(CH$_3$)$_2$). C$_{10}$H$_{22}$O$_2$Si ($202.37$ g mol$^{-1}$).

(S,E)-N-(4-((tert-Butyldimethylsilyl)oxy)butylidene)-tert-butylsulfinamide (5t)

Synthesis: GP-1, reaction scale: 4.13 mmol of 4-((tert-butyldimethylsilyl)oxy)butanal and 4.30 mmol of sulfinamide (S)-1. Reaction for 1 h at 85 °C. The reaction progress was monitored by TLC. Purification by column chromatography. Compound 5t has already been described by Bauer, DiBlasi and Tan [45].

Colourless oil, yield: 1.13 g, 3.70 mmol, 90 %. $^1$H NMR (500 MHz, Chloroform-d) $\delta = 8.10$ (t, $^3J = 4.5$ Hz, 1H, CHN), 3.68 (t, $^3J = 6.2$ Hz, 2H, OCH$_2$), 2.60 (td, $^3J = 7.5$ Hz, $^3J = 4.5$ Hz, 2H, CHNCH$_2$), 1.88-1.82 (m, 2H, OCH$_2$CH$_2$), 1.19 (s, 9H, SC(CH$_3$)$_3$), 0.89 (s, 9H, SiC(CH$_3$)$_3$), 0.05 (s, 6H, Si(CH$_3$)$_2$). $^{13}$C NMR (126 MHz, Chloroform-d) $\delta = 169.6$ (CN), 62.3 (SiC(CH$_3$)$_3$), 56.7 (SC(CH$_3$)$_3$), 32.9 (OCH$_2$), 28.7 (CHNCH$_2$), 26.1 (SiC(CH$_3$)$_3$), 22.5 (SC(CH$_3$)$_3$), 18.5 (OCH$_2$CH$_2$), -5.2 (Si(CH$_3$)$_2$). C$_{14}$H$_{31}$NO$_2$SSi (305.55 g mol$^{-1}$). MS(ESI): $m/z = 306.1924$ (306.1918 [M+H$^+$]). TLC: R$_f$(PE/EtOAc, 2:1) = 0.54.
(S,E)-N-(4-Chlorobutylidene)-tert-butylsulfamid (5u)

4-Chlorobutanal

![Chemical Structure](image)

Synthesis: GP-8, reaction scale: 37.0 mmol of 4-chlorobutane-1-ol. No further purification.

Yellow oil, yield: 3.04 g, 28.5 mmol, 77%. $^1$H NMR (300 MHz, Chloroform-d) δ = 9.81 (t, $^3$J = 1.1 Hz, 1H, CHO), 3.60 (t, $^3$J = 6.3 Hz, 2H, CH₂Cl), 2.67 (td, $^3$J = 7.1 Hz, $^3$J = 1.1 Hz, 2H, CHOCH₂), 2.30-1.91 (m, 2H, CH₂CH₂CH₂). C₄H₇ClO (106.55 g mol⁻¹). TLC: Rₘ (EtOAc) = 0.7.

(S,E)-N-(4-Chlorobutylidene)-tert-butylsulfamid (5u)

![Chemical Structure](image)

Synthesis: GP-1, reaction scale: 8.24 mmol of sulfamid (S)-1 and 8.5 mmol of 4-chlorobutanal. Reaction mixture was heated up to 90 °C. No further purification.

Orange oil, yield: 1.57 g, 7.00 mmol, 85%. $^1$H NMR (300 MHz, Chloroform-d) δ = 8.10 (t, $^3$J = 4.0 Hz, 1H, CHN), 3.62 (td, $^3$J = 6.5 Hz, $^4$J = 1.2 Hz, 2H, ClCH₂), 2.78-2.66 (m, 2H, CHNCH₂), 2.17-2.10 (m, 2H, CHNCH₂CH₂), 1.19 (s, 9H, SC(CH₃)₃). $^{13}$C NMR (75 MHz, Chloroform-d) δ = 168.1 (CHN), 56.8 (SC(CH₃)₃), 44.2 (ClCH₂), 33.3 (CHNCH₂), 28.1 (CHNCH₂CH₂), 22.5 (SC(CH₃)₃). C₈H₁₆ClNOS (209.73 g mol⁻¹). TLC: Rₘ (EtOAc) = 0.64.

(S,E)-N-(5-Azidopentylidene)-tert-butylsulfamid (5v)

5-Iodopentane-1-ol

![Chemical Structure](image)

This synthesis was carried out analogue to the conversion of THF as first described by Sasano, Nagasawa, Yamazaki, Shibuya, Park and Iwabuchi [41] with some modifications.

NaBH₄ (1.00 g, 27 mmol, 1 equiv) was dissolved in dry Et₂O (25 mL). The suspension was cooled to 0 °C and a solution of tetrahydropyrane (10 mL, 102 mmol, 3.7 equiv) in Et₂O (25 mL) was added in one portion. A solution of iodine (13.4 g, 52.8 mmol, 2 equiv) in Et₂O
(50 mL) was added dropwise to the reaction mixture over a period of more than 3 hours at 0 °C. After each portion, the reaction mixture turned instantly a dark purple colour, which bleached within about 30 seconds. After the addition was complete, the solution was allowed to warm to room temperature overnight. Water was added to the resulting purple solution which immediately developed heat and gas. The organic solvent was evaporated and the aqueous layer was extracted with Et₂O (3 × 70 mL). The combined organic layers were washed with a solution of Na₂SO₃ and brine and dried over Na₂SO₄ to yield the title compound in form of a slightly orange, highly fluid oil.

Colourless oil, yield: 2.36 g, 11.02 mmol, 41 %. ¹H NMR (500 MHz, Chloroform-d) δ = 3.77 (t, 3 J = 6.4 Hz, 1H, OH), 3.66 (t, 3 J = 6.4 Hz, 2H, HOCH₂), 3.20 (t, 3 J = 7.0 Hz, 2H, ICH₂), 1.86 (p, 3 J = 7.0 Hz, 2H, ICH₂CH₂CH₂), 1.63- 1.52 (m, 2H, HOCH₂CH₂), 1.52- 1.42 (m, 1H, ICH₂CH₂). ¹³C NMR (126 MHz, Chloroform-d) δ = 62.8 (HOCH₂), 33.4 (ICH₂), 31.7 (ICH₂CH₂CH₂), 30.5 (HOCH₂CH₂), 26.9 (ICH₂CH₂). C₅H₉IO (214.05 g mol⁻¹).

5-Azidopentane-1-ol

Similar reaction conditions were used as described by Sasano, Nagasawa, Yamazaki, Shibuya, Park and Iwabuchi [41]: An aqueous solution of NaN₃ (1.78 g, 26.5 mmol, 2.4 eq in 25 mL) was added to a solution of freshly prepared 5-iodopentanol (2.36 g, 11.0 mmol, 1 equiv) in THF (25 mL). After 12 hours, the dark yellow reaction mixture was diluted with an aqueous solution of Na₂SO₃, which made the colour vanish instantly. The organic solvent was evaporated and the residue was extracted with Et₂O (3 × 50 mL) and dried over Na₂SO₄. Evaporation of the solvent yielded the title compound in form of a colourless, thin oil (1.313 g, 10.17 mmol, 92 %).

An alternative preparation was executed, starting from 5-aminopentane-1-ol:

An azide transfer reagent was prepared in situ, as proposed by Barner-Kowolik et al. [46] and applied, as described by Días et al. [47]: Trifluoromethanesulfonic anhydride (3.25 mL, 19.4 mmol, 2.0 equiv) was added dropwise at 0 °C to a suspension of NaN₃ (4.53 g, 69.8 mmol, 7.2 equiv) in a mixture of DCM and H₂O (9:17, 25 mL). After 2 h, the aqueous layer was separated, extracted with DCM (15 mL) and the combined organic layers were washed with a saturated solution of Na₂CO₃ and dried over Na₂SO₄. After reduction of the solvent under reduced pressure, the concentrated solution was added to a mixture of 5-
aminopentan-1-ol (1.05 mL, 9.69 mmol, 1.0 equiv), CuSO₄ × 5 H₂O (200 mg, 0.8 mmol, 0.1 equiv) and K₂CO₃ (1.6 g, 11.6 mmol, 1.2 equiv) in H₂O/MeOH (2:3, 70 mL). After 12 h, the organic solvent was evaporated and the residue was extracted with Et₂O (3 × 50 mL). The combined organic layers were dried over Na₂SO₄ and the solvent evaporated to yield the title compound (1.05 g, 8.14 mmol, 84 %).

¹H NMR (500 MHz, Chloroform-d) δ = 3.66 (t, 3J = 6.4 Hz, 2H, HOCH₂), 3.29 (t, 3J = 6.9 Hz, 2H, N₃CH₃), 1.68 - 1.57 (m, 4H, N₃CH₂CH₂, HOCH₂CH₂), 1.50 - 1.43 (m, 2H, N₃CH₂CH₂CH₂). ¹³C NMR (126 MHz, Chloroform-d) δ = 62.8 (CHO), 51.5 (CN₃), 32.3 (N₃CH₂CH₂CH₂), 28.8 (HOCH₂CH₂), 23.2 (N₃CH₂CH₂). C₁₅H₂₀N₃O (271.15 g mol⁻¹).

5-Azidopentanal

Synthesis: GP-8, reaction scale: 8.17 mmol of 5-azidopentanol. The product was slightly contaminated by DMSO and was applied for the following synthesis without further purification.

Colourless oil, yield: 0.61 g, 4.74 mmol, 58 %. ¹H NMR (500 MHz, Chloroform-d) δ = 9.79 (t, 3J = 1.4 Hz, 1H, CHO), 3.31 (t, 3J = 6.6 Hz, 2H, CH₂N₃), 2.50 (td, 3J = 7.1 Hz, 4J = 1.5 Hz, 2H, CHOCH₂), 1.77 - 1.69 (m, 2H, N₃CH₂CH₂CH₂), 1.67 - 1.60 (m, 2H, N₃CH₂CH₂). ¹³C NMR (126 MHz, Chloroform-d) δ = 201.8 (CHO), 51.3 (N₃CH₂), 43.4 (CHOCH₂), 28.4 (N₃CH₂CH₂), 19.4 (N₃CH₂CH₂CH₂). C₁₅H₂₀N₃O (271.15 g mol⁻¹).

(S,E)-N-(5-Azidopentylidene)-tert-butylsulfinamide (5v)

Synthesis: GP-2, reaction scale: 10.08 mmol of sulfinamide (S)-1 and 10.10 mmol of 5-azidopentanal. Purification by column chromatography (PE/EtOAc, 4:1). Compound 5v has been first described by Ye, He and Zhang [29].

Colourless oil, yield: 1.21 g, 5.24 mmol, 52 % (over two steps, referred to 5-azidopentane-1-ol). ¹H NMR (500 MHz, Chloroform-d) δ = 8.07 (t, 3J = 4.4 Hz, 1H, CHN), 3.31 (t, 3J = 6.5 Hz, 2H, N₃CH₂), 2.56 (td, 3J = 7.1 Hz, 4J = 4.5 Hz, 2H, CHNCH₂), 1.78 - 1.64 (m, 2H, N₃CH₂CH₂), 1.19 (s, 9H, C(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 168.8 (CHN), 56.8 (C(CH₃)₃), 51.3 (N₃CH₂), 35.6 (CHN-CH₂), 28.6 (N₃CH₂CH₂), 22.7 (N₃CH₂CH₂CH₂), 20.2 (N₃CH₂CH₂CH₂).
22.5 (C(CH₃)₃). C₉H₁₈N₄OS (230.33 g mol⁻¹). MS(ESI): m/z = 253.1 (M+Na⁺). TLC: Rₚ (EtOAc/PE, 1:2) = 0.57. IR(ATR): ν [cm⁻¹] = 2949 (CH), 2930 (CH), 2867 (CH), 2100 (N₃), 1622 (C=N), 1451 (SO), 1359, 1081 (SC).

(S,E)-N-(4-Azidobutylidene)-tert-butylsulfinamide (5w)

4-Azidobutane-1-ol

\[
\text{HO-CH₂-N₃} \quad \text{An aqueous solution of NaN₃ (170 mg, 2.57 mmol, 3.0 eq, 5 mL) was added in one portion to a solution of 4-iodobutane-1-ol (170 mg, 0.85 mmol, 1 equiv) in THF (5 mL). The reaction mixture was heated for 19 h to 80 °C. The solution was concentrated under reduced pressure, before it was extracted with DCM (4 × 10 mL). The combined organic layers were washed with brine and dried over Na₂SO₄. The title compound was isolated in pure form. The synthesis of 4-azidobutane-1-ol has been first described by Sasano, Nagasawa, Yamazaki, Shibuya, Park and Iwabuchi [41].}

Colourless viscous oil, yield: 3.911 g, 33.97 mmol, 94 %. ¹H NMR (300 MHz, Chloroform-d): δ [ppm] = 3.60 (t, 3 J = 6.4 Hz, 2H, CH₂OH), 3.17 (t, 3 J = 6.9 Hz, 2H, CH₂N₃), 1.84-1.76 (m, 2H, CH₂CH₂), 1.66-1.56 (m, 2H, CH₂CH₂). C₅H₁₁N₃O (129.16 g mol⁻¹). IR(ATR): ν [cm⁻¹] = 3600-3200 (O-H), 2926 (CH₂), 2885 (CH₂), 2356-2334 (N₃). C₅H₉N₃O (115.14 g mol⁻¹). TLC: Rₚ (PE/EtOAc, 2:1) = 0.5.

4-Azidobutanal

\[
\text{H-CH₂-N₃} \quad \text{Synthesis: GP-8, reaction scale: 34 mmol of 4-azidobutanol. Purification by filtration through a pad of silica gel (PE/EtOAc, 10:1).}

Slightly yellow, fluid oil, yield: quant. ¹H NMR (600 MHz, Chloroform-d) δ = 9.74 (s, 1H, CHO), 3.55 (dd, 3 J = 7.3 Hz, 3 J = 5.4 Hz, 1H, N₃CH₂), 3.31 (t, 3 J = 6.6 Hz, 1H, N₃CH₂), 2.62 (td, 3 J = 7.0 Hz, 4 J = 1.1 Hz, 1H, N₃CH₂CH₂CH₂), 2.53 (td, 3 J = 7.0 Hz, 4 J = 1.2 Hz, 1H, N₃CH₂CH₂CH₂), 2.05 (p, 3 J = 6.7 Hz, 1H, N₃CH₂CH₂), 1.86 (pd, 3 J = 6.8 Hz, 4 J = 1.8 Hz, 1H, N₃CH₂CH₂). ¹³C NMR (126 MHz, Chloroform-d) δ = 201.0 (CHO), 50.7 (N₃CH₂), 41.0 (CH₂CHO), 21.6 (N₃CH₂CH₂). C₄H₇N₃O (113.12 g mol⁻¹).
(S,E)-N-(4-Azidobutylidene)- tert-butylsulfinamide (5w)

Synthesis: GP-2, reaction scale: 56.0 mmol of sulfinamide (S)-1 and
60.0 mmol of 4-azidobutanal. Purification by column chromatography
(PE/EtOAc, 4:1). Compound 5w has been first described by Shu, Liu,
Wang, Li and Ye [48].

Faintly green, thin oil, yield: 10.1 g, 46.9 mmol, 84% (over two steps, referred to 4-
azidobutan-1-ol). $^1$H NMR (500 MHz, Chloroform-d) $\delta$ = 8.09 (t, $^3J = 4.2$ Hz, 1H, CHN),
3.38 (t, $^3J = 6.8$ Hz, 2H, N$_3$CH$_2$), 2.62 (td, $^3J = 7.2$ Hz, $^3J = 4.9$ Hz, 2H, CHNCH$_2$), 1.94 (m, 2H, N$_3$CH$_2$CH$_2$), 1.19 (s, 9H, C(CH$_3$)$_3$). $^{13}$C NMR (126 MHz, Chloroform-d) $\delta$ = 168.1
(CHN), 56.8 (C(CH$_3$)$_3$), 50.8 (N$_3$CH$_2$), 33.2 (CHNCH$_2$), 24.7 (N$_3$CH$_2$CH$_2$), 22.5 (C(CH$_3$)$_3$).

$^{1}S$8H$_{16}$N$_4$OS (216.30 g mol$^{-1}$). MS(ESI): m/z = 239.0 (239.1 [M+Na$^+$]). IR(ATR): $\tilde{\nu}$ [cm$^{-1}$] =
2955 (CH), 2924 (CH), 2867 (CH), 2091 (N$_3$), 1625 (C=N), 1458 (SO), 1363, 1255, 1080
(SC). TLC: $R_f$ (PE/EtOAc, 1:1) = 0.62, $R_f$ (EtOAc/PE, 1:2) = 0.57.

TMS protected propargylamines 6

In most cases, compound 6 was not isolated. The crude product of the described synthesis was
directly converted to propargylamine 7, without further purification.

(S)-N-((S)-4-(Trimethylsilyl)but-3-yn-2-yl)- tert-butylsulfinamide (6a)

Synthesis: GP-3, reaction scale: 12.7 mmol of imine 5a. Alkyne 6a
was not purified. The crude product was directly converted to 7a.

$^1$H NMR (300 MHz, Chloroform-d) $\delta$ [ppm] = 4.20 (qd, $^3J = 6.7$ Hz,
$^3J = 4.5$ Hz, 1H, C$^6$H), 3.36 (d, $^3J = 4.6$ Hz, 1H, NH), 1.43 (d, $^3J = 6.7$ Hz, 3H, CH$_3$), 1.22 (s, 9H, C(CH$_3$)$_3$), 0.16 (s, 9H, Si(CH$_3$)$_3$). C$_{11}$H$_{23}$NOSSi (245.46 g mol$^{-1}$). TLC: $R_f$ (PE/EtOAc, 1:1) = 0.4.

(S)-N-((S)-4-Methyl-1-(trimethylsilyl)pent-1-yn-3-yl)- tert-butylsulfinamide (6b)

Synthesis: GP-3, reaction scale: 22.5 mmol of imine 5b. The
application of two equivalents of lithiated acetylene lead to a
decreased yield. The crude product was directly converted to form 7b without further purification.

Brown oil, $^1$H NMR (600 MHz, Chloroform-$d$): $\delta = 3.92 \text{ (dd, } ^2J = 5.3 \text{ Hz, } ^3J = 6.4 \text{ Hz, 1H, NHCH}_2\text{H}), 3.30 \text{ (d, } ^3J = 5.4 \text{ Hz, 1H, NH)}, 1.92 \text{ (m, 1H, CH(CH}_3)_2\text{), 1.22 \text{ (s, 9H, C(CH}_3)_3\text{), 1.01 \text{ (d, } ^3J = 6.3 \text{ Hz, 3H, CHCH}_3\text{), 1.00 \text{ (d, } ^3J = 7.5 \text{ Hz, 3H, CHCH}_3\text{), 0.16 \text{ (s, 9H, Si(CH}_3)_3\text{).}}}}$

C$_{13}$H$_{27}$NOSSi (273.51 g mol$^{-1}$).

**(S)-N-((S)-5-Methyl-1-(trimethylsilyl)hex-1-yn-3-yl)-tert-butylsulfonamide (6c)**

![Structure 6c]

Synthesis: GP-3, reaction scale: 7.61 mmol of imine 5c. The crude product of alkyne 6c was directly converted to propargylamine 7c without further purification.

Dark green oil, yield: 1.07 g, 3.73 mmol, 49 %. $^1$H NMR (300 MHz, Chloroform-$d$): $\delta = 4.05 \text{ (td, } ^3J = 7.6 \text{ Hz, } ^3J = 6.2 \text{ Hz, 1H, CH}_2\text{H}), 3.26 \text{ (d, } ^3J = 6.0 \text{ Hz, 1H, NH), 1.83 \text{ (m, 1H, CH(CH}_3)_2\text{), 1.56 \text{ (t, } ^3J = 7.3 \text{ Hz, 2H, CH}_2\text{), 1.20 \text{ (s, 9H, C(CH}_3)_3\text{), 0.92 \text{ (d, } ^3J = 6.6 \text{ Hz, 3H, CHCH}_3\text{), 0.91 \text{ (d, } ^3J = 6.6 \text{ Hz, 3H, CHCH}_3\text{), 0.14 \text{ (s, 9H, Si(CH}_3)_3\text{). C}_{14}H_{29}NOSSi (287.54 g mol$^{-1}$). TLC: R$_f$ (PE/EtOAc, 1:1) = 0.65.

**(S)-N-((S)-1-Cyclohexyl-3-(trimethylsilyl)prop-2-yn-1-yl)-tert-butylsulfonamide (6d)**

![Structure 6d]

Synthesis: GP-3, reaction scale: 12.12 mmol of imine 5d. The crude product was applied for the conversion to propargylamine 7d without further purification.

