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Asymmetric Transfer Hydrogenation - Dynamic Kinetic Resolution of α-Amino Ketones

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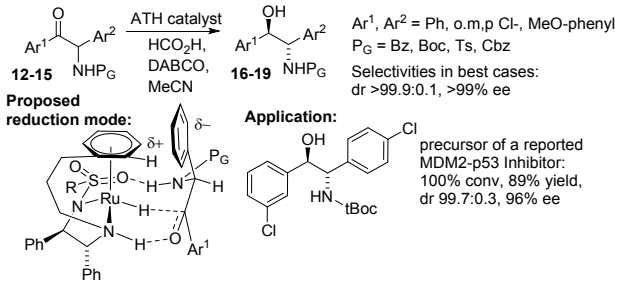
Supporting Information Placeholder



ABSTRACT: A series of α-amino ketones were reduced using asymmetric transfer hydrogenation (ATH) through a dynamic kinetic resolution (DKR). The protecting group was matched to the reducing agent and following optimization, a series of substrates were investigated, giving products in high diastereoselectivity, over 99% ee in several cases and full conversion. The methodology was applied to the enantioselective synthesis of a MDM2–p53 inhibitor precursor.

Introduction

Asymmetric Transfer Hydrogenation (ATH), using [(arene)Ru(TsDPEN)Cl] pre-catalysts **1**, including the class of complexes **2** and **3**, is a powerful method for the asymmetric reduction of ketones (Figure 1).[1-3] The pre-catalyst forms a hydride which transfers hydrogen to the substrate in a stereochemically-predictable manner (Figure 1).[4]

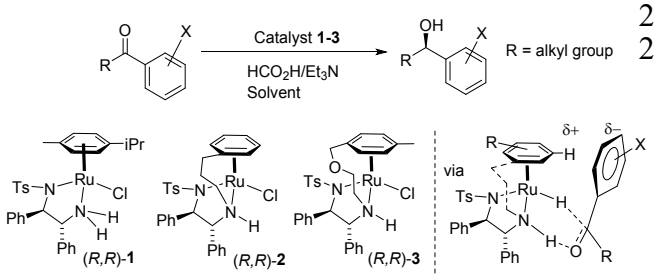
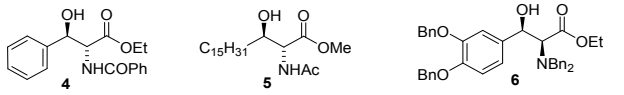


Figure 1. Asymmetric Transfer Hydrogenation (ATH) of acetophenones by [(arene)Ru((*R,R*)-TsDPEN)Cl] catalysts **1-3** and orientation of substrate to catalyst in reduction step.

ATH in combination with dynamic kinetic resolution (DKR) has been used to good effect.[5-12] For α-amino ketones,[6-12] ATH-DKR of α–amino-β-keto esters have been reported (Figure 2A).[6-9] In an example by Echeverria *et al*., reduction of a β-keto-α-amino ester gave **4** in up to 83/17 *anti/syn* and 98% ee using catalyst **2**.[6] Researchers at Takasago described the large scale ATH-DKR of α-N-acylamino-β-keto esters using ATH to **5** using catalyst **3**.[7] An efficient DKR-ATH was achieved in the synthesis of enantiomeric pure *syn*-β-hydroxy-α-dibenzylamino esters[8] to make **6**.

Products of ATH-DKR of α-amino-β-keto-esters:

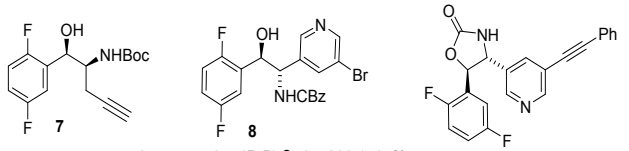


Using catalyst (*S,S*)-**2**: 83/17 *anti/syn* and 98% ee Via reduction of the amine hydrochloride precursor

Using catalyst (*R,R*)-**3**: 69.4% de, 97% ee prepared on 58 kg scale: >99% de, >99% ee

Using catalyst (*R,R*)-**3**: 98% yield, >20:1 dr, >99% ee Droxidopa precursor

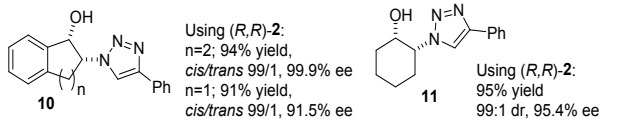
Products of ATH-DKR of other α-amino ketones:



using catalyst (*R,R*)-**3**: 93% yield, dr 96:4, 99% ee

using (*R,R*)-**2**: dr >200:1, 97% ee
using (*R,R*)-**3**: dr >200:1, 98% ee

9 (from **8** prepared using *S,S*)-catalyst)



Using (*R,R*)-**2**:
n=2; 94% yield, *cis/trans* 99/1, 99.9% ee
n=1; 91% yield, *cis/trans* 99/1, 91.5% ee

Using (*R,R*)-**2**: 95% yield 99:1 dr, 95.4% ee

This work:

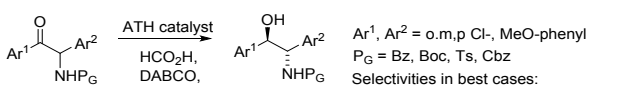


Figure 2. Products of ATH-DKR of α-amino ketones of different classes.

α–Amino ketones in which racemisation is slower have been less investigated.[10-12] The ATH-DKR of a Boc-protected α-amino ketone to alcohol **7** was employed in the synthesis of the type 2 diabetes drug omariglyptin (Figure 2B).[10] The ATH/DKR, using a range of catalysts including **2** and **3** gave amino alcohol **8** in 97-98% ee and a dr of >200:1 (Figure 2B).[11] Intramolecular cyclisation, with inversion of configuration, led to the mGluR5 **9**.[11] Other relevant ATH-DKRs of α-amino ketones have led to cis-β-azolo-α-cycloalkanols **10** and **11** (Figure 2B).[12] We were interested in establishing the scope of the ATH/DKR of α-amino ketones (Figure 2C), as the extension of the methodology would provide access to a range of valuable target molecules.

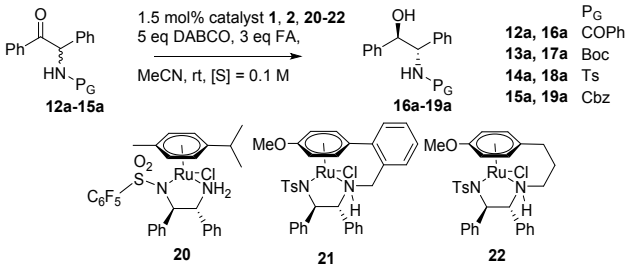
Results and Discussion

Compounds **12a-14a** (Table 1)were prepared *via* bromination of α-phenylacetophenone, reaction with potassium phthalimide, then deprotection and addition of the N-protecting group, whereas **15a** was prepared through the reaction of an acylimine with benzaldehyde using a thiazolium catalyst[13] (Supporting Information). A series of conditions were tested using catalyst (*R,R*)-**2**. Racemic standards were prepared by reduction with $NaBH_4$, which was less diastereoselective than the ATH-DKR and allowed the minor diastereomers to be identified by HPLC (other than for **16a**). In all cases, the *anti*-products **16a-19a** (Table S1, Table 1) were predominantly formed.[14] Using FA/TEA azeotrope (5:2) with DCM (A, Table S1), the medium in the reduction of **12a** became heterogeneous after 24h. Both precipitate and filtrate from the reaction contained product of high dr, however of differing ee. Using a 1:1 ratio of FA:TEA (B, Table S1), conversion was incomplete and the ees were lower. Using a combination of 5:3 DABCO/FA (C, Table S1).[11] gave a product in improved ee, which did not change significantly when a 5:6 ratio of reagents was used (D, Table S1).

Reduction of N-Boc-protected substrate **13a** using both TEA and DABCO as base with catalyst (*R,R*)-**2** (A and C, Table S1) also revealed that the latter base gave the best result. Working up the reductions of **12a** and **13a** with a DCM extraction gave a product which reflected the overall ee of the reaction (Table S1, Table 1). The N-Ts-protected substrate **14a** was reduced in an excellent 99% ee under conditions C (Table S1, Table 1) with catalyst (*R,R*)-**2** whereas the best ee for the reduction of the N-Cbz-protected substrate **15a** was just 44% (Table S1, Table 1); the reactions for the formation of both **18a** and **19a** remained homogeneous. The X-ray crystallographic structure of the major enantiomer of **18a** (Supporting Information) confirmed both its absolute configuration and the *anti*-diastereoselectivity matches the related product **8** containing a Cbz group.[11]

Since slow racemisation can reduce the potential for the formation of high ee products in DKR reactions, they were followed over time. The substrates (with the exception of **18a**) remained essentially racemic throughout (Scheme S1, Table S2), confirming that racemisation is rapid. The product ees remained consistent (within ca. 5%) throughout the reductions. Hence the catalyst controls the reduction of one enantiomer of ketone substrate over the other, however the N-protecting group also has an influence on the selectivity.

Table 1. Catalyst screening on substrates **12a-15a**, and catalysts (*R,R*)-**1**, **2** and **20-22**.



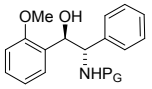
Catalyst	Substrate	t/h	Conv[a] /% (dr)[b] yield	Ee[c] /%
(*R,R*)-**2**	**12a**	24	100 (>99.9:<0.1[d]) 60% yield	25
(*R,R*)-**1**	**12a**	72	95 (>99.9:<0.1[d])	76
(*R,R*)-**20**	**12a**	72	70 (>99.9:<0.1[d])	94
(*R,R*)-**21**	**12a**	24	100 (>99.9:<0.1[d])	61
(*R,R*)-**22**	**12a**	48	63 (>99.9:<0.1[d])	69 [e]
(*R,R*)-**2**	**13a**	24	100 (>99.9:<0.1) 65% yield	73
(*R,R*)-**1**	**13a**	72	91 (>99.9:<0.1[f])	94
(*R,R*)-**20**	**13a**	72	96 (>99.9:<0.1)	93
(*R,R*)-**21**	**13a**	24	100 (>99.9:<0.1)	76
(*R,R*)-**22**	**13a**	48	46 (ca. 95:5[g])	12 [e]
(*R,R*)-**2**	**14a**	24	100 (>99.9:<0.1) 69% yield	99
(*R,R*)-**1**	**14a**	72	89 (>99.9:<0.1[h])	>99
(*R,R*)-**20**	**14a**	72	97 (>99.9:<0.1)	98
(*R,R*)-**21**	**14a**	24	100 (>99.9:<0.1)	94
(*R,R*)-**22**	**14a**	48	21 (>99.9:<0.1[h])	69
(*R,R*)-**2**	**15a**	24	100 (>99.9:<0.1) 59% yield	44
(*R,R*)-**1**	**15a**	72	39 (>99.9:<0.1)	71
(*R,R*)-**20**	**15a**	48	98 (>99.9:<0.1)	85
(*R,R*)-**21**	**15a**	24	100 (>99.9:<0.1)	67
(*R,R*)-**22**	**15a**	48	54 (>99.9:<0.1)	60 [d]

a. HPLC conversions and ee of isolated product using (*R,R*)-**2** and of crude product for other catalysts; b. >99.9:<0.1 indicates only one diastereoisomer observed by chiral HPLC. c. ee of major diastereoisomer. d. Minor diastereoisomer not detected in racemic reduction. e. opposite enantiomer of product formed. f. tentative as HPLC did not run to minor isomer. g. Estimated as minor diastereoisomer was not integrated. h. tentatively assigned as some small HPLC peaks are of similar RT to minor diastereomer.

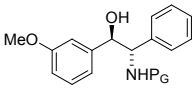
We evaluated a series of catalysts; (*R,R*)-**1** and (*R,R*)-**20**,[9e] (*R,R*)-**21**,[3f] and (*R,R*)-**22**,[3g] under the same conditions for each substrate (Table 1). Catalyst **1** and the pentafluorinated (*R,R*)-**20** gave product **16a** in good ee however they were slow compared to the $CH_2(C_6H_4)$-linked catalyst (*R,R*)-**21**. Catalyst (*R,R*)-**20** generated a product of 94% ee in the reduction of **12a** compared to just 25% ee with catalyst (*R,R*)-**2**. The tosyl substrate **14a** gave a product in >90% ee with all the catalysts except (*R,R*)-**22**. Catalysts (*R,R*)-**1** and (*R,R*)-**20** gave similar results with N-Boc-protected**13a**. Although there is no direct evidence, there is potential for a reduction product such as **18a** to replace the ligand in the catalysts, and this is likely to happen more rapidly with untethered complexes.[2b] Catalyst (*R,R*)-**22** was found to be the least active and in several cases gave the opposite enantiomer of product, although still a high dr. Acetophenone reduction with catalyst (*R,R*)-**22** gave the (*R*)-

alcohol, as expected. As a result of this study, two catalyst/substrate systems were selected for further study; fluorinated catalyst (*R,R*)-**20** with N-Boc-protected substrate **13a** and complex (*R,R*)-**2** with N-Ts-protected compound **14a**. A solvent study was carried out (Supporting information, Table S3) however none of the alternative solvents, or solvent–free conditions, improved the results.

The reduction of a range of substrates; **13b-13l** and **14b--14l** and the precursors to **23-27**, were undertaken (Figure 3). The N-Boc-protected ketones,[13] were prepared initially, then the N-Ts-protected ketones were prepared via their deprotection followed by N-tosylation. A representative series of substrates were prepared with electron-donating (OMe) and electron-withdrawing (Cl) substituents at the *o*-, *m*- and *p*- positions of each aromatic ring Ar^1/Ar^2. In addition, one NMs product (**23**) was formed by reduction of the corresponding ketone, as were **24-27** in which one phenyl ring was replaced by a methyl.



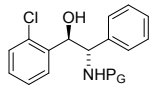
17b P_G=Boc; cat. (*R,R*)-**20**, 48h: 100% conv, 87.4% yield, dr >99.9:0.1, 94% ee



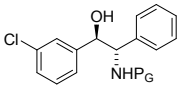
17c P_G=Boc; cat. (*R,R*)-**20**, 72h: 100% conv, 87.4% yield, dr >99.9:0.1, 93% ee

18b P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 79.3% yield dr >99.9:0.1, 95% ee

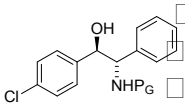
18c P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% c, 85.6% yield, dr 98.3/1.7, 94% ee



17d P_G=Boc; cat. (*R,R*)-**20**, 48h: 95% conv, 71.4% yield, dr 97.7:2.3, 95% ee



17e P_G=Boc; cat. (*R,R*)-**20**, 24h: 100% conv, 78.3% yield, dr >99.9:0.1, 97% ee

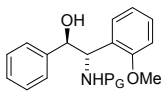


17f P_G=Boc; cat. (*R,R*)-**20**, 24h: 100% conv, 80.6% yield, dr >99.9:0.1, 99% ee

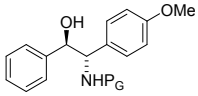
18d P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 43.9% yield, dr >99.9:0.1, 89% ee

18e P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 89.7% yield, dr >99.9:0.1, 94% ee

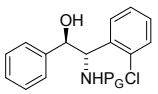
18f P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 44.8% yield, dr 97.7:2.3, 89% ee



17g P_G=Boc; cat. (*R,R*)-**20**, 6d: 90% conv, 64.2% yield, dr >99.9:0.1, 89% ee



17h P_G=Boc; cat. (*R,R*)-**20**, 72h: 90% conv, 69.9% yield, dr 99.1:0.9, 90% ee

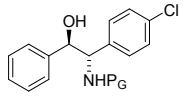


17i P_G=Boc; cat. (*R,R*)-**20**, 96h: 95% conv, 92.2% yield, dr 99.5:0.5, 90% ee

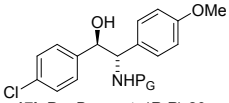
18g P_G=Ts; cat. (*R,R*)-**2**, 48h: 100% conv, 85.6% yield, dr 94.8:5.2, 80% ee

18h P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 95.2% yield, dr 98.2:1.8, 90% ee

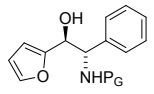
18i P_G=Ts; cat. (*R,R*)-**2**, 48h: 100% conv, 69.8% yield, dr 88:12, 80/18% ee



17j P_G=Boc; cat. (*R,R*)-**20**, 72h: 100% conv, 92.2% yield, dr 99.5:0.5, 90% ee



17k P_G=Boc; cat. (*R,R*)-**20**, 72h: 100% conv, 93.5% yield, dr >99.9:0.1, 97% ee

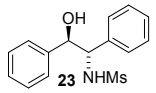


17l P_G=Boc; cat. (*R,R*)-**20**, 72h: 100% conv, 79.2% yield, dr 96:4, 79/57% ee

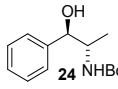
18j P_G=Ts; cat. (*R,R*)-**2**, 24h: 100% conv, 84.8% yield, dr 97.7:2.3, 92/>99% ee

18k P_G=Ts; cat. (*R,R*)-**2**, 48h: 100% conv, 88.2% yield, dr >99.9:0.1, 98% ee

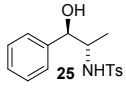
18l P_G=Ts; cat. (*R,R*)-**2**, 48h:100% conv, 92.4% yield, dr 55:45, 72/98% ee



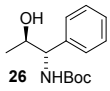
cat. (*R,R*)-**2**; 24h, 100% conv, 79.0% yield, dr 97.4:2.6, 95% ee



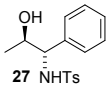
cat. (*R,R*)-**20**: 6d, 76% conv, 53.1% yield, dr 79:21, 34[a]/82% ee



cat. (*R,R*)-**2**; 48h, 93% conv, 85.2% yield, dr 68:32, ca. 36/>99% ee



cat. (*R,R*)-**20**: 24h, 100% conv, 86.8% yield, dr 98.3:1.7, 95% ee



cat. (*R,R*)-**2**; 24h, 100% conv, 78.4% yield, dr 75.4:24.6, 97/61% ee

Figure 3. Reduction products of ketones **13b-13l** (using (*R,R*)-**20**) and **14b-14l** (using (*R,R*)-**2**). Conditions are as in Figure 2/Table 1 except that 2 mol% catalyst was used for the formation of **17b**, **17d**, **17g** and **17h**. Ees are of major diastereoisomers except where indicated. a. Overlap of peaks in HPLC limits the accuracy of this measurement.

Substrates containing substituents on the aromatic rings adjacent to the ketone (Ar^1), leading to products **17b-17f** and **18b-18f,** were fully reduced in most cases and in high dr and ee, although the *o*- and *p*-chloro substituted products were formed in slightly lower ee. Although the configurations of products were generally assigned by analogy to **17a**/**18a**, the X-ray crystallographic structure of **17d** was determined and served to confirm the assignment (Supporting Information).

Substrates with substituted aromatic rings proximal to the amine (Ar^2) were generally reduced to **17g-17k** and **18g-/18k** in high dr although the ee was dependent on both the nature and position of the substituents. The *o*-chloro N-Ts-protected substrate **14i** gave product **18i** in a poor dr however substrates**13k**/**14k**, containing a combination of *p*- substituents gave a product in high dr and eeThe furyl-containing products **17l**/**18l** were formed in poor dr and ee. NMs product **23** was formed in an excellent 96% ee and high dr, indicating that the aromatic ring of the Ts is not required for high selectivity. When the aromatic ring proximal to the amine (Ar^2) was replaced by a methyl group, products **24** and **25** were formed in poor dr and low ee. On the other hand, replacement of the Ph adjacent to the ketone followed by ATH-DKR gave a high dr and ee for the N-Boc-protected product **26**, but the N-Ts-protected product **27** in much lower dr. The formation of two products, N-Boc-prtected **17e** and N-Ts-protected **18h** were carried out on 1.0g scale with respect to starting material ketone. In both cases the reductions proceeded cleanly to give products in 88.7% and 89.4% yields respectively, and with 95% and 90% ee respectively (previously 97% and 90% ee) (see the Supporting Information).

The results indicate that the reductions proceed with preferential formation of the *anti*-diastereoisomers.[11,14] The results observed for products **24-27** indicate that the aromatic ring adjacent to the protected amine (Ar^2) is required for control of dr and ee in the reductions whereas the aromatic ring adjacent to the ketone (Ar^1) is not. Previous studies have indicated that a H-bond between the substrate and the SO_2 of the sulfonamido group can play an important part in the control of the ATH of imines[15a,b] and α-amino ketones,[12c] as can an interaction between an amido on the substrate and the η^6-arene of the

catalyst.[15c] Considering the related studies, and our observations, the stereochemical outcome can be explained by a transition state (Figure 4) for hydride transfer which is stabilised by a hydrogen bond between an N-H in the substrate and the sulfonamido group, coupled with a CH/π edge/face interaction as illustrated. This results in the formation of the observed product and agrees with previous reports for this class of substrate (Figure 1)[11] and for a reported α-amino acetophenone reduction.[16a] However it is not consistent with other observations on the reduction of non-α-substituted α-amino ketones[16b] and related products of non-DKR ATH reductions using Rh(III) catalysts.[17]

The reduction of analogous compounds lacking the N-H function generally give products with the opposite diastereoselectivity to ours, indicating the importance of this group in the direction of the reduction.[9] In order to investigate this factor in our compounds, we investigated the ATH of N-methylated analogues of **13a** and **14a**. In the event, the NMe derivative of **13a** was prepared in low yield however its reduction proceded in low conversion and purity and it was not possible to analyse the products by HPLC. Compound **14aMe**, which is the NMe derivative of NTs ketone **14a**, was prepared and was successfully reduced to give **18aMe** in 47% yield, dr: 83:17 with 90% and 35% ee respectively. i.e. lower than for **14a** (Figure 5). The configuration of the major product is not known. This again evidences the importance of the NH group in the reduction selectivity. The different protecting groups will also have a moderating influence on the selectivity, presumably due to their differing bulk and electronic properties.

Hence the detailed and complex controlling factors in the ATH reaction of α-amino ketones described herein remain to be fully understood and are the subject of ongong studies In addition, the reversal of configuration using catalyst (*R,R*)-**22** in several cases is not fully understood (Table 1) but reflects the potential for subtle additional interactions between the substrates described herein and the groups on the η^6-arene ring.

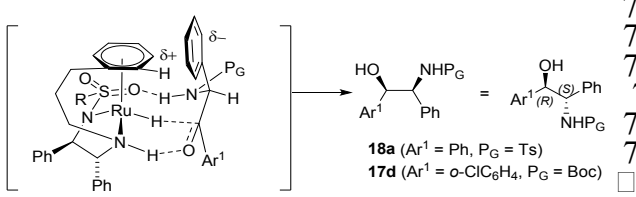


Figure 4. Proposed mode of reduction of **14a** and **13d** to **18a** and **17d** respectively, stabilised by hydrogen bonding and the known CH/π edge/face interaction.

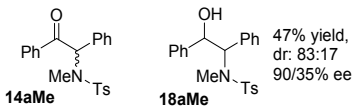


Figure 5. N-methylated derivative substrate **14aMe** and reducation product **18aMe**.

As an example of the value of the ATH-DKR, we reduced ketone **28** to each enantiomer of amino alcohol **29** using catalyst (*R,R*)-**20**. In both cases a product of high dr and ee was formed (Figure 6). Cyclisation of (*1S,2R*)-**29** with inversion of configuration, following the reported precedent,[18] gave oxazolidinone (*4S,5S*)-**30**, a precursor of a recently reported MDM2–p53 inhibitor molecule which had previously been prepared in asymmetric form through a chiral resolution.[18]

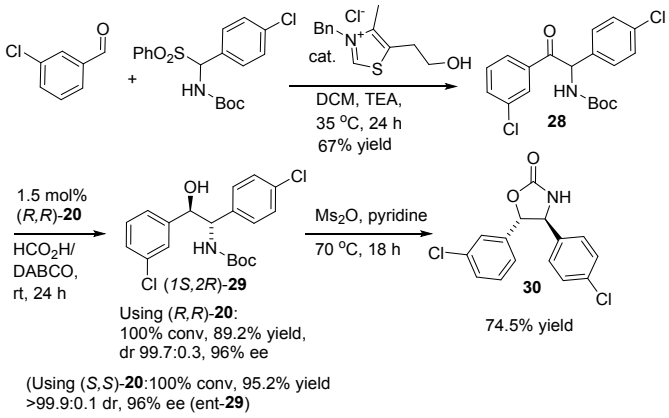


Figure 6. Synthesis of MDM2–p53 inhibitor precursor **30** *via* ATH-DKR of α-N-Boc-protected ketone **28**.

Conclusions

In conclusion, we report the optimization and scope expansion of the ATH-DKR of α-aminoketones with varying N-protecting groups and substitution patterns. We have identified the most suitable catalysts from a series for the N-Boc-protected and N–Ts-protected substrates and have explored the scope of the applications. This study allowed us to identify a suitable catalyst for a very concise synthesis of an MDM2–p53 inihibitor precursor in high ee, representing a valuable approach to this class of target molecule.

EXPERIMENTAL SECTION

General procedures for the syntheses.

Solvents and reagents for the synthesis of complexes and catalytic reactions were degassed prior to use and all reactions were carried out under either a nitrogen or argon atmosphere. Reactions were monitored by TLC using aluminum backed silica gel 60 (F254) plates, visualized using UV 254 nm and phosphomolybdic acid (PMA), potassium permanganate or vanillin dips as appropriate. Flash column chromatography was carried out routinely using 60 micrometer silica gel. Reagents were used as received from commercial sources unless otherwise stated. ^{1}H NMR spectra were recorded on a Bruker DPX (300, 400 or 500 MHz) spectrometer. Chemical shifts are reported in δ units, parts per million relative to the singlet at 7.26 ppm for chloroform and 0.00 ppm for TMS. Coupling constants (J) are measured in Hertz. Structural assignments were made with additional information from gCOSY, gHSQC, and gHMBC experiments. IR spectra were recorded on a Perkin-Elmer Spectrum One FT-IR Golden Gate. Mass spectra were recorded on a Bruker Esquire2000 or a Bruker MicroTOF mass spectrometer. Melting points were recorded on a Stuart Scientific SMP 1 instrument and are uncorrected. Dry solvents were purchased and used as received. HPLC analyses were carried out on a Hewlett-Packard 1050 instrument. Optical

rotations were measured on an AA-1000 polarimeter. The X-ray crystallographic structures were recorded on a Rigaku Oxford Diffraction SuperNova diffractometer with a duel source (Cu at zero) equipped with an AtlasS2 CCD area detector. Enantiomeric excesses were measured to one decimal place, however the results in Table 1 in the paper have been rounded to whole numbers or to >99% ee where the measured ee was 99.5% or above, and drs are given as >99.9:<0.1 where only one diastereoisomer was observed.

General procedure A for the synthesis of racemic alcohols. To a solution of ketone (1.0 eq.) in MeOH ([S] = 0.1 M) was added $NaBH_4$ (2.0 eq.) portion-wise. The solution was stirred at rt until the ketone had been consumed. The solvent was then removed under reduced pressure and the residue partitioned between water and EtOAc. The organic extract was collected and the aqueous layer extracted a further 2 times with EtOAc. The organic layers were combined, dried over $MgSO_4$, filtered and the solvent removed under reduced pressure to afford racemic alcohols.

Section on initial substrates 12a-15a and their reductions.

2-Bromo-1, 2-diphenylethan-1-one.
This compound is known and has been previously characterised.[19] N-Bromosuccinimide (4.50 g, 38.3 mmol, 1.5 eq) and *p*-toluenesulphonic acid (0.88 g, 5.1 mmol, 0.20 eq) were dissolved in anhydrous DCM (50 mL) and the reaction mixture was cooled to 0 ˚C. To the cold reaction mixture, a solution of 1, 2-diphenylethan-1-one (5.00 g, 25.5 mmol, 1.0 eq) in dry DCM (25 mL) was added dropwise over a period of 1h. After the addition, the reaction mixture was stirred under N_2 for 8 hours at 40 ˚C. The completion of the reaction was confirmed by ^{1}H NMR. After the completion of the reaction, the reaction mixture was cooled to rt and H_2O (100 mL) and DCM (25 mL) were added and organic layer was separated. The aqueous layer was extracted with DCM (2 x 30 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$. The organic layer was concentrated under reduced pressure to afford the product as an off-white solid (6.9 g, 25 mmol, 98%) which was used in the next step without further purification. TLC: R_f ca 0.5 (9:1, Hexane: EtOAc), strong UV active; υ_{max} 1678, 1593, 1446, 1171, 991, 754, 677, 611 cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, 2H, J = 7.2 Hz), 7.57-7.53 (m, 3H) , 7.47-7.45 (m, 2H), 7.38-7.36 (m, 3H), 6.38 (s, 1H) ; 13C{1H} NMR ($CDCl_3$, 101 MHz,): δ 191.2, 136.0 134.31, 133.8, 129.3, 129.2, 128.9, 51.2. The data matches the reported data.

2-(2-Oxo-1,2-diphenylethyl)isoindoline-1,3-dione.
This compound is known and has been previously characterised.[20] 2-Bromo-1, 2-diphenylethan-1-one (5.0 g, 18 mmol, 1.0 eq) and potassium phthalimide (5.07 g, 27.3 mmol, 1.5 eq) were dissolved in anhydrous DMF (50 mL) and the resulting reaction mixture was stirred under N_2 for 24 hours at rt. After the completion of the reaction, indicated by TLC, the reaction mixture was quenched with ice-cold water H_2O (1 L). The obtained solid was filtered through Buchner filtration and washed with ice cold water (1 L) and dried to afford the product as a white solid (6.02 g, 17.6 mmol, 97.7%) which was used in next step without further purification. TLC: R_f ca 0.3 (9:1 Hexane: EtOAc), strong UV active; υ_{max} 1711, 1684,1382, 1358, 1115, 713, 703, 688, 625, 528 cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.86 (d, 2H, J = 7.4 Hz), 7.83-7.82 (m, 2H), 7.77-7.76 (m, 1H), 7.71-7.70 (m, 2H), 7.51 - 7.47 (m, 3H), 7.39-7.32 (m, 4H), 6.78 (s, 1H); ^{13}C{^{1}H} NMR ($CDCl_3$, 101 MHz): δ 193.2, 167.6, 135.1, 134.6, 134.5, 134.3, 133.4, 131.9, 130.5, 128.9, 128.8, 128.8, 123. 8, 123.7, 60.4; m/z (ESI) 364.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

2-Oxo-1,2-diphenylethan-1-aminium chloride.
This compound is known and has been previously characterised.[20] 2-(2-Oxo-1,2-diphenylethyl)isoindoline-1,3-dione (6.00 g, 17.5 mmol) in acetic acid (45 mL) and 6N HCl (45 mL) was stirred at 100 ºC for 3 days. The reaction mixture was cooled to rt and washed with DCM (30 mL). The aqueous layer was concentrated under reduced pressure to afford the product as a white solid. (3.01 g, 12.1 mmol, 69.1%) which was used in the next step without further purification. ^{1}H NMR (D_2O ,400 MHz): δ 7.97 (d, 2H, J = 7.6 Hz), 7.79-7.77 (m, 1H), 7.66-7.61 (m, 2H), 7.48-7.47 (m, 5H), 6.27 (s, 1H); ^{13}C{^{1}H} NMR (D_2O, 101 MHz): δ 194.5, 135.1, 132.4, 131.7 131.3, 130.4, 129.9, 129.2, 129.0, 128.4, 128.7, 59.7; m/z (ESI) 212.2 [$(M+H)^+$, 100%]. The data matches the reported data.

N-(2-Oxo-1,2-diphenylethyl)benzamide 12a.
This compound is known and has been previously characterised.[21] 2-Oxo-1, 2-diphenylethan-1-aminium chloride (1.0 g, 4.0 mmol, 1.0 eq) was suspended in DCM (15 mL) and cooled to 0 ˚C in an ice bath. Triethylamine (1.6 g, 2.2 mL, 16 mmol, 4.0 eq) was added dropwise to the reaction mixture and stirred at same temperature for 30 minutes. During the addition of triethylamine, the initially cloudy reaction mixture became clear. To the reaction mixture, benzoyl chloride (0.84 g, 0.76 mL, 6.0 mmol, 1.5 eq) was added dropwise and the resulting reaction mixture was stirred at 0 ˚C for 30 minutes followed by overnight stirring at rt. Once the reaction was complete (assessed by TLC), water (50 mL) and DCM (25 mL) were added and organic layer was separated. The aqueous layer was extracted with DCM (2 x 30 mL). The combined organic layers were washed with brine (50 mL), dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to afford the product **12a** as a white solid (0.60 g, 1.9 mmol, 47%).TLC: R_f ca 0.4 (7:3, Hexane: EtOAc), strong UV active; υ_{max} 3388, 3056, 3031, 1716, 1685, 1647, 1509, 1481, 1447, 1297, 1252, 706, 690, 531 cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.97 (d, 2H, J = 7.1 Hz), 7.79 (d, 2H, J = 6.9 Hz), 7.68 (d, 1H, J = 4.4 Hz) 7.47-7.36 (m, 8H), 7.28-7.24 (m, 2H), 7.19 (s, 1H), 6.70 (d, 1H, J = 6.7 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 101 MHz): δ 196.0, 166.4, 137.4, 134.4, 134.0, 131.9, 130.3, 129.4, 129.3, 128.9, 128.7, 128.6, 128.5, 127.3, 59.0; m/z (ESI) 338.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

***t*-Butyl (2-oxo-1,2-diphenylethyl)carbamate) 13a.**
This compound is known and has been previously characterised.[22] 2-Oxo-1,2-diphenylethan-1-aminium chloride (0.70 g, 2.8 mmol, 1.0 eq) was suspended in THF (10 mL) and cooled to 0 ˚C in an ice salt bath. Triethylamine (1.8 g, 2.5 mL, 18 mmol, 6.5 eq) was added dropwise to the reaction mixture and stirred at same temperature for 30 minutes. During the

addition of triethylamine, the initially cloudy reaction mixture became clear. To the reaction mixture, Boc anhydride (1.23 g, 5.66 mmol, 2.0 eq) in THF (5 mL) was added dropwise and the resulting reaction mixture was stirred at 0 °C for 30 minutes followed by overnight stirring at rt. Once the reaction was complete (assessed by TLC), water (150 mL) and DCM (50 mL) were added and the organic layer was separated. The aqueous layer was extracted with DCM (3 x 50 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to afford the product **13a** as a white solid (0.410 g, 1.31 mmol, 46.6%).TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; υ_{max} 3384, 3364, 2980, 2934, 1703, 1694, 1675, 1493, 1158, 752, 693, cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.96 (d, 2H, J = 6.4 Hz), 7.49 (d, 2H, J = 6.4 Hz), 7.39-7.37 (m, 4H) 7.30-7.24 (m, 2H), 6.28 (d, 1H, J = 6.2 Hz), 6.04 (1H, s), 1.37 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 196.2, 155.1, 137.6, 134.6, 133.7, 129.3, 129.1, 128.7, 128.5, 128.2, 80.0, 59.9, 28.5; m/z (ESI) 334.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

4-Methyl-N-(2-oxo-1,2-diphenylethyl)benzenesulfonamide 14a.

This compound is known and has been previously characterised.[23] 2-Oxo-1, 2-diphenylethan-1-aminium chloride (1.0 g, 4.0 mmol, 1 eq) was suspended in DCM (20 mL) and cooled to 0 ˚C in an ice bath. Triethylamine (1.6 g, 2.2 mL, 16 mmol, 4 eq) was added dropwise to the reaction mixture and stirred at the same temperature for 30 minutes. During the addition of triethylamine, the initially cloudy reaction mixture became clear. To the reaction mixture, tosyl chloride (1.5 g, 8.1 mmol, 2 eq) i n DCM (5 mL) was added dropwise and the resulting reaction mixture was stirred at 0 ˚C for 30 minutes followed by overnight stirring at rt. Once the reaction was complete (assessed by TLC), water (50 mL) and DCM (25 mL) were added and the organic layer was separated. The aqueous layer was extracted with DCM (2 x 30 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography (40% EtOAc in petroleum ether (40-60)) to afford the product **14a** as a white solid (0.57 g, 16 mmol, 39%). TLC: R_f ca 0.3 (7:3, Petroleum ether (40-60): EtOAc), strong UV active; υ_{max} 3286, 1715, 1290, 1258, 1216, 1115, 665, 628, 646, 494 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz):) δ 7.80 (d, 2H, J = 7.0 Hz), 7.53 (d, 2H, J = 7.8 Hz), 7.48 (d, 1H, J = 6.9 Hz), 7.37-7.35 (m, 2H), 7.18 (m, 5H), 7.05 (d, 2H, J = 7.5 Hz), 6.26 (d, 1H, J = 6.0 Hz), 6.00 (d, 1H, J = 8.0 Hz), 2.29 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 194.7, 143.3 143.2, 137.5 135.7, 134.1, 133.9, 129.4, 129.2, 129.1, 128.8, 128.6, 128.1, 127.1, 61.9, 21.1; m/z (ESI) 388.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

Benzyl (2-oxo-1,2-diphenylethyl)carbamate 15a.