Dark, brown, viscous oil, yield: 3.496 g, 11.15 mmol, 92 %. $^1$H NMR (300 MHz, Chloroform-$d$) $\delta = 3.88 \text{ (dd, } ^2J = 5.8 \text{ Hz, } ^3J = 6.1 \text{ Hz, 1H, CH}_2\text{H}), 3.24 \text{ (d, } ^3J = 6.1 \text{ Hz, 1H, NH), 2.37 \text{ (m, 1H, cy-1-H)}, 1.75 \text{ (dd, } ^2J = 11.9 \text{ Hz, } ^3J = 6.1 \text{ Hz, 6H, cy-2-H, cy-6-H)}, 1.66 \text{ (d, } ^2J = 11.0 \text{ Hz, 1H, cy-4-H)), 1.55 \text{ (dd, } ^2J = 11.0 \text{ Hz, } ^3J = 6.1 \text{ Hz, 6H, cy-2-H, cy-6-H)}, 1.29-1.23 \text{ (m, 2H, cy-6-H, cy-2-H), 1.22 \text{ (s, 9H, C(CH}_3)_3\text{), 1.09 \text{ (m, 1H, cy-5-H)}, 0.88 \text{ (m, 1H, cy-3-H)}, 0.16 \text{ (s, 9H, Si(CH}_3)_3\text{). C}_{16}H_{31}NOSSi (313.57 g mol$^{-1}$).}
(S)-N-((S)-4,4-Dimethyl-1-(trimethylsilyl)pent-1-yn-3-yl)-tert-butylsulfinamide (6e)

Synthesis: GP-4, reaction scale: 6.62 mmol of imine 5e. In analogy to the preparation of compounds 7vy and 7wy, PPh₃ (2 equiv) was added in one portion to the reaction mixture at -78 °C. After 2 h, water was added and the reaction mixture warmed up to rt. The organic layer was washed with a saturated solution of NH₄Cl and KHSO₄ (5 %). The aqueous layers were extracted with Et₂O (2 × 40 mL) and the combined organic layers were washed with brine and dried over Na₂SO₄. The crude product was investigated by LCMS and 6e was purified by column chromatography (EtOAc/PE, 1:10). Propargylamine 7e could not be observed by LCMS. Colourless crystalline solid, yield: 856 mg, 2.98 mmol, 45 %. ¹H NMR (500 MHz, Chloroform-d) δ = 3.66 (d, ³J = 8.1 Hz, 1H, CαH), 3.19 (d, ³J = 8.2 Hz, 1H, NH), 1.24 (s, 9H, SC(CH₃)₃), 0.98 (s, 9H, CαC(CH₃)₃), 0.16 (s, 9H, Si(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 104.8 (Cα≡C), 104.4 (Cα≡C=CTMS), 90.4 (CαC=CTMS), 58.7 (CαC(CH₃)₃), 56.9 (SC(CH₃)₃), 36.4 (CαH), 26.2 (CαC(CH₃)₃), 23.0 (SC(CH₃)₃), 0.1 (Si(CH₃)₃). C₁₄H₂₉NOSSi (287.54 g mol⁻¹). TLC: Rf (EtOAc/PE, 1:4) = 0.52.

(S)-N-((1S)-1-((1r,3R,5S)-Adamantan-1-yl)-3-(trimethylsilyl)prop-2-yn-1-yl)-tert-butylsulfinamide (6f)

Synthesis: GP-4. Reaction scale: 1.7 mmol of imine 5f. Compound 6f was directly converted to the free propargylamine 7f without further purification or investigation. C₂₀H₃₅NOSSi (365.65 g mol⁻¹).

(R)-N-((R)-5-(Methylthio)-1-(trimethylsilyl)pent-1-yn-3-yl)-tert-butylsulfinamide (6g)

Synthesis: GP-4, reaction scale: 12.6 mmol of imine 5g. Both stereocenters are (R)-configured. The crude product was not further purified after the aqueous workup. Compound 6g was directly converted to propargylamine 7g without further purification of the crude product.
Brown oil, yield: 2.07 g, \( dr = 96:4 \). \(^1\)H NMR (500 MHz, Chloroform-\( d \)) \( \delta = 4.23 \) (ddd, \( ^3J = 6.1 \text{ Hz} \), \( ^3J = 6.3 \text{ Hz} \), \( ^3J = 6.3 \text{ Hz} \), 1H, C\( ^{\alpha}\)H), 3.40 (d, \( ^3J = 5.7 \text{ Hz} \), 1H, NH), 2.67-2.59 (m, 2H, S-CH\(_2\)), 2.10 (s, 3H, S-CH\(_3\)), 2.05-1.93 (m, 2H, C\(^{\alpha}\)CH\(_2\)), 1.21 (s, 9H, SC(CH\(_3\))\(_3\)), 0.15 (s, 9H, Si(CH\(_3\))\(_3\)). C\(_{13}\)H\(_{27}\)NOS\(_2\)Si (305.57 g mol\(^{-1}\)).

\((S)-N-((S)-1\text{-Phenyl-4-(trimethylsilyl)but-3-yne-2-yl})\text{-}tert\text{-butylsulfanamide (6h)}\)

Synthesis: GP-4, reaction scale: 3.12 mmol of imine 5h. Compound 6h was not purified. The crude product was purified by filtration through a pad of silica (PE/EtOAc/Net\(_3\), 85:14:1).

Yellow oil, yield: 341 mg, 1.06 mmol, 34 \%. \( dr = 97:3 \). \(^1\)H NMR (500 MHz, Chloroform-\( d \)): \( \delta = 7.38-7.27 \) (m, 5H, ar-H), 4.26 (m, 1H, C\(^{\alpha}\)H), 3.37 (d, \( ^3J = 6.1 \text{ Hz} \), 1H, NH), 3.08-2.95 (m, 2H, C\(^{\alpha}\)CH\(_2\)), 1.15 (s, 9H, SC(CH\(_3\))\(_3\)), 0.15 (s, 9H, Si(CH\(_3\))\(_3\)). \(^{13}\)C NMR (125 MHz, Chloroform-\( d \)\)): \( \delta \text{ [ppm]} = 136.6 \) (ar-C-1), 130.1 (ar-C-3, ar-C-5), 128.4 (ar-C-2, ar-C-6), 127.0 (ar-C-4), 104.8 (TMS-C=C), 90.8 (TMS-C=C), 56.4 (SC(CH\(_3\))\(_3\)), 49.6 (C\(^{\alpha}\)), 43.4 (C\(^{\alpha}\)CH\(_2\)), 22.6 (SC(CH\(_3\))\(_3\)), -0.10 (Si(CH\(_3\))\(_3\)). C\(_{17}\)H\(_{27}\)NOS\(_2\)Si (321.55 g mol\(^{-1}\)). TLC: \( R_f\) (PE/EtOAc/NEt\(_3\), 85:14:1) = 0.17.

\((S)-N-((R)-1\text{-Phenyl-3-(trimethylsilyl)prop-2-yn-1-yl})\text{-}tert\text{-butylsulfanamide (6i)}\)

Synthesis: GP-4, reaction scale: 14.0 mmol of imine 5i. Purification by column chromatography (PE/EtOAc/Net\(_3\), 85:14:1).

Yellow oil, yield: 2.34 g, 7.56 mmol, 54 \%. \( dr = 95:5 \). \(^1\)H NMR (500 MHz, Chloroform-\( d \)): \( \delta = 7.50-7.49 \) (m, 2H, ar-2-H, ar-6-H), 7.38-7.31 (m, 3H, ar-3-H, ar-4-H, ar-5-H), 5.24 (d, \( ^3J = 5.2 \text{ Hz} \), 1H, C\(^{\alpha}\)H), 3.68 (d, \( ^3J = 5.2 \text{ Hz} \), 1H, NH), 1.20 (s, 9H, SC(CH\(_3\))\(_3\)), 0.19 (s, 9H, Si(CH\(_3\))\(_3\)). \(^{13}\)C NMR (125 MHz, Chloroform-\( d \)\)): \( \delta \text{ [ppm]} = 139.0 \) (ar-C-1), 128.7 (ar-C-3, ar-C-5), 128.4 (ar-C-2, ar-C-6), 128.0 (ar-C-4), 104.0 (C\(^{\alpha}\)C=CTMS), 91.5 (C\(^{\alpha}\)C=CTMS), 56.5 (SC(CH\(_3\))\(_3\)), 51.1 (C\(^{\alpha}\)), 22.7 (SC(CH\(_3\))\(_3\)), -0.1 (Si(CH\(_3\))\(_3\)). C\(_{18}\)H\(_{25}\)NOS\(_2\)Si (307.53 g mol\(^{-1}\)). TLC: \( R_f\) (PE/EtOAc/NEt\(_3\), 85:14:1) = 0.38.
(S)-N-(5-pentafluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-yl-tert-butylsulfinamide (6j)

**Synthesis:** GP-4, reaction scale: 3.12 mmol of imine 5j. Purification by column chromatography (PE/EtOAc, 2:1).

Colourless crystals, yield: 1.30 g, 3.28 mmol, 41 %, dr = 100:0.

$^1$H NMR (500 MHz, Chloroform-d) $\delta = 5.58$ (d, $^3J_{HH} = 5.3$ Hz, 1H, C$^\alpha$H), 3.87 (d, $^4J_{HH} = 5.4$ Hz, 1H, C$^\alpha$NH), 1.15 (s, 9H, SC(CH$_3$)$_3$), 0.14 (s, 9H, Si(CH$_3$)$_3$). $^{19}$F NMR (282 MHz, Chloroform-d) $\delta = -141.9$ (dt, $^2J_{FF} = 13.9$ Hz, $^4J_{FF} = 1.9$ Hz, 2F, ar-2-F, ar-6-F), -153.4 (tt, $^3J_{FF} = 21.0$ Hz, $^4J_{FF} = 2.1$ Hz, 1F, ar-4-F), -161.0 (dd, $^3J_{FF} = 20.9$ Hz, $^4J_{FF} = 13.8$ Hz, 2F, ar-3-F, ar-5-F). C$_{16}$H$_{20}$F$_3$NOSSi (397.48 g mol$^{-1}$).

(S)-N-((R)-1,1,1-Trifluoro-4-(trimethylsilyl)but-3-yn-2-yl)-tert-butylsulfinamide (6k)

**Synthesis:** modified GP-4. A solution of n-Butyl lithium (1.6 M in n-hexane, 20 mL, 32 mmol, 1.5 equiv) was added dropwise to a solution of trimethylsilylethyne (3.152 g, 32.1 mmol, 1.5 equiv) in toluene at $-78 \, ^\circ\text{C}$ and the solution was stirred for 2 h at the same temperature. Afterwards, a solution of crude 5k (21.86 mmol, 1 equiv) in toluene was added dropwise and the reaction mixture was stirred for another 2 h, before warming up to rt. A saturated aqueous solution of NH$_4$Cl (40 mL) was added, the phases separated and the aqueous layer was extracted with Et$_2$O (4 x 75 mL). The combined organic layers were washed with brine (15 mL), dried over MgSO$_4$ and the solvent was removed under reduced pressure. The crude product was obtained in the form of a brown oil. It was filtered through a short column of silica gel with EtOAc/PE, 1:2, to yield TMS protected alkyne 6k in pure form.

Colourless crystals, yield: 2.45 g, 8.18 mmol, 33 % (referred to sulfinamide (S)-1). $^1$H NMR (300 MHz, Chloroform-d) $\delta = 4.51$ (qd, $^3J_{HF} = 6.4$ Hz, $^3J_{HH} = 7.2$ Hz, 1H, C$^\alpha$H), 3.82 (d, $^3J_{HH} = 7.2$ Hz, 1H, C$^\alpha$NH), 1.20 (s, 9H, C(CH$_3$)$_3$), 0.14 (s, 9H, Si(CH$_3$)$_3$). $^{19}$F NMR (282 MHz, Chloroform-d) $\delta = -75.94$ (d, $^3J_{HF} = 6.3$ Hz, CF$_3$). C$_{11}$H$_{20}$F$_3$NOSSi (299.43 g mol$^{-1}$). MS(ESI): $m/z = 322.154$ (322.088 [M+Na]$^+$). TLC: R$_f$ (PE/EtOAc, 2:1) = 0.61.

When hemiaminal 8k was used instead of imine 5k, the yield was considerably reduced to 24.2 mg, 106 µmol, 5 %. When imine 5k was used, and AlMe$_3$ was added as a Lewis acid, as described in GP-4, the yield was also notably decreased: 1.384 g, 0.414 mmol, 22 %.
(S)-N-((R)-1,1,1-Trichloro-4-(trimethylsilyl)but-3-yn-2-yl)-tert-butylsulfinamide (6l)

Synthesis: GP-4, reaction scale: 1.50 mmol of imine 5l. Conversion: 68 % (Isolation of 32 % starting material). When (S)-1 was used, nucleophilic attack from the si-face could not be observed at all. The new stereo center only formed in (R)-configuration. Compound 5l was purified by column chromatography (PE/EtOAc, 4:1).

Colourless crystals, yield: 50.6 mg, 0.15 mmol, 10 %. \(^1\)H NMR (500 MHz, Chloroform-\(d\)) \(\delta = 4.69 (d, ^3J = 8.0 \text{ Hz}, 1\text{H}, \text{C}^6\text{H}), 3.97 (d, ^3J = 7.9 \text{ Hz}, 1\text{H}, \text{NH}), 1.28 (s, 9\text{H}, \text{SC(CH}_3)_3), 0.18 (s, 9\text{H}, \text{Si(CH}_3)_3). \(^13\)C NMR (126 MHz, Chloroform-\(d\)) \(\delta = 101.2 (\text{Cl}_2\text{C}), 98.5 (\text{C}^6\text{C}=\text{CTMC}), 94.7 (\text{C}^6\text{C}=\text{CTMS}), 65.3 (\text{C}^6), 57.9 (\text{SC(CH}_3)_3), 22.9 (\text{SC(CH}_3)_3), -0.4 (\text{Si(CH}_3)_3). \)C\(_{11}\)H\(_{20}\)Cl\(_3\)NOSSi (348.78 g mol\(^{-1}\)). MS(ESI): \(m/z = 243.9888 \ (C_7H_{12}Cl_3NSi)^+\). TLC: \(R_f\) (PE/EtOc, 4:1) = 0.55.

(R)-N-((S)-1-(Benzyloxy)-4-(trimethylsilyl)but-3-yn-2-yl)-tert-butylsulfinamide (6n)

Synthesis: GP-3, reaction scale: 197 \(\mu\)mol of imine 5n. The crude product 6n was directly converted into propargylamine 7n, without further purification or characterization.

(S)-N-((R)-1-(Allyloxy)-4-(trimethylsilyl)but-3-yn-2-yl)-tert-butylsulfinamide (6o)

Synthesis GP-4, reaction scale: 1.58 mmol of imine 5o. The crude product was directly converted to propargylamine 7o without further purification. The diastereoselectivity of the reaction could be determined by \(^1\)H NMR spectroscopy of the crude product.

Dark yellow oil, yield: not determined, \(dr = 89:11\), \(^1\)H NMR (500 MHz, Chloroform-\(d\)): \(\delta = 5.87 (m, 1\text{H}, \text{CH}=\text{CH}_2), 5.27 (\text{dddd}, ^4J = 1.3 \text{ Hz}, ^4J = 1.6 \text{ Hz}, ^2J = 1.6 \text{ Hz}, ^3J = 17.2 \text{ Hz}, 1\text{H}, \text{C}=\text{H}_2\text{CH}_2), 5.17 (\text{dddd}, ^4J = 1.0 \text{ Hz}, 1\text{H}, \text{CH}=\text{CH}_2), ^2J = 1.7 \text{ Hz}, ^3J = 10.4 \text{ Hz}, 1\text{H}, \text{C}=\text{H}_2\text{CH}_2), 4.22 (m, 1\text{H}, \text{C}^6\text{H}), 4.04-4.03 (m, 2\text{H}, \text{CH}_2\text{CH}=), 3.70 (d, ^3J = 5.2 \text{ Hz}, 1\text{H}, \text{NH}), 3.59-3.56 (m,
2H, HC=CH₂, 1.20 (s, 9H, S(C(CH₃)₃), 0.14 (s, 9H, Si(CH₃)₃). C₁₄H₂₇NO₂Si (301.52 g mol⁻¹).

(R)-N-((S)-1-(Benzythrlo)-4-(trimethylsilyl)but-3-yn-2-yl)-tert-butylsulfinamide (6p)

Synthesis: GP-3, reaction scale: 4.45 mmol of imine 5p. Compound 6p was directly converted to propargylamine 7p without further purification or characterization.

(S)-N-((S)-6-Cyano-1-(trimethylsilyl)hex-1-yn-3-yl)-tert-butylsulfinamide (6q)

Synthesis: GP-4, reaction scale: 5.02 mmol of imine 5q. The crude product was directly converted to propargylamine 7q without further purification or characterization.

Dark yellow oil, yield (crude) 1.0491 g, 3.514 mmol, 70 %. C₁₄H₂₆N₂OSSi (298.52 g mol⁻¹).

tert-Butyl (S)-4-(((S)-tert-butylsulfinyl)amino)-6-(trimethylsilyl)hex-5-ynoate (6s)

Synthesis: GP-4, reaction scale: 4.06 mmol of imine 5s. A Lewis Acid (AlMe₃) was left out. Isolation by fractionated filtration through a short column with silica gel. (EtOAc/PE, 10:1 − 4:1 − 2:1 − 1:1).

Colourless crystals, yield: 0.773 g, 2.15 mmol, 53 %, dr = 93:7. ¹H NMR (500 MHz, Chloroform-d) δ = 4.14 (ddd, ²J = 7.4 Hz, ³J = 5.9 Hz, ⁴J = 5.9 Hz, 1H, CαH), 3.37 (d, ²J = 5.6 Hz, 1H, NH), 2.46-2.34 (m, 2H, CαCH₂CH₂), 2.02 (m, 1H, CαCH₂), 1.93 (ddt, ²J = 13.7 Hz, ³J = 8.5 Hz, ⁴J = 6.7 Hz, 1H, CαCH₂), 1.83 (ddt, ²J = 13.1 Hz, ³J = 8.3 Hz, ⁴J = 6.8 Hz, 1H, CαCH₂), 1.45 (s, 9H, CO₂C(CH₃)₃), 1.22 (s, 9H, SC(CH₃)₃), 0.17 (s, 9H, Si(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 172.7 (CO₂), 104.1 (CO₂CMe₃), 89.9 (CαC=CTMS), 80.5 (CαC=CTMS), 56.0 (SC(CH₃)₃), 47.1 (CαH), 31.6 (CαCH₂CH₂), 28.1
(CO₂C(CH₃)₃), 27.5 (C₆H₂), 22.4 (SC(CH₃)₃), -0.3 (SiC(CH₃)₃). C₁₇H₃₅NO₃Si (359.60 g mol⁻¹). MS(ESI): m/z = 360.479 (360.203 [M+H]^+). TLC: R_f (EtOAc/PE, 1:1) = 0.78.

(S)-N-((S)-6-((tert-Butyldimethylsilyl)oxy)-1-(trimethylsilyl)hex-1-yn-3-yl)-tert-butylsulfinamide (6t)

Synthesis: GP-3, reaction scale: 3.67 mmol of imine 5t. The crude product was directly applied for the following desilylation reaction without further purification. Compound 6t has already been described by Bauer, DiBlasi and Tan [45].

Brown oil, yield: not determined. ¹H NMR (500 MHz, Chloroform-d) δ = 4.11 (t, ³J = 5.6 Hz, 1H, CαH), 3.64 (t, ³J = 6.1 Hz, 2H, SiOCH₂), 3.38 (d, ³J = 5.3 Hz, 1H, CαNH), 1.81 (m, 1H, CαCH₂), 1.74-1.64 (m, 2H, CαCH₂, CαCH₂CH₂), 1.57 (m, 1H, CαCH₂CH₂), 1.21 (s, 9H, SC(CH₃)₃), 0.89 (s, 9H, SiC(CH₃)₃), 0.16 (s, 9H, Si(CH₃)₃), 0.05 (s, 6H, Si(CH₃)₂). C₁₉H₄₁NO₂SSi₂ (403.77 g mol⁻¹). MS(ESI): m/z = 404.141 (404.2469 [M+H]^+).

(R)-N-((R)-7-Azido-1-(trimethylsilyl)hept-1-yn-3-yl)-tert-butylsulfinamide (6v)

Synthesis: GP-4, reaction scale: 1.16 mmol of imine 5v. Compound 6v was directly converted to propargylamine 7vx without further purification.

Yellow oil, yield not determined. ¹H NMR (300 MHz, Chloroform-d) δ = 4.08 (m, 1H, CαH), 3.37 (d, ³J = 5.2 Hz, 1H, NH), 3.34-3.24 (m, 2H, N₃CH₂), 2.55 (m, 1H, CαCH₂), 1.86-1.50 (m, 5H, CαCH₂CH₂CH₂), 1.21 (s, 9H, C(CH₃)₃), 0.15 (s, 9H, Si(CH₃)₃). C₁₄H₂₈N₄OSSi (328.55 g mol⁻¹). MS(ESI): m/z = 329.085 (329.185 [M+H]^+).
Propargylamines 7

When compound 6 was not isolated, the yield of propargylamine 7 usually refers to imine 5 (2 steps, mentioned in parentheses).

(S)-N-((S)-But-3-yn-2-yl)-tert-butylsulfinamide (7a)

Synthesis: GP-5, starting material was the crude product of 6a. Reaction scale: 12.7 mmol of imine 5a. Purification by column chromatography (PE/EtOAc, 2:1 or Et₂O) and recrystallization from DCM or Et₂O. Colourless, crystalline solid. Yield = 1.03 g, 5.96 mmol, 47% (over two steps, referred to aldime 5a). dr: 100:0. 1H NMR (500 MHz, Chloroform-d) δ [ppm] = 4.16 (m, 1H, CH), 3.38 (d, 3J = 4.4 Hz, 1H, NH), 2.39 (d, 4J = 2.3 Hz, 1H, C≡CH), 1.46 (d, 3J = 6.8 Hz, 3H, C(CH₃)₃), 1.21 (s, 9H, C(CH₃)₃). 13C NMR (126 MHz, Chloroform-d) δ [ppm] = 84.8 (C=C=CH), 72.3 (C≡C=CH), 56.1 (C(CH₃)₃), 42.7 (C(CH₃)₃), 23.3 (CH₃), 22.6 (C(CH₃)₃). C₆H₁₅NOS (173.27 g mol⁻¹). MS(ESI): m/z = 196.0757 (196.0767 [M+Na]+). de = 100%. IR(ATR): v[cm⁻¹] = 3725 (CH), 3706 (CH), 3623 (CH), 3595 (CH), 3212 (CH), 2946 (CH), 1125 (SO), 1024 (SC), 1014, 846, 699. [α]²²°₅₈₉ = 55.15 (c = 0.65; CHCl₃). Smp.: 43–44 °C.

(S)-N-((S)-4-Methylpent-1-yn-3-yl)-tert-butylsulfinamide (7b)

Synthesis: GP-5, starting material was the crude product of 6b. Reaction scale: 22.5 mmol of imine 5b. Purification by column chromatography (PE/EtOAc, 2:1) and recrystallization from Et₂O or DCM. Colourless crystalline solid, yield: 2.77 g, 13.7 mmol, 61 % (over two steps, referred to imine 5b), dr = 97:3. 1H NMR (Chloroform-d, 600 MHz): δ = 3.89 ppm (ddd, 3J = 7.4 Hz, 4J = 5.2 Hz, 4J = 2.3 Hz, 1H, CH) 3.31 (d, 3J = 7.1 Hz, 1H, NH), 2.40 (d, 4J = 2.3 Hz, 1H, C≡C=CH), 1.94 (m, 1H, CH(CH₃)₂), 1.23 (s, 9H, C(CH₃)₃), 1.01 (d, 3J = 6.6 Hz, 3H, CHCH₃), 1.00 (d, 3J = 6.6 Hz, 3H, C≡HCH₃). 13C NMR (125 MHz, Chloroform-d): δ [ppm] = 82.4 (C=C=CH), 73.9 (C≡C=CH), 56.4 (C(CH₃)₃), 53.7 (C(CH₃)₃), 33.6 (C≡CH(CH₃)₂), 22.7 (C(CH₃)₃), 18.9 ((CH₃)CHCH₃), 17.5 ((CH₃)CHCH₃). C₁₀H₁₉NOS (201.33 g mol⁻¹). MS(ESI): m/z = 425.22789 (calc. 425.22668 [2M+Na]+). TLC: Rf (PE:EE 2:1) = 0.38. [α]²²°₅₈₉ = 42.4 (c = 2.82; CHCl₃). EA: C(61.083%), H(9.618%), N(6.322%), S(14.249%).
(S)-N-((S)-5-Methylhex-1-yn-3-yl)-tert-butylsulfinamide (7c)

Synthesis: GP-5, starting material was the crude product of 6c. Reaction scale: 7.81 mmol of imine 5c. Isolation by column chromatography (EtOAc/PE, 1:2). Recrystallization from Et2O or DCM. Compound 7c was first described by Ye, He and Zhang [29], as well as Burke, Cogan, Gao, Heim-Riether, Eugene, Ramsden, Thompson and Xiong [49].

Colourless crystalline solid, yield: 1.03 g, 4.14 mmol, 53% (over two steps, referred to imine 5c). $\text{dr} = 97:3$. $^1\text{H NMR}$ (300 MHz, Chloroform-$d$): $\delta = 4.03$ (m, 1 H, $C^a\text{H}$), 3.26 (d, $^3J = 7.5$ Hz, 1 H, NH), 2.41 (d, $^4J = 2.3$ Hz, 1H, $C^a\text{C}=\text{CH}$), 1.86 (m, 1H, (CH$_3$)$_2$CH), 1.59 (t, $^3J = 7.4$ Hz, 2H, $C^a\text{CH}_2$), 1.21 (s, 9 H, SC(CH$_3$)$_3$), 0.93 (d, $^3J = 6.6$ Hz, 3H, CHCH$_3$), 0.93 (d, $^3J = 6.6$ Hz, 3H, CHCH$_3$). $^{13}\text{C NMR}$ (125 MHz, Chloroform-$d$): $\delta = 84.2$ (C$^a\text{C}=\text{CH}$), 73.1 (C$^a\text{C}=\text{CH}$), 56.4 (C(CH$_3$)$_3$), 46.4 (C$_a$), 46.2 (CH$_2$), 24.9 (HC(CH$_3$)$_2$), 22.7 (C(CH$_3$)$_3$), 22.6 ((CH$_3$)CHCH$_3$), 22.2 ((CH$_3$)CHCH$_3$). C$_{11}$H$_{21}$NOS (215.36 g mol$^{-1}$). MS(ESI): $m/z = 453.25884$ (453.25799 [2M+Na]$^+$). $[\alpha]^{26}_{D89} = 26.1$ (c = 1.94; CHCl$_3$). TLC: R$_f$ (PE/EtOAc, 2:1) = 0.27. EA: C (60.703%), H (9.790%), N (6.574%), S (14.195%).

(S)-N-((S)-1-Cyclohexylprop-2-yn-1-yl)-tert-butylsulfinamide (7d)

Synthesis: GP-5, starting material was the crude product of 6d. Reaction scale: 11.1 mmol of imine 5d. Purification by column chromatography (EtOAc/PE, 1:2). Recrystallization from EtOAc/PE (1:4). Compound 7d has been first described by Jordan, Starks, Whatley and Turlington [50].

Colourless, crystalline solid, yield: 1.741 g, 7.212 mmol, 65% (59% over two steps, referred to imine 5d). $\text{dr} = 97:3$. $^1\text{H NMR}$ (500 MHz, Chloroform-$d$) $\delta = 3.85$ (ddd, $^3J = 7.7$ Hz, $^3J = 5.7$ Hz, $^4J = 2.3$ Hz, 1H, $C^a\text{H}$), 3.28 (d, $^3J = 7.5$ Hz, 1H, NH), 2.41 (d, $^4J = 2.3$ Hz, 1H, C$^a\text{C}=\text{CH}$), 1.82 (d, $^2J = 12.2$ Hz, 2H, cy-2-H, cy-6-H), 1.77 (d, $^2J = 11.6$ Hz, 2H, cy-3-H, cy-5-H), 1.67 (d, $^2J = 11.9$ Hz, 2H, cy-4-H), 1.59 (ddd, $^2J = 11.5$ Hz, $^3J = 6.0$ Hz, $^4J = 3.2$ Hz, 1H, cy-1-H), 1.29-1.23 (m, 2H, cy-5-H, cy-3-H), 1.22 (s, 9H, C(CH$_3$)$_3$), 1.15 (ddd, $^2J = 15.8$ Hz, $^3J = 7.9$ Hz, $^3J = 3.9$ Hz, 1H, cy-6-H), 1.09 (dd, $^2J = 12.2$ Hz, $^3J = 3.4$ Hz, 1H, cy-2-H). $^{13}\text{C NMR}$ (126 MHz, Chloroform-$d$) $\delta = 82.9$ (C$^a\text{C}=\text{CH}$), 73.9 (C$^a\text{C}=\text{CH}$), 56.5
(C(CH₃)₃), 53.1 (Cα), 43.2 (cy-C-1), 29.4 (cy-C-3), 28.3 (cy-C-5), 26.4 (cy-C-6), 26.1 (cy-C-2), 26.0 (cy-C-4), 22.8 (C(CH₃)₃). C₁₃H₂₃NOS (241.39 g mol⁻¹). MS(ESI): m/z = 264.1 (264.14 [M+Na⁺]). IR(ATR): ̃ν [cm⁻¹] = 3217 (NH), 2848 (CH), 1445 (SO), 1059 (SC), 897, 674. Smp. = 59 °C. [α]₂⁰°° = 32.9 (c = 0.82; CHCl₃).

(S)-N-((S)-4,4-Dimethylpent-1-yn-3-yl)-tert-butylsulfinamide (7e)

Synthesis: GP-5, starting material was the crude product of 6e. Reaction scale: 2.98 mmol of imine 5e. The crude product was purified by column chromatography (PE/EtOAc, 2:1) and recrystallization from EtOAc. Compound 7e has been first described by Burke, Cogan, Gao, Heim-Riether, Hickey, Ramsden, Thompson and Xiong [49].

Colourless crystals, yield: 577 mg, 2.68 mmol, 90 % (41 % over two steps, referred to imine 5e), dr = 80:20. ¹H NMR (500 MHz, Chloroform-d) δ = 3.66 (dd, ³J = 9.3 Hz, ⁴J = 1.7 Hz, 1H, CαH), 3.24 (d, ³J = 9.3 Hz, 1H, NH), 2.44 (d, ⁴J = 2.0 Hz, 1H, CαC=CH), 1.24 (s, 9H, SC(CH₃)₃), 1.00 (s, 9H, CαC(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 83.0 (CαC=CH), 74.2 (CαC=CH), 58.4 (CαC(CH₃)₃), 56.9 (SC(CH₃)₃), 36.2 (Cα), 26.1 (CαC(CH₃)₃), 22.9 (SC(CH₃)₃). C₁₁H₂₁NOS (215.36 g mol⁻¹). MS(ESI): m/z = 216.1434 (216.1422 [M+H⁺]). TLC: Rf(EtOAc/PE, 1:4) = 0.08.

(S)-N-((S)-1-((3S,5S,7S)-Adamantane-1-yl)prop-2-yn-1-yl)-tert-butylsulfinamide (7f)

Synthesis: GP-5, starting material was the crude product of 6f. Reaction scale: 853 µmol of imine 5f. Purification by column chromatography (PE/EtOAc, 1:1) and recrystallization from n-hexane/Et₂O (1:1). The formation of the undesired diastereomer could not be observed in this case (checked by NMR spectroscopy of the crude product).

Colourless, crystalline solid, yield: 37.6 mg, 128 µmol, 15 % (over 2 steps, referred to imine 5f), dr = 100:0. ¹H NMR (500 MHz, Chloroform-d) δ = 3.51 (dd, ³J = 9.3, ⁴J = 2.2 Hz, 1H,
C\textsuperscript{6}H), 3.21 (d, $^3J = 9.3$ Hz, 1H, C\textsuperscript{6}NH), 2.43 (d, $^4J = 2.3$ Hz, 1H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}}), 2.01 (s, 3H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}}}), 1.71 (d, $^2J = 12.2$ Hz, 3H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}}}), 1.66 (d, $^2J = 12.4$ Hz, 3H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}}}), 1.61 (d, $^2J = 12.0$ Hz, 3H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}}}), 1.55 (d, $^2J = 11.8$ Hz, 3H, C\textsuperscript{6}C\textsuperscript{CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}}}), 1.23 (s, 9H, SC(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{13}C NMR (126 MHz, Chloroform-d) δ = 82.1 (C\textsuperscript{6}C=CH), 74.6 (C\textsuperscript{6}C=CH), 58.6 (C\textsuperscript{6}), 57.0 (SC(CH\textsubscript{3})\textsubscript{3}), 38.6 (C\textsuperscript{6}C(CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}})), 37.6 (C\textsuperscript{6}C(CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}})), 37.0 (C\textsuperscript{6}C(CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}})), 28.4 (C\textsuperscript{6}C(CH\textsubscript{2}CH\textsubscript{2}C\textsubscript{CH\textsubscript{2}CH\textsubscript{2}})), 22.9 (C(CH\textsubscript{3})\textsubscript{3}). C\textsubscript{17}H\textsubscript{27}NOS (293.47 g mol\textsuperscript{-1}), MS(ESI): m/z = 294.1886 (294.1886 [M+H]\textsuperscript{+}). TLC: R\textsubscript{f} (EtOAc/PE, 1:1) = 0.32. [α]\textsubscript{D}\textsuperscript{22} = 3.45 (c = 1.89; CHCl\textsubscript{3}).

(R)-N-((R)-5-(Methylthio)pent-1-yn-3-yl)-\textit{tert}-butylsulfinamide (7g)

Synthesis: GP-6, starting material was the crude product of 6g. Reaction scale: 12.6 mmol of imine 5g. Both stereocenters are (R)-configured. Purification by column chromatography (EtOAc/PE, 1:2).

Highly viscous, colourless oil, yield: 999 mg, 4.284 mmol, 34 % (over two steps, referred to imine 5g) d.r = 96:4. \textsuperscript{1}H NMR (500 MHz, Chloroform-d) δ = 4.23 (m, 1H, C\textsuperscript{6}H), 3.59 (d, $^3J = 7.2$ Hz, 1H, NH), 2.72- 2.62 (m, 2H, (CH\textsubscript{3})SCH\textsubscript{2}), 2.46 (d, $^4J = 2.3$ Hz, 1H, C\textsuperscript{6}C=CH), 2.11 (s, 3H, S(CH\textsubscript{3})\textsubscript{3}), 2.04 (dd, $^2J = 14.4$ Hz, $^3J = 3.0$ Hz, 2H, C\textsuperscript{6}CH\textsubscript{2}), 2.01 (dd, $^2J = 14.3$ Hz, $^3J = 3.2$ Hz, 2H, C\textsuperscript{6}CH\textsubscript{2}), 1.23 (s, 9H, SC(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{13}C NMR (126 MHz, Chloroform-d) δ = 83.1 (C\textsuperscript{6}C=CH), 73.7 (C\textsuperscript{6}C=CH), 56.4 (SC(CH\textsubscript{3})\textsubscript{3}), 46.6 (C\textsuperscript{6}), 35.9 (C\textsuperscript{6}H\textsubscript{CH\textsubscript{2}}), 30.0 ((CH\textsubscript{3})SC\textsubscript{2}), 22.6 (SC(CH\textsubscript{3})\textsubscript{3}), 15.5 (SCH\textsubscript{3}). C\textsubscript{10}H\textsubscript{19}NOS\textsubscript{2} (233.39 g mol\textsuperscript{-1}). MS(ESI): m/z = 256.0798 (256.0800 [M+Na]\textsuperscript{+}). IR(ATR): $\tilde{\nu}$[cm\textsuperscript{-1}] = 3208 (NH), 2958 (CH), 2917 (CH), 2863 (CH), 1736 (SO), 1648 (CSC), 1546 (SC), 1477, 1454, 1432, 1363, 1315, 1264, 1223, 1176, 1059, 936, 669, 647. [α]\textsubscript{D}\textsuperscript{22} = -58.48 (c = 0.46; CHCl\textsubscript{3}). TLC: R\textsubscript{f} (PE/EtOAc, 2:1) = 0.14.

(S)-N-[(S)-1-Phenylbut-3-yn-2-yl]-\textit{tert}-butylsulfinamide (7h)

Synthesis: GP-5, starting material was the crude product of 6h. Reaction scale: 1.52 mmol of imine 5h. Purification by column chromatography (PE/EtOAc, 2:1). Compound 7h was first described by Burke, Cogan, Gao, Heim-Riether, Hickey, Ramsden, Thompson, Xiong [49].
Yellow oil, yield: 249 mg, 1.00 mmol, 35% (when the crude material of 6h was used in this conversion, the yield was decreased to 234 mg, 938 μmol, 15% over two steps, ref. to imine 5h). $dr = 97:3$. $^1$H NMR (500 MHz, Chloroform-$d$): $\delta = 7.33-7.29$ (m, 2H, ar-2-H, ar-6-H), 7.27-7.25 (m, 3H, ar-3-H, ar-4-H, ar-5-H), 4.27 (m, 1H, C\(^{5}\)H), 3.36 (d, $^3J = 7.2$ Hz, 1H, NH), 3.07-3.00 (m, 2H, C\(^{6}\)CH\(_2\)), 2.45 (d, $^4J = 2.3$ Hz, 1H, C≡CH), 1.14 (s, 9H, SC(CH\(_3\))\(_3\)). $^{13}$C NMR (125 MHz, Chloroform-$d$): $\delta = 136.4$ (ar-C-1), 130.0 (ar-C-3, ar-C-5), 128.5 (ar-C-2, ar-C-6), 127.2 (ar-C-4), 83.2 (C\(^{a}\)C=CH), 74.3 (C\(^{a}\)C=CH), 56.5 (SC(CH\(_3\))\(_3\)), 49.0 (C\(^{b}\)), 43.3 (C\(^{a}\)CH\(_2\)), 22.6 (SC(CH\(_3\))\(_3\)). C\(_{14}H_{19}NOS (249.37$ g mol$^{-1}$). MS(ESI): $m/z = 250.0$ (250.13 [M+H]$^+$). TLC: $R_f$ (PE/EtOAc, 2:1) = 0.14. [$\alpha$]_{D}^{20} = 18.6 (c = 1.0; CHCl\(_3\)).

(S)-N-((R)-1-Phenylprop-2-yn-1-yl)-tert-buty1sulfinamide (7i)

Synthesis: GP-7, starting material was the crude product of 6i. Reaction scale: 8.30 mmol of imine 5i. Purification by column chromatography (PE/EtOAc, 2:1). Recrystallization from Et\(_2\)O. Compound 7i has been first described by Verrier, Carret, Poisson [51] and Jordan, Starks, Whatley, Turlington [50].

Yellow solid, yield: 1.29 g, 5.48 mmol, 66% (36% over two steps, referred to imine 5i), $dr = 95:5$. $^1$H NMR (500 MHz, Chloroform-$d$): $\delta$ [ppm] = 7.52-7.50 (m, 2H, ar-2-H, ar-6-H), 7.38-7.33 (m, 3H, ar-3-H, ar-4-H, ar-5-H), 5.22 (dd, $^3J = 6.5$ Hz, $^4J = 2.4$ Hz, 1H, C\(^{a}\)H), 3.75 (d, $^3J = 6.4$ Hz, 1H, NH), 2.64 (d, $^4J = 2.4$ Hz, 1H, C≡CH), 1.21 (s, 9H, S(C(CH\(_3\))\(_3\)). $^{13}$C NMR (125 MHz, Chloroform-$d$): $\delta$ [ppm] = 138.5 (ar-C-1), 128.8 (ar-C-2, ar-C-6), 128.6 (ar-C-3, ar-C-5), 127.8 (ar-C-4), 82.6 (HC=CC\(^{a}\)), 75.1 (HC=CC\(^{a}\)), 56.5 (SC(CH\(_3\))\(_3\)), 50.8 (NHC\(^{a}\)), 22.7 (SC(CH\(_3\))\(_3\)). C\(_{13}H_{17}NOS (235.35$ g mol$^{-1}$). MS(ESI): $m/z = 493.19639$ (493.19539 [2M+Na]$^+$). TLC: $R_f$ (PE/EtOAc, 2:1) = 0.19. [$\alpha$]_{D}^{20} = 17.4 (c = 0.5; CHCl\(_3\)).

(S)-N-((R)-1-(Pentafluorophenyl)prop-2-yn-1-yl)-tert-buty1sulfinamide (7j)

Synthesis: GP-6, starting material was the crude product of 6j. Reaction scale: 3.12 mmol of imine 5j. Purification by column chromatography (PE/EtOAc, 2:1). Recrystallization from EtOAc/PE, 1:8.

Colourless crystals, yield: 0.53 g, 1.62 mmol, 52% (21% over two steps,
referred to imine 5j). $\delta r = 100:0$. $^1$H NMR (600 MHz, Chloroform-$d$) $\delta = 5.55$ (d, $^3J_{HH} = 5.3$ Hz, 1H, C$^a$(H)), 4.01 (d, $^3J_{HH} = 5.4$ Hz, 1H, C$^a$(NH)), 2.56 (d, $^3J_{HH} = 2.5$ Hz, 1H, C=CH), 1.13 (s, 9H, SC(CH$_3$)$_3$). $^19$F NMR (565 MHz, Chloroform-$d$) $\delta = -142.0$ (td, $^4J_{FF} = 21.3$ Hz, $^4J_{HF} = 7.7$ Hz, 2F, ar-3-F, ar-5-F), -153.3 (t, $^3J_{FF} = 18.9$ Hz, 1F, ar-4-F), -161.0 (t, $^3J_{FF} = 7.3$ Hz, 2F, ar-2-F, ar-6-F). $^{13}$C NMR (151 MHz, Chloroform-$d$) $\delta = 144.7$ (ddt, $^1J_{CF} = 251.2$ Hz, $^2J_{CF} = 8.1$ Hz, $^3J_{CF} = 3.9$ Hz, ar-C-3, ar-C-5), 141.5 (d, $^1J_{CF} = 256.1$ Hz, ar-C-4), 137.7 (dt, $^1J_{CF} = 252$ Hz, $^2J_{CF} = 15.8$ Hz, ar-C-2, ar-C-6), 113.4 (td, $^2J_{CF} = 14.8$ Hz, $^3J_{CF} = 3.6$ Hz, ar-C-1), 79.2 (C$^a$(C=CH)), 74.5 (C$^a$(C=CH)), 56.7 (C(CH$_3$)$_3$), 40.9 (C$^a$), 22.3 (C(CH$_3$)$_3$). C$_{13}$H$_{12}$F$_3$NOS (325.28 g mol$^{-1}$). MS(ESI): $m/z = 348.0470$ (348.0457 [M+Na$^+$]). $[\alpha]_{	ext{D}}^{23} = 38.8$ (c = 0.53; CHCl$_3$). TLC: $R_f$(PE/EtOAc, 2:1) = 0.32. IR(ATR): $\tilde{\nu}$ [cm$^{-1}$] = 3306 (NH), 3208 (≡C-H), 2958 (−CH$_3$), 2356-2331 (−C≡C−), 1524-1498 (ar, C=C), 1074 (S=O).

(S)-N-((R)-1,1,1-Trifluorobut-3-yn-2-yl)-tert-butyxulfimamide (7k)

Synthesis: GP-6, starting material was the crude product of 6k. Reaction scale: 7.21 mmol of imine 5k. The crude product was washed with pentane and then either purified by column chromatography (EtOAc/PE, 1:2 to 1:1) or by recrystallization from DCM/n-hexane (1:1).