This compound is known however it has not been fully characterized previously.[24] Benzyl (phenyl(benzenesulfonyl)methyl)carbamate (0.70 g, 1.8 mmol, 1.0 eq) and 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.15 g, 0.55 mmol, 0.3 eq) were degassed and purged with nitrogen for 15 min. To this mixture was added CH_2Cl_2 (30 mL) followed by benzaldehyde (0.30 g, 2.8 mmol, 1.5 eq) and the resulting mixture was stirred and heated to 35 ºC. Triethylamine (3.8 mL, 2.8 g, 27 mmol, 15 eq) was added in one portion via syringe and the reaction mixture was stirred at 35 °C for 24 h. After the reaction was complete (assessed by TLC), it was cooled to 25 °C and water (50 mL) and DCM (25 mL) were added and organic layer was separated. The aqueous layer was extracted with DCM (2 x 30 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to afford the product **15a** as a pale yellow solid (0.28 g, 0.81 mmol, 45%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; M.P. 92-93 ˚C; HRMS (ESI): found $[M+Na]^+$ 368.1261, $C_{22}H_{19}NNaO_3$ requires $[M+Na]^+$ 368.1257, (error 1.1 ppm); υ_{max} 3386, 1719, 1676, 1502, 1231, 1028, 694 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): 7.95 (d, 2H, J = 7.6 Hz), 7.50 (m, 1H), 7.41-7.37 (m, 4H), 7.35 – 7.24 (m, 8H), -) 6.33-6.23 (m, 2H), 5.14 (d, 1H, J = 12.2 Hz), 5.04 (d, 1H, J = 12.6 Hz) ; $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): 195.6, 155.6, 137.4, 137.3 136.4, 124.4, 134.4 133.8, 129.3, 129.2, 128.8, 128.6, 128.6, 128.3, 128.3, 67.1, 60.3; m/z (ESI) 368.2 [$(M+Na)^+$, 100%].

N-((*1S,2R*)-2-hydroxy-1,2-diphenylethyl)benzamide 16a.

This compound is known and has been previously characterised in racemic form.[14a] *t*-Butyl (2-oxo-1, 2-diphenylethyl) carbamate) **12a** (0.100 g, 0.317 mmol, 1.0 eq) and DABCO (0.181 g, 1.61 mmol, 5.0 eq) were dissolved in acetonitrile (2 mL). Once the reaction became clear, catalyst (*R,R*)-**2** (3.0 mg, 4.8 µmol, 0.015 eq) in MeCN (1 mL) followed by formic acid (36 µL, 0.96 mmol, 3.0 eq) were added and the resulting reaction mixture was stirred at room temperature for 24 h. After overnight stirring, the reaction mixture was concentrated. The residue was dissolved in DCM (50 mL) and organic layer was washed with water (30 mL). The aqueous layer was extracted with DCM (2 x 50 mL). The combined organic layers were washed with brine (50 mL), dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by trituration in diethyl ether to afford the product **16a** as a white solid (0.060 g, 0.189 mmol, 59.7%). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; $[\alpha]_D^{25}$ = -33.5 (c = 0.05, $CHCl_3$) 25% ee; Enantiomeric excess and conversion determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 8:92, 1 mL/min, 210 nm, T = 25 ºC), major diastereomer 25.4 min and 27.5 min; minor diastereomer 17.0 min and 20.3 min, >99.9:<0.1 dr; HRMS (ESI): found $[M+Na]^+$ 340.1308, $C_{21}H_{19}NNaO_2$ requires $[M+Na]^+$ 340.1308 (error 0.0 ppm); υ_{max} 3342, 3036, 3032, 1633, 1523, 1303, 754, 699, 602 cm^{-1}; ^1H NMR (DMSO-d_6, 400 MHz): δ 8.62 (d, 1H, J = 8.9 Hz), 7.63 (d, 2H, J = 7.0 Hz), 7.50 – 7.36 (m, 7H), 7.28-7.24 (m, 4H), 7.21-7.19 (m, 2H), 5.45 (s, 1H), 5.13 (t, 1H, J = 8.6 Hz), 4.92 (d, 1H, J = 4.5 Hz); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 101 MHz): δ 165.2, 143.7, 141.4, 134.6, 131.0, 128.4 128.1, 127.6, 127.6, 127.1, 127.0 126.9 126.7, 74.6, 59.1; m/z (ESI) 340.2 [$(M+Na)^+$, 100%]. The data matches the reported data. A racemic standard was prepared by reduction with $NaBH_4$ via procedure A.

_t_-Butyl ((*1S,2R*)-2-hydroxy-1,2-diphenylethyl)carbamate 17a.

This compound is known and has been previously characterised.[14b,14c] _t_-Butyl (2-oxo-1, 2-diphenylethyl) carbamate) **13a** (0.100 g, 0.321 mmol, 1.0 eq) and DABCO (0.181 g, 1.61 mmol, 5.0 eq) were dissolved in 2 mL acetonitrile. Once the reaction became clear solution, catalyst (*R,R*)-**2** (3.0 mg, 4.8 µmol, 0.015 eq) in MeCN (1 mL) followed by formic acid (36 µL, 0.96 mmol, 0.030 eq) were added and the resulting reaction mixture was stirred at room temperature for 24 h. After overnight stirring, the reaction mixture was concentrated. The residue was dissolved in DCM (20 mL) and the organic layer was washed with water (30 mL). The aqueous layer was extracted with DCM (2 x 15 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by trituration in diethyl ether to afford the product **17a** as a white solid. (0.065 g, 0.207 mmol, 64.5%). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; $[\alpha]_D^{25}$ = -21.6 (c = 0.1, $CHCl_3$) 73% ee [lit[14c] $[\alpha]_D^{25}$ = -57.6 (c = 1, $CHCl_3$) 100% ee]; Enantiomeric excess and conversion determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 10:90, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 6.4 min, (*1R,2S)* 8.2 min, other diastereomer 18.8 min and 21.9 min, >99.9:<0.1 dr; HRMS (ESI): found $[M+Na]^+$ 336.1570, $C_{19}H_{23}NNaO_3$ requires $[M+Na]^+$ 336.1570 (error 0.0 ppm); υ_{max} 3378, 2978, 1680, 1645, 1519, 1250, 1170, 997, 698, 603 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.26- 7.23 (m, 6H), 7.06-7.02 (m, 4H), 5.30 (br.s., 1H), 5.04 (s, 1H) 4.96 (br.s., 1H), 2.70 (br.s., 1H), 1.40 (s, 9H); 1H NMR (DMSO-d_6, 400 MHz): δ 7.31-7.20 (m, 11H), 5.29 (s, 1H), 4.66 (s, 1H), 4.58 (t, 1H, J = 8.3 Hz), 1.21 (s, 9H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 101 MHz): δ 154.5, 143.4, 141.5, 128.1 127.4, 127.0, 126.8, 126.5, 77.6, 75.2, 60.1, 40.1, 28.1; m/z (ESI) 336.2 $[(M+Na)^+$, 100%]. The data matches the reported data. A racemic standard was prepared by reduction with $NaBH_4$ via procedure A.

N-((*1S,2R*)-2-Hydroxy-1,2-diphenylethyl)-4-methylbenzenesulfonamide 18a.

This compound is known and has been previously characterised.[14c,14d,] 4-Methyl-N-(2-oxo-1,2-diphenylethyl) benzene sulfonamide **14a** (0.100 g, 0.274 mmol, 1.0 eq) and DABCO (0.153 g, 1.37 mmol, 5.0 eq) were dissolved in acetonitrile (2 mL). Once the reaction became clear, catalyst (*R,R*)-**2** (2.5 mg, 4.1 µmol, 0.015 eq) in MeCN (0.7 mL), followed by formic acid (30 µL, 0.82 mmol, 3.0 eq) were added and the resulting reaction mixture was stirred at room temperature for 24 h. After this time, the reaction mixture was concentrated. The residue was dissolved in DCM (20 mL) and the organic layer was washed with water (20 mL). The aqueous layer was extracted with DCM (2 x 15 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by trituration in diethyl ether to afford product **18a** as a white solid (0.69 g, 0.19 mmol, 69 %). TLC: R_f ca 0.4 (5:5, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; $[\alpha]_D^{25}$ = -45 (c = 0.1, THF) 99% ee [lit[14d] $[\alpha]_D^{25}$ = -97.0 (c = 0.1, THF) 100% ee]; Enantiomeric excess and conversion determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 14.9 min, (*1R,2S)* 18.0 min, other diastereomer 12.0 min and 13.6 min, >99.9:<0.1 dr; HRMS (ESI): found $[M+Na]^+$ 390.1136, $C_{21}H_{21}NNaO_3S$ requires $[M+Na]^+$ 390.1134 (error 0.5 ppm); υ_{max} 3459, 3322, 3063, 1402, 1303, 1254, 1150, 699, 560, 539 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.48 (d, 2H, J = 8.2 Hz), 7.22-7.05 (m, 8H), 6.95 – 6.93 (m, 2H), 6.82 (d, 2H, J = 7.2 Hz), 5.30-5.28 (m, 1H), 5.00 (d, 1H, J = 4.3 Hz), 4.55 (dd, 1H, J = 7.8, 4.4 Hz), 2.33 (s, 4H); 1H NMR (DMSO-d_6, 400 MHz): δ 8.12 (d, 1H, J = 8.0 Hz), 7.29 (d, 2H, J = 8.0 Hz), 7.18 (s, 3H), 7.13 (s, 2H), 7.09-6.98 (m, 7H), 5.38 (s, 1H), 4.61 (s, 1H), 4.28 (t, 1H, J = 7.6 Hz), 2.26 (s, 3H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 101 MHz): δ 142.7, 141.7, 138.9, 138.6, 128.9, 128.3, 127.6, 127.1 127.0, 126.7, 126.4, 126.2, 75.4, 63.4, 20.9; m/z (ESI) 390.2 $[(M+H)^+$, 100%]. The data matches the reported data. A racemic standard was prepared by reduction with $NaBH_4$ via procedure A.

Benzyl ((*1S,2R*)-2-hydroxy-1,2-diphenylethyl)carbamate 19a.

This compound is known and has been previously characterised.[14c.14e] Benzyl (2-oxo-1, 2-diphenylethyl) carbamate) **15a** (0.100 g, 0.289 mmol, 1.0 eq) and DABCO (0.162 g, 1.45 mmol, 5.0 eq) were dissolved in 2 mL acetonitrile. Once the reaction became clear, catalyst (*R,R*)-**2** (2.6 mg, 4.3 µmol, 0.015 eq) in MeCN (1 mL) followed by formic acid (33 µL, 0.87 mmol, 3.0 eq) were added and the resulting reaction mixture was stirred at room temperature for 24 h. After overnight stirring, the reaction mixture was concentrated. The residue weas dissolved in DCM (20 mL) and organic layer was washed with water (30 mL). The aqueous layer was extracted with DCM (2 x 15 mL). The combined organic layers were washed with brine (50 mL) and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by trituration in diethyl ether to afford the product **19a** as a white solid (0.050 g, 0.144 mmol, 49.8 %). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; $[\alpha]_D^{25}$ = -28.4 (c = 0.05, $CHCl_3$) 44% ee [lit[14c] $[\alpha]_D^{25}$ = -67.4 (c = 0.1, $CHCl_3$) 100% ee]; Enantiomeric excess and conversion determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 10:90, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 11.1 min, (*1R,2S)* 15.5 min, other diastereomer 7.1 min and 10.1 min, >99.9:<0.1 dr; HRMS (ESI): found $[M+Na]^+$ 370.1117, $C_{22}H_{21}NNaO_3$ requires $[M+Na]^+$ 370.1414 (error 0.8 ppm); υ_{max} 3346, 3061, 3034, 1687, 1535, 1254, 1009, 697 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.33 (s, 5H), 7.26-7.23 (m, 6H), 7.04-7.03 (m, 4H), 5.56 (br.s., 1H), 5.12-5.09 (m, 4H), 2.46 (br.s., 1H); 1H NMR (DMSO-d_6, 400 MHz): δ 7.73 (d, 1H, J = 8.7 Hz), 7.42 – 7.17 (m, 13H), 7.12-7.13 (m, 2H), 5.35 (s, 1H), 4.91 (d, 1H, J = 12.6 Hz), 4.82 (d, 1H, J = 12.6 Hz), 4.69 (s, 1H), 4.65-4.61 (m, 1H,); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 101 MHz): δ 155.1 143.4, 141.4, 137.1, 128.3, 128.1, 127.3, 127.6, 127.3, 127.0, 126.7, 75.0, 65.0 60.8; m/z (ESI) 370.3 $[(M+H)^+$, 100%]. The data matches the reported data. A racemic standard was prepared by reduction with $NaBH_4$ via procedure A.

Section on the later derivatives (Figure 3).

General procedure B for formation of α-NBoc amino ketones.

Substituted *tert*-butyl (phenyl (benzenesulfonyl) methyl) carbamate and 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride were degassed and purged with nitrogen for 15 min. To this mixture was added DCM followed by the corresponding aldehyde and the resulting mixture was stirred and heated to 35 °C. Triethylamine was added in one portion via syringe and the reaction mixture was stirred at 35 °C for 24 h. After the reaction was complete (assessed by TLC), it was cooled to 25 °C and water and DCM were added and organic layer was separated. The aqueous layer was extracted with DCM. The organic layer was washed with 2% aqueous HCl solution to remove triethylamine. The combined organic layers were washed with brine and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product, which was purified by column chromatography to afford the α-N-Boc-protected amino ketone.

t-Butyl-(2-(2-methoxyphenyl)-2-oxo-1-phenylethyl) carbamate 13b.

This compound is novel and was prepared following the standard procedure **B** using 2-*tert*-butyl(phenyl(benzenesulfonyl)methyl)carbamate (3.00 g, 8.64 mmol, 1.0 eq) in DCM (60 mL), 2-methoxybenzaldehyde (1.29 g, 9.51 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.700 g, 2.59 mmol, 0.3 eq) and triethylamine (13.1 g, 18 mL, 129 mmol, 15 eq) for 48 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **13b** as a yellow liquid (1.89 g, 5.54 mmol, 64.1%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 364.1516, $C_{20}H_{23}NNaO_4$ requires $[M+Na]^+$ 364.1519 (error 0.9 ppm); υ_{max} 3369, 2980, 1700, 1660, 1505, 1486, 1240, 698 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.67 (d, 1H, J = 7.5 Hz), 7.39 (t, 1H, J = 7.8 Hz), 7.26-7.17 (m, 5H) 6.91 (t, 1H, J = 7.5 Hz), 6.84 (d, 1H, J = 8.3 Hz), 6.41 (d, 1H, J = 7.6 Hz), 6.04 (d, 1H, J = 6.8 Hz), 3.83 (s, 3H), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 197.7, 158.4 155.1, 134.4, 131.4, 128.9, 128.7, 128.2, 127.9, 127.6, 120.8, 111.6, 79.7, 63.5, 55.5, 28.5; m/z (ESI) 364.3 $[(M+Na)^+$, 100%].

t-Butyl-(2-(3-methoxyphenyl)-2-oxo-1-phenylethyl) carbamate 13c.

This compound is known and has been previously characterised.[13a] This compound was prepared following the standard procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (1.00 g, 2.88 mmol, 1.0 eq) in DCM (20 mL), 3-methoxybenzaldehyde (0.431 g, 3.17 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.233 g, 0.864 mmol, 0.3 eq) and triethylamine (4.37 g, 6 mL, 43.2 mmol, 15 eq) for 24 h, water (50 mL) to quench and was washed twice with 5% aqueous HCl (80 mL) to generate the crude product which was purified by column chromatography (10% EtOAc in petroleum ether (40-60)) to give **13c** as a yellow solid (0.645 g, 1.89 mmol, 65.6%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 102-104 ºC; HRMS (ESI): found $[M+Na]^+$ 364.1521, $C_{20}H_{23}NNaO_4$ requires $[M+Na]^+$ 364.1519 (error -0.8 ppm); υ_{max} 3395, 2973, 1703, 1674, 1581, 1493, 1287, 1160, 702 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.47 (d, 1H, J = 7.6 Hz), 7.39 (s, 1H), 7.30 – 7.28 (m, 2H), 7.24-7.16 (m, 4H), 6.97 (dd, 1H, J = 8.2, 2.3 Hz), 6.18 (d, 1H, J = 7.5 Hz), 5.93 (d, 1H, J = 7.0 Hz), 3.72 (s, 3H), 1.36 (s, 9H) $^{13}C\{^1H\}$ NMR ($CDCl_3$,126 MHz): δ 196.1, 159.9, 155.1, 137.7, 135.9 129.8, 129.3, 128.4, 128.2, 121.8, 120.4, 113.2, 80.1, 60.0, 55.5, 28.5; m/z (ESI) 364.3 $[(M+Na)^+$, 100%]. The data matches the reported data.

t-Butyl-(2-(2-chlorophenyl)-2-oxo-1-phenylethyl)carbamate 13d.