Colourless crystals, yield: 474.6 mg, 2.088 mmol, 29 %. (25 % over two steps, referred to sulfinamide (S)-1) $dr = 93:7$. $^1$H NMR (600 MHz, Chloroform-$d$) $\delta = 4.55$ (dqd, $^3J_{HH} = 7.7$ Hz, $^3J_{HF} = 6.3$ Hz, $^4J_{HH} = 2.5$ Hz, 1H, C$^a$(H)), 3.68 (d, $^3J_{HH} = 8.0$ Hz, 1H, C$^a$(NH)), 2.62 (d, $^4J_{HH} = 2.5$ Hz, 1H, C$^a$(C=CH)), 1.26 (s, 9H, C(CH$_3$)$_3$). $^19$F NMR (565 MHz, Chloroform-$d$) $\delta = -76.51$ (d, $^3J_{HF} = 6.2$ Hz, CF$_3$). $^{13}$C NMR (75 MHz, Chloroform-$d$) $\delta = 122.9$ (q, $^1J_{CF} = 281.2$ Hz, CF$_3$), 78.0 (C=CH), 73.7 (q, $^3J_{CF} = 2.3$ Hz, C≡CH), 57.0 (C(CH$_3$)$_3$), 49.6 (q, $^2J_{CF} = 35.0$ Hz, C$^a$), 22.4 (C(CH$_3$)$_3$). C$_9$H$_{12}$F$_3$NOS (227.25 g mol$^{-1}$). MS(ESI): $m/z = 250.0493$ (250.0484 [M+Na$^+$]). TLC: $R_f$(EtOAc/PE, 2:7) = 0.27. Smp = 83.7 °C. $[\alpha]_{	ext{D}}^{23} = 52.1$ (c = 0.97; DCM).

When GP-5 was applied, a far lower yield of propargylamine 7k was achieved: 24.2 mg, 0.11 mmol, 10 %. When the crude product of 6k was not purified, but instantly converted by GP-6, the total yield of the whole synthesis could be increased to 1.197 g, 5.267 mmol, 25 % (referred to the chiral sulfinamide (S)-1, 3 steps).
(S)-N-((R)-1,1,1-Trichlorobut-3-yn-2-yl)-tert-butylsulfinamide (7l)

Synthesis: GP-6, starting material was the crude product of 6l. Reaction scale: 149 µmol of imine 5l. Reaction was monitored by TLC. Purification by column chromatography (PE/EtOAc, 2:1).

Colourless crystals, yield: 23.5 mg, 85 µmol, 57 % (6 % over two steps, referred to imine 5l). dr = 100:0. $^1$H NMR (500 MHz, Chloroform-d) δ = 4.71 (dd, $^3$J = 8.6 Hz, $^4$J = 2.3 Hz, 1H, C$^a$H), 4.05 (d, $^3$J = 8.7 Hz, 1H, NH), 2.72 (d, $^4$J = 2.3 Hz, 1H, C=CH), 1.29 (s, 9H, SC(CH$_3$)$_3$). $^{13}$C NMR (126 MHz, Chloroform-d) δ = 100.6 (CCl$_3$), 77.9 (C$^b$C=CH), 77.4 (C$^c$C=CH), 65.0 (C$^a$), 58.0 (C(CH$_3$)$_3$), 22.8 (C(CH$_3$)$_3$). C$_8$H$_{12}$Cl$_3$NOS (276.60 g mol$^{-1}$). MS(ESI): m/z = 275.9771 (275.9778 [M+H]$^+$). TLC: R$_f$(EtOAc/PE, 1:2) = 0.27. [α]$_{589}^2$ = 15.0 (c = 0.59; CHCl$_3$). IR(ATR): $\tilde{\nu}$ [cm$^{-1}$] = 3281 (NH), 3196 (CH), 3196 (C=H), 2360 (-C=C-), 1068 (S=O), 869, 802, 685.

(R)-N-((S)-1-(Benzyloxy)but-3-yn-2-yl)-tert-butylsulfinamide (7n)

Synthesis: GP-5, starting material was the crude product of 6n. Reaction scale: 197 µmol of imine 5n. Purification by column chromatography (EtOAc/PE, 1:4).

Yellow oil, yield: 17 mg, 61 µmol, 31 % (over two steps, referred to imine 5n), dr = 95:5. $^1$H NMR (500 MHz, Chloroform-d) δ = 7.36-7.27 (m, 5H, ar-H), 4.64 (d, $^2$J = 12.0 Hz, 1H, C$^a$CH$_2$), 4.57 (d, $^2$J = 12.1 Hz, 1H, C$^b$CH$_2$), 4.24 (m, 1H, C$^c$), 3.75 (d, $^3$J = 6.4 Hz, 1H, C$^d$NH), 3.65 (dd, $^3$J = 5.6 Hz, $^4$J = 1.3 Hz, 2H, PhCH$_2$), 2.45 (d, $^4$J = 2.4 Hz, 1H, C=CH), 1.21 (s, 9H, C(CH$_3$)$_3$). $^{13}$C NMR (126 MHz, Chloroform-d) δ = 137.7 (ar-C-1), 128.6 (ar-C-3, ar-C-5), 128.0 (ar-C-4), 127.9 (ar-C-2, ar-C-6), 81.1 (C$^b$C=CH), 74.2 (C$^c$C=CH), 73.5 (C$^d$CH$_2$), 73.2 (PhCH$_2$), 56.5 (SC(CH$_3$)$_3$), 47.5 (C$^a$), 22.7 (SC(CH$_3$)$_3$). C$_{15}$H$_{21}$NO$_2$S (279.40 g mol$^{-1}$). TLC: R$_f$(EtOAc/PE, 1:4) = 0.13.
(S)-N-((R)-1-(Allyloxy)but-3-yn-2-yl)-tert-butylsulfinamide (7o)

Synthesis: GP-5, starting material was the crude product of 6o. Reaction scale: 1.58 mmol of imine 5o. Purification by column chromatography (PE/EtOAC, 2:1 or DCM/MeOH, 98:2).

Yellow oil, yield: 149 mg, 490 μmol, 31 % (over two steps, referred to imine 5o). δr = 93:7. 1H NMR (500 MHz, Chloroform-d): δ = 5.86 (m, 1H, CH=CH2), 5.27 (dddd, 2J = 1.4 Hz, 4J = 1.5 Hz, 3J = 1.5 Hz, 5J = 12.7 Hz, 1H, C≡CCH2), 5.16 (dddd, 2J = 1.4 Hz, 4J = 1.4 Hz, 3J = 1.5 Hz, 5J = 10.4 Hz, 1H, C≡CCH2), 4.18 (m, 1H, NHC≡H), 4.04 (m, 2H, CH2-CH=), 3.72 (d, 3J = 6.4 Hz, 1H, NH), 3.58-3.57 (m, 2H, HC≡CH2), 2.42 (d, 4J = 2.4 Hz, 1H, C≡CH), 1.20 (s, 9H, SC(CH3)3). 13C NMR (125 MHz, Chloroform-d): δ = 134.2 (CH=CH2), 117.6 (CH=CH2), 81.0 (HC≡CC≡), 74.1 (HC≡CC≡), 73.1 (C≡CH2), 72.3 (OCH2CH=), 56.4 (SC(CH3)3), 47.4 (C≡), 22.6 (SC(CH3)3). C11H19NO2S (229.34 g mol⁻¹). MS(ESI): m/z = 252.0 (252.33 [M+Na]+). [α]D²⁰ = 36.3 (c = 0.99; CHCl3). TLC: Rf (DCM/MeOH, 50:1) = 0.17.

(R)-N-((S)-1-(Benzythio)but-3-yn-2-yl)-tert-butylsulfinamide (7p)

Synthesis: GP-5, starting material was the crude product of 6p. Reaction scale: 4.45 mmol of imine 5p. Purification by preparative HPLC.

Brown oil, yield: 57.2 mg, 194 μmol, 4 % (over two steps, referred to imine 5p). δr = 93:7. 1H NMR (300 MHz, Chloroform-d) δ = 7.39-7.22 (m, 5H, arCH), 4.13 (m, 1H, C≡H), 3.84 (s, 2H, SCH2Ph), 3.81-3.77 (m, 1H, NH), 2.82 (dd, 2J = 13.9 Hz, 4J = 6.3 Hz, 1H, C≡CH2), 2.74 (dd, 3J = 13.8 Hz, 5J = 6.2 Hz, 1H, C≡CH2), 2.50 (d, 4J = 2.3 Hz, 1H, C≡C≡CH), 1.22 (s, 9H, SC(CH3)3). 13C NMR (151 MHz, Chloroform-d) δ = 137.9 (ar-C-1), 129.1 (ar-C-2, ar-C-6), 128.7 (ar-C-3, ar-C-5), 127.3 (ar-C-4), 82.7 (C≡C≡), 74.1 (C≡C≡), 56.6 (SC(CH3)3), 47.3 (C≡), 38.3 (C≡CH2), 36.9 (SCH2Ph), 22.6 (SC(CH3)3). C13H21NOS2 (295.46 g mol⁻¹), MS(ESI): m/z = 317.98 (318.10 [M+Na]+). [α]D²⁰ = -56.1 (c = 0.19; CHCl3). IR(ATR): v [cm⁻¹] = 3218 (NH), 2958 (CH), 2335 (C≡C).
(S)-N-((S)-6-Cyanohex-1-yn-3-yl)-tert-butylsulfinamide (7q)

Synthesis: GP-6, starting material was the crude product of 6q. Reaction scale: 3.53 mmol of imine 5q. Purification by column chromatography (EtOAc/PE, 1:2).

Yellow crystals, yield: 0.344 g, 1.52 mmol, 43 % (30 % over two steps, referred to imine 5q). dr = 95:5. 1H NMR (500 MHz, Chloroform-d): δ = 4.11 (m, 1H, CαH), 3.36 (d, J = 6.1 Hz, 1H, NH), 2.46 (d, J = 2.3 Hz, 1H, C≡CH), 2.42 (t, J = 6.4 Hz, 2H, CH2CN), 1.83-1.95 (m, 4H, CHNCH2CH2), 1.23 (s, 9H, C(CH3)3). 13C NMR (126 MHz, Chloroform-d): δ = 77.1 (HC≡C), 74.2 (HC≡CH), 56.5 (C(CH3)3), 46.7 (CαH), 35.5 (CHNCH2CH2), 22.7 (C(CH3)3), 21.6 (CHNCH2CH2), 17.1 (CH2CN). C11H18N2OS (226.34 g mol⁻¹). MS(ESI): m/z = 249.1026 (249.1032 [M+Na]+). TLC: Rf (EtOAc/PE, 1:2) = 0.33. [α]20°S99 = 63.4 (c = 0.84; CHCl3). IR(ATR): δ [cm⁻¹] = 3250 (NH), 2955 (CH), 2930 (CH), 2867 (CH), 2360 (C=C), 2235 (C≡C), 1458 (CN), 1423, 1363, 1182, 1059, 878, 647.

tert-Butyl-(S)-4-(((S)-tert-butylsulfinyl)amino)hex-5-ynoate (7s)

Synthesis: GP-6, starting material was the crude product of 6s. Reaction scale: 4.04 mmol of imine 5s. Purification by column chromatography (EtOAc/PE, 1:1).

Colourless crystals, yield: 0.54 g, 1.9 mmol, 47 % (25 % over two steps, referred to imine 5s). dr = 93:7. 1H NMR (500 MHz, Chloroform-d) δ = 4.06 (qd, J = 6.9 Hz, J = 2.2 Hz, 1H, CαH), 3.47 (d, J = 7.0 Hz, 1H, NH), 2.40 (d, J = 2.4 Hz, 1H, CαC≡CH), 2.40- 2.30 (m, 2H, CO2CH2), 2.04-1.87 (m, 2H, CαCH2), 1.39 (s, 9H, CO2C(CH3)3), 1.17 (s, 9H, SC(CH3)3). 13C NMR (126 MHz, Chloroform-d) δ = 172.1 (CO2), 83.0 (CO2C≡CH), 80.7 (CO2C(CH3)3), 73.7 (CαC≡CH), 56.3 (SC(CH3)3), 46.8 (Cα), 31.9 (CαCH2), 31.4 (CO2CH2), 28.1 (CO2C(CH3)3), 22.6 (SC(CH3)3). C14H25NO3S (287.42 g mol⁻¹), MS(ESI): m/z = 288.1635 (288.16279 [M+H]+). [α]22°S99 = 0.16 (c = 0.16; CHCl3) = 33.27°. TLC: Rf (PE/EtOAc, 1:1) = 0.46.
(S)-N-((S)-6-Hydroxyhex-1-yn-3-yl)-tert-butyldisulfonamide (7t)

Synthesis: GP-5, starting material was the crude product of 6t. Reaction scale: 3.67 mmol of imine 5t. 6 eq of TBAF were used. Reaction was carried out for 2 h at 0 °C. Purification by column chromatography (EtOAc). Compound 7t has already been described by Bauer, DiBlasi and Tan [45]. X-ray crystal structure analysis has been performed before by Hou et al. [14].

Colourless crystals, yield: 215.1 mg, 989.7 μmol, 27 % (over two steps, referred to aldimine 5t). \( d_r = 93.7. \) \( ^1H \) NMR (500 MHz, Chloroform-d) \( \delta = 3.99 (m, 1H, C^\text{N}H), 3.80 (d, \ ^2J = 6.8 Hz, 1H, C^\text{N}H), 3.56 (t, \ ^3J = 6.2 Hz, 2H, CH_2OH), 3.37 (s, 1H, OH), 2.39 (d, \ ^4J = 2.3 Hz, 1H, C≡CH), 1.80 (ddt, \ ^2J = 12.9 Hz, \ ^3J = 8.9 Hz, \ ^3J = 6.4 Hz, 1H, C^\text{CH}_2 H), 1.77-1.68 (m, 1H, C^\text{CH}_2 H), 1.64 (td, \ ^2J = 9.2 Hz, \ ^3J = 8.6 Hz, \ ^3J = 4.1 Hz, 2H, C^\text{CH}_2 CH_2 H), 1.14 (s, 9H, SC(CH_3)_3). \( ^{13}C \) NMR (126 MHz, Chloroform-d) \( \delta = 83.6 (C^\text{C}═CH), 73.2 (C^\text{C}═CH), 61.6 (CH_2OH), 56.3 (C(CH_3)_3), 47.3 (C^\text{C}), 33.5 (C^\text{CH}_2 H), 28.6 (C^\text{CH}_2 CH_2 H), 22.6 (SC(CH_3)_3). \)

C_{10}H_{19}NO_2 S (217.33 g mol\(^{-1}\)). MS(ESI): \( m/z = 218.1213 (218.1209 [\text{M+H}]^+). \) TLC: \( R_f (\text{EtOAc}) = 0.15. [\alpha]_D^{\text{289}} = 34.8 (c = 1.0; CHCl_3). \) IR( ATR): \( \tilde{\nu} [\text{cm}^{-1}] = 3360 (\text{OH}), 3262 (\text{NH}), 3132 (\text{CH}_3), 2948 (\text{CH}_2), 2898 (\text{CH}_2), 1027 (\text{SO}). \)

(S)-N-((S)-7-Azidohept-1-yn-3-yl)-tert-butyldisulfonamide (7vx)

Synthesis: GP-5, starting material was the crude product of 6v. Reaction scale: 1.16 mmol of imine 5v. Purification by column chromatography (PE/EtOAc, 2:1). Compound 7vx has been first described by Ye, He and Zhang [29].

Yellow oil, yield: 170 mg, 0.67 mmol, 58 % (over two steps, referred to imine 5v). \( d_r = 74:26. \) \( ^1H \) NMR (500 MHz, Chloroform-d) \( \delta = 4.00 (m, 1H, C^\text{N}H), 3.42 (d, \ ^2J = 6.7 Hz, 1H, NH), 3.26 (t, \ ^3J = 6.6 Hz, 2H, N_3 CH_2 H), 2.41 (d, \ ^4J = 2.4 Hz, 1H, C≡CH), 1.72 (ddd, \ ^2J = 15.0 Hz, \ ^3J = 8.1 Hz, \ ^3J = 6.2 Hz, 2H, C^\text{CH}_2 H), 1.63-1.57 (m, 2H, N_3 CH_2 CH_2 H), 1.56-1.48 (m, 2H, C^\text{CH}_2 CH_2 H), 1.19 (s, 9H, C(CH_3)_3). \( ^{13}C \) NMR (126 MHz, Chloroform-d) \( \delta = 83.4 (C^\text{C}═CH), 73.4 (C^\text{C}═CH), 56.7 (C(CH_3)_3), 51.2 (N_3 CH_2 H), 47.3 (C^\text{C}), 36.2 (C^\text{CH}_2 CH_2 H), 28.4 (C^\text{CH}_2 H), 22.7 (N_3 CH_2 CH_2 H), 22.6 (C(CH_3)_3). \) C_{11}H_{20}N_4 OS (256.37 g mol\(^{-1}\)), MS(ESI): \( m/z = 279.15 (279.13 [\text{M+Na}]^+). \) TLC: \( R_f (\text{EtOAc/PE}, 1:2) = 0.25. \)
(S)-N-((S)-7-Aminohept-1-yn-3-yl)-tert-butylsulfinamide (7vy)

Synthesis: GP-4mod, (compare conversion of 5w to 7wy), starting material was the crude product of 6v. Reaction scale: 5.24 mmol of imine 5v.

Faintly yellow oil, yield: 0.82 g, 3.559 mmol, 68 %. dr = 91:9. \(^1\)H NMR (500 MHz, Chloroform-d) \(\delta = 3.98\) (m, 1H, C\(^\alpha\)H), 3.48 (d, \(^3\)J = 6.7 Hz, 1H, NH), 2.67 (t, \(^3\)J = 6.5 Hz, 2H, H\_2NCH\_2), 2.39 (d, \(^2\)J = 2.3 Hz, 1H, C=CH), 1.94-1.87 (m, 2H, NH\_2), 1.77-1.64 (m, 2H, C\(^\alpha\)CH\_2), 1.50-1.40 (m, 4H, C\(^\beta\)CH\_2CH\_2CH\_2), 1.18 (s, 9H, C(CH\_3)_3). \(^13\)C NMR (126 MHz, Chloroform-d) \(\delta = 83.8\) (C\(^\alpha\)C=CH), 73.1 (C\(^\beta\)C=CH), 56.2 (C(CH\_3)_3), 47.5 (C\(^\beta\)), 41.9 (H\_2NCH\_2), 36.6 (C\(^\gamma\)CH\_2), 33.0 (C\(^\delta\)CH\_2CH\_2), 22.8 (H\_2NCH\_2CH\_2), 22.6 (C(CH\_3)_3).

C\(_{11}\)H\(_{22}\)N\(_2\)OS (230.37 g mol\(^{-1}\)). MS(ESI): \(m/z = 253.1352\) (253.1345 [M+Na]). \([\alpha] \sub{D}{89}^2 = 9.3\) (c = 2.5; CH\(_2\)Cl). TLC: R\(_f\) (DCM/MeOH/NEt\(_3\), 88:10:2) = 0.18. IR(ATR): \(\delta\) [cm\(^{-1}\)] = 3297 (NH), 2927 (NH\_2), 2863 (CH), 1695, 1521, 1458, 1366, 1253, 1169, 1052, 669.

tert-Butyl ((S)-5-(((S)-tert-Butylsulfinyl)amino)hept-6-yn-1-yl)carbamate (7vz)

The Boc protection of propargylamine 7vy was carried out as suggested by Basel and Hassner [52]: Propargylamine 7vy (820 mg, 3.56 mmol, 1 equiv) was dissolved in a mixture of THF/H\(_2\)O (1:1, 12 mL). Boc\(_2\)O (1.55 g, 7.12 mmol, 2 equiv) and NaHCO\(_3\) (900 mg, 10.7 mmol, 3 equiv) was added in one portion. The colourless suspension was stirred at rt overnight. When all starting material was consumed (monitored by TLC), imidazole (730 mg, 10.7 mmol, 3 equiv) was added and the reaction mixture was stirred for another 4 h at rt. The solution was concentrated under vacuum and then diluted with EtOAc (35 mL). The phases were separated and the organic layer was washed with aqueous HCl (0.1 M, 3 × approximately 10 mL) until the aqueous layer was acidic. The organic layer was washed with brine (5 mL), dried over Na\(_2\)SO\(_4\) and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography (PE/EtOAc, 2:1). Compound 7vz has been first described by Ye, He and Zhang [29].

Faintly yellow oil, yield: 531 mg, 1.607 mmol, 45 %. \(^1\)H NMR (500 MHz, Chloroform-d) \(\delta = 4.56\) (s, 1H, NH\(_{\text{Boc}}\)), 4.02 (m, 1H, C\(^\gamma\)H), 3.35 (d, \(^3\)J = 6.6 Hz, 1H, NH), 3.12 (t, \(^3\)J = 6.6 Hz, 2H, NH\_CH\_2), 2.41 (d, \(^4\)J = 2.2 Hz, 1H, C\(^\alpha\)C=CH), 1.80-1.67 (m, 2H, C\(^\beta\)CH\_2CH\_2), 1.66-1.59
(m, 2H, C\textsuperscript{6}CH\textsubscript{2}CH\textsubscript{2}H\textsubscript{2}), 1.53-1.47 (m, 2H, C\textsuperscript{6}CH\textsubscript{2}), 1.44 (s, 9H, OC(CH\textsubscript{3})\textsubscript{3}), 1.22 (s, 9H, SC(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{1}H NMR (500 MHz, DMSO-\textit{d}_{6}) δ = 6.76 (t, \textit{J} = 5.8 Hz, 1H, NHBoc), 5.62 (d, \textit{J} = 7.9 Hz, 1H, C\textsuperscript{6}NH), 3.82 (q, \textit{J} = 7.2 Hz, 1H, C\textsuperscript{6}H), 3.26 (d, \textit{J} = 1.6 Hz, 1H, C\textsuperscript{6}C=CH), 2.89 (m, 2H, BocHNCH\textsubscript{2}), 1.63 (m, 2H, C\textsuperscript{6}CH\textsubscript{2}), 1.37 (s, 9H, CO\textsubscript{2}C(CH\textsubscript{3})\textsubscript{3}), 1.29-1.41 (m, 4H, C\textsuperscript{6}CH\textsubscript{2}CH\textsubscript{2}CH\textsubscript{2}), 1.12 (s, 9H, SC(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{13}C NMR (126 MHz, DMSO) δ = 155.5 (CO\textsubscript{2}), 85.2 (C≡CH), 77.3 (CO\textsubscript{2}C(CH\textsubscript{3})\textsubscript{3}), 74.3 (C\textsuperscript{5}C≡CH), 55.5 (SC(CH\textsubscript{3})\textsubscript{3}), 46.7 (C\textsuperscript{6}), 36.4 (BocHNCH\textsubscript{2}), 28.9 (C\textsuperscript{6}CH\textsubscript{2}), 28.3 (SC(CH\textsubscript{3})\textsubscript{3}), 22.7 (BocHNCH\textsubscript{2}CH\textsubscript{2}), 22.6 (CO\textsubscript{2}C(CH\textsubscript{3})\textsubscript{3}), 22.5 (C\textsuperscript{6}CH\textsubscript{2}CH\textsubscript{2}). C\textsubscript{16}H\textsubscript{30}N\textsubscript{2}O\textsubscript{5}S (330.49 g mol\textsuperscript{-1}). MS(ESI): 331.2045 (331.20499 [M+H]+). [\textgreek{a}]\textsubscript{D\textsuperscript{2}9} = 25.0 (c = 0.19; CHCl\textsubscript{3}). TLC: R\textsubscript{f}(PE/EtOAc, 2:1) = 0.37.