This compound is novel and was prepared following the general procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (3.00 g, 8.64 mmol, 1.0 eq) in DCM (60 mL), 2-chlorobenzaldehyde (1.33 g, 9.51 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.700 g, 2.59 mmol, 0.3 eq) and triethylamine (13.1g, 18 mL, 129 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **13d** as a yellow solid (1.88 g, 5.44 mmol, 63.1%). TLC: R_f ca 0.5 (8:2, Hexane: EtOAc), strong UV active; MP: 94-96 ºC; HRMS (ESI): found $[M+Na]^+$ 368.1021, $C_{19}H_{20}ClNNaO_3$ requires $[M+Na]^+$ 368.1024 (error 0.9 ppm); υ_{max} 3329, 2970, 1692, 1587, 1156, 699 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.37-7.29 (m, 3H), 7.26-7.20 (m, 6H), 6.12 (d, 1H, J = 7.0 Hz), 6.01 (d, 1H, J = 6.0 Hz), 1.44 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 198.3, 155.1, 136.8, 135.7, 132.2, 130.7, 129.5, 129.1, 128.6, 128.2, 126.7, 80.2, 63.4, 28.5; m/z (ESI) 368.2 $[(M+Na)^+$, 100%] 370.2 $[(M+2+Na)^+$, 40%].

t-Butyl-(2-(3-chlorophenyl)-2-oxo-1-phenylethyl)carbamate 13e.

This compound is novel and was prepared following the general procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (3.00 g, 8.64 mmol, 1.0 eq) in DCM (60 mL), 3-chlorobenzaldehyde (1.33 g, 9.51 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.700 g, 2.59 mmol, 0.3 eq) and triethylamine (13.1 g, 18 mL, 129 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (10% EtOAc in petroleum ether (40-60)) to give **13e** as a yellow solid (2.45 g, 7.10 mmol, 82.2%).TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 121-123 ºC; HRMS (ESI): found $[M+Na]^+$ 368.1021, $C_{19}H_{20}ClNNaO_3$ requires $[M+Na]^+$ 368.1024 (error 0.8 ppm); υ_{max} 3391,1680, 1492, 1243, 1090, 695 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.94 (s, 1H), 7.80 (d, 1H, J = 7.8 Hz), 7.47 (d, 1H, J = 8.0 Hz), 7.35-7.30 (m, 5H), 7.28 -7.25 (m, 1H), 6.21 (d, 1H, J = 7.5 Hz), 5.92 (d, 1H, J = 7.1 Hz), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 195.2, 155.1, 136.9, 136.3, 135.2, 133.6, 130.1 129.5, 129.1, 128.7, 128.2, 127.2, 80.2, 60.1, 28.5; m/z (ESI) 368.2 $[(M+Na)^+$, 100%], 370.2 $[(M+2+Na)^+$, 30%].

t-Butyl-(2-(4-chlorophenyl)-2-oxo-1-phenylethyl)carbamate 13f.

This compound is novel and was prepared following the general procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (3.00 g, 8.64

mmol, 1.0 eq) in DCM (60 mL), 4-chlorobenzaldehyde (1.33 g, 9.51 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.700 g, 2.59 mmol, 0.3 eq) and triethylamine (13.1 g, 18 mL, 129 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **13f** as a yellow solid (2.20 g, 6.38 mmol, 73.8%). TLC: R_f ca 0.3 (9:1, petroleum ether (40-60): EtOAc), strong UV active; MP: 115-117 ºC; HRMS (ESI): found $[M+Na]^+$ 368.1021, $C_{19}H_{20}ClNNaO_3$ requires $[M+Na]^+$ 368.1024 (error 0.8 ppm); υ_{max} 3393, 2977, 1702, 1675, 1493, 1242, 1092, 699, 534 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.89 (d, 2H, J = 8.5 Hz), 7.37- 7.24 (m, 7H), 6.21 (d, 1H, J = 7.5 Hz), 5.94 (d, 1H, J = 7.1 Hz), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 195.1, 155.1, 140.2, 137.3, 133.0, 130.5, 129.4, 129.2, 128.6, 128.2, 80.2, 60.0, 28.5; m/z (ESI) 368.2 $[(M+Na)^+$, 100%], 370.2 $[(M+2+Na)^+$, 40%].

***t*-Butyl-(1-(2-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate 13g.**

This compound is novel and was prepared following the general procedure **B** using *tert*-butyl ((2-methoxyphenyl)(benzenesulfonyl)methyl)carbamate (3.00 g, 7.95 mmol, 1.0 eq) in DCM (60 mL), benzaldehyde (1.26 g, 11.9 mmol, 1.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.644 g, 2.38 mmol, 0.3 eq) and triethylamine (12.0 g, 17 mL, 119 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **13g** as a yellow solid (2.10 g, 6.15 mmol, 77.5%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 126-129 ºC; HRMS (ESI): found $[M+Na]^+$ 364.1520, $C_{20}H_{23}NNaO_4$ requires $[M+Na]^+$ 364.1519 (error -0.2 ppm); υ_{max} 3375, 2983, 1685, 1493, 1240, 1161, 690, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.96 (d, 2H, J = 7.7 Hz), 7.46 (t, 1H, J = 7.3 Hz), 7.34 (t, 2H, J = 7.6 Hz), 7.29 (d, 1H, J = 7.4 Hz), 7.21 (t, 1H, J = 7.8 Hz), 6.89 (t, 1H, J = 7.5 Hz), 6.81 (d, 1H, J = 8.2 Hz), 6.50 (d, 1H, J = 8.1 Hz), 5.86 (d, 1H, J = 7.5 Hz), 3.83 (s, 3H), 1.44 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 196.9 156.7, 155.3, 135.1, 133.3, 129.8, 129.5, 128.8, 128.5, 126.2, 121.2, 111.6, 79.8, 55.7, 55.3, 28.5; m/z (ESI) 364.2 $[(M+Na)^+$, 100%].

***t*-Butyl-(1-(4-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate 13h.**

This compound is known however it has not been fully characterized previously.[25] This compound was prepared following the general procedure **B** using *tert*-butyl ((4-methoxyphenyl)(benzenesulfonyl)methyl)carbamate (2.55 g, 6.63 mmol, 1.0 eq) in DCM (60 mL), benzaldehyde (1.05 g, 9.49 mmol, 1.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.537 g, 1.98 mmol, 0.3 eq) and triethylamine (10.0 g, 14 mL, 99.5 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **13h** as a yellow solid (1.60 g, 4.68 mmol, 70.7%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), strong UV active; MP: 126-129 ºC; HRMS (ESI): found $[M+Na]^+$ 364.1518, $C_{20}H_{23}NNaO_4$ requires $[M+Na]^+$ 364.1519 (error 0.3 ppm); υ_{max} 3375, 1702, 1675, 1510, 1248, 1159, 688, 585 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.95-7.91 (m, 2H), 7.49-7.32 (m, 4H), 7.29-7.26 (m, 1H), 6.82 (d, 2H, J = 8.7 Hz), 6.22 (d, 1H, J = 7.5 Hz), 5.98-5.95 (m, 1H), 3.74 (s, 3H), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 196.3, 159.6, 155.1, 134.7, 134.0, 133.6, 129.7, 129.5, 129.2, 129.2, 129.1, 128.8, 128.7, 127.9, 114.6, 79.9, 59.3, 55.3, 28.5; m/z (ESI) 364.2 $[(M+Na)^+$, 100%].

***t*-Butyl-(1-(2-chlorophenyl)-2-oxo-2-phenylethyl)carbamate 13i.**

This compound is novel and was prepared following the general procedure **B** using *tert*-butyl ((2-chlorophenyl)(benzenesulfonyl)methyl)carbamate (3.00 g, 7.87 mmol, 1.0 eq) in DCM (60 mL), benzaldehyde (1.25 g, 11.8 mmol, 1.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.637 g, 2.36 mmol, 0.3 eq) and triethylamine (11.9 g, 16 mL, 118 mmol, 15 eq), water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **13i** as a white solid (0.897 g, 2.60 mmol, 31.4%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 114-117 ºC; HRMS (ESI): found $[M+Na]^+$ 368.1020, $C_{19}H_{20}ClNNaO_3$ requires $[M+Na]^+$ 368.1024 (error 1.0 ppm); υ_{max} 3370, 2971, 1712, 1680, 1520, 1244, 1158, 750, 590 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.98 (d, 2H, J = 7.6 Hz), 7.51 (t, 1H , J = 7.3 Hz), 7.41-7.37 (m, 3H), 7.27-7.17 (m, 3H), 6.64 (d, 1H, J = 7.6 Hz), 5.82 (d, 1H, J = 6.7 Hz), 1.44 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 196.2, 155.0, 135.3, 134.7, 133.9, 133.8, 130.6, 129.8, 129.5, 128.9, 128.8, 127.6, 80.2, 57.2, 28.5; m/z (ESI) 368.2 $[(M+Na)^+$,100%], 370.2 $[(M+2+Na)^+$, 40%].

***t*-Butyl-(1-(4-chlorophenyl)-2-oxo-2-phenylethyl)carbamate 13j.**

This compound is novel and was prepared following the general procedure **B** using *tert*-butyl ((4-chlorophenyl)(benzenesulfonyl)methyl)carbamate (3.00 g, 7.87 mmol, 1.0 eq) in DCM (60 mL), benzaldehyde (1.25 g, 11.8 mmol, 1.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.637 g, 2.36 mmol, 0.3 eq) and triethylamine (11.9 g, 16 mL, 118 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (10% EtOAc in petroleum ether (40-60)) to give **13j** as a white solid (1.50 g, 4.34 mmol, 55.2%). TLC: R_f ca 0.4 (8:2, Hexane: EtOAc), strong UV active; MP: 148-151 ºC; HRMS (ESI): found $[M+Na]^+$ 368.1028, $C_{19}H_{20}ClNNaO_3$ requires $[M+Na]^+$ 368.1024 (error -1.1 ppm); υ_{max} 3373, 2981, 1703, 1673, 1520, 1491, 1239, 1158, 719, 580 cm^{-1}; ^1H NMR ($CDCl_3$, 600 MHz): δ 7.93 (d, 2H, J = 7.7 Hz), 7.52 (t, 1H, J = 7.4 Hz), 7.42-7.39 (m, 2H), 7.31-7.26 (m, 4H), 6.24 (d, 1H, J = 7.2 Hz), 6.09 (d, 1H, J = 6.8 Hz), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 151 MHz): δ 195.8, 155.0, 136.3, 134.4, 134.0, 129.6, 129.4, 129.1, 128.9, 80.2, 59.1, 28.5; m/z (ESI) 368.2 $[(M+Na)^+$, 80%], 370.2 $[(M+2+Na)^+$, 30%].

***tert*-Butyl-(2-(4-chlorophenyl)-1-(4-methoxyphenyl)-2-oxoethyl)carbamate 13k.**

This compound is novel and was prepared following the general procedure **B** using *tert*-butyl ((4-methoxyphenyl)(benzenesulfonyl)methyl)carbamate (3.00 g, 7.95 mmol, 1.0 eq) in DCM (60 mL), 4-chlorobenzaldehyde (1.67 g, 11.9 mmol, 1.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.644 g, 2.38 mmol, 0.3 eq) and triethylamine (12.0 g, 17 mL, 119 mmol, 15 eq) for 48 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (15% EtOAc in petroleum ether (40-60)) to give **13k** as a yellow solid (1.77 g, 4.98 mmol, 62.7%). TLC: R_f ca 0.4 (8:2, Hexane: EtOAc), strong UV active; MP: 134-137 ºC; HRMS (ESI): found $[M+Na]^+$ 398.1132, $C_{20}H_{22}ClNNaO_4$ requires $[M+Na]^+$ 398.1130 (error -0.6 ppm); υ_{max} 3380, 2977, 1702, 1676, 1509, 1239, 1159, 824, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 600 MHz): δ 7.88 (d, 2H, J = 8.4 Hz), 7.36 (d, 2H, J = 8.4 Hz), 7.25 (d, 2H, J = 11.0 Hz), 6.83 (d, 2H, J = 8.6 Hz), 6.15 (d, 1H, J = 7.4 Hz), 5.90 (d, 1H, J = 7.2 Hz), 3.75 (s, 3H), 1.43 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 151 MHz): δ 195.2, 159.8, 155.1, 140.1, 133.1, 130.5, 129.5, 129.3, 129.1, 114.8, 80.1, 59.4, 55.4, 28.5; m/z (ESI) 398.3 [$(M+Na)^+$, 100%], 400.2 [$(M+2+Na)^+$, 40%].

t-*Butyl*-(2-(furan-2-yl)-2-oxo-1-phenylethyl)carbamate 13l.
This compound is known and has been previously characterised.[13a] This compound was prepared following the general procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (3.00 g, 8.64 mmol, 1.0 eq) in DCM (60 mL), furan-2-carbaldehyde (0.931 g, 9.51 mmol, 1.1 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.700 g, 2.59 mmol, 0.3 eq) and triethylamine (13.1 g, 18 mL, 129 mmol, 15 eq) for 48 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (40% EtOAc in petroleum ether (40-60)) to give **13l** as a yellow solid (2.20 g, 7.31 mmol, 84.6%). TLC: R_f ca 0.4 (7:3, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 324.1209, $C_{17}H_{19}NNaO_4$ requires $[M+Na]^+$ 324.1206 (error -0.9 ppm); υ_{max} 3400, 2976, 1706, 1663, 1490, 1465, 1392, 1161, 762, 528 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.55 (s, 1H), 7.41 (d, 2H, J = 7.5 Hz), 7.33-7.30 (m, 2H), 7.28 – 7.23 (m, 2H), 6.48 (s, 1H), 6.06 (d, 1H, J = 7.5 Hz), 5.92 (d, 1H, J = 6.4 Hz), 1.42 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 184.9, 155.0, 150.8, 147.2 137.2, 129.1, 128.5, 128.1, 119.4, 113.2, 112.7, 80.1, 60.0, 28.4; m/z (ESI) 324.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

2-Bromo-1-phenylpropan-1-one (route to 24 and 25).
This compound has been reported and fully characterised.[26] To a stirred ice cold solution of propiophenone (3.00 g, 22.3 mmol, 1.0 eq) in DCM (50 mL) was added bromine (1.1 mL, 22 mmol, 1.0 eq) dropwise under N_2 atmosphere and stirred at 0º C for 1h and then at room temperature for 30 minutes (colour changed from dark red to orange. The completion of the reaction was confirmed by ^1H NMR. After the completion, the reaction was quenched with saturated $NaHCO_3$ solution (200 mL) and DCM (50 mL) were added and organic layer was separated. The aqueous layer was extracted with DCM (2 x 30 mL). The combined organic layers were washed with brine (80 mL) and dried over $MgSO_4$. The organic layer was concentrated under reduced pressure to afford the product as a dark brown viscous liquid (4.50 g, 21.2 mmol, 96.0%) which was used in the next step without further purification. TLC: R_f ca 0.4 (9:1, Hexane: EtOAc), strong UV active; υ_{max} 1682, 1447, 1235, 948, 704, 683 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.03 (d, 2H, J = 8.6 Hz), 7.60 (t, 1H, J = 7.4 Hz), 7.51-7.47 (m, 2H), 5.30 (q, 1H, J = 6.6 Hz), 1.91 (d, 3H, J = 6.6 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 193.5, 134.2, 133.8, 129.1 128.9, 41.6, 20.3. The data matches the reported data.

2-(1-Oxo-1-phenylpropan-2-yl) isoindoline-1,3-dione (route to 24 and 25).
This compound has been reported and fully characterised.[27] This compound was prepared following the same procedure as used for 2-(2-oxo-1,2-diphenylethyl)isoindoline-1,3-dione using 2-bromo-1-phenylpropan-1-one (4.50 g, 21.2 mmol, 1.0 eq) in DMF (60 mL) and potassium phthalimide (5.60 g, 31.8 mmol, 1.5 eq) and ice cold water (1 L) to quench and was washed twice with ice cold water (300 mL) to give the product as a white solid (5.10 g, 18.3 mmol, 86.2%)**.** TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 302.0788, $C_{17}H_{13}NNaO_3$ requires $[M+Na]^+$ 302.0788 (error -0.1 ppm); υ_{max} 1706, 1693, 1384, 1231, 1139, 971, 712, 692 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.79 (m, 4H), 7.72-7.68 (m, 2H), 7.51-7.47 (m, 1H), 7.41-7.38 (m, 2H), 5.66 (q, 1H, J = 7.1 Hz), 1.73 (d, 3H, J = 7.1 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 196.2, 167.6, 135.4, 134.3, 133.2, 131.9, 128.8 128.1, 123.6, 51.1, 15.0; m/z (ESI) 302.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

1-Oxo-1-phenylpropan-2-aminium hydrochloride (route to 24 and 25).
This compound has been reported and fully characterised.[28] This compound was prepared following the same procedure as used for 2-oxo-1,2-diphenylethan-1-aminium chloride using 2-(1-oxo-1-phenylpropan-2-yl) isoindoline-1,3-dione **(**5.10 g, 18.3 mmol, 1.0 eq) in 6N HCl (60 mL) and glacial acetic acid (60 mL) to generate the crude product which was stirred in acetone (3 x 30 mL) to give the product as a white solid (2.10 g, 11.3 mmol, 61.7%). HRMS (ESI): found $[M+Na]^+$ 172.0732, $C_9H_{11}NNaO$ requires $[M+Na]^+$ 172.0733 (error 0.3 ppm) This corresponds to the RNH_2Na ion; υ_{max} 1688, 1597, 1499, 1451, 1242, 1217, 1104, 973, 698 cm^{-1}; ^1H NMR (D_2O, 400 MHz): δ 8.03 (d, 2H, J = 7.3 Hz), 7.79 (t, 1H, J = 7.5 Hz), 7.65-7.61 (m, 2H), 5.21 (q, 1H, J = 7.3 Hz), 1.61 (d, 3H, J = 7.3 Hz); $^{13}C\{^1H\}$ NMR (D_2O, 101 MHz): δ 198.1, 135.2, 132.3, 129.2, 128.8, 51.9, 16.6; m/z (ESI) 150.1 [$(M+1)^+$, 100%], 172.2 [$(M+Na)^+$, 35%]. The data matches the reported data.

***t*-Butyl-(1-oxo-1-phenylpropan-2-yl)carbamate (precursor of 24).**
This compound has been reported and fully characterised.[29] This compound was prepared following the same procedure as used for *t*-butyl-(2-oxo-1,2-diphenylethyl)carbamate) **13a** using 1-oxo-1-phenylpropan-2-aminium hydrochloride (0.700 g, 3.78 mmol, 1.0 eq) in DCM (20 mL), triethylamine (1.53 g, 2.1mL, 15.1 mmol, 4 eq) and boc anhydride (1.65g, 7.56 mmol, 1.5 eq), water (100 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give the prodcut as a white solid (0.55 g, 2.20 mmol,

58.4%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$; MP: 72-74 ºC; HRMS (ESI): found $[M+Na]^+$ 272.1257, $C_{14}H_{19}NNaO_3$ requires $[M+Na]^+$ 272.1257 (error 0.0 ppm); υ_{max} 3333, 2973, 1708, 1679, 1523, 1234, 1158, 682 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.98 (d, 2H, J = 7.7 Hz), 7.60 (t, 1H, J = 7.4 Hz), 7.49 (t, 2H, J = 7.7 Hz), 5.58 (d, 1H, J = 6.5 Hz), 5.33 – 5.27 (m, 1H), 1.46 (s, 9H), 1.40 (d, 3H, J = 7.1 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 199.6, 155.3, 134.3, 133.8. 128.9, 128.8, 79.8, 51.2, 28.5, 20.0; m/z (ESI) 272.2 $[(M+Na)^+$, 100%]. The data matches the reported data.

_t_-Butyl-(2-oxo-1-phenylpropyl)carbamate (precursor to 26).

This compound is known and has been previously characterised.[13ab]This compound was prepared following the general procedure **B** using 2-*tert*-butyl (phenyl(benzenesulfonyl)methyl)carbamate (2.00 g, 5.76 mmol, 1.0 eq) in DCM (40 mL), acetaldehyde (0.633 g, 14.4 mmol, 2.5 eq), 3-benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.46 g, 1.78 mmol, 0.3 eq) and triethylamine (5.71 g, 12 mL, 86.4 mmol, 15 eq) for 48 h, water (150 mL) to quench and was washed twice with 5% aqueous HCl (200 mL) to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give the product as a yellow solid (0.800 g, 3.21 mmol, 55.7%).TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ active; HRMS (ESI): found $[M+Na]^+$ 272.1257, $C_{14}H_{19}NNaO_3$ requires $[M+Na]^+$ 272.1257 (error 0.0 ppm); υ_{max} 3399, 29601693, 1493, 1309, 1154, 702 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.38 – 7.28 (m, 5H), 5.90 (s, 1H), 5.29 (d, 1H, J = 5.8 Hz), 2.08 (s, 3H), 1.40 (s, 9H); $^{13}C\{^1H\}$ NMR (126 MHz, $CDCl_3$): δ 203.7, 155.0 137.0, 129.3, 128.6, 127.9, 79.9, 64.8, 28.4, 27.1; m/z (ESI) 272.2 $[(M+Na)^+$, 100%]. The data matches the reported data.

Synthesis of amine salts for N-Ts protection.

General procedure C for N-Boc deprotection.

N-Boc intermediate was dissolved in dichloromethane and cooled to 0 ˚C using an ice bath. To this stirred solution was added trifluoroacetic acid dropwise under a nitrogen atmosphere and the resulting reaction mixture was stirred at 0 ˚C for 30 minutes followed by stirring at rt for 6h. Once the reaction was complete (assessed by TLC), the reaction mixture was concentrated under reduced pressure to give the crude amine trifluoroacaetic acid salt. The crude material was purified by trituration using n-pentane: ethyl acetate (8:2) to afford the corresponding amines as a trifluoroacetate salt. HRMS (ESI) correspond to the RNH_3 component.

2-(2-Methoxyphenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is novel and was prepared following general procedure **C** using *tert*-butyl (2-(2-methoxyphenyl)-2-oxo-1-phenylethyl)carbamate (1.30 g, 3.81 mmol, 1.0 eq) and trifluoroacetic acid (4.35 g, 38.1 mmol, 10 eq) in DCM (30 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.05 g, 2.95 mmol, 77.8%). TLC: Rf 0.0 (8:2, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 158-160 ºC; HRMS (ESI): found $[M+H]^+$ 242.1174, $C_{15}H_{16}NO_2$ requires $[M+H]^+$ 242.1176 (error 0.7 ppm); υ_{max} 1656, 1596, 1532, 1186, 762, 700 cm^{-1}; ^1H NMR (D_2O, 500 MHz): δ 7.82 (dd, 1H, J = 7.9, 1.5 Hz), 7.53-7.49 (m, 1H), 7.40 (s, 5H), 7.01 (t, 1H, J = 7.6 Hz), 6.96 (d, 1H, J = 8.5 Hz), 6.26 (s, 1H), 3.81 (s, 3H); $^{13}C\{^1H\}$ NMR (D_2O, 126 MHz): δ 195.2, 158.7, 136.5, 131.2, 131.0, 130.1, 129.4, 128.9, 122.5, 120.9, 112.4, 62.6, 55.3; m/z (ESI) 242.2 $[(M+H)^+$, 10%], 483.4 $[(2M+H]^+$, 100%].

2-(3-Methoxyphenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is novel and was prepared following the general procedure **C** using *tert*-butyl (2-(3-methoxyphenyl)-2-oxo-1-phenylethyl)carbamate (0.341 g, 1.00 mmol, 1.0 eq.) and trifluoroacetic acid (1.14 g, 10 mmol, 10 eq) in DCM (5 mL) and the crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 30 mL) to give the product as a brown solid (0.44 g, 1.23 mmol, quantitative yield, excess TFA present). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 90-101 ºC; HRMS (ESI): found $[M+H]^+$ 242.1172, $C_{15}H_{16}NO_2$ requires $[M+H]^+$ 242.1176 (error 1.5 ppm); υ_{max} 1665, 1566, 1496, 1165, 1144, 781, 701 cm^{-1}; ^1H NMR (D_2O, 500 MHz)): δ 7.55 (d, 1H, J = 7.8 Hz), 7.48-7.45 (m, 6H), 7.36 (t, 1H, J = 8.0 Hz), 7.19-7.17 (m, 1H), 6.24 (s, 1H), 3.78 (s, 3H); $^{13}C\{^1H\}$ NMR (D_2O, 126 MHz): δ 194.1, 159.2, 133.8, 131.3, 130.4, 130.3, 130.0 128.6 122.1, 121.0, 113.6, 59.8 55.5; m/z (ESI) 242.2 $[(M+H)^+$, 10%], 483.4 $[(2M+H)^+$, 100%].

2-(2-Chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is novel and was prepared following the general procedure **C** using *tert*-butyl (2-(2-chlorophenyl)-2-oxo-1-phenylethyl)carbamate (1.00 g, 2.89 mmol, 1.0 eq) and trifluoroacetic acid (3.29 g, 28.9 mmol, 10 eq) in DCM (20 mL) and the crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.20g, 3.35 mmol, quantitative yield , excess TFA present). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 161-163 ºC; HRMS (ESI): found $[M+H]^+$ 246.0678, $C_{14}H_{13}ClNO$ requires $[M+H]^+$ 246.0680 (error 0.9 ppm); υ_{max} 1709, 1649, 1512, 1187, 1141, 765, 696 cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.67-7.65 (m, 1H), 7.47-7.39 (m, 7H), 7.37-7.33 (m, 1H), 6.12 (s, 1H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 195.4, 135.7, 134.3, 133.0, 132.2, 132.0, 131.4, 131.1, 130.8, 130.0, 128.3, 63.0; m/z (ESI) 246.1 $[(M+H)^+$, 10%], 491.3 $[(2M+H)^+$, 100%].

2-(3-Chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is novel and was prepared following the general procedure **C** using *tert*-butyl (2-(3-chlorophenyl)-2-oxo-1-phenylethyl)carbamate (1.00 g, 2.89 mmol, 1.0 eq) and trifluoroacetic acid (3.29 g, 28.9 mmol, 10 eq) in DCM (20 mL) and the crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.20 g, 3.35 mmol in quantitative yield, excess TFA present). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 102-105 ºC; HRMS (ESI): found $[M+H]^+$ 246.0681,

$C_{14}H_{13}ClNO$ requires $[M+H]^+$ 246.0680 (error -0.2 ppm); υ_{max} 1682, 1531, 1431, 1180, 1135, 799, 699 cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.98 (s, 1H), 7.90 (d, 1H, J = 7.9 Hz), 7.61 (d, 1H, J = 8.1 Hz), 7.52 – 7.43 (m, 6H), 6.22 (s, 1H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 193.2, 136.2, 136.2, 135.4, 133.1 131.7, 131.5, 131.1, 130.0, 129.9, 128.7, 60.8; m/z (ESI) 246.2 $[(M+H)^+$, 10%], 491.3 $[(2M+H)^+$, 100%].

2-(4-Chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is known however it has not been fully characterized previously.[30] This compound was prepared following the general procedure **C** using *tert*-butyl (2-(4-chlorophenyl)-2-oxo-1-phenylethyl)carbamate (1.00 g, 2.89 mmol, 1.0 eq) and trifluoroacetic acid (3.29 g, 28.9 mmol, 10 eq) in DCM (20 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.22 g, 3.40 mmol, quantitative yield, excess TFA present). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 77-80 ºC; HRMS (ESI): found $[M+H]^+$ 246.0680, $C_{14}H_{13}ClNO$ requires $[M+H]^+$ 246.0680 (error 0.1 ppm); υ_{max} 1676, 1651, 1537, 1175, 1139, 797, 723 cm^{-1}; ^1H NMR (D_2O, 500 MHz): δ 7.77-7.75 (m, 2H), 7.41 – 7.38 (m, 5H), 7.21-7.20 (m, 2H), 6.15 (s, 1H); $^{13}C\{^1H\}$ NMR (D_2O, 126 MHz,): δ 193.2, 140.7, 131.0, 130.6, 130.5, 130.5, 130.0, 129.1, 128.6, 59.6; m/z (ESI) 246.1 $[(M+H)^+$, 100%], 491.3 $[(2M+H)^+$, 70%].

1-(2-Methoxyphenyl)-2-oxo-2-phenylethan-1-aminium trifluoroacetate.

The compound is novel and was prepared following the general procedure **C** using *tert*- Butyl (1-(2-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate (1.00 g, 2.93 mmol, 1.0 eq) and trifluoroacetic acid (3.34 g, 29.3 mmol, 10 eq) in DCM (20 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.30 g, 3.66 mmol in quantitative yield, excess TFA present). TLC: Rf 0.0 (8:2, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 87-91 ºC; HRMS (ESI): found $[M+H]^+$ 242.1173, $C_{15}H_{16}NO_2$ requires $[M+H]^+$ 242.1176 (error 0.9 ppm); υ_{max} 1685, 1599, 1495, 1164, 1104, 754, 697 cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.90 (d, 2H, J = 7.5 Hz), , 7.57 (t, 1H, J = 7.5 Hz), , 7.44-7.42 (m, 3H), 7.33-7.31 (m, 1H), 7.10 (d, 1H, J = 8.4 Hz), 6.99 (t, 1H, J = 7.5 Hz), 6.26 (s, 1H), 3.92 (s, 3H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 194.6, 158.3, 135.3, 134.7, 133.3, 131.0, 129.9, 129.78 122.6, 121.9, 113.1, 56.3, 56.1; m/z (ESI) 242.3 $[(M+H)^+$, 20%], 483.4 $[(2M+H)^+$, 100%].

1-(4-Methoxyphenyl)-2-oxo-2-phenylethan-1-aminium trifluoroacetate.

This compound is known however it has not been fully characterized previously.[31] This compound was prepared following the general procedure **C** using *tert*-butyl (1-(4-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate (1.00 g, 2.93 mmol, 1.0 eq) and trifluoroacetic acid (3.34 g, 29.3 mmol, 10 eq) in DCM (20 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 60 mL) to give the product as a brown solid (1.23 g, 3.46 mmol in quantitative yield, excess TFA present). TLC: Rf 0.0 (8:2, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 139-142 ºC; HRMS (ESI): found $[M+H]^+$ 242.1172, $C_{15}H_{16}NO_2$ requires $[M+H]^+$ 242.1176 (error 1.4 ppm); υ_{max} 1650, 1595, 1515, 1183, 1137, 723, 687 cm^{-1}; ^1H NMR (CD_3OD, 600 MHz): δ 7.98 (d, 2H, J = 7.6 Hz), 7.58 (t, 1H, J = 7.4 Hz), 7.46 – 7.41 (m, 4H), 6.97 (d, 2H, J = 8.7 Hz), 6.14 (s, 1H), 3.76 (s, 3H); $^{13}C\{^1H\}$ NMR (CD_3OD, 151 MHz): δ 194.3, 162.5, 135.5, 134.6, 131.4, 130.2, 130.0 125.2, 116.2, 60.2, 55.9; m/z (ESI) 242.2 $[(M+H)^+$, 10%], 483.4 $[(2M+H)^+$, 100%].

1-(2-Chlorophenyl)-2-oxo-2-phenylethan-1-aminiumtrifluoroacetate.

This compound is novel and was prepared following the general procedure **C** using *tert*-butyl (1-(2-chlorophenyl)-2-oxo-2-phenylethyl)carbamate (0.500 g, 1.45 mmol, 1.0 eq) and trifluoroacetic acid (1.65 g, 14.5 mmol, 10 eq) in DCM (10 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 80 mL) to give the product as a brown solid (0.418 g, 1.16 mmol, 80%). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 130-133 ºC; HRMS (ESI): found $[M+H]^+$ 246.0677, $C_{14}H_{13}ClNO$ requires $[M+H]^+$ 246.0680 (error 1.5 ppm); υ_{max} 1664, 1533, 1176, 1138, 797, 719, cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.92 (d, 2H, J = 7.9 Hz), 7.64-7.60 (m, 2H), 7.49-7.44 (m, 3H), 7.37-7.32 (m, 2H), 6.49 (s, 1H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 193.7, 135.4, 135.5 134.3, 133.3, 132.1, 131.3 131.0, 130.2, 129.9, 129.6, 57.5; m/z (ESI) 246.1 $[(M+H)^+$, 100%], 491.3 $[(2M+H)^+$, 70%].

1-(4-Chlorophenyl)-2-oxo-2-phenylethan-1-aminiumtrifluoroacetate.

This compound is known however it has not been fully characterized previously.[32] This compound was prepared following the general procedure **C** using *tert*-butyl (1-(4-chlorophenyl)-2-oxo-2-phenylethyl)carbamate (1.00 g, 2.89 mmol, 1.0 eq) and trifluoroacetic acid (3.30 g, 28.9 mmol, 10 eq) in DCM (20 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (8:2 v/v, 80 mL) to give the product as a brown solid (0.980 g, 2.74 mmol, 94.9%). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 126-130 ºC; HRMS (ESI): found $[M+H]^+$ 246.0680, $C_{14}H_{13}ClNO$ requires $[M+H]^+$ 246.0680 (error -0.1 ppm); υ_{max} 1642, 1540, 1208, 1184, 1137, 801, 714, cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.98 (d, 2H, J = 7.7 Hz), 7.62 (t, 1H, J = 7.5 Hz), 7.51-7.46 (m, 6H), 6.24 (s, 1H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 193.9, 137.5, 135.8, 134.3, 132.2, 131.7 131.1, 130.3, 130.1, 59.9; m/z (ESI) 246.0 $[(M+H)^+$, 100%].

2-(4-Chlorophenyl)-1-(4-methoxyphenyl)-2-oxoethan-1-aminium trifluoroacetate.

This compound is known however it has not been fully characterized previously.[33] This compound was prepared following the general procedure **C** using *tert*-butyl (1-(4-chlorophenyl)-2-(4-methoxyphenyl)-2-oxoethyl)carbamate (1.00 g, 2.81 mmol, 1.0 eq) and trifluoroacetic acid (3.20 g, 28.1 mmol, 10 eq) in DCM (20 mL) and the crude product was purified by trituration using n-pentane : EtOAc (9:1 v/v, 100 mL) to give the product as a yellow solid (0.750 g, 1.92

mmol, 68.6%). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, checked to confirm the consumption of starting material; MP: 79-80 ºC; HRMS (ESI): found $[M+H]^+$, 276.0790, $C_{15}H_{15}ClNO_2$ requires $[M+H]^+$ 276.0786 (error -1.6 ppm); υ_{max} 1665, 1588, 1512, 1492, 1176, 1130, 1092, 797, 720, 565 cm^{-1}; ^1H NMR (CD_3OD, 600 MHz): δ 7.95 (d, 2H, J = 8.6 Hz), 7.47 (d, 2H, J = 8.6 Hz), 7.41 (d, 2H, J = 8.7 Hz), 6.98 (d, 2H, J = 8.7 Hz), 6.12 (s, 1H), 3.77 (s, 3H); $^{13}C\{^1H\}$ NMR (CD_3OD, 151 MHz): δ 193.3, 162.6 141.8, 133.1 131.9, 131.4, 130.3, 124.8, 116.3, 60.2, 55.989); m/z (ESI) 276.2 $[(M+H)^+$, 100%], 278.2 $[(M+2+H)^+$, 100%].

2-(Furan-2-yl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate.

This compound is novel and was prepared following the general procedure **C** using *tert*-butyl (2-(furan-2-yl)-2-oxo-1-phenylethyl)carbamate (1.00 g, 3.32 mmol, 1.0 eq) and trifluoroacetic acid (3.78 g, 33.2 mmol, 10 eq) in DCM (20 mL) and generated crude product was purified by trituration using n-pentane : EtOAc (9:1 v/v, 60 mL) to give the product as a white solid (0.980 g, 3.11 mmol, 93.6%). TLC: Rf 0.0 (7:3, Hexane: EtOAc), strong UV active, TLC checked to confirm the consumption of starting material; MP: 152-155 ºC; HRMS (ESI): found $[M+H]^+$, 202.0868, $C_{12}H_{12}NO_2$ requires $[M+H]^+$ 202.0863 (error -2.5 ppm); υ_{max} 1677, 1463, 1406, 1179, 1132, 798, 780, 576 cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.79 (s, 1H), 7.54 (d, 2H, J = 7.1 Hz), 7.48 – 7.46 (m, 3H), 7.43 (d, 1H, J = 3.7 Hz), 6.63 (d, 1H, J = 3.7 Hz), 5.89 (s, 1H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 182.3, 151.0 , 150.1, 133.4, 131.3, 130.8, 129.8, 122.1, 114.1, 60.4); m/z (ESI) 202.0 $[(M+H)^+$, 30%], 403.2 $[(2M+H)^+$, 100%].