\textbf{(S)-N-[(S)-6-Azidohex-1-yn-3-yl]-\textit{tert}-butylsulfinamide 7wx}

\begin{center}
\includegraphics[width=0.2\textwidth]{figure1}
\end{center}

\textbf{Synthesis: GP-6, starting material was the crude product of 6w. Reaction scale: 11.53 mmol of imine 5w. The crude product was separated by column chromatography (elution with EtOAc/PE, 1:1). The ratio of propargylamine 7wx and triazole 13 was 1:4. Compound 7wx was observed to be instable. A solution of 7wx was investigated by \textsuperscript{1}H NMR spectroscopy. After one week, 66 \% of the alkyne had undergone an intramolecular Huisgen reaction and formed compound 14.}

Faintly yellow oil, yield: 0.531 g, 2.19 mmol, 19 \% (isolated yield), \textit{dr} = 96:4. \textsuperscript{1}H NMR (500 MHz, Chloroform-\textit{d}) δ = 4.09 (m, 1H, C\textsuperscript{6}H), 3.58 (t, \textit{J} = 6.3 Hz, 2H, N\textsubscript{3}CH\textsubscript{2}), 3.35 (d, \textit{J} = 6.5 Hz, 1H, NH), 2.44 (d, \textit{J} = 2.3 Hz, 1H, C\textsuperscript{6}C≡CH), 2.01-1.93 (m, 2H, C\textsuperscript{6}CH\textsubscript{2}), 1.93-1.84 (m, 2H, C\textsuperscript{6}CH\textsubscript{2}CH\textsubscript{2}), 1.23 (s, 9H, C(CH\textsubscript{3})\textsubscript{3}). \textsuperscript{13}C NMR (126 MHz, Chloroform-\textit{d}) δ = 83.2 (C\textsuperscript{6}C≡CH), 73.8 (C\textsuperscript{5}C≡CH), 56.4 (C(CH\textsubscript{3})\textsubscript{3}), 46.9 (C\textsuperscript{4}), 44.5 (H\textsubscript{2}NCH\textsubscript{2}), 34.1 (C\textsuperscript{6}HCH\textsubscript{2}), 28.6 (H\textsubscript{2}NCH\textsubscript{2}CH\textsubscript{2}), 22.7 (C(CH\textsubscript{3})\textsubscript{3}). C\textsubscript{16}H\textsubscript{18}N\textsubscript{3}O\textsubscript{5}S (242.34 g mol\textsuperscript{-1}). MS(ESI): \textit{m/z} = 265.1 (265.34 [M+Na]+). [\textgreek{a}]\textsubscript{D\textsuperscript{2}9} = 45.0 (c = 0.10; CHCl\textsubscript{3}). IR(ATR): \textnu [cm\textsuperscript{-1}] = 3287-3202 (NH), 2955 (CH\textsubscript{2}), 2369-2331 (N\textsubscript{3}), 1071 (SO).

\textbf{(S)-N-[(S)-6-Aminohex-1-yn-3-yl]-2-methylpropane-2-sulfinamide (7wy)}

\begin{center}
\includegraphics[width=0.2\textwidth]{figure2}
\end{center}

\textbf{Synthesis: n-Butyllithium (1.6 M in \textit{n}-hexane, 35.2 mL, 56.3 mmol, 1.2 equiv) was added dropwise to a solution of TMS-acetylene (7.9 mL,}
56.3 mmol, 1.2 equiv) in toluene (90 mL) at −78 °C. The clear solution was stirred for 2 h, before a solution of imine 5w (10.14 g, 46.9 mmol, 1 equiv) in toluene (90 mL) was dropped very slowly into the mixture. After full conversion (3–4 h, monitored by analytical HPLC), a solution of PPh₃ (49.2 g, 187 mmol, 4.0 equiv) in THF (150 mL) was added to the reaction mixture and the cooling bath was removed, so that the solution could warm up to rt. When no further evolution of gas could be observed (2 h later), water (150 mL) was added to the orange reaction mixture and stirring was continued vigorously for 10 h. Then, the phases were separated. The organic phase was washed with a solution of NaHCO₃ (5%, 50 mL). The combined aqueous layers were extracted with DCM (5 × 40 mL). The combined organic layers were dried over Na₂SO₄ and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography (DCM/MeOH/NEt₃, 88:10:2) to yield compound 7wy in pure form.

Yellow oil, yield: 7.330 g, 33.88 mmol, 86%, dr = 80:20. ¹H NMR (500 MHz, Chloroform-d) δ = 3.99 (dd, ²J = 5.9 Hz, ³J = 5.9 Hz, 1H, C=H), 2.70 (t, ⁴J = 6.8 Hz, 2H, H₂NCH₂), 2.57 (s, 2H, NH₂), 2.40 (d, ⁵J = 2.0 Hz, 1H, C=CH), 1.77 (m, 1H, CH₂), 1.69 (m, 1H, CH₂), 1.60 (m, 2H, CH₂), 1.16 (s, 9H, SC(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 83.7 (C=CH), 73.2 (C=CH), 56.3 (C(CH₃)₃), 47.3 (C=), 41.3 (NH₂CH₂), 34.3 (C(CH₂)), 28.8 (C(CH₂)CH₂), 22.6 (C(CH₃)₃). C₁₀H₂₀N₂OS (216.34 g mol⁻¹). MS(ESI): m/z = 217.1357 (217.1369 [M+H]+). [α]²⁵(Path) = 26.2 (c = 0.51; CHCl₃). TLC: Rf (DCM/MeOH/NEt₃, 88:10:2) = 0.25.

** tert-Butyl ((S)-4-(((S)-tert-butylsulfinyl)amino)hex-5-yn-1-yl)carbamate 7wz**

**Synthesis:** See preparation of 7vz, starting material was the crude product of 7wy. Reaction scale: 19.83 mmol of imine 5w. Purification by column chromatography (PE/EtOAc, 2:1).

Colourless highly viscous oil, yield: 3.9515 g, 12.487 mmol, 63%, dr = 90:10. ¹H NMR (500 MHz, Chloroform-d) δ = 4.57 (s, 1H, NHBoc), 4.06 (qd, ⁴J = 6.5 Hz, ⁵J = 2.3 Hz, 1H, C=H), 3.37 (d, ⁶J = 6.6 Hz, 1H, NH), 3.16 (q, ⁷J = 6.8 Hz, 2H, BocHNCH₂), 2.42 (d, ⁸J = 2.3 Hz, 1H, C=CH), 1.82-1.70 (m, 2H, CH₂), 1.69-1.62 (m, 2H, CH₂), 1.44 (s, 9H, CO₂C(CH₃)₃), 1.22 (s, 9H, SC(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 156.1 (CO₂), 83.5 (C=CH), 79.4 (CO₂C(CH₃)₃), 73.5 (C=CH), 56.4 (SC(CH₃)₃), 47.3 (C=), 34.1 (BocHNCH₂), 28.6 (CO₂C(CH₃)₃), 26.3 (C=CH₂), 22.7
(SC(CH₃)₃), 22.6 (C≡CH₂CH₂). C₁₅H₂₈N₂O₃S (316.46 g mol⁻¹), MS(ESI): m/z = 339.1709 (339.1713 [M+Na⁺]), [α]₂₅° = 42.3 (c = 0.24; CHCl₃). TLC: R_f (EtOAc) = 0.56. IR(ATR): ν [cm⁻¹] = 3297 (NH), 2971 (CH), 2924 (CH), 2867 (CH), 1689 (CO), 1524 (SO), 1363, 1252, 1169, 1055.

DiBoc protected arginine analogue Propargylamine 7x

![Propargylamine 7x](image)

Propargylamine 7wy (3.378 g, 15.61 mmol, 1 equiv) and DiBocisothiourea (4.5 g, 15.5 mmol, 1.0 equiv) were dissolved under argon atmosphere in dry DCM (20 mL). The reaction mixture was stirred for 3 d at rt. Then the solvent was evaporated under reduced pressure. The residue was diluted with water (30 mL) and the solution was extracted with DCM (5 × 30 mL). The combined organic layers were washed with brine (15 mL) and dried over Na₂SO₄ before the solvent was evaporated in vacuum. The crude product was purified by column chromatography (DCM/MeOH, 10:1).

Faintly yellow, highly viscous oil, yield: 5.625 g, 12.27 mmol, 79 %, dr = 93:7, ¹H NMR (500 MHz, Chloroform-δ) δ = 11.48 (s, 1H, NHBOc), 8.37 (s, 1H, NHCN₂), 4.11-4.04 (m, 1H, CάH), 3.47 (t, 3J = 6.2 Hz, 2H, N₂CNCH₂), 3.40 (d, 3J = 6.5 Hz, 1H, CάNH), 2.42 (d, 4J = 2.3 Hz, 1H, C≡CH), 1.81-1.72 (m, 4H, CάCH₂CH₂), 1.49 (s, 9H, C=NCO₂C(CH₃)₃), 1.49 (s, 9H, CHNCO₂C(CH₃)₃), 1.21 (s, 9H, SC(CH₃)₃). ¹³C NMR (126 MHz, Chloroform-δ) δ = 163.7 (NCN₂), 156.3 (C=NCO₂Bu), 153.4 (CHNCO₂Bu), 83.4 (C≡C=CH), 83.3 (C≡C=CH), 79.5 (CHNCO₂C(CH₃)₃), 73.6 (C≡C=CH), 56.4 (SC(CH₃)₃), 47.2 (C≡C=CH), 40.4 (CH₂NHCN₂), 34.0 (C≡CH₂), 28.4 (C≡C=CH), 28.2 (CHNCO₂C(CH₃)₃), 25.2 (C≡CH₂CH₂), 22.7 (SC(CH₃)₃). C₁₂H₁₃NO₃S (458.62 g mol⁻¹), MS(ESI): m/z = 459.2719 (459.2636 [M+H]^+), 481.2453 (481.2455 [M+Na]^+).

Hydrolysis of imine 5 forms hemiaminal 8

(S)-N-(2,2,2-Trifluoro-1-hydroxyethyl)-tert-butylsulfinamide (8k)

A solution of crude imine 5k in DCM was diluted with water. The organic layer was evaporated under reduced pressure. Then, the aqueous layer was extracted with DCM (3 × 30 mL). The combined organic layers were dried
over Na₂SO₄ and the solvent was evaporated under vacuum to yield a colourless solid. Recrystallization from EtOAc yielded hemiaminal 8k in high purity.

Colourless crystals, yield: 1.773 g, 8.810 mmol, 34 % (referred to Ellman’s sulfinamide (S)-1). ¹H NMR (300 MHz, DMSO-d₆) δ = 7.41 (d, ³JHH = 5.2 Hz, 1H, OH), 6.59 (d, ³JHH = 8.2 Hz, 1H, NH), 4.98 (m, 1H, C⁶H), 1.10 (s, 9H, C(CH₃)₃). ¹⁹F NMR (282 MHz, DMSO-d₆) δ = -80.0 (d, ³JFH = 5.6 Hz, CF₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 122.5 (q, ¹JCF = 281.8 Hz, CF₃), 80.3 (q, ²JCF = 34.9 Hz, C⁶H), 57.3 (C(CH₃)₃), 22.5 (CH₃). C₆H₁₂F₃NO₂S (219.22 g mol⁻¹).

Ellman’s chiral sulfinamide (S)-1 (1.00 g, 8.25 mmol, 1 equiv) was added in one portion to freshly dried and distilled chloral (1.21 g, 9.38 mmol, 1 equiv) and the mixture was dissolved in DCM (20 mL). After stirring of the solution for 3 d, conversion of the starting material was complete (monitored by TLC). Water (20 mL) was added and the emulsion was concentrated up under reduced pressure. The residue was stirred for 1.5 h at rt, before it was extracted with DCM (3 × 30 mL). TLC showed complete consumption of the formed intermediate. The combined organic layers were washed with brine (10 mL), dried over MgSO₄ and the solvent was evaporated under vacuum. The crude product was obtained in form of a colourless, crystalline solid. Hemiaminal 8l was isolated by column chromatography.

Colourless crystals, yield: 1.0847 g, 4.0386 mmol, 49 % (referred to Ellman’s sulfinamide (S)-1), ¹H NMR (500 MHz, DMSO-d₆) δ = 7.82 (d, ³J = 6.7 Hz, 1H, OH), 5.83 (d, ³J = 8.7 Hz, 1H, NH), 5.05 (dd, ³J = 8.7 Hz, ³J = 6.6 Hz, 1H, C⁶H), 1.17 (s, 9H, SC(CH₃)₃). ¹³C NMR (126 MHz, DMSO) δ = 103.6 (Cl₃C), 89.4 (C⁶), 56.6 (C(CH₃)₃), 22.8 (C(CH₃)₃). C₆H₁₂Cl₃NO₂S (268.58 g mol⁻¹). TLC: Rf(EtOAc/PE, 1:4) = 0.14.

**Side-product 9k of the conversion of 5k with GP-3**

(S)-N-((R)-2,2,2-trifluoro-1-isopropoxyethyl)-tert-butylsulfinamide (9k)

Synthesis: GP-3: Ti(OiPr)₄ (2.61 mL, 8.816 mmol, 1 equiv) was added to a solution of crude 5k (8.816 mmol) and the mixture was dropped
directly into a solution of trimethylsilyl ethynyl lithium (14.1 mmol, 1.6 equiv) in THF (50 mL) at −78 °C. The reaction mixture was stirred at −78 °C for 2 h, and then warmed up to rt. The solution was diluted with a saturated aqueous solution of NH₄Cl (40 mL) and the colourless precipitate was filtered through a pad of celite. The phases were separated and the aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with brine (10 mL) and dried over Na₂SO₄ before the solvent was evaporated under reduced pressure. The crude product was recrystallized from EtOAc/Et₂O, 1:2 to yield aminal 9k in pure form.

Colourless crystals, yield: 727.9 mg, 2.786 mmol, 32 % (referred to Ellman’s sulfinamide (S)-1). ¹H NMR (300 MHz, Chloroform-d) δ = 4.72 (dq, 3J_HH = 9.6 Hz, 3J_HF = 4.7 Hz, 1H, C⁹H), 4.10 (septett, 2J_HH = 6.1 Hz, 1H, (CH₃)₂CH), 3.90 (d, 2J_HH = 9.9 Hz, 1H, NH), 1.19 (d, 3J_HH = 6.3 Hz, 3H, (CH₃)CHCH₃), 1.17 (s, 9H, C(CH₃)₃), 1.14 (d, 3J_HH = 6.1 Hz, 3H, (CH₃)CHCH₃). ¹³C NMR (126 MHz, Chloroform-d) δ = 122.3 (q, 1J_CF = 282.4 Hz, CF₃), 83.5 (q, 2J_CF = 33.7 Hz), 70.7 (OCH(CH₃)₂), 56.9 (C(CH₃)₃), 22.8 (C(CH₃)₃), 22.3 ((CH₃)CHCH₃), 20.5 ((CH₃)CHCH₃). ¹⁹F NMR (282 MHz, Chloroform-d) δ = -80.8 (d, 3J_FH = 5.0 Hz, CF₃). C₉H₁₈F₃NO₂S (261.30 g mol⁻¹). MS(ESI): m/z = 262.1080 (262.10831 [M+H]⁺). TLC: Rₖ (PE/EtOAc, 2:1) = 0.42.

Side-product 10k of the conversion of 5k with GP-4

(S)-N-((R)-1,1,1-Trifluoropropane-2-yl)-tert-butylsulfinamide (10k)

Synthesis: GP-4. A solution of AlMe₃ (2.0 M in n-hexane, 9.8 mL, 19.6 mmol, 1 equiv) was added to a solution of crude 5k (19.68 mmol) and the mixture was dropped directly into a solution of trimethylsilylene thynyl lithium (31.5 mmol, 1.6 equiv) in toluene (70 mL) at −78 °C. The reaction mixture was stirred at −78 °C for 2 h, and then warmed up to rt. The solution was diluted with a saturated aqueous solution of NH₄Cl (40 mL) and the colourless slurry was filtered through a pad of celite. The phases were separated and the aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with brine (10 mL) and dried over Na₂SO₄ before the solvent was evaporated under reduced pressure. The crude product was recrystallised from EtOAc/n-hexane, 1:5 to yield aminal 10k in pure form. Racemic compound 10k has been first prepared by Packer, Melassis, Wells, Light and Linclau, by adding Ellman’s sulfinamide (R)-1 to 1,1,1-trifluoropropan-2-one [53].

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Colourless crystals, yield: 2.262 g, 10.41 mmol, 53 % (referred to Ellman’s sulfinamide (S)-1). 1H NMR (300 MHz, Chloroform-d) δ = 3.84 (m, 1H, CαH), 3.13 (d, 3JHH = 7.4 Hz, 1H, NH), 1.46 (d, 3JHH = 6.9 Hz, 3H, CαCH3), 1.22 (s, 9H, C(CH3)3). 13C NMR (75 MHz, Chloroform-d) δ = 125.4 (q, 1JCF = 280.1 Hz, CF3), 56.8 (C(CH3)3), 54.6 (q, 2JCF = 31.8 Hz, CαH), 22.5 (C(CH3)3), 16.7 (q, 4JCF = 1.9 Hz, CαCH3). 19F NMR (282 MHz, Chloroform-d) δ = -78.3 (d, 3JFH = 7.0 Hz, CF3). C7H14F3NOS (217.25 g mol⁻¹). MS(ESI): m/z = 218.0813 (218.0821 [M+H]⁺). [α]22°S = -17.2 (c = 0.33; MeOH).

Furthermore, TMS-protected alkyne 6k could be isolated in a low amount of 1.384 g, 0.414 mmol, 22 %.

### Sonogashira cross-coupling products as peptidomimetics 11

Methyl 4-((S)-3-(((S)-tert-butylsulfinylamido)-3-phenylprop-1-yn-1-yl)benzoate (11i)

![Sonogashira cross-coupling products as peptidomimetics 11](image)

Synthesis: GP-9, reaction scale was 407 μmol of propargylamine 7i. The crude product was purified by column chromatography (PE/EtOAc, 1:1) and then recrystallized from Et2O.

Colourless crystalline solid, yield: 83 mg, 225 μmol, 54 %.

1H NMR (500 MHz, Chloroform-d) δ = 7.98 (d, 3J = 8.4 Hz, 2H, ar-2-H, ar-6-H), 7.56 (d, 3J = 6.9 Hz, 1H, Ph-2-H, Ph-6-H), 7.53 (d, 3J = 8.4 Hz, 2H, ar-3-H, ar-5-H), 7.41 (t, 3J = 7.3 Hz, 2H, Ph-3-H, Ph-5-H), 7.37 (m, 1H, Ph-4-H), 5.47 (m, 1H, CαH), 3.92 (s, 3H, CO2CH3), 1.27 (s, 9H, SC(CH3)3). 13C NMR (126 MHz, Chloroform-d) δ = 166.6 (CO2CH3), 138.3 (Ph-C-1), 131.9 (ar-C-3, ar-C-5), 130.1 (ar-C-1), 129.6 (ar-C-2, ar-C-6), 129.0 (Ph-C-3, Ph-C-5), 128.8 (Ph-C-1), 127.8 (Ph-C-2, Ph-C-6), 127.0 (Ph-C-4), 90.2 (CαC=Car), 86.3 (CαC=Car), 57.3 (SC(CH3)3), 52.4 (CO2CH3), 52.3 (Cα), 22.7 (SC(CH3)3). C21H21NO3S (369.48 g mol⁻¹), MS(ESI): m/z = 392.975 (392.129 [M+Na]+). IR(ATR): ν [cm⁻¹] = 2977 (CH), 2948 (CH), 2920 (CH), 2328 (C≡C), 2353 (C=C), 1720 (C=O), 1543 (ar, C=C), 1280 (C-N). TLC: Rf (EtOAc/PE, 1:2) = 0.44. [α]19°S = 10.4 (c = 0.72; CHCl3).
Methyl 3-((R)-3-(([(S)-tert-butylsulfinyl]amido)-4,4,4-trifluorobut-1-yn-1-yl)benzoate (11k)

Synthesis: GP-9, reaction scale: 582 μmol of propargylamine 7k. The crude product was purified by column chromatography (PE/EtOAc, 1:1).

Faintly yellow oil, yield: 94.7 mg, 262 μmol, 45 %.