2-Oxo-1-phenylpropan-1-aminium trifluoroacetate.

This compound has been reported as hydrochloride salt.[34]

This compound was prepared following the general procedure **C** using *tert*-butyl (2-oxo-1-phenylpropyl) carbamate (0.600 g, 2.55 mmol, and 1.0 eq) and trifluoroacetic acid (2.90 g, 25.5 mmol, 10 eq) in DCM (10 mL) and the crude product was purified by trituration using n-pentane: EtOAc (8:2 v/v, 80 mL) to give the product as a yellow solid (0.530 g, 2.12 mmol, 83.1%). HRMS (ESI): found $[M+H]^+$ 150.0911, $C_9H_{12}NO$ requires $[M+H]^+$ 150.0913 (error 0.3 ppm); υ_{max} 1762, 1655, 1614, 1528, 1190, 1132, 839, 722, 697cm^{-1}; ^1H NMR (CD_3OD, 500 MHz): δ 7.54-7.52 (m, 3H), 7.47-7.45 (m, 2H), 5.27 (s, 1H), 2.11 (s, 3H); $^{13}C\{^1H\}$ NMR (CD_3OD, 126 MHz): δ 202.2, 132.9, 131.5, 131.0, 129.8, 64.2, 26.5; m/z (ESI) 150.1 $[(M+1)^+$, 25%]. The data matches the reported data.

General procedure for formation of α-NTs-amino ketones.

Method D

Substituted amine trifluoroacetate derivative was suspended in DCM and cooled to 0^0 C in an ice bath. Triethylamine was added dropwise to the reaction mixture and stirred at this temperature for 30 minutes. During the addition of triethylamine, the initially cloudy reaction mixture became clear. To the reaction mixture, tosyl chloride in DCM was added dropwise and the resulting reaction mixture was stirred at 0 ˚C for 30 minutes followed by overnight stirring at rt. Once the reaction was complete (assessed by TLC), water and DCM were added and organic layer was separated. The aqueous layer was extracted with DCM. The combined organic layers were washed with brine and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography to afford the desired product.

Method E

Substituted amine trifluoroacetate derivative was suspended in acetone and cooled to 0^0 C in an ice bath. Saturated aqueous $NaHCO_3$ and solution of tosyl chloride was added dropwise simultaneously to the reaction mixture and stirred at same temperature for 30 minutes followed by stirring at rt for 7h. During the addition, the initially clear reaction mixture started to become a suspension. Once the reaction was complete (assessed by TLC), the reaction mixture was filtered through a Buchner filter and the residue was washed with acetone. The combined filtrate was concentrated. To the obtained residue, water and DCM were added and organic layer was separated. The aqueous layer was extracted with DCM . The combined organic layers were washed with brine and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography to afford the desire product.

N-(2-(2-Methoxyphenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14b.

This compound is novel and was prepared following the general procedure **D** using 2-(2-methoxyphenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (1.00 g, 2.81mmol, 1.0 eq) in DCM (20 mL), triethylamine (1.42 g, 1.95 mL, 22.6 mmol, 5 eq) and tosyl chloride (1.17 g, 6.19 mmol, 2.2 eq) in DCM (30 mL), water (50 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14b** as a yellow solid (0.69 g, 1.74 mmol, 62.1%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), strong UV active; MP: 138-140 ºC; HRMS (ESI): found $[M+Na]^+$ 418.1085, $C_{22}H_{21}NNaO_4S$ requires $[M+Na]^+$ 418.1083 (error -0.3 ppm); υ_{max} 3264, 1662, 1595, 1209, 1175, 756, 673, 535 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.60 (d, 2H, J = 8.2 Hz), 7.48-7.46 (m, 1H), 7.40 – 7.36 (m, 1H), 7.14 -7.09 (m, 7H), 6.87 – 6.81 (m, 2H), 6.27 (d, 1H, J = 7.5 Hz), 6.20 (d, 1H, J = 7.5 Hz), 3.80 (s, 3H), 2.31 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$,126 MHz): δ 196.4, 158.2, 143.1, 137.6, 136.1, 134.8 131.4, 129.4, 128.7, 128.2, 128.2, 127.2, 124.7, 120.9, 111.6, 65.1, 55.5, 21.5; m/z (ESI) 418.3 $[(M+Na)^+$, 100%].

N-(2-(3-Methoxyphenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14c.

This compound is novel and was prepared following the standard procedure **D** using 2-(3-methoxyphenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (0.400 g, 1.12 mmol, 1.0 eq) in DCM (10 mL), triethylamine (0.453 g, 0.62 mL, 4.48 mmol, 4 eq) and tosyl chloride (0.322 g, 1.68 mmol, 1.5 eq) in DCM (10 mL), water (50 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14c** as a white solid (0.205 g, 0.519 mmol, 46.3%). TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), strong UV active; MP: 158-160 ºC; HRMS (ESI): found $[M+Na]^+$ 418.1086, $C_{22}H_{21}NNaO_4S$ requires $[M+Na]^+$ 418.1083 (error -

0.5 ppm); υ_{max} 3276, 1677, 1588, 1254, 1159, 662, 530 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.52 (d, 2H, J = 8.2 Hz), 7.37 (d, 1H, J = 7.7 Hz), 7.30 – 7.24 (m, 2H), 7.18 (s, 5H), 7.07– 7.02 (m, 3H), 6.20 (d, 1H, J = 7.4 Hz), 5.96 (d, 1H, J = 7.4 Hz),, 3.77 (s, 3H), 2.30 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 195.0 159.9 143.3, 137.6, 1359, 135.2, 129.8, 129.5129.2, 128.6, 128.2, 127.1, 121.7, 120.6, 113.3, 62.0, 55.5, 21.5; m/z (ESI) 418.1 [$(M+Na)^+$, 100%].

N-(2-(2-Chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14d.

This compound is novel and was prepared following the general procedure **E** using 2-(2-chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (1.00 g, 2.79 mmol, 1.0 eq.) in acetone (20 mL), saturated aqueous $NaHCO_3$ (20 mL) and tosyl chloride (0.590 g, 3.07 mmol, 1.1 eq) in acetone (20 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (10% EtOAc in petroleum ether (40-60)) to give **14d** as a yellow solid (0.45 g, 1.12 mmol, 44.9%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), strong UV active; MP: 87-89 ºC; HRMS (ESI): found $[M+Na]^+$ 422.0592, $C_{21}H_{18}ClNNaO_3S$ requires $[M+Na]^+$ 422.0588 (error -0.9 ppm); υ_{max} 3258, 1691, 1587, 1335, 1161, 758, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): 7.60 (d, 2H, J = 8.3 Hz), 7.29-7.26 (m, 2H), 7.16 -7.17 (m, 6H), 7.07-7.05 (m, 3H), 6.26 (d, 1H, J = 6.3 Hz), 5.91 (d, 1H, J = 6.4 Hz), 2.34 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 196.8, 143.5, 137.4, 135.8, 134.3, 132.5, 131.3, 129.6, 129.5, 129.0, 128.7, 128.2, 127.2, 126.8, 64.9, 21.6; m/z (ESI) 422.1 [$(M+Na)^+$, 100%] 424.3 [$(M+2+Na)^+$, 35%]

N-(2-(3-Chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14e.

This compound is novel and was prepared following the general procedure **D** 2-(3-chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (1.00 g, 2.79 mmol, 1.0 eq) in DCM (25 mL), triethylamine (1.40 g, 2.00 mL, 13.9 mmol, 5 eq) and tosyl chloride (1.17 g, 6.14 mmol, 2.2 eq) in DCM (25 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (50% EtOAc in petroleum ether (40-60)) to give **14e** as a yellow solid (0.290 g, 0.726 mmol, 26.0%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), strong UV active; MP: 210-211 ºC; HRMS (ESI): found $[M+Na]^+$ 422.0593, $C_{21}H_{18}ClNNaO_3S$ requires $[M+Na]^+$ 422.0588 (error -1.1 ppm); υ_{max} 3250, 1697, 1329, 1154, 664, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.75 (s, 1H), 7.65 (d, 1H, J = 7.9 Hz) 7.52 (d, 2H, J = 8.2 Hz), 7.47-7.46 (m, 1H), 7.30 (t, 1H, J = 7.9 Hz), 7.20-7.15 (m, 5H), 7.07 (d, 2H, J = 8.1 Hz), 6.14 (d, 1H, J = 7.5 Hz), 5.93 (d, 1H, J = 7.5 Hz), 2.32 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz_3): δ 193.7, 143.4, 137.4, 135.5, 135.3, 135.2, 134.0, 130.1, 129.5, 129.4, 128.9, 128.2, 127.1, 127.1, 62.0 21.6; m/z (ESI) 422.1 [$(M+Na)^+$, 90%] 424.3 [$(M+2+Na)^+$, 50%].

N-(2-(4-Chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14f.

This compound is novel and was prepared following the general procedure **D using** 2-(4-chlorophenyl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (1.10 g, 3.07 mmol, 1.0 eq) in DCM (20 mL), triethylamine (1.24 g, 1.71 mL, 12.3 mmol, 4 eq) and tosyl chloride (0.878 g, 4.60 mmol, 1.5 eq) in DCM (20 mL), water (60 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14f** as a brown solid (0.385 g, 0.964 mmol, 31.4%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 161-163 ºC; HRMS (ESI): found $[M+Na]^+$ 422.0591, $C_{21}H_{18}ClNNaO_3S$ requires $[M+Na]^+$ 422.0588 (error -0.7 ppm); υ_{max} 3250, 1697, 1329, 1154, 664, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ7.74 (d, 2H, J = 8.6 Hz), 7.51 (d, 2H, J = 8.2 Hz), 7.33 (d, 2H, J = 8.6 Hz), 7.19 – 7.14 (m, 5H),7.07 (d, 2H, J = 8.1 Hz), 6.18 (d, 1H, J = 7.3 Hz), 5.94 (d, 1H, J = 7.4 Hz), 2.31 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 193.5, 143.3, 140.7, 137.5, 135.5, 132.2, 130.4, 129.5, 129.3, 129.2, 128.8, 128.2, 127.1, 61.9, 21.5; m/z (ESI) 422.1 [$(M+Na)^+$, 100%] 424.3 [$(M+2+Na)^+$, 40%].

N-(1-(2-Methoxyphenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide 14g.

This compound is novel and was prepared following the general procedure **E** using 1-(2-methoxyphenyl)-2-oxo-2-phenylethan-1-aminium (1.20 g, 3.37 mmol, 1.0 eq) in acetone (25 mL), saturated aqueous $NaHCO_3$ (25 mL) and tosyl chloride (0.708 g, 3.71 mmol, 1.1 eq) in acetone (25 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **14g** as a white solid (0.750 g, 1.89 mmol, 56.1%). TLC: R_f ca 0.35 (6:4, Hexane: EtOAc), strong UV active; MP: 162-165 ºC; HRMS (ESI): found $[M+Na]^+$ 418.1082, $C_{22}H_{21}NNaO_4S$ requires $[M+Na]^+$ 418.1083 (error 0.4 ppm); υ_{max} 3260, 2983, 1697, 1597, 1229, 1160, 754, 688, 536 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.83 (d, 2H, J = 7.9 Hz), 7.57 (d, 2H, J = 7.6 Hz), 7.45 (t, 1H, J = 7.4 Hz), 7.33-7.30 (m, 2H), 7.12 (t, 1H, J = 7.8 Hz), 7.07 (m, 3H), 6.76 (t, 1H, J = 7.5 Hz), 6.67 (d, 1H, J = 8.1 Hz), 6.25-6.22 (m, 2H), 3.74 (s, 3H), 2.30 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 194.8, 156.3, 143.0, 137.6, 134.1, 133.7, 130.0, 129.4, 129.3, 128.8, 128.6, 127.2, 124.7, 121.3, 111.4, 56.8, 55.6, 21.5; m/z (ESI) 418.3 [$(M+Na)^+$, 100%].

N-(1-(4-Methoxyphenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide 14h.

This compound has been reported.[23] This compound was prepared following the general procedure **E** using 1-(4-methoxyphenyl)-2-oxo-2-phenylethan-1-aminium (1.20 g, 3.37 mmol, 1.0 eq) in acetone (25 mL), saturated aqueous $NaHCO_3$ (25 mL) and tosyl chloride (0.708 g, 3.71 mmol, 1.1 eq) in acetone (25 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14h** as a white solid (1.00 g, 2.53 mmol, 75.1%). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), strong UV active; MP: 61-62 ºC; HRMS (ESI): found $[M+Na]^+$ 418.1083, $C_{22}H_{21}NNaO_4S$ requires $[M+Na]^+$ 418.1083 (error 0.0 ppm); υ_{max} 3270, 1680, 1580, 1248, 1154, 752, 676, 529 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.79 (d, 2H, J = 7.8 Hz), 7.53 – 7.47 (m, 3H), 7.37-7.33 (m, 2H)), 7.09-7.06 (m, 4H), 6.68 (d, 2H, J = 8.4 Hz), 6.18 (d, 1H, J = 7.3 Hz), 5.95 (d, 1H, J = 7.3 Hz), 3.70 (s, 3H), 2.30 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 194.7 159.8, 143.1, 137.7, 134.0, 133.9, 129.6, 129.4, 129.0, 128.8, 127.8, 127.1, 114.6, 61.3, 55.3, 21.5; m/z (ESI) 418.2 [$(M+Na)^+$, 100%].

N-(1-(2-Chlorophenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide 14i.

This compound is novel and was prepared following the general procedure **E** using 1-(2-chlorophenyl)-2-oxo-2-phenylethan-1-aminium (0.400 g, 1.11 mmol, 1.0 eq) in acetone (10 mL), saturated aqueous $NaHCO_3$ (10 mL) and tosyl chloride (0.233 g, 1.22 mmol, 1.1 eq) in acetone (10 mL), water (50 mL) to quench and DCM (2 x 20 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14i** as a white solid (0.310 g, 0.776 mmol, 70.6%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 134-135 ºC, HRMS (ESI): found $[M+Na]^+$ 422.0591, $C_{21}H_{18}ClNNaO_3S$ requires $[M+Na]^+$ 422.0588 (error -0.6 ppm); υ_{max} 3261, 1690, 1596, 1328, 1152, 717, 546 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.85 (d, 2H, J = 7.9 Hz), 7.62 (d, 2H, J = 7.9 Hz), 7.50 (t, 1H, J = 7.4 Hz), 7.36 (m, 2H), 7.26-7.23 (m, 1H), , 7.11-7.04 (m, 5H), 6.34 (d, 1H, J = 7.0 Hz), 6.26 (d, 1H , J = 7.0 Hz), 2.32 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 194.3, 143.4, 137.2, 134.2, 133.8, 133.8, 133.7, 130.4, 130.0, 129.7, 129.5, 128.9, 128.8, 127.7, 127.3, 58.7, 21.6; m/z (ESI) 422.2 $[(M+Na)^+$, 100%] 424.1 $[(M+2+Na)^+$, 35%].

N-(1-(4-Chlorophenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide 14j.

This compound is novel and was prepared following the general procedure **E** using 1-(4-chlorophenyl)-2-oxo-2-phenylethan-1-aminium trifluoroacetate (0.900 g, 2.51 mmol, 1.0 eq) in acetone (18 mL), saturated aqueous $NaHCO_3$ (18 mL) and tosyl chloride (0.528 g, 2.76 mmol, 1.1 eq) in acetone (18 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14j** as a white solid (0.586 g, 1.57 mmol, 58.5%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; MP: 166-169 ºC; HRMS (ESI): found $[M+Na]^+$ 422.0588, $C_{21}H_{18}ClNNaO_3S$ requires $[M+Na]^+$ 422.0588 (error 0.1 ppm); υ_{max} 3219, 1696, 1399, 1155, 652, 543 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.78 (d, 2H , J = 7.9 Hz), 7.54-7.49 (m, 3H), 7.38 (t, 2H, J = 7.6 Hz), 7.26 (s, 1H) , 7.13-7.07 (m, 5H), 6.22 (d, 1H, J = 6.9 Hz), 5.96 (d, 1H, J = 7.0 Hz), 2.32 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 194.2, 143.5, 137.5, 134.8, 134.3, 134.3, 133.7, 129.6, 129.5, 129.4, 129.1, 128.9, 127.1, 61.1, 21.5; m/z (ESI) 422.2 $[(M+Na)^+$, 100%] 424.1 $[(M+2+Na)^+$, 35%].

N-(2-(4-Chlorophenyl)-1-(4-methoxyphenyl)-2-oxoethyl)-4-methylbenzenesulfonamide 14k.

This compound is novel and was prepared following the general procedure **E** using 1-(4-chlorophenyl)-2-(4-methoxyphenyl)-2-oxoethan-1-aminium trifluoroacetate (0.750 g, 1.92 mmol, 1.0 eq) in acetone (14 mL), saturated aqueous $NaHCO_3$ (20 mL) and tosyl chloride (0.405 g, 2.12 mmol, 1.1 eq) in acetone (14 mL), water (50 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **14k** as a yellow solid (0.600 g, 1.39 mmol, 72.8%). TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), strong UV active; MP: 72-76 ºC; HRMS (ESI): found $[M+Na]^+$ 452.0694, $C_{22}H_{20}ClNNaO_4S$ requires $[M+Na]^+$ 452.0694 (error -0.0 ppm); υ_{max} 3269, 1682, 1588, 1510, 1249, 1156, 1089, 810, 663, 532 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.74-7.72 (m, 2H), 7.53-7.51 (m, 2H), 7.34-7.31 (m, 2H), 7.08-7.04 (m, 4H), 6.70-6.67 (m, 2H), 6.15 (d, 1H, J = 7.3 Hz), 5.90 (d, 1H, J = 7.3 Hz), 3.71 (s, 3H), 2.31 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz):) δ 193.6, 159.9, 143.2, 140.5, 137.7, 132.3, 130.4, 129.5, 129.5, 129.2, 127.4, 127.1, 114.7, 61.4, 55.4, 21.5; m/z (ESI) 452.2 $[(M+Na)^+$, 100%], 454.2 $[(M+2+Na)^+$, 35%].

N-(2-(Furan-2-yl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide 14l.

This compound is novel and was prepared following the general procedure **E** using 2-(furan-2-yl)-2-oxo-1-phenylethan-1-aminium trifluoroacetate (0.800 g, 2.53 mmol, 1.0 eq) in acetone (18 mL), saturated aqueous $NaHCO_3$ (18 mL) and tosyl chloride (0.532 g, 2.79 mmol, 1.1 eq) in acetone (18 mL), water (80 mL) to quench and DCM (2 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (50% EtOAc in petroleum ether (40-60))to give **14l** as a white solid (0.706 g, 1.98 mmol, 78.6%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), strong UV active; MP: 147-149 ºC; HRMS (ESI): found $[M+Na]^+$ 378.0769, $C_{19}H_{17}NNaO_4S$ requires $[M+Na]^+$ 378.0770 (error 0.5 ppm); υ_{max} 3268, 1658, 1464, 1345, 1159, 1090, 989, 773, 525 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.54-7.52 (m, 3H), 7.23-7.18 (m, 5H), 7.14 (d, 1H, J = 3.6 Hz), 7.07 (d, 2H, J = 8.1 Hz), 6.46 (d, 1H, J = 5.2 Hz), 6.13 (d, 1H, J = 7.6 Hz), 5.81 (d, 1H, J = 7.6 Hz), 2.31 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 183.32 150.2, 147.5, 143.3, 137.5, 135.5, 129.4, 129.0, 128.6, 128.2, 127.1, 119.8, 112.9, 61.7, 21.5; m/z (ESI) 378.1 $[(M+Na)^+$, 100%].

N-(2-Oxo-1,2-diphenylethyl)methanesulfonamide (precursor of 23).

This compound has been reported.[35] This compound was prepared following the general procedure **D** using 2-oxo-1,2-diphenylethan-1-aminium hydrochloride **(**0.500 g, 2.02 mmol, 1.0 eq) in DCM (10 mL), triethylamine (0.816 g, 1.12mL, 8.08 mmol, 4.0 eq) and mesyl chloride (0.348 g, 3.03 mmol, 1.5 eq) in DCM (10 mL), water (50 mL) to quench and DCM (2 x 25 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give the product as a white solid (0.310 g, 1.07 mmol, 52.9%). TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 312.0696, $C_{15}H_{15}NNaO_3S$ requires $[M+Na]^+$ 312.0665 (error 0.7 ppm); υ_{max} 3242, 1687, 1313, 1293, 1247, 994, 731, 508 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.93 (d, 2H, J = 7.3 Hz), 7.53 (t, 1H, J = 7.4 Hz), 7.42 – 7.24 (m, 7H), 6.13 (d, 1H, J = 6.4 Hz), 6.07 (d, 1H, J = 6.2 Hz), 2.58 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 194.3, 136.3, 134.2, 133.7 129.7, 129.3 129.2, 128.9, 128.4, 62.2, 42.4; m/z (ESI) 312.2 $[(M+Na)^+$, 100%]. The data matches the reported data.

4-Methyl-N-(1-oxo-1-phenylpropan-2-yl)benzenesulfonamide (precursor to 25).

This compound has been reported and fully characterised.[36] This compound was prepared following the same procedure as used for 4-methyl-N-(2-oxo-1,2-diphenylethyl)benzenesulfonamide **14a** using 1-oxo-1-phenylpropan-2-aminium hydrochloride (1.50 g, 8.10 mmol, 1.0 eq) in DCM (40 mL), triethylamine (3.28 g, 4.50 mL, 32.4 mmol, 4 eq) and tosyl chloride (3.10g, 16.2 mmol, 1.2 eq) in

DCM (20 mL), water (100 mL) to quench and DCM (2 x 40 mL) for extraction to generate the crude product which was purified by column chromatography (15% EtOAc in petroleum ether (40-60)) to give the product as a white solid (0.55 g, 1.81 mmol, 22.3%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 326.0819, $C_{16}H_{17}NNaO_3S$ requires $[M+Na]^+$ 326.0821 (error 0.8 ppm); υ_{max} 3267, 1679, 1596, 1337, 1164, 965, 702, 680, 551 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.78 – 7.75 (m, 2H), 7.69 (d, 2H, J = 8.3 Hz), 7.59 (t, 1H, J = 7.4 Hz), 7.47-7.43 (t, 2H, J = 7.7 Hz), 7.17 (d, 2H, J = 8.0 Hz), 5.79 (d, 1H, J = 8.0 Hz), 4.97-4.90 (m, 1H), 2.32 (s, 3H), 1.40 (d, 3H, J = 7.2 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 101 MHz): δ 198.2, 143.6, 137.2, 134.2, 133.5, 129.8, 128.9, 128.6, 127.2, 53.5, 21.6, 21.2; m/z (ESI) 326.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

4-Methyl-N-(2-oxo-1-phenylpropyl)benzenesulfonamide (precursor to 27).

This compound has been reported and fully characterised.[37] This compound was prepared following the general procedure **E** using 2-oxo-1-phenylpropan-1-aminium trifluoroacetate (0.780 g, 2.96 mmol, 1.0 eq) in acetone (20 mL), saturated aqueous $NaHCO_3$ (20 mL) and tosyl chloride (0.621 g, 3.26 mmol, 1.1 eq) in acetone (20 mL), water (60 mL) to quench and DCM (2 x 20 mL) for extraction to generate the crude product which was purified by column chromatography (60% EtOAc in petroleum ether (40-60)) to give the product as a white solid (0.400 g, 1.32 mmol, 45.8%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 326.0822, $C_{16}H_{17}NNaO_3S$ requires $[M+Na]^+$ 326.0821 (error -0.3 ppm); υ_{max} 3373, 3266, 1705, 1672, 1339, 1244, 1158, 774, 667, 565 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.47 (d, 2H, J = 7.6 Hz), 7.26 – 7.21 (m, 3H), 7.11-7.08 (m, 4H), 6.06 (d, 1H, J = 4.4 Hz), 5.02 (d, 1H, J = 4.9 Hz), 2.34 (s, 3H), 1.99 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 201.9, 143.3, 137.4, 135.2, 129.4, 129.2, 128.8, 128.2, 127.1, 66.5, 26.7, 21.6); m/z (ESI) 326.1 [$(M+Na)^+$, 100%]. The data matches the reported data.

General procedure F for asymmetric transfer hydrogenation (ATH).

Substituted ketone derivatives and DABCO were dissolved in small amount of MeCN. Once the reaction became clear, catalyst ((*R,R*)-**20** for N-Boc-protected substrates and (*R,R*)-**2** for N-Ts-protected substrates) and remaining solvent added (to give [S] = 0.1M) after which formic acid was added and the resulting reaction mixture was stirred at room temperature. After stirring for the time indicated, the reaction mixture was concentrated. The residue was dissolved in DCM and the organic layer was washed with water. The aqueous layer was extracted with DCM. The combined organic layers were washed with brine and dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography to afford the substituted amino alcohol. In cases where only a single diastereoisomer of ATH product was observed, the dr is given as >99.9:<0.1. Racemic standards were prepared using general procedure A.

***t*-Butyl-((*1S,2R*)-2-hydroxy-2-(2-methoxyphenyl)-1-phenylethyl)carbamate 17b.**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(2-methoxyphenyl)-2-oxo-1-phenylethyl)carbamate **13b** (0.171 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (7.1 mg, 0.01 mmol, 0.02 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 48h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (40% EtOAc in petroleum ether (40-60)) to give **17b** as a white solid (0.150 g, 0.437 mmol, 87.4%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 115-118 ºC; HRMS (ESI): found $[M+Na]^+$ 366.1677, $C_{20}H_{25}NNaO_4$ requires $[M+Na]^+$ 366.1676 (error -0.2 ppm); υ_{max} 3531, 3381, 1679, 1520, 1218, 1166, 988, 699 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, T = 25 ºC), (*1S,2R*) 16.4 min, (*1R,2S*) 19.1 min, other diastereomer 52.2 min and 62.4 min; $[\alpha]_D^{22}$ = -122 (*c* = 0.1, $CHCl_3$); dr: >99.9:<0.1, major diastereomer 94% ee; ^1H NMR (DMSO-*d*$_6$, 500 MHz): δ 7.17-7.12 (m, 4H), 7.03-6.90 (m, 5H), 6.73-6.70 (m, 1H), 5.21 (d, 1H, J = 4.8 Hz), 5.09 (t, 1H, J = 5.0 Hz), 4.75 (dd, 1H, J = 8.7, 5.5 Hz), 3.84 (s, 3H), 1.29 (s, 9H); $^{13}C\{^1H\}$ NMR (DMSO-*d*$_6$, 126 MHz): δ 155.8, 154.5, 140.4, 130.2, 128.1, 127.9 127.3, 127.0, 126.4, 119.7, 110.2, 77.8, 69.5, 58.1, 55.4, 28.2; m/z (ESI) 366.3 [$(M+Na)^+$, 100%].

***t*-Butyl ((*1S,2R*)-2-hydroxy-2-(3-methoxyphenyl)-1-phenylethyl)carbamate 17c.**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(3-methoxyphenyl)-2-oxo-1-phenylethyl)carbamate **13c** (0.171 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 72h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (50% EtOAc in petroleum ether (40-60)) to give **17c** as a white solid (0.150 g, 0.437 mmol, 87.4%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 163-165 ºC; HRMS (ESI): found $[M+Na]^+$ 366.1674, $C_{20}H_{25}NNaO_4$ requires $[M+Na]^+$ 366.1676 (error 0.6 ppm); υ_{max} 3420, 1660, 1520, 1291, 1160, 1166, 980, 698 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 16.5 min, (*1R,2S*) isomer 21.6 min, other diastereomer 47.3 min and 143.1 min; $[\alpha]_D^{22}$ = -109 (*c*=0.1, $CHCl_3$), dr: >99.9:<0.1, 93% ee; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.26-7.23 (m, 3H), 7.15 (t, 1H, J = 7.9 Hz), 7.04 (s, 2H), 6.78-6.76 (m, 1H), 6.66 (d, 1H, J = 7.2 Hz), 6.53 (s, 1H), 5.33 (d, 1H, J = 6.3 Hz), 5.02-4.97 (m, 2H), 3.65 (s, 3H), 2.75 (s, 1H), 1.41 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 159.4, 155.8, 141.6, 137.8, 129.1, 128.2, 127.9, 127.7, 119.1, 114.0, 111.7, 80.1, 77.2, 60.6, 55.2 28.4; m/z (ESI) 366.3 [$(M+Na)^+$, 100%].

***t*-Butyl-((*1S,2R*)-2-hydroxy-2-(2-chlorophenyl)-1-phenylethyl)carbamate 17d.**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(2-chlorophenyl)-2-oxo-1-

phenylethyl)carbamate **13d** (0.173 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (7.1 mg, 0.01 mmol, 0.02 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 48h when 95% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **17d** as a white solid (0.124 g, 0.357 mmol, 71.4%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 128-130 ºC; HRMS (ESI): found $[M+Na]^+$ 370.1179, $C_{19}H_{22}ClNNaO_3$ requires $[M+Na]^+$ 370.1180 (error 0.5 ppm); υ_{max} 3399, 2982, 1684, 1492, 1154, 698 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 7:93, 0.5 mL/min, 210 nm, T = 25 ºC), (*1R,2S*) 21.9 min, (*1S,2R)* 23.5 min, other diastereomer 42.8 min and 47.2 min; $[\alpha]_D^{22}$ = -150 (*c* = 0.1, $CHCl_3$), dr: 97.7:2.3, major diastereomer 95% ee; ^{1}H NMR ($CDCl_3$, 500 MHz_3): δ 7.32 (d, 1H, J = 7.9 Hz), 7.23-7.22 (m, 3H), 7.16 (t, 1H, J = 8.4 Hz), 7.10-7.06 (m, 4H), 5.51-5.46 (m, 2H), 5.01 (s, 1H), 2.53 (s, 1H), 1.37 (s, 9H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 155.3, 138.0, 138.1, 132.4, 129.2, 128.9, 128.5, 128.2, 1278.0., 127.7, 126.7, 79.9, 73.1, 58.9, 28.4; m/z (ESI) 370.3 [$(M+Na)^+$, 100%], 372.2 [$(M+2+Na)^+$, 40%].

***t*-Butyl-((*1S,2R*)-2-(3-chlorophenyl)-2-hydroxy-1-phenylethyl)carbamate 17e**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(3-chlorophenyl)-2-oxo-1-phenylethyl)carbamate **13e** (0.173 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 1.5 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (20-60% EtOAc in petroleum ether (40-60)) to give **17e** as a white solid (0.136 g, 0.391 mmol, 78.3%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 202-205 ºC; HRMS (ESI): found $[M+Na]^+$ 370.1185, $C_{19}H_{22}ClNNaO_3$ requires $[M+Na]^+$ 370.1180 (error 1.3 ppm); υ_{max} 3374, 2977, 1681, 1529, 1165, 1003, 696 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 7:93, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 16.1 min, (*1R,2S)* 21.2 min, other diastereomer 28.9 min and 36.8 min; $[\alpha]_D^{22}$ = -106 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 967% ee; ^{1}H NMR (DMSO-d_6, 500 MHz): δ 7.37 – 7.20 (m, 10H), 5.45 (d, 1H, J = 5.2 Hz), 4.64-4.62 (m, 1H), 4.53 (t, 1H, J = 9.1 Hz), 1.20 (s, 9H); ^{13}C{^{1}H} NMR (DMSO-d_6, 126 MHz): δ 154.4, 146.4, 146.1 141.3, 132.2, 129.4, 128.1, 127.6, 126.9, 126.7, 126.7, 125.7, 77.7, 74.7, 74.4, 59.7, 28.1; m/z (ESI) 370.2 [$(M+Na)^+$, 100%), 372.2 [$(M+2+Na)^+$, 40%].

***t*-Butyl-((*1S,2R*)-2-(4-chlorophenyl)-2-hydroxy-1-phenylethyl)carbamate 17f**.

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(4-chlorophenyl)-2-oxo-1-phenylethyl)carbamate **13f** (0.173 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq) DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **17f** as a white solid (0.140 g, 0.403 mmol, 80.6%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 200-201 ºC; HRMS (ESI): found $[M+Na]^+$ 370.1182, $C_{19}H_{22}ClNNaO_3$ requires $[M+Na]^+$ 370.1180 (error -0.5 ppm); IR υ_{max} 3375, 2981, 1677, 1524, 1166, 1000, 702 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 9.4 min, (*1R,2S)* 10.9 min, other diastereomer at 17.0 min and 26.4 min; $[\alpha]_D^{22}$ = -82 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 99.4% ee; ^{1}H NMR (DMSO-d_6, 500 MHz): δ 7.33-7.19 (m, 10H), 5.42 (d, 1H, J = 5.1 Hz), 4.65 (dd, 1H, J = 8.1, 5.2 Hz), 4.53 (t, 1H, J = 8.9 Hz), 1.20 (s, 9H); ^{13}C{^{1}H} NMR (DMSO-d_6, 126 MHz): δ 154.5, 142.5, 141.3, 131.4, 128.9, 128.2, 127.4, 126.7, 77.7, 74.6, 60.0, 28.1; m/z (ESI) 370.2 [$(M+Na)^+$, 100%], 372.2 [$(M+2+Na)^+$, 35%].

***t*- Butyl-((*1S,2R*)-2-hydroxy-1-(2-methoxyphenyl)-2-phenylethyl)carbamate 17g.**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (1-(2-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate **13g** (0.171 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (7.1 mg, 0.01 mmol, 0.02 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 6 days when 90% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 X 10 mL) for extraction to generate the crude product which was purified by column chromatography (25% EtOAc in petroleum ether (40-60)) to give **17g** as a white solid (0.110 g, 0.320 mmol, 64.2%). TLC: R_f ca 0.2 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 120-124 ºC; HRMS (ESI): found $[M+Na]^+$ 366.1672, $C_{20}H_{25}NNaO_4$ requires $[M+Na]^+$ 366.1676 (error 1 ppm); υ_{max} 3400, 2975, 1696, 1517, 1494, 1245, 1169, 996, 750 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 16.6 min, (*1R,2S)* isomer 20.6 min, other diastereomer 52.3 min and 108.2 min; $[\alpha]_D^{22}$ = -5 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 89% ee; ^{1}H NMR ($CDCl_3$, 500 MHz,): δ 7.26-7.23 (m, 4H), 7.14 (s, 2H), 6.97 (d, 1H, J = 6.4 Hz), 6.88-6.83 (m, 2H), 5.60 (d, 1H, J = 7.8 Hz), 5.26 (s, 1H), 5.02 (s, 1H), 3.71 (s, 3H), 2.90 (s, 1H), 1.36 (s, 9H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 157.0, 155.8, 140.6, 129.9, 129.0, 127.8, 127.6, 127.0, 126.1, 120.7 110.9, 79.7, 57.9, 55.4, 28.5; m/z (ESI) 366.2 [$(M+Na)^+$, 100%].

***t*-Butyl-((*1S,2R*)-2-hydroxy-1-(4-methoxyphenyl)-2-phenylethyl)carbamate 17h.**

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (1-(4-methoxyphenyl)-2-oxo-2-phenylethyl)carbamate **13h** (0.171 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (7.1 mg, 0.01 mmol, 0.02 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.5 mmol, 3.0 eq) for 72h when 90% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude

product which was purified by column chromatography (25% EtOAc in petroleum ether (40-60)) to give **17h** as a yellowish white solid (0.120 g, 0.349 mmol, 69.9%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 172-175 ºC; HRMS (ESI): found $[M+Na]^+$ 366.1675, $C_{20}H_{25}NNaO_4$ requires $[M+Na]^+$ 366.1676 (error 0.2 ppm); υ_{max} 3374, 2979, 1679, 1511, 1242, 1164, 996, 757 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 10:90, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 17.7 min, (*1R,2S)* 27.6 min, other diastereomer 32.1 min and 35.2 min; $[\alpha]_D^{22}$ - 82.3 (*c* 0.1 in $CHCl_3$), dr: 99.1:0.9, major diastereomer 90% ee; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.24-7.22 (m, 3H), 7.07-7.06 (m, 2H), 6.94 (d, 2H, J = 8.5 Hz), 6.78-6.75 (m, 2H), 5.25 (d, 1H, J = 6.3 Hz), 5.00 (s, 1H), 4.90 (s, 1H), 3.77 (s, 3H), 2.71 (s, 1H), 1.39 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 159.1, 155.8 140.2, 140.1, 129.0, 128.2, 128.1, 127.8, 127.1, 126.8, 113.7, 80.0, 79.3, 77.3, 55.3, 28.5; m/z (ESI) 366.2 [$(M+Na)^+$, 100%].

t-Butyl-((*1S,2R*)-1-(2-chlorophenyl)-2-hydroxy-2-phenylethyl)carbamate 17i.