$^1$H NMR (300 MHz, Chloroform-d) δ = 8.10 (t, $^3J = 1.7$ Hz, 1H, ar-2-H), 8.01 (dt, $^3J = 7.9$ Hz, $^4J = 1.5$ Hz, 1H, ar-6-H), 7.62 (dt, $^3J = 7.7$ Hz, $^4J = 1.5$ Hz, 1H, ar-4-H), 7.39 (t, $^3J = 7.8$ Hz, 1H, ar-5-H), 4.77 (dq, $^3J = 7.6$ Hz, $^5J = 6.3$ Hz, 1H, C$^α$H), 4.04 (d, $^3J = 7.6$ Hz, 1H, NH), 3.90 (s, 3H, CO$_2$CH$_3$), 1.25 (s, 9H, SC(CH$_3$)$_3$). $^{19}$F NMR (282 MHz, Chloroform-d) δ = -76.3 (d, $^3J_{FH} = 6.3$ Hz, CF$_3$). $^{13}$C NMR (75 MHz, Chloroform-d) δ = 166.2 (CO$_2$(CH$_3$)), 136.2 (ar-C-4), 133.2 (ar-C-2), 130.6 (ar-C-1), 130.5 (ar-C-6), 128.7 (ar-C-5), 121.5 (ar-C-3), 121.3 (q, $^1J_{CF} = 280.7$ Hz, CF$_3$), 86.7 (C$^α$C═Car), 80.6 (q, $^3J_{CF} = 2.2$ Hz, C$^α$C═Car), 57.6 (SC(CH$_3$)$_3$), 52.4 (CO$_2$CH$_3$), 51.5 (q, $^2J_{CF} = 35.1$ Hz, C$^α$H), 22.5 (SC(CH$_3$)$_3$). C$_{16}$H$_{18}$F$_3$NO$_2$S (361.38 g mol$^{-1}$). MS(ESI): m/z = 362.1022 (362.1032 [M+H]$^+$). TLC: R$_f$(EtOAc/PE, 1:1) = 0.63.

Rearrangement products: α,β-unsaturated imines 12

Methyl 4-((1E,3Z)-3-(([(S)-tert-butylsulfinyl]imido)-3-phenylprop-1-en-1-yl)benzoate (12i)

Piperidine (1 mL) was added to a solution of 11i (151.5 mg, 409 μmol) in THF (3 mL) at 0 °C. The reaction mixture instantly turned brightly yellow. After 30 min, Et$_2$O (20 mL) was added and the solution was washed with a KHSO$_4$ solution (5 %, 2 × approximately 20 mL) and brine (5 mL). The organic layer was dried over Na$_2$SO$_4$ and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography (PE/EtOAc, 10:1) and recrystallization from Et$_2$O.

Brightly yellow crystalline solid, yield: 81.8 mg, 221 μmol, 98 % (isolated yield). $^1$H NMR (600 MHz, Chloroform-d) δ = 8.19 (d, $^3J = 16.3$ Hz, 1H, C$^α$HC═CHar), 8.01 (d, $^3J = 8.3$ Hz, 2H, ar-2-H, ar-6-H), 7.64 (d, $^3J = 8.2$ Hz, 2H, Ph-2-H, Ph-6-H), 7.56 (d, $^3J = 7.9$ Hz, 2H, ar-3-H, ar-5-H), 7.51 (t, $^3J = 7.4$ Hz, 1H, Ph-4-H), 7.45 (t, $^3J = 7.5$ Hz, 2H, Ph-3-H, Ph-5-H), 6.90 (d, $^3J = 16.3$ Hz, 1H, C$^α$HC═CHar), 3.91 (s, 3H, CO$_2$CH$_3$), 1.35 (s, 9H, SC(CH$_3$)$_3$).
\[^{13}\text{C NMR} \ (151 \text{ MHz, Chloroform-}d) \ \delta = 174.6 \ (\text{PhC}^\text{\textgreek{a}}=\text{N}), \ 166.6 \ (\text{CO}_2(\text{CH}_3)), \ 142.2 \ (\text{C}^\text{\textgreek{a}}\text{HC}=\text{CHar}), \ 139.6 \ (\text{ar-C-1}), \ 138.6 \ (\text{Ph-C-1}), \ 131.1 \ (\text{ar-C-4}), \ 131.0 \ (\text{Ph-C-4}), \ 130.2 \ (\text{ar-C-2}, \ \text{ar-C-6}), \ 129.3 \ (\text{Ph-C-2}, \ \text{Ph-C-6}), \ 128.5 \ (\text{Ph-C-3}, \ \text{Ph-C-5}), \ 128.0 \ (\text{ar-C-3}, \ \text{ar-C-5}), \ 124.7 \ (\text{C}^\text{\textgreek{a}}\text{HC}=\text{CHar}), \ 58.8 \ (\text{C(CH}_3)_3), \ 52.4 \ (\text{CO}_2\text{CH}_3), \ 23.0 \ (\text{SC(CH}_3)_3). \ \text{C}_2\text{H}_5\text{NO}_3\text{S} \ (369.48 \text{ g mol}^{-1}). \ \text{MS(ESI):} \ m/z = 370.1 \ (370.15 [\text{M+H}]^+) \ (362.1022 \text{ g mol}^{-1}). \ \text{IR(FTIR):} \ \nu \ [\text{cm}^{-1}] = 2977 \ (\text{CH}), \ 2948 \ (\text{CH}), \ 2920 \ (\text{CH}), \ 2328 \ (\text{C}=\text{C}), \ 2353 \ (\text{C-C}), \ 1720 \ (\text{CO}), \ 1543 \ (\ar, \ \text{C}=\text{C}), \ 1280 \ (\text{C-N}).

**Methyl (E)-3-(4,4,4-trifluoro-3-iminobut-1-en-1-yl)benzoate (12k)**

Propargylamine 11k was dissolved in MeOH and an aqueous solution of LiOH (3 equiv, 1 M) was added dropwise at 0 °C. After 5 min, the solution turned brightly yellow, while the reaction progress was monitored by TLC. After complete conversion, the reaction mixture was acidified with HCl and extracted with EtOAc (3 × 30 mL). The combined organic layers were dried over NaSO\(_4\), the solvent was evaporated and the crude product directly investigated by NMR spectroscopy.

Crude product, brightly yellow oil, yield: 16.8 mg, 65.4 µmol, 84 %. \[^1\text{H NMR} \ (500 \text{ MHz, Chloroform-}d) \ \delta = 8.32 \ (t, \ ^4J = 1.8 \text{ Hz, 1H, ar-2-H}), \ 8.16 \ (dt, \ ^3J = 7.8 \text{ Hz, } ^4J = 1.4 \text{ Hz, 1H, ar-6-H}), \ 7.99 \ (d, \ ^3J = 16.0 \text{ Hz, 1H, C}^\text{\textgreek{a}}\text{C}=\text{CHar}), \ 7.81 \ (dt, \ ^3J = 7.7 \text{ Hz, } ^4J = 1.5 \text{ Hz, 1H, ar-4-H}), \ 7.55 \ (t, \ ^3J = 7.8 \text{ Hz, 1H, ar-5-H}), \ 7.09 \ (dd, \ ^3J = 16.0 \text{ Hz, } ^4J = 0.9 \text{ Hz, 1H, C}^\text{\textgreek{a}}\text{CH}=\text{Car}), \ 3.97 \ (s, \ 3\text{H, CO}_2\text{CH}_3). \ \text{^19F NMR} \ (470 \text{ MHz, Chloroform-}d) \ \delta = -77.7 \ (s, \ \text{CF}_3). \ \text{^13C NMR} \ (126 \text{ MHz, Chloroform-}d) \ \delta = 180.0 \ (q, \ ^2J_{\text{CF}} = 35.7 \text{ Hz, C}=\text{N}), \ 162.1 \ (\text{CO}_2(\text{CH}_3)), \ 148.6 \ (\text{C}^\text{\textgreek{a}}\text{C}=\text{Car}), \ 134.2 \ (\text{ar-C-4}), \ 134.0 \ (\text{ar-C-1}), \ 133.6 \ (\text{ar-C-6}), \ 131.2 \ (\text{ar-C-3}), \ 130.7 \ (\text{ar-C-2}), \ 129.8 \ (\text{ar-C-5}), \ 118.2 \ (\text{C}^\text{\textgreek{a}}\text{C}=\text{Car}), \ 117.7 \ (q, \ ^1J_{\text{CF}} = 290.8 \text{ Hz, CF}_3). \ \text{C}_{12}\text{H}_{16}\text{F}_3\text{NO}_2 \ (257.21 \text{ g mol}^{-1}). \ \text{MS(ESI):} \ m/z = 362.1022 \ (362.1032 \ [\text{M+H}]^+). \ \text{TLC:} \ R_f \ (\text{EtOAc/PE, 1:2}) = 0.74. \ \text{UV/vis:} \ \varepsilon = 12.60 \text{ L mol}^{-1}\text{cm}^{-1} \ (304 \text{ nm}).

**Intramolecular Huisgen reaction of 6w gives triazole 13w**

\((S)-\text{N}-((S)-3-(\text{Trimethylsilyl})-4,5,6,7-\text{tetrahydro-[1,2,3]triazolo[1,5-a]pyridine-4-yl})-\text{tert-butylsulfinamid}e \ (13w)\)
Synthesis: GP-4, reaction scale was 8.96 mmol of imine 5w. The crude product was separated by column chromatography (elution with EtOAc).

The ratio of propargylamine 6w and triazole 13w was 1:4. Triazole 13w was recrystallized from toluene.

Colourless crystals, yield: 1.578 g, 5.017 mmol, 56 %, dr = 100:0. 1H NMR (500 MHz, Chloroform-d) δ = 4.88 (m, 1H, C=αH), 4.66 (dd, 2J = 13.3 Hz, 3J = 5.4 Hz, 1H, N3CH2), 4.13 (dt, 2J = 13.5 Hz, 3J = 5.2 Hz, 1H, N3CH2), 3.07 (s, 1H, NH), 2.38-2.23 (m, 2H, C=CCH2CH2), 1.99 (m, 1H, C=CH2), 1.82 (m, 1H, C=CH2), 1.19 (s, 9H, SC(CH3)3), 0.39 (s, 9H, Si(CH3)3). 13C NMR (126 MHz, Chloroform-d) δ = 143.5 (TMS=C), 139.3 (TMS=C), 55.7 (SC(CH3)3), 46.3 (C=), 43.6 (CH2N3), 26.1 (C=CCH2), 22.5 (SC(CH3)3), 16.8 (C=CCH2CH2), -0.8 (Si(CH3)3). C13H26N4OSSi (314.52 g mol⁻¹). MS(ESI): m/z = 315.1668 (315.16693 [M+H]+). Smp.: 167 °C. IR(ATR): δ [cm⁻¹] = 3307 (NH), 3234 (CH), 2952 (CH), 2898 (CH), 2860 (CH), 2091, 1477, 1439 (SO), 1363, 1249, 1185, 1154, 1071 (SC), 970, 843, 758. TLC: Rf(EtOAc) = 0.35. EA: C: 49.713%, H: 8.388%, N: 17.643%, S: 9.832%.

**Intramolecular Huisgen reaction of 7wx gives triazole 14w**

(S)-N-((S)-4,5,6,7-Tetrahydro-[1,2,3]triazolo[1,5-a]pyridine-4-yl)-tert-butylsulfinamide (14w)

A solution of 7wx in CDCl3 was monitored for 7d via NMR spectroscopy at rt. The conversion of the starting material was 66 %.

1H NMR (600 MHz, Chloroform-d) δ = 7.86 (s, 1H, C=CH), 4.66 (dd, 3J = 8.1 Hz, 3J = 5.4 Hz, 1H, C=αH), 4.40 (dt, 2J = 13.1 Hz, 3J = 5.2 Hz, 2H, N3CH2), 4.30 (dd, 2J = 13.5 Hz, 3J = 8.6 Hz, 3J = 5.0 Hz, 1H, N3CH2), 3.59 (d, 3J = 5.8 Hz, NH), 2.29 (dddt, 2J = 12.2 Hz, 3J = 6.8 Hz, 3J = 4.9 Hz, 4J = 1.8 Hz, 1H, C=CCH2), 2.23 (tdd, 3J = 7.6 Hz, 3J = 5.6 Hz, 3J = 3.1 Hz, 1H, N3CH2CH2), 2.06 (dddt, 2J = 11.6 Hz, 3J = 8.5 Hz, 3J = 6.5 Hz, 3J = 6.0 Hz, 4J = 2.9 Hz, 1H, N3CH2CH2), 1.98 (dddt, 2J = 13.3 Hz, 3J = 10.6 Hz, 3J = 7.9 Hz, 4J = 2.1 Hz, 1H, C=CCH2), 1.25 (s, 9H, C(CH3)3). 13C NMR (126 MHz, Chloroform-d) δ = 135.8 (C=CH), 132.5 (C=CH), 56.1 (C(CH3)3), 48.5 (C=), 45.7 (N3CH2), 29.3 (C=CCH2), 22.6 (C(CH3)3), 20.3 (N3CH2CH2). C10H18N4OS (242.34 g mol⁻¹). MS(ESI): m/z = 243.1268 (243.12741 [M+H]+).
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X-ray structure analysis

Details of crystal and refinement data can be found in Table S1. CCDC 1566791 - CCDC 1566804 contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

Table S1: Crystal and refinement data.

| Identification code | 7a  | 7c  | 7d  |
|---------------------|-----|-----|-----|
| **Empirical formula**| C₈H₁₅NOS | C₁₁H₂₁NOS | C₁₃H₂₃NOS |
| **Formula weight** | 173.27 | 215.35 | 241.38 |
| **Crystal system** | orthorhombic | orthorhombic | monoclinic |
| **Space group** | P₂₁₂₁₂₁ | P₂₁₂₁₂₁ | I2 |
| a/Å | 8.7104(4) | 7.42311(6) | 15.2100(2) |
| b/Å | 8.8865(3) | 8.20918(9) | 5.52038(7) |
| c/Å | 12.8249(5) | 21.5429(2) | 16.9739(2) |
| β/° | 105.2626(14) | | |
| **Volume/Å³** | 992.71(6) | 1312.77(2) | 1374.95(3) |
| **Z** | 4 | 4 | 4 |
| **ρcalc mg/mm³** | 1.156 | 1.090 | 1.166 |
| **μ/mm⁻¹** | 2.489 | 1.965 | 1.929 |
| **F(000)** | 376.0 | 472.0 | 528.0 |
| **Crystal size/mm³** | 0.306 × 0.19 × 0.178 | 0.3786 × 0.2147 × 0.0328 | 0.3786 × 0.1633 × 0.0951 |
| **2Θ range for data collection** | 12.116 to 143.96° | 8.2 to 152.8854° | 6.95 to 143.932° |
| **Index ranges** | -9 ≤ h ≤ 9, -10 ≤ k ≤ 10, -15 ≤ l ≤ 15 | -18 ≤ h ≤ 18, -10 ≤ k ≤ 10, -20 ≤ l ≤ 20 | |
| **Reflections collected** | 35722 | 52103 | 24224 |
| **Independent reflections** | 1942[R(int) = 0.0235] | 2663[R(int) = 0.0338] | 2673[R(int) = 0.0348] |
| **Reflections with [I ≥ 2σ(I)]** | 1942 | 2604 | 2657 |
| **Completeness / Θ full** | 0.99 / 72.0° | 0.99 / 76.4 | 0.99 / 72.0 |
| **Data/restraints/parameters** | 1942/0/108 | 2663/0/136 | 2673/1/237 |
| **Goodness-of-fit on F²** | 1.101 | 1.038 | 1.037 |
| **Final R indexes [I ≥ 2σ(I)]** | R₁ = 0.0182, wR₂ = 0.0500 | R₁ = 0.0182, wR₂ = 0.0500 | R₁ = 0.0182, wR₂ = 0.0500 |
| **Final R indexes [all data]** | R₁ = 0.0210, wR₂ = 0.0555 | R₁ = 0.0216, wR₂ = 0.0561 | R₁ = 0.0237, wR₂ = 0.0632 |
| **Largest diff. peak/hole / e Å⁻³** | 0.16/-0.19 | 0.18/-0.22 | 0.17/-0.18 |
| **Flack parameter** | 0.002(3) | -0.015(11) | -0.008(7) |
| Identification code | 7e | 7i | 7j |
|--------------------|----|----|----|
| **Empirical formula** | $\text{C}_11\text{H}_{21}\text{NOS}$ | $\text{C}_{13}\text{H}_{17.03}\text{NOS}$ | $\text{C}_{13}\text{H}_{12}\text{F}_2\text{NOS}$ |
| **Formula weight** | 215.35 | 235.37 | 325.30 |
| **Crystal system** | orthorhombic | monoclinic | monoclinic |
| **Space group** | $\text{P}_2_1\_2_1\_2_1$ | $\text{P}_2_1/c$ | $\text{I}_2$ |
| **a/Å** | 7.51335(10) | 19.2823(6) | 16.0227(4) |
| **b/Å** | 9.18409(9) | 6.0708(2) | 5.58447(14) |
| **c/Å** | 18.8630(2) | 21.7783(7) | 17.1518(4) |
| **β/°** | | 93.696(3) | 112.519(3) |
| **Volume/Å$^3$** | 1301.61(3) | 2544.02(14) | 1417.70(6) |
| **Z** | 4 | 8 | 4 |
| **ρ_{calc} mg/mm$^3$** | 1.099 | 1.229 | 1.524 |
| **μ/mm$^{-1}$** | 1.982 | 2.084 | 2.571 |
| **F(000)** | 472.0 | 1008.0 | 664.0 |
| **Crystal size/mm$^3$** | $0.359 \times 0.094 \times 0.041$ | $0.1499 \times 0.0586 \times 0.362 \times 0.125 \times 0.092$ | $0.02$ |
| **2θ range for data collection** | 10.7 to 144.6° | 8.136 to 134.09° | 6.424 to 144.044° |
| **Index ranges** | $-9 \leq h \leq 9$, $-11 \leq k \leq -11$, $-22 \leq l \leq -22$ | $-7 \leq h \leq 19$, $-6 \leq k \leq 5$, $-21 \leq l \leq 21$ | $-19 \leq h \leq 19$, $-7 \leq k \leq 7$, $-21 \leq l \leq 21$ |
| **Reflections collected** | 21947 | 40018 | 10869 |
| **Independent reflections** | 2578 [R(int) = 0.0389] | 4506 [R_{int} = 0.0445] | 2574 [R(int) = 0.0242] |
| **Reflections with [I ≥ 2σ (I)]** | 2544 | 3847 | 2536 |
| **Completeness / Θ full** | 1.00 / 67.7° | 0.99 / 67.0° | 1.00 / 72.0° |
| **Data/restraints/parameters** | 2578/0/137 | 4506/0/408 | 2574/1/207 |
| **Goodness-of-fit on F$^2$** | 1.039 | 1.051 | 1.035 |
| **Final R indexes [I ≥ 2σ (I)]** | $R_1 = 0.0226$, $wR_2 = 0.1275$ | $R_1 = 0.0457$, $wR_2 = 0.0810$ | $R_1 = 0.0296$, $wR_2 = 0.0815$ |
| **Final R indexes [all data]** | $R_1 = 0.0230$, $wR_2 = 0.1352$ | $R_1 = 0.0536$, $wR_2 = 0.0815$ | $R_1 = 0.0300$, $wR_2 = 0.0815$ |
| **Largest diff. peak/hole / e Å$^{-3}$** | 0.18/-0.20 | 0.51/-0.46 | 0.26/-0.21 |
| **Flack parameter** | -0.017(7) | -0.010(14) | |
| **CCDC** | 1566794 | 1566795 | 1566796 |

| Identification code | 7k | 7q | 7s |
|--------------------|----|----|----|
| **Empirical formula** | $\text{C}_8\text{H}_{12}\text{F}_3\text{NOS}$ | $\text{C}_{11}\text{H}_{18}\text{N}_2\text{OS}$ | $\text{C}_{14}\text{H}_{25}\text{NO}_3\text{S}$ |
| **Formula weight** | 227.25 | 226.33 | 287.41 |
| **Crystal system** | orthorhombic | orthorhombic | orthorhombic |
| **Space group** | $\text{P}_2_1\_2_1\_2_1$ | $\text{P}_2_1\_2_1\_2_1$ | $\text{P}_2_1\_2_1\_2_1$ |
| **a/Å** | 9.8970(3) | 7.61092(13) | 5.99613(6) |
| **b/Å** | 10.5858(4) | 8.47774(13) | 11.66404(10) |
### Crystal Data

| Property                        | Value                  |
|--------------------------------|------------------------|
| c/Å                            | 31.7578(12)            |
| Volume/Å³                       | 3327.2(2)              |
| Z                              | 12                     |
| $\rho_{\text{calc}}$/mg/mm³    | 1.361                  |
| $\mu$/mm⁻¹                     | 2.766                  |
| F(000)                         | 1416.0                 |
| Crystal size/mm³               | 0.28 x 0.04 x 0.02     |

### Refinement

| Parameter                        | Value                  |
|----------------------------------|------------------------|
| 2Θ range for data collection    | 5.566 to 143.994°      |
| Index ranges                     | -12 ≤ h ≤ 12, -13 ≤ k ≤ 13, -39 ≤ l ≤ 37      |
| Reflections collected            | 58973                  |
| Independent reflections          | 6525[R(int)]           |
| Data/restraints/parameters       | 6525/3/387            |
| Reflections with [I ≥ 2σ(I)]    | 5599                   |
| Completeness / Θ full            | 1.00 / 77.0           |
| Goodness-of-fit on F²            | 1.045                  |
| Final R indexes [I ≥ 2σ(I)]     | R₁ = 0.0522, wR₂ = 0.1336 |
|                                  | R₁ = 0.0204, wR₂ = 0.0550 |
| Final R indexes [all data]      | R₁ = 0.0627, wR₂ = 0.1419 |
|                                  | R₁ = 0.0204, wR₂ = 0.0550 |
| Largest diff. peak/hole / e Å⁻³ | 0.61/-0.46             |
| Flack parameter                  | -0.008(10)             |
| CCDC                            | 1566797                |

### Crystallographic Information

| Identification code | Empirical formula | Formula weight | Crystal system | Space group | a/Å | b/Å | c/Å | β/° | Volume/Å³ | Z | $\rho_{\text{calc}}$/mg/mm³ | $\mu$/mm⁻¹ | F(000) | Crystal size/mm³ | 2Θ range for data collection |
|---------------------|-------------------|----------------|----------------|-------------|-----|-----|-----|-----|-----------|---|--------------------|------------|--------|-------------------|-----------------------------|
| 10k                 | C₁₇H₁₅F₃NOS       | 217.25         | orthorhombic   | P2₁2₁2₁     | 5.81687(9) | 9.36864(17) | 18.6951(3) | 101.162(8) | 1018.81(3) | 4 | 1.416              | 0.325       | 456.0   | 0.383 x 0.143 x 0.104 | 4.4 to 60.1° |
| 11i                 | C₂₁H₂₃NO₃S       | 369.46         | monoclinic     | P₂₁         | 10.3754(9) | 5.8828(3)  | 15.9341(16) | 90.000     | 954.17(14) | 2 | 1.288              | 1.668       | 392.0   | 0.358 x 0.071 x 0.027 | 5.654 to 143.896° |
| 12i                 | C₂₁H₂₃NO₃S       | 370.47         | orthorhombic   | P₂₁2₁2₁     | 6.03357(10)| 10.31093(18)| 31.0591(6)  | 90.000     | 1932.24(6) | 4 | 1.274              | 1.648       | 788.0   | 0.2716 x 0.123 x 0.028 | 9.036 to 143.992° |
| Index ranges                  | -8 ≤ h ≤ 8, -13 ≤ k ≤ -12, -7 ≤ l ≤ 12, -7 ≤ h ≤ 7, -12 ≤ k ≤ 13, -26 ≤ l ≤ 26 |
| Reflections collected        | 24538                                              | 19976                                              | 47179                                              |
| Independent reflections      | 2991[R(int) = 0.0404]                               | 5148[R(int) = 0.0726]                               | 3806[R(int) = 0.0443]                               |
| Reflections with [I ≥ 2σ (I)] | 2865                                               | 4697                                               | 3719                                               |
| Completions / Θ full         | 1.00 / 25.2°                                       | 1.00 / 71.9                                        | 1.00 / 72.0                                        |
| Data/restraints/parameters   | 2991/0/174                                         | 5148/1/244                                         | 3806/0/239                                         |
| Goodness-of-fit on F²        | 1.103                                              | 1.128                                              | 1.039                                              |
| Final R indexes [I ≥ 2σ (I)] | R₁ = 0.0237, wR₂ = 0.0588                           | R₁ = 0.0574, wR₂ = 0.1628                          | R₁ = 0.0382, wR₂ = 0.096                           |
| Final R indexes [all data]   | R₁ = 0.0253, wR₂ = 0.0597                           | R₁ = 0.0613, wR₂ = 0.1651                          | R₁ = 0.0391, wR₂ = 0.1005                          |
| Largest diff. peak/hole / e Å⁻³ | 0.24/-0.18                                       | 0.72/-0.45                                        | 0.82/-0.41                                        |
| Flack parameter              | 0.00(3)                                            | -0.03(3)                                           | 0.004(5)                                           |
| CCDC                        | 1566800                                            | 1566801                                            | 1566802                                            |

| Identification code | 12i | 13w |
|---------------------|-----|-----|
| Empirical formula   | C₁₁H₇F₃O₃ | C₁₃H₂₆N₄OSSi |
| Formula weight      | 244.17 | 314.53 |
| Crystal system      | monoclinic | orthorhombic |
| Space group         | C₂/c    | P₂₁₂₁ |
| a/Å                 | 15.9688(11) | 8.6570(8) |
| b/Å                 | 10.3072(7)  | 11.4855(4) |
| c/Å                 | 13.6073(13) | 16.8678(7) |
| β/°                 | 104.846(8)  |       |
| Volume/Å³           | 2164.9(3)  | 1677.17(18) |
| Z                   | 8          | 4      |
| ρcalc mg/mm³        | 1.498      | 1.246  |
| μ/mm⁻¹              | 0.141      | 2.414  |
| F(000)              | 992.0      | 680.0  |
| Crystal size/mm³    | 0.393 × 0.307 × 0.12 × 0.098 × 0.193              | 0.024  |
| 2Θ range for data collection | 4.8 to 52.0° | 9.3 to 152.4° |
| Index ranges        | -17 ≤ h ≤ 19, -12 ≤ k ≤ -7, -16 ≤ l ≤ 13, -10 ≤ h ≤ 10, -14 ≤ k ≤ 14, -21 ≤ l ≤ 20 |
| Reflections collected | 4376      | 64158  |
| Independent reflections | 2089[R(int) = 0.0339] = 3495[R(int) = 0.0390] | |
| Reflections with [I ≥ 2σ (I)] | 1473      | 3451   |
| Completions / Θ full | 0.97 / 26.0° | 1.00 / 67.7° |
| Data/restraints/parameters | 2089/0/182 | 3495/0/191 |
Goodness-of-fit on F² = 1.060
Final R indexes [I ≥ 2σ] R₁ = 0.0509, wR₂ = 0.1105
Final R indexes [all data] R₁ = 0.0798, wR₂ = 0.1307
Largest diff. peak/hole / e Å⁻³ = 0.28/-0.30
Flack parameter = -0.012(4)
CCDC = 1566803

(S)-N-((S)-But-3-yn-2-yl)-2-methylpropane-2-sulfinamide (7a)

Single crystals of C₈H₁₅NOS (7a) were achieved out of a saturated solution in n-hexane.
Table S2: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 7a. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{ij} tensor.

| Atom | x (×10^4) | y (×10^4) | z (×10^3) | U(eq) (Å^2×10^3) |
|------|-----------|-----------|-----------|-------------------|
| S1   | 4843.9    | 4082.3    | 3561.6    | 17.22(10)         |
| O1   | 5343.1    | 3554.0    | 2502.1    | 22.0(3)           |
| N1   | 3965.5    | 5716.5    | 3484(1)   | 20.7(3)           |
| C1   | 6627.7    | 4706.0    | 4201.2    | 18.1(3)           |
| C2   | 6204(2)   | 5205(2)   | 5303.7    | 28.6(4)           |
| C3   | 7377.5    | 5951.2    | 3568.0    | 19.9(3)           |
| C4   | 7643(2)   | 3305.6    | 4228.9    | 25.7(3)           |
| C5   | 2269.5    | 5753.4    | 3434.2    | 20.9(3)           |
| C6   | 1557.4    | 4628(2)   | 2681.1    | 30.8(4)           |
| C7   | 1596.3    | 5604.3    | 4487.0    | 18.8(3)           |
| C8   | 974.7     | 5521.9    | 5305.8    | 21.2(3)           |

(S)-2-Methyl-N-((S)-5-methylhex-1-yn-3-yl)propane-2-sulfinamide (7c)

Single crystals of C_{11}H_{21}NOS (7c) were achieved out of a saturated solution in Et_2O.
Table S3: Fractional Atomic Coordinates (×10⁴) and Equivalent Isotropic Displacement Parameters (Å²×10³) for 7c. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

|     | x     | y     | z     | $U_{eq}$ |
|-----|-------|-------|-------|----------|
| S(1)| 7880(1)| 7020(1)| 2111(1)| 17(1)    |
| O(1)| 9617(1)| 6189(1)| 2274(1)| 24(1)    |
| N(1)| 7693(1)| 8762(1)| 2485(1)| 19(1)    |
(S)-N-((S)-1-Cyclohexylprop-2-yn-1-yl)-2-methylpropane-2-sulfinamide (7d)

Single crystals of C_{13}H_{23}NOS (7d) were achieved out of a saturated solution in Et_{2}O.
Table S4: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\AA^2\times 10^3$) for $7d$. $U_{eq}$ is defined as $1/3$ of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | x      | y      | z      | U(eq)  |
|------|--------|--------|--------|--------|
| S1   | 4850.7(3) | 7186.4(8) | 2984.7(2) | 18.86(13) |
| O1   | 4233.6(11) | 5726(3) | 3346.1(8) | 35.4(4) |
| N1   | 5283.8(10) | 9543(3) | 3577.4(9) | 18.8(3) |
| C1   | 4100.5(11) | 8906(4) | 2140(1) | 16.4(3) |
| C2   | 4697.8(13) | 10562(4) | 1782.7(12) | 23.7(4) |
(S)-N-((S)-4,4-Dimethylpent-1-yn-3-yl)-2-methylpropane-2-sulfinamide (7e)

Single crystals of C11H21NOS (7e) were achieved out of a saturated solution in EtOAc.
Table S5: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\AA^2 \times 10^3$) for 7e. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | x       | y       | z       | $U_{eq}$ |
|------|---------|---------|---------|----------|
| S1   | 8548.3(5)| 2785.4(4)| 7938.1(2)| 17.89(11) |
| O1   | 10227.9(17)| 1989.8(12)| 7769.9(6)| 24.0(3) |
| N1   | 8117.3(18)| 4096.2(14)| 7365.9(7)| 18.5(3) |
| C1   | 9074(2)  | 3908.6(18)| 8723.7(8)| 19.9(3) |
| C2   | 7561(3)  | 4982(2)  | 8850.7(10)| 31.9(4) |
| C3   | 9181(3)  | 2790(2)  | 9326.6(9)| 25.9(4) |
| C4   | 10861(3)| 4658.1(19)| 8623.7(9)| 25.1(4) |
| C5   | 7310(2)  | 3605.5(17)| 6692.9(8)| 18.3(3) |
| C6   | 8626(2)  | 3639.6(17)| 6112.6(8)| 21.5(3) |
| C7   | 9685(3)  | 3684(2)  | 5646.6(10)| 28.2(4) |
| C8   | 5586(2)  | 4460.8(17)| 6511.3(8)| 19.0(3) |
| C9   | 6011(2)  | 6076.1(18)| 6400.0(9)| 21.7(3) |
| C10  | 4790(2)  | 3819(2)  | 5831.1(9)| 26.2(4) |
| C11  | 4254(2)  | 4268(2)  | 7116.5(10)| 26.8(4) |

(S)-N-[(R)-1-Phenylprop-2-yn-1-yl]-2-methylpropan sulfinamide (7i)

Single crystals of C$_{13}$H$_{17}$NOS (7i) were achieved out of a saturated solution in DCM. Nearly the complete molecule is disordered in ratio 93:7. All atoms of minor occupied part were refined isotropically with idealized geometry of the phenyl rings.
Table S6: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\text{Å}^2 \times 10^3$) for 7i. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$       | $y$        | $z$        | $U_{eq}$   |
|------|-----------|------------|------------|------------|
| S1   | 7828.1(3) | 10703.0(9) | 7870.6(2)  | 25.96(17)  |
| O1   | 8277.5(8) | 9077(3)    | 8212.5(8)  | 39.1(4)    |
| N1   | 7217.5(9) | 9490(3)    | 7406.2(8)  | 24.1(4)    |
| C1   | 8360.5(13)| 11792(4)   | 7265.1(10) | 28.9(5)    |
| C2   | 7910.8(15)| 13337(6)   | 6865.1(15) | 58.7(9)    |
|   |   |   |   |   |
|---|---|---|---|---|
| C3 | 8652.2(16) | 9920(5) | 6900.8(14) | 55.5(8) |
| C4 | 8946.5(16) | 13082(6) | 7612.1(13) | 47.4(7) |
| C5 | 6572.6(10) | 8862(3) | 7700.9(9) | 22.0(4) |
| C6 | 6665.8(11) | 6879(5) | 8089.3(12) | 23.9(4) |
| C7 | 6744.8(11) | 5262(4) | 8391.2(10) | 27.1(5) |
| C8 | 5981.8(10) | 8636(3) | 7208.2(9) | 21.2(4) |
| C9 | 5566.9(10) | 6754(3) | 7153.6(9) | 23.2(4) |
| C10 | 5026.6(11) | 6618(4) | 6699.4(10) | 26.9(4) |
| C11 | 4890.1(10) | 8359(4) | 6299.9(9) | 27.1(5) |
| C12 | 5296.2(11) | 10252(4) | 6356.2(10) | 29.4(5) |
| C13 | 5836.7(10) | 10389(3) | 6805.5(10) | 25.7(4) |
| S2 | 7129.3(2) | 5427.9(8) | 4568.7(2) | 24.50(17) |
| O2 | 6689.4(8) | 3740(3) | 4242.8(8) | 39.8(4) |
| N2 | 7756.2(9) | 4319(3) | 5033.0(8) | 23.6(4) |
| C14 | 6593.9(11) | 6506(3) | 5172.7(9) | 26.1(4) |
| C15 | 5967.7(13) | 7518(5) | 4824.5(11) | 46.0(6) |
| C16 | 7021.5(16) | 8238(6) | 5529.8(16) | 58.0(8) |
| C17 | 6362.3(14) | 4672(5) | 5582.9(12) | 46.0(7) |
| C18 | 8411.9(10) | 3760(4) | 4741(1) | 22.1(4) |
| C19 | 8354.9(10) | 1687(5) | 4387.9(10) | 24.2(5) |
| C20 | 8284.8(10) | 47(4) | 4096.9(10) | 27.6(5) |
| C21 | 9005.5(10) | 3766(3) | 5240.2(9) | 22.7(4) |
| C22 | 9431.4(11) | 1955(4) | 5354.5(9) | 27.4(5) |
| C23 | 9978.2(11) | 2055(4) | 5803.7(10) | 33.2(5) |
| C24 | 10104.1(11) | 3967(4) | 6137.2(10) | 34.4(5) |
| C25 | 9678.4(12) | 5772(4) | 6028.2(12) | 39.3(6) |
| C26 | 9131.4(12) | 5677(4) | 5583.3(11) | 33.5(5) |
| S1B | 7868(3) | 4632(12) | 7964(3) | 25.96(17) |
| O1B | 8322(12) | 6280(40) | 8270(10) | 38(5) |
|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| N1B | 7236(13) | 5700(40) | 7495(11) | 28(5) |
| C1B | 8388(16) | 3400(60) | 7352(14) | 32(7) |
| C2B | 8050(30) | 1960(80) | 7080(20) | 54(12) |
| C3B | 8611(19) | 5280(60) | 6937(17) | 43(8) |
| C4B | 9095(16) | 2190(50) | 7657(15) | 16(7) |
| C5B | 6598(14) | 6320(50) | 7843(15) | 16(7) |
| C6B | 6646(17) | 8020(70) | 8146(16) | 29(8) |
| C7B | 6742(15) | 9980(50) | 8444(14) | 31(6) |
| C8B | 5979(11) | 6390(40) | 7266(10) | 39(8) |
| C9B | 5570(12) | 8270(30) | 7192(10) | 27(6) |
| C10B | 5020(13) | 8310(40) | 6746(12) | 48(9) |
| C11B | 4881(14) | 6490(50) | 6374(13) | 110(20) |
| C12B | 5290(15) | 4610(40) | 6448(12) | 76(14) |
| C13B | 5840(13) | 4560(30) | 6894(12) | 39(7) |
| S2B | 7165(3) | 9458(11) | 4677(3) | 24.50(17) |
| O2B | 6701(13) | 11100(40) | 4336(12) | 46(6) |
| N2B | 7788(13) | 10610(40) | 5154(12) | 30(5) |
| C14B | 6660(20) | 8250(80) | 5240(20) | 55(10) |
| C16B | 7100(30) | 6630(120) | 5570(30) | 94(18) |
| C17B | 6390(20) | 10120(70) | 5664(19) | 55(10) |
| C18B | 8438(12) | 11170(40) | 4856(12) | 17(5) |
| C19B | 8348(14) | 12770(60) | 4447(15) | 14(6) |
| C20B | 8251(13) | 14810(40) | 4147(12) | 22(5) |
| C21B | 9057(9) | 11370(30) | 5342(7) | 31(7) |
| C22B | 9464(10) | 13260(30) | 5396(8) | 20(5) |
| C23B | 9991(9) | 13420(30) | 5861(9) | 23(6) |
| C24B | 10111(8) | 11680(30) | 6271(7) | 23(5) |
| C25B | 9704(9) | 9800(20) | 6217(7) | 24(6) |
| C26B | 9177(9) | 9640(30) | 5753(8) | 24(6) |
(S)-2-Methyl-N-((R)-1-(perfluorophenyl)prop-2-yn-1-yl)propane-2-sulfinamide (7j)

Single crystals of $C_{13}H_{12}F_5NOS$ (7j) were achieved out of a saturated solution in Et$_2$O. The NSO unit is disorder at two positions with ratio 73:27. The anisotropic displacement parameters of these three atoms were constrained to be same pairwisely.
Table S7: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\AA^2 \times 10^3$) for 7j. $U_{eq}$ is defined as 1/3 of of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$   | $y$   | $z$   | $U(eq)$ |
|------|-------|-------|-------|---------|
| S1   | 5074.3(11) | -2084(2) | 7010.6(9) | 25.9(3) |
| S1B  | 5256(3)    | -1807(9)  | 6885(3)   | 25.9(3) |
| F1   | 2475.2(9)  | -3333(3)  | 5104.1(9) | 34.4(4) |
| F2   | 982.5(10)  | -3091(4)  | 5448.4(10)| 40.8(4) |
| F3   | 738.7(10)  | 630(4)    | 6361.7(11)| 43.5(4) |
| F4   | 2025.6(11) | 4075(3)   | 6945(1)   | 39.9(4) |
| F5   | 3513.1(9)  | 3889(3)   | 6595.3(10)| 34.5(4) |
| O1   | 5588(2)    | -3759(7)  | 6691.6(19)| 49.5(10) |
| O1B  | 5907(7)    | -2700(20) | 6544(5)   | 49.5(10) |
| N1   | 4736(6)    | 356(17)   | 6359(4)   | 24.6(11) |
| N1B  | 4708(18)   | 580(60)   | 6524(14)  | 24.6(11) |
| C1   | 5918.5(15) | -521(5)   | 7928.5(15)| 26.0(5) |
| C2   | 5368.4(16) | 1094(5)   | 8258.8(16)| 31.9(6) |
| C3   | 6345.5(18) | -2568(5)  | 8542.2(16)| 35.3(6) |
| C4   | 6634.6(17) | 841(6)    | 7723.3(18)| 37.6(6) |
| C5   | 3899.2(14) | 81(5)     | 5633.4(15)| 28.4(5) |
| C6   | 3863.1(15) | 1923(6)   | 5011.6(15)| 31.2(6) |
| C7   | 3850.0(15) | 3426(6)   | 4523.2(16)| 35.4(7) |
| C8   | 3057.0(14) | 229(5)    | 5849.3(14)| 23.8(5) |
| C9   | 2390.4(15) | -1476(5)  | 5567.0(13)| 25.9(5) |
| C10  | 1607.7(16) | -1376(5)  | 5730.9(15)| 29.3(5) |
| C11  | 1489.0(16) | 500(6)    | 6194.7(15)| 30.0(5) |
| C12  | 2141.5(16) | 2255(5)   | 6488.0(14)| 28.8(6) |
| C13  | 2914.0(15) | 2115(5)   | 6310.9(14)| 26.4(5) |
(S)-2-Methyl-N-((R)-1,1,1-trifluorobut-3-yn-2-yl)propane-2-sulfinamide (7k)

Single crystals of C_{13}H_{12}F_{5}NOS (7k) were achieved out of a saturated solution in EtOAc. One C(CCH)(CF_{3}) unit is disordered in ratio 51:49. The anisotropic displacement parameters of these atoms were constrained to be same pairwisely. The N-H distances were restrained to a value of 0.86 Å.
Table S8: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\AA^2 \times 10^3$) for 7k. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | x      | y      | z       | $U_{eq}$ |
|------|--------|--------|---------|----------|
| S1   | 7760.9(13) | 9077.2(11) | 3804.3(4) | 36.5(3) |
| F1   | 7273(4)   | 9709(3)  | 4812.8(10) | 53.6(8) |
| F2   | 5421(4)   | 9013(3)  | 5078.7(10) | 58.8(9) |
| F3   | 7090(4)   | 7752(3)  | 4991.4(11) | 54.4(9) |
| O1   | 7269(4)   | 8891(3)  | 3365.0(11) | 42.2(8) |
|     |      |      |      |      |
|-----|------|------|------|------|
| N1  | 7071(5) | 8024(4) | 4120.7(14) | 37.2(9) |
| C1  | 9492(5) | 8446(5) | 3808.4(17) | 41.1(11) |
| C2  | 9504(6) | 7069(6) | 3679(2) | 54.1(15) |
| C3  | 10270(6) | 9245(6) | 3484.2(18) | 50.5(14) |
| C4  | 10059(7) | 8666(7) | 4247.5(19) | 63.0(17) |
| C5  | 5926(5) | 8383(5) | 4379.5(17) | 37.4(7) |
| C6  | 5095(5) | 9405(5) | 4208.4(18) | 42.4(8) |
| C7  | 4477(6) | 10243(6) | 4055(2) | 56.3(10) |
| C8  | 6423(6) | 8719(5) | 4819.1(18) | 45.0(13) |
| S2  | 5700.7(12) | 4808.3(11) | 4256.3(4) | 34.4(3) |
| F4  | 1123(3) | 4290(3) | 3811.1(13) | 57.1(9) |
| F5  | 2207(4) | 4129(4) | 4395.7(11) | 60.8(9) |
| F6  | 2253(3) | 2619(3) | 3952.6(12) | 53.5(8) |
| O2  | 6794(4) | 5379(3) | 3994.1(12) | 44.1(9) |
| N2  | 4720(4) | 3890(4) | 3964.4(14) | 34.3(9) |
| C9  | 6528(5) | 3589(5) | 4573.9(18) | 41.0(12) |
| C10 | 7297(6) | 2664(5) | 4298(2) | 51.3(14) |
| C11 | 7476(7) | 4334(6) | 4861(2) | 58.5(17) |
| C12 | 5423(6) | 2932(6) | 4835.4(19) | 52.9(14) |
| C13 | 3502(5) | 4435(4) | 3775.6(18) | 37.4(7) |
| C14 | 3433(5) | 5810(5) | 3788.7(18) | 42.4(8) |
| C15 | 3405(6) | 6922(6) | 3791(2) | 56.3(10) |
| C16 | 2266(5) | 3882(5) | 3989.2(17) | 40.0(11) |
| S3  | 5297.5(13) | 2044.2(11) | 2848.1(4) | 36.4(3) |
| F7A | 7850(40) | 2060(40) | 2116(16) | 55(4) |
| F7B | 7580(40) | 2290(40) | 2157(15) | 55(4) |
| F8A | 8070(30) | 20(20) | 2140(8) | 67(4) |
| F8B | 8280(30) | 390(20) | 2220(8) | 67(4) |
| F9A | 9710(20) | 1249(17) | 2323(7) | 85(4) |
| Atom | U (Å²) 1 | U2 (Å²) 1 | U3 (Å²) 1 | U12 (Å²) 1 | U13 (Å²) 1 | U23 (Å²) 1 |
|------|----------|----------|----------|------------|------------|------------|
| F9B  | 9630(20) | 1920(16) | 2369(7)  | 85(4)      |            |            |
| O3   | 4824(4)  | 2244(3)  | 3290.3(11)| 42.2(8)    |            |            |
| N3   | 6475(4)  | 939(4)   | 2835.2(15)| 42.4(10)   |            |            |
| C17  | 3941(6)  | 1168(7)  | 2594.1(19)| 52.6(15)   |            |            |
| C18  | 2760(7)  | 2120(10) | 2593(3)  | 95(3)      |            |            |
| C19  | 3633(8)  | -26(7)   | 2841(3)  | 83(3)      |            |            |
| C20  | 4381(7)  | 883(8)   | 2145(2)  | 72(2)      |            |            |
| C21A | 7890(12) | 1105(11) | 2793(4)  | 37.4(7)    |            |            |
| C21B | 7881(12) | 1507(11) | 2841(4)  | 37.4(7)    |            |            |
| C22A | 8324(13) | 2333(13) | 2994(4)  | 42.4(8)    |            |            |
| C22B | 8082(13) | 2687(13) | 3066(4)  | 42.4(8)    |            |            |
| C23A | 8577(16) | 3279(14) | 3180(5)  | 56.3(10)   |            |            |
| C23B | 8163(15) | 3629(14) | 3236(5)  | 56.3(10)   |            |            |
| C24A | 8400(30) | 1070(30) | 2343(10) | 48(4)      |            |            |
| C24B | 8350(30) | 1510(20) | 2418(9)  | 48(4)      |            |            |

(S)-2-Methyl-N-((R)-1,1,1-trichlorobut-3-yn-2-yl)propane-2-sulfinamide (7I)

Single crystals of C$_8$H$_{12}$Cl$_3$NOS (7I) were achieved out of a saturated solution in DCM/Et$_2$O, 1:2.
Table S9: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\AA^2 \times 10^3$) for propargylamine 7l. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$   | $y$       | $z$       | $U_{eq}$ |
|------|-------|-----------|-----------|----------|
| Cl1  | 3854(3)| 3874.3(16)| 6848.8(8) | 39.4(5)  |
| Cl2  | 7752(3)| 5568.0(18)| 6928.0(8) | 41.6(5)  |
| Cl3  | 3641(3)| 6492.0(16)| 6324.8(8) | 40.1(5)  |
| S1   | 6445(3)| 1954.7(14)| 5685.1(7) | 26.7(4)  |
| O1   | 6925(7)| 1547(4)   | 5011(2)   | 29.8(10) |
| N1   | 7652(9)| 3412(5)   | 5844(3)   | 27.6(11) |
| C1   | 8229(12)| 902(6)    | 6208(3)   | 33.9(14) |
| C2   | 10723(12)| 1067(7)  | 6052(3)   | 35.9(15) |
| C3   | 7415(13)| -495(7)   | 6062(4)   | 45.9(19) |
| C4   | 7715(13)| 1292(8)   | 6909(3)   | 41.4(17) |
|  |  |  |  |  |
|---|---|---|---|---|
| C5 | 6220(12) | 4581(6) | 5772(3) | 30.0(13) |
| C6 | 5445(12) | 5109(7) | 6443(3) | 34.0(15) |
| C7 | 7421(11) | 5629(6) | 5430(3) | 28.4(13) |
| C8 | 8451(13) | 6461(7) | 5161(4) | 38.8(15) |

(S)-N-((S)-6-Cyanohex-1-yn-3-yl)-2-methylpropane-2-sulfinamide (7q)

Single crystals of $C_{11}H_{18}N_2OS$ (7q) were achieved out of a saturated solution in EtOAc.
Table S10: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 7q. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{ij} tensor.

| Atom | x     | y     | z     | U(eq)  |
|------|-------|-------|-------|--------|
| S1   | 2694.2(4) | 6821.9(4) | 3380.1(2) | 15.64(10) |
| O1   | 815.5(13)  | 6379.1(12) | 3473.2(6)  | 24.4(2)   |
| N1   | 4006.7(16)  | 5374.0(13) | 3643.7(6)  | 14.2(2)   |
| N2   | 8058.6(19)  | 1710.6(16) | 5076.5(6)  | 27.4(3)   |
| C1   | 3170(2)     | 8274.2(16) | 4040.2(7)  | 18.8(3)   |
| C2   | 2906(2)     | 7528.6(19) | 4724.4(7)  | 24.4(3)   |
| C3   | 5041(2)     | 8856.7(18) | 3936.1(7)  | 22.3(3)   |
| C4   | 1839(3)     | 9596.2(19) | 3921.3(9)  | 31.5(4)   |
| C5   | 4616.7(18)  | 4270.9(16) | 3121.2(6)  | 15.0(3)   |
| C6   | 3182.5(19)  | 3405.8(16) | 2786.4(7)  | 18.4(3)   |
| C7   | 2039(2)     | 2751.5(18) | 2488.9(7)  | 23.3(3)   |
| C8   | 5970.1(17)  | 3153.9(15) | 3436.4(6)  | 15.7(3)   |
| C9   | 7639(2)     | 4017.0(17) | 3633.3(7)  | 21.2(3)   |
| C10  | 9037(2)     | 2945.1(19) | 3941.0(8)  | 24.1(3)   |
| C11  | 8491(2)     | 2250.1(16) | 4578.7(7)  | 20.6(3)   |

*tert*-Butyl-((S)-4-(((S)-tert-butylsulfinyl)amino)hex-5-inoate (7s)

Single crystals of C_{14}H_{25}NO_{3}S (7s) were achieved out of a saturated solution in EtOAc.
Table S11: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\text{Å}^2 \times 10^3$) for 7s. $U_{eq}$ is defined as $1/3$ of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$       | $y$       | $z$       | $U_{eq}$    |
|------|-----------|-----------|-----------|-------------|
| S1   | 7903.9(6) | 5097.1(3) | 7148.7(2) | 18.42(11)   |
| O1   | 10079(2)  | 4508.1(11)| 7057.4(5) | 27.3(3)     |
| O2   | -1022(2)  | 5817.7(11)| 5440.9(5) | 22.3(3)     |
| O3   | 686.4(18) | 4938.6(10)| 4704.4(4) | 18.9(2)     |
| N1   | 6662(2)   | 5389.8(12)| 6531.2(6) | 18.2(3)     |
| C1   | 8608(3)   | 6584.0(14)| 7356.4(7) | 18.3(3)     |
(S)-2-Methyl-N-((R)-1,1,1-trifluoropropan-2-yl)propane-2-sulfinamide (10k)

Single crystals of C$_7$H$_{14}$F$_3$NOS (10k) were achieved out of a saturated solution in EtOAc.
Table S12: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 10k. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{ij} tensor.

| Atom | x      | y      | z      | U(eq)  |
|------|--------|--------|--------|--------|
| S1   | 8146.3(6) | 7780.4(4) | 5813.0(2) | 12.92(9) |
| F1   | 10538(2)  | 3219.2(11) | 6109.6(6) | 25.2(2)  |
| F2   | 7680(2)   | 3890.0(12) | 6758.6(6) | 28.5(3)  |
| F3   | 10563(2)  | 5288.4(12) | 6609.2(6) | 26.3(2)  |
| O1   | 7612.7(19) | 8589.2(13) | 5142.0(6) | 16.8(2)  |
| N1   | 6760(2)   | 6224.1(14) | 5807.8(7) | 14.9(2)  |
| C1   | 9212(3)   | 4347.0(18) | 6275.4(8) | 18.3(3)  |
| C2   | 8103(3)   | 4964.2(17) | 5609.8(8) | 14.8(3)  |
| C3   | 6546(3)   | 3856(2)  | 5265.9(10) | 23.7(4)  |
| C4   | 6511(3)   | 8669.5(18) | 6528.3(8) | 15.8(3)  |
| C5   | 7096(3)   | 7886(2)  | 7220.4(9) | 21.7(3)  |
| C6   | 7420(3)   | 10196(2) | 6541.9(11) | 25.0(4)  |
| C7   | 3944(3)   | 8636(2)  | 6378.9(10) | 21.7(4)  |

Methyl 4-(((S)-3-(((S)-tert-Butylsulfinyl)amino)-3-phenylprop-1-yn-1-yl)benzoate (11i)

Single crystals of C_{21}H_{23}NO_{3}S (11i) were achieved out of a saturated solution in CHCl₃. The crystal was twinned with ratio 60:40 by a rotation of 180° around 100. Both domains were taken into account during data reduction and refinement.
Table S13: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\text{Å}^2 \times 10^3$) for 11i. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | x      | y      | z      | $U(\text{eq})$ |
|------|--------|--------|--------|---------------|
| S1   | 3625.0(14) | 1722(3) | 5182.7(8) | 17.6(3)       |
| O1   | 5017(4)  | 2166(8) | 5617(3) | 21.3(10)     |
| O2   | 8272(6)  | 5050(11) | -390(4) | 39.8(14)     |
| O3   | 7635(5)  | 8606(9) | -177(3) | 25.5(11)     |
| N1   | 3295(6)  | 3101(10) | 4254(3) | 20.3(11)     |
| Atom | Atom Atomic | | Atom Atomic | | Atom Atomic |
|------|-------------|---|-------------|---|-------------|
| C1   | 2594(6)     | 3384(12) | 5789(4) | 21.5(13) |
| C2   | 1180(6)     | 2645(13) | 5458(4) | 24.9(14) |
| C3   | 3065(7)     | 2617(14) | 6717(4) | 28.3(16) |
| C4   | 2786(7)     | 5923(12) | 5694(4) | 25.4(14) |
| C5   | 3283(6)     | 1620(13) | 3498(3) | 18.0(11) |
| C6   | 1901(6)     | 1006(11) | 3050(3) | 18.7(13) |
| C7   | 1676(7)     | -1122(13) | 2655(4) | 23.8(14) |
| C8   | 445(7)      | -1634(13) | 2184(4) | 24.6(14) |
| C9   | -573(7)     | -43(13)   | 2103(4) | 25.1(14) |
| C10  | -351(6)     | 2018(14)  | 2513(4) | 24.7(15) |
| C11  | 885(7)      | 2566(12)  | 2984(4) | 22.4(13) |
| C12  | 3964(6)     | 2721(13)  | 2873(4) | 20.1(13) |
| C13  | 4477(6)     | 3494(13)  | 2324(4) | 20.2(13) |
| C14  | 5203(6)     | 4279(12)  | 1692(4) | 20.5(14) |
| C15  | 5001(6)     | 6405(13)  | 1306(4) | 22.0(14) |
| C16  | 5779(6)     | 7106(12)  | 736(4)  | 21.1(14) |
| C17  | 6741(6)     | 5669(12)  | 536(3)  | 19.0(13) |
| C18  | 6922(7)     | 3527(13)  | 897(4)  | 21.6(13) |
| C19  | 6160(6)     | 2839(12)  | 1477(4) | 21.4(14) |
| C20  | 7613(6)     | 6354(13)  | -59(4)  | 22.9(15) |
| C21  | 8496(7)     | 9386(15)  | -739(4) | 29.8(16) |

Methyl 4-((1E,3Z)-3-(((S)-tert-Butylsulfinyl)imino)-3-phenylprop-1-en-1-yl)benzoate (12i)

Single crystals of C_{21}H_{23}NO_{3}S (12i) were achieved out of a saturated solution in CHCl_{3}. 
Table S14: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\text{Å}^2 \times 10^3$) for 12i. $U_{eq}$ is defined as $1/3$ of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$     | $y$     | $z$     | $U(eq)$ |
|------|---------|---------|---------|---------|
| S1   | 5313.5(11) | 5191.5(6) | 3501.6(2) | 26.65(17) |
| O1   | 3568(4)     | 6178(2)  | 3586.6(8) | 40.6(6)   |
| O2   | -7437(3)    | 5126(2)  | 5629.0(7) | 33.0(5)   |
| Atom | X  | Y  | Z  | U11 | U22 | U33 | U12 | U13 | U23 |
|------|----|----|----|-----|-----|-----|-----|-----|-----|
| O3   | -5236(3) | 6883.7(17) | 5585.6(6) | 28.8(4) |
| N1   | 4352(4) | 3670(2) | 3444.7(7) | 24.7(5) |
| C1   | 6103(4) | 5394(3) | 2929.1(8) | 23.5(5) |
| C2   | 7134(6) | 6752(3) | 2910.6(10) | 37.5(7) |
| C3   | 4073(5) | 5320(3) | 2643.6(10) | 35.3(7) |
| C4   | 7818(5) | 4369(3) | 2822.5(10) | 32.6(6) |
| C5   | 2672(4) | 3189(3) | 3652.1(8) | 21.8(5) |
| C6   | 2266(4) | 1784(2) | 3565.6(8) | 20.8(5) |
| C7   | 296(5) | 1351(2) | 3386.1(8) | 24.2(5) |
| C8   | -3(5) | 38(3) | 3299.2(9) | 26.5(5) |
| C9   | 1650(5) | -848(3) | 3403.3(9) | 28.0(6) |
| C10  | 3592(5) | -420(3) | 3591.3(10) | 30.6(6) |
| C11  | 3923(5) | 892(3) | 3668.3(9) | 27.3(6) |
| C12  | 1280(4) | 3866(2) | 3967.0(8) | 22.5(5) |
| C13  | -305(4) | 3275(2) | 4199.4(8) | 22.0(5) |
| C14  | -1651(4) | 3914(2) | 4530.8(8) | 21.1(5) |
| C15  | -3746(4) | 3405(2) | 4629.2(8) | 22.4(5) |
| C16  | -5087(4) | 3993(2) | 4932.5(8) | 22.9(5) |
| C17  | -4345(4) | 5092(2) | 5150.5(8) | 21.0(5) |
| C18  | -2247(5) | 5597(3) | 5062.6(9) | 25.5(6) |
| C19  | -924(4) | 5005(3) | 4755.1(9) | 24.3(5) |
Methyl 3-\(((1E,3Z)-3-(((S)-\text{tert-Butylsulfinyl})\text{imino})-4,4,4\text{-tri‐fluorobut-1-en-1-yl})\text{benzoate (12k)}}

Single crystals of C_{11}H_{7}F_{3}O_{3} (12k) were achieved out of a saturated solution in CHCl_{3}.

Table S15: Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 12k. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{ij} tensor.

| Atom | x      | y      | z        | U(eq)   |
|------|--------|--------|----------|---------|
| F1   | 1467.9(9) | 6458.8(17) | 1152.3(11) | 49.7(5) |
| F2   | 1058(1)   | 6633.7(18) | 2521.6(13) | 56.5(5) |
| F3   | 583.9(10) | 5069.4(19) | 1493.9(16) | 82.2(8) |
| O1   | 1913(1)   | 3810.2(18) | 2611.1(13) | 37.3(5) |
| O2   | 6460.9(10) | 2704.4(18) | 4669.3(12) | 33.6(5) |
| O3   | 7476.2(10) | 4218(2)   | 4694.8(13) | 34.1(5) |
| C1   | 4484.7(13) | 5390(2)   | 3557.0(15) | 21.7(5) |
| C2   | 5145.0(14) | 4473(3)  | 3864.5(17) | 24.0(6)  |
| C3   | 6004.6(13) | 4855(3)  | 4202.6(16) | 22.9(5)  |
| C4   | 6213.4(14) | 6167(3)  | 4242.9(17) | 26.6(6)  |
| C5   | 5567.0(15) | 7082(3)  | 3956.6(17) | 26.9(6)  |
| C6   | 4707.5(14) | 6706(3)  | 3608.7(17) | 24.8(6)  |
| C7   | 3593.3(14) | 4922(3)  | 3204.7(17) | 24.5(6)  |
| C8   | 2877.7(13) | 5612(3)  | 2801.6(17) | 24.7(6)  |
| C9   | 2046.3(14) | 4945(3)  | 2468.1(18) | 27.8(6)  |
| C10  | 1276.7(15) | 5782(3)  | 1898(2)    | 39.0(7)  |
| C15  | 6668.0(14) | 3833(3)  | 4538.2(16) | 25.9(6)  |

(S)-2-Methyl-N-((S)-3-(Trimethylsilyl)-4,5,6,7-tetrahydro-[1,2,3]triazolo[1,5-a]pyridin-4-yl)propane-2-sulfinamide (13w)

Single crystals of C_{15}H_{26}N_{4}OSSi (13w) were achieved out of a saturated solution in toluene.
Table S16: Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($\text{Å}^2 \times 10^3$) for 13w. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{ij}$ tensor.

| Atom | $x$    | $y$     | $z$     | $U_{eq}$  |
|------|--------|---------|---------|-----------|
| S1   | 7886.8(4) | 4926.8(3) | 6980.4(2) | 17.48(9)  |
| Si1  | 4242.6(5) | 4312.6(4) | 4794.9(3) | 16.7(1)   |
| O1   | 7588.4(15)| 3706.2(11)| 6735.9(8) | 28.0(3)   |
| N1   | 6982.1(15)| 5879.4(12)| 6404.5(8) | 17.0(3)   |
| N2   | 3991.5(16)| 7522.0(11)| 5766.3(8) | 16.6(3)   |
|   |       |       |       |       |
|---|-------|-------|-------|-------|
| N3| 3223.0(18) | 7664.4(12) | 5080.6(9) | 20.8(3) |
| N4| 3235.2(16) | 6654.8(12) | 4714.0(9) | 20.0(3) |
| C1| 9879.4(18) | 5246.7(14) | 6671.3(10) | 18.4(3) |
| C2| 10248(2) | 6508.0(16) | 6874.0(13) | 29.8(4) |
| C3| 10861(2) | 4409.7(16) | 7167.8(11) | 25.6(4) |
| C4| 10072.8(19) | 4976.3(17) | 5795.5(10) | 24.8(4) |
| C5| 5319.6(17) | 6029.0(14) | 6583.2(9) | 15.7(3) |
| C6| 5113.7(19) | 6918.2(15) | 7249.5(10) | 20.1(3) |
| C7| 5401.8(19) | 8147.2(15) | 6934.7(11) | 21.8(3) |
| C8| 4167(2) | 8474.0(14) | 6336.7(10) | 21.9(3) |
| C9| 4481.3(17) | 6410.7(13) | 5848.5(9) | 14.7(3) |
| C10| 4005.2(17) | 5844.8(13) | 5167.9(10) | 16.0(3) |
| C11| 4213(2) | 3269.7(14) | 5643.2(11) | 24.1(3) |
| C12| 6144(2) | 4190.3(17) | 4278.8(11) | 27.5(4) |
| C13| 2626.6(19) | 4024.2(15) | 4095.1(10) | 22.7(3) |
Spectra

Ethyl (3-hydroxypropynyl)-benzoate derivatives 1
Ethyl (3-Oxopropynyl)-benzoate derivatives 2
Ethyl (tert-Butylsulfinyl)imino)propynyl)benzoate derivatives 3
[Chemical structures and spectra images]
Ethyl benzoate substituted propargylamine derivatives 4
Chiral aldimes 5

([S,E]-N-ethylidene-2-tort-butylsulfynamide (5a))

([S,E]-N-ethylidene-2-tort-butylsulfynamide (5a))
Trimethylsilyl protected propargylamines 6

\[ \text{(S)-N-((S)-4-Methyloxazolidin-2-yl)methanimino-(1-azido-3-ynyl)-N-(tert-butylsulfonylamide (6a))} \]

\[ \text{(S)-N-((S)-4-Dimethylsilyl)methanimino-(1-azido-3-ynyl)-N-(tert-butylsulfonylamide (6c))} \]
Propargylamines 7
(S)-N-(4-Dimethylaminomethyl-1-ym-3-yl) tert-butylationamide (7a)

(S)-N-(4)-1, (S5,5,7S)-Adamantane-1-y)pro-2-yn-1-yl) tert-butylationamide (7M)

S153
Hydrolysis of imine 5 forms hemiaminal 8
(S)-N-(2,2,2-Trichloro-1-hydroxyethyl)-l-tyrosine (86)
Side-product 9k of the conversion of 5k under conditions GP-3
Side-product 10k of the conversion of 5k under conditions GP-4
Sonogashira cross-coupling products: Peptidomimetics 11
Rearrangement products: α,β-unsaturated imines 12
Intramolecular Huisgen reaction of 6w gives triazole 13w
Intramolecular Huisgen reaction of \textbf{7wx} gives triazole \textbf{14w}

\textbf{Intramolecular Huisgen Reaction, triazole 14w/alkyne 7wx, 2:1}