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (1-(2-chlorophenyl)-2-oxo-2-phenylethyl)carbamate **13i** (0.173 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 96h when 95% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **17i** as a white solid (0.150 g, 0.461 mmol, 92.2%). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 123-126 ºC; HRMS (ESI): found $[M+Na]^+$ 370.1181, $C_{19}H_{22}ClNNaO_3$ requires $[M+Na]^+$ 370.1180 (error -0.1 ppm); υ_{max} 3371, 2977, 1687, 1523, 1165, 773, 702 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 11.8 min, (*1R,2S)* 13.1 min, other diastereomer 35.1 and 50.4 min; $[\alpha]_D^{22}$ = -76.6 (*c* = 0.1 in $CHCl_3$), dr: 95.5:0.5, major diastereomer 90% ee; ^1H NMR (DMSO-d_6, 500 MHz): δ 7.65 (d, 1H, J = 7.4 Hz), 7.30-7.26 (m, 6H), 7.25-7.21 (m, 3H), 5.35 (d, 1H, J = 4.1 Hz), 5.21 (t, 1H, J = 8.6 Hz), 4.72-4.70 (m, 1H), 1.21 (s, 9H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 126 MHz): δ 154.9, 143.5, 139.9, 134.1, 129.8, 128.9, 128.6, 127.9, 127.5, 127.2, 78.3, 75.6, 56.3, 28.6; m/z (ESI) 370.2 [$(M+Na)^+$, 100%], 372.2 [$(M+2+Na)^+$, 35%].

t- Butyl-((*1S,2R*)-1-(4-chlorophenyl)-2-hydroxy-2-phenylethyl)carbamate 17j.

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (1-(4-chlorophenyl)-2-oxo-2-phenylethyl)carbamate **13j** (0.087 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**20** (2.7 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.75 mmol, 3.0 eq) for 72h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and obtained solid material was filtered and dried to give **17j** as a white solid (0.080 g, 0.230 mmol, 92.2%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 191-193 ºC; HRMS (ESI): found $[M+Na]^+$ 370.1182, $C_{19}H_{22}ClNNaO_3$ requires $[M+Na]^+$ 370.1180 (error -0.6 ppm); υ_{max} 3373, 2979, 1681, 1282, 1167, 999, 703 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralcel OD-H, 250 x 4,6 mm column, iPrOH: hexane 5:95, 1 mL/min, 210 nm, T = 25 ºC), (*1R,2S*) 10.8 min, (*1S,2R)* 12.5 min, other diastereomer 6.5, 16.6 min; $[\alpha]_D^{22}$ = -164.3 (*c* = 0.1 in $CHCl_3$), dr: 99.5:0.5, 90% ee; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.26-7.24 (m, 3H), 7.18 (d, 2H, J = 8.3 Hz), 7.04-7.03 (m, 2H), 6.94 (d, 2H, J = 7.9 Hz), 5.38 (s, 1H), 5.06 (s, 1H), 4.90 (s, 1H), 2.48 (s, 1H), 1.40 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 155.4, 139.8, 133.3, 129.2, 128.2, 128.1, 127.9, 126.4, 80.1, 76.7, 59.8, 28.3 m/z (ESI) 370.2 [$(M+Na)^+$, 100%), 372.2 [$(M+2+Na)^+$, 35%].

t-Butyl-((*1S,2R*)-2-(4-chlorophenyl)-2-hydroxy-1-(4-methoxyphenyl)ethyl)carbamate 17k.

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(4-chlorophenyl)-1-(4-methoxyphenyl)-2-oxoethyl)carbamate **13k** (0.089 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**20** (2.7 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 72h when 100% conversion of ketone achieved (determined by ^1H NMR), water (20 mL) to quench and obtained solid material was filtered and dried to give **17k** as a brown solid (0.083 g, 0.233 mmol, 93.5%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 208-211 ºC; HRMS (ESI): found $[M+Na]^+$, 400.1284, $C_{20}H_{24}ClNNaO_4$ requires $[M+Na]^+$ 400.1286 (error 0.5 ppm); υ_{max} 3372, 2977, 1674, 1495, 1296, 1240, 1168, 1000, 814, 541 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 7.9 min, (*1R,2S)* isomer 9.2 min, other diastereomer 12.8 min and 17.9 min; $[\alpha]_D^{22}$ = -118 (*c* 0.1 in $CHCl_3$), dr >99.9:<0.1%, major diastereomer 97% ee ; ^1H NMR (DMSO-d_6, 500 MHz):δ 7.31 (s, 4H), 7.19 (d, 2H, J = 11.6 Hz), 7.13 (d, 1H, J = 9.6 Hz), 6.81 (d, 2H, J = 8.5 Hz), 5.39 (d, 1H, J = 5.1 Hz), 4.63-4.61 (m, 1H), 4.48 (t, 1H, J = 8.7 Hz), 3.71 (s, 3H), 1.20 (s, 9H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 126 MHz): δ 158.2, 154.6, 142.6, 133.2, 131.4, 129.3, 128.9, 127.5, 113.1, 77.8, 74.8, 59.5, 55.1, 28.2; m/z (ESI) 400.3 [$(M+Na)^+$, 100%].

t-Butyl-((1S,2S)-2-(furan-2-yl)-2-hydroxy-1-phenylethyl)carbamate 17l.

This compound is novel and was prepared following the general procedure **F** using *tert*-butyl (2-(furan-2-yl)-2-oxo-1-phenylethyl)carbamate **13l** (0.151 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 72h when 100% conversion of ketone achieved (determined by 1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **17l** as a brown solid (0.120 g, 0.396 mmol, 79.2%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 163-164 ºC, HRMS (ESI): found $[M+Na]^+$ 326.1362, $C_{17}H_{21}NNaO_4$ requires $[M+Na]^+$ 326.1363 (error 0.1 ppm); υ_{max} 3373, 2976, 1681, 1527, 1292, 1169, 1001, 734, 698 cm^{-1};

Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 10:90, 1 mL/min, 210nm, T = 25 ºC), (*1S, 2S*) 10.4 min, (*1R,2R)* isomer 19.2 min, other diastereomer 14.1 min and 34.0; $[\alpha]_D^{22}$ = -42.3 (*c* 0.1 in $CHCl_3$), dr, 96:4, major diastereomer 79% ee, minor diastereomer 56.7%; ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.36 (s, 1H), 7.28-7.22 (m, 3H), 7.09 (d, 2H, J = 7.8 Hz), 6.27 (d, 1H, J = 5.0 Hz), 6.06 (d, 1H, J = 3.2 Hz), 5.45 (s, 1H), 5.12 (s, 1H), 4.98 (s, 1H), 2.81 (s, 1H), 1.42 (s, 9H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 155.8 153.2, 142.2, 138.2, 128.5, 127.9, 127.2, 126.9, 110.4, 108.0, 80.2, 71.5, 59.2, 28.5; m/z (ESI) 326.2 [$(M+Na)^+$, 100%].

***t*-Butyl-((*1R,2S*)-1-hydroxy-1-phenylpropan-2-yl)carbamate 24.**

This compound is known and has been previously characterised:..[29b,38] This compound was prepared following the general procedure **F** using *tert*-butyl (1-oxo-1-phenylpropan-2-yl)carbamate (0.125 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 6 days when 76% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **24** as a colourless oil (0.066 g, 0.265 mmol, 53.1%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc) less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 274.1417, $C_{14}H_{21}NNaO_3$ requires $[M+Na]^+$ 274.1414 (error 1.3 ppm); υ_{max} 3413, 2977, 1681, 1496, 1365, 1124, 1050, 734 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1R,2S*) 10.9 min, (*1S,2R)* isomer 11.7 min, other diastereomer 12.9 min and 23.8; dr: 79:21, major diastereomer 34% ee (accuracy limited by overlap of peaks), minor diastereomer 82% ee**;**) **Major diastereomer** ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.41-7.09 (m, 5H), 4.82-4.79 (m, 2H), 3.97 (s, 1H), 3.55 (s, 1H), 1.45 (s, 9H), 0.96 (d, 3H, J = 6.9 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): 156.3, 140.9, 128.1, 127.4, 126.3, 79.7, 76.6, 52.01.99, 28.4, 14.7; m/z (ESI) 274.2 (M+Na, 100%); **Minor diastereomer** ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.41-7.09 (m, 5H), 4.82-4.79 (m, 1H), 4.53 (s, 1H), 3.85-3.84 (d, 1H J = 5.8 Hz), 1.99 (s, 1H), 1.39 (s, 9H), 1.06 (s, 3H, J = 6.9 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 156.3, 141.7, 128.3, 127.7, 126.6, 79.7, 77.8 52.4, 28.3, 17.5; m/z (ESI) 274.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

***t*-Butyl-((*1S,2R*)-2-hydroxy-1-phenylpropyl)carbamate 26.**

This compound is known and has been previously characterised.[29] This compound was prepared following the general procedure **F** using *tert*-butyl (2-oxo-1-phenylpropyl)carbamate (0.125 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**20** (5.3 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **26** as a brown solid (0.109 g, 0.434 mmol, 86.8%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 113-116 ºC; HRMS (ESI): found $[M+Na]^+$ 274.1410, $C_{14}H_{21}NNaO_3$ requires $[M+Na]^+$ 274.1414 (error 1.3 ppm); υ_{max} 3371, 2976, 1679, 1520, 1368, 1291, 1165, 1009, 877, 698 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 12:88, 0.5 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 15.8 min, (*1R,2S)* 19.5 min, other diastereomer 20.9 min and 24.7; $[\alpha]_D^{22}$ = + 22.6 (*c* = 0.1 in $CHCl_3$), dr, 98.3: 1.7, 95% ee; lit[above] $[\alpha]_D^{20}$ = +24.0 (c = 0.1, $CHCl_3$); ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.36 – 7.26 (m, 5H), 5.42 (d, 1H, J = 6.8 Hz), 4.62 (s, 1H), 4.07 (s, 1H), 1.89 (s, 1H), 1.42 (s, 9H), 1.08 (s, 3H, J = 6.4 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 155.8 138.4, 128.6, 127.8, 126.7 79.9, 70.5, 60.2, 28.5, 19.8; m/z (ESI) 274.2 [$(M+Na)^+$, 100%]. The data matches the reported data.

N-*((1S,2R*)-2-Hydroxy-2-(2-methoxyphenyl)-1-phenylethyl)-4-methylbenzene sulfonamide 18b.

This compound is novel and was prepared following the general procedure **F** using N-(2-(2-methoxyphenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14b** (0.197 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (20-60% EtOAc in petroleum ether (40-60)) to give **18b** as a white solid (0.158 g, 0.396 mmol, 79.3%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 120-121 ºC; HRMS (ESI): found $[M+Na]^+$ 420.1242, $C_{22}H_{23}NNaO_4S$ requires $[M+Na]^+$ 420.1240 (error -0.4 ppm); υ_{max} 3519, 3324, 1323, 1236, 1158, 1053, 536 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 21.2 min, (*1R,2S)* isomer 28.1min, other diastereomer 45.0 min and 66.2 min; $[\alpha]_D^{22}$ = -42.3 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 95% ee; ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.48 (d, 2H, J = 8.2 Hz), 7.18 (m, 1H), 7.14-7.06 (m, 5H), 6.91-6.88 (m, 3H), 6.79-6.74 (m, 2H), 5.70 (d, 1H, J = 7.5 Hz), 5.13 (t, 1H, J = 5.8 Hz), 4.57-4.55 (m, 1H), 3.64 (s, 3H), 2.71 (d, 1H, J = 6.6 Hz), 2.34 (s, 3H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz: δ 156.2, 142.9, 137.5, 137.1, 129.4, 129.0, 128.0, 127.9, 127.6, 127.1, 120.9, 110.5, 62.4, 55.4, 21.6; m/z (ESI) 420.3 [$(M+Na)^+$, 100%].

N-*((1S,2R*)-2-Hydroxy-2-(3-methoxyphenyl)-1-phenylethyl)-4-methylbenzene sulfonamide 18c.

This compound is novel and was prepared following the general procedure **F** using N-(2-(3-methoxyphenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14c** (0.100 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**2** (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (20 mL) to quench and DCM (2 x 5 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **18c** as a white solid (0.085 g, 0.214 mmol, 85.6%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 153-155 ºC; HRMS (ESI): found

[M+Na]$^+$ 420.1239, $C_{22}H_{23}NNaO_4S$ requires [M+Na]$^+$ 420.1240 (error 0.3 ppm); υ_{max} 3482, 3317, 1312, 1247, 1151, 1086, 560 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 24.1 min, (*1R,2S)* 26.2 min, other diastereomer 51.9 min and 81.2 min; $[\alpha]_D^{22}$ = -17.4 (*c* = 0.1 in $CHCl_3$), dr: 98.3: 1.7, major diastereomer 94% ee; ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.48 (d, 2H, J = 8.2 Hz), 7.16-7.07 (m, 6H), 6.87 (d, 2H, J = 7.4 Hz), 6.75 (d, 1H, J = 10.3 Hz), 6.58 (d, 1H, J = 7.6 Hz), 6.40 (s, 1H), 5.32 (d, 1H, J = 7.8 Hz), 4.95 (t, 1H, J = 4.5 Hz), 4.52-4.50 (m, 1H), 3.61 (s, 3H), 2.37 (d, 1H, J = 4.6 Hz), 2.33 (s, 3H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 159.6, 143.3, 140.8, 137.1, 136.1, 129.5, 129.4, 128.1, 128.1, 127.8, 127.2, 118.9, 114.4, 111.6, 76.9, 63.2, 55.2 21.6; m/z (ESI) 420.2 [(M+Na)$^+$, 100%].

N-*((1S,2R)*-2-Hydroxy-2-(2-chlorophenyl)-1-phenylethyl)-4-methylbenzene sulfonamide 18d.

This compound is novel and was prepared following the general procedure **F** using N-(2-(2-chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14d** (0.100 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**2** (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (20 mL) to quench and DCM (2 x 5 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **18d** as a white solid (0.044 g, 0.109 mmol, 43.9%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 150-153 ºC; HRMS (ESI): found [M+Na]$^+$ 424.0746, $C_{21}H_{20}ClNNaO_3S$ requires [M+Na]$^+$ 424.0745 (error -0.3 ppm); υ_{max} 3483, 3319, 1409, 1302, 1155, 1030, 659 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1R,2S*) 17.3 min, (*1S,2R)* isomer 20.6 min, other diastereomer 24.0 min and 37.1 min; $[\alpha]_D^{22}$ = -271.6 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 89% ee; ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.59 (d, 2H, J = 8.2 Hz), 7.26-7.23 (d, 1H, J = 3.8 Hz), 7.11-7.07 (m, 4H), 7.00 (t, 2H, J = 7.6 Hz), 6.92 (t, 1H, J = 7.5 Hz), 6.81-6.80 (m, 3H), 5.87 (d, 1H, J = 8.1 Hz), 5.45 (s, 1H), 4.69-4.67 (m, 1H), 2.74 (s, 1H), 2.31 (s, 3H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 143.3, 137.4, 137.2, 135.8, 131.7, 129.5, 129.0, 128.9, 128.3, 128.2, 127.8, 127.7, 127.3, 126.6 72.9, 60.6, 21.6; m/z (ESI) 424.2 [(M+Na)$^+$, 100%], 426.1 [(M+2+Na)$^+$, 35%].

N-*((1S,2R)*-2-Hydroxy-2-(3-chlorophenyl)-1-phenylethyl)-4-methylbenzene sulfonamide 18e.

This compound is novel and was prepared following the general procedure **F** using N-(2-(3-chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14e** (0.100 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**2** (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5 eq) and formic acid (28 µL, 0.750 mmol, 3 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (20 mL) to quench and obtained solid material was filtered and dried to give **18e** as a brown solid (0.090 g, 0.229 mmol, 89.7%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 210-213 ºC; HRMS (ESI): found [M+Na]$^+$ 424.0744, $C_{21}H_{20}ClNNaO_3S$ requires [M+Na]$^+$ 424.0745 (error 0.2 ppm); υ_{max} 3466, 3325, 1404, 1289, 1152, 1032, 530 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 10.9 min, (*1R,2S)* 12.5 min, other diastereomer 26.2 min and 30.1 min; $[\alpha]_D^{22}$ = -40 (*c* = 0.1 in $CHCl_3$), dr: >99.9:<0.1, 94% ee; ^{1}H NMR (DMSO-d_6, 500 MHz): δ 8.14 (d, 1H, J = 10.0 Hz), 7.26 (d, 2H, J = 8.2 Hz), 7.22-7.21 (m, 2H), 7.15-7.13 (m, 2H), 7.10 (s, 5H), 7.05 (d, 2H, J = 8.0 Hz), 5.52 (d, 1H, J = 10.0 Hz), 4.58-4.56 (m, 1H), 4.24 (m, 1H), 2.27 (s, 3H); ^{13}C{^{1}H} NMR (DMSO-d_6, 126 MHz): δ 145.9, 142.2, 139.8, 138.9, 132.9, 129.9, 129.4, 128.6, 127.7, 127.4, 127.2, 127.1, 126.5, 126.1, 75.2, 63.6, 21.4; m/z (ESI) 424.2 [(M+Na)$^+$, 100%], 426.2 [(M+2+Na)$^+$, 35%].

N-*((1S,2R)*-2-Hydroxy-2-(4-chlorophenyl)-1-phenylethyl)-4-methylbenzene sulfonamide 18f.

This compound is known however it has not been fully characterized previously.[40] This compound was prepared following the general procedure **F** using N-(2-(4-chlorophenyl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14f** (0.199 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (80% EtOAc in petroleum ether (40-60)) to give **18f** as a white solid (0.090 g, 0.224 mmol, 44.8%). TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 243-245 ºC; HRMS (ESI): found [M+Na]$^+$ 424.0746, $C_{21}H_{20}ClNNaO_3S$ requires [M+Na]$^+$ 424.0745 (error 0.4 ppm); υ_{max} 3460, 3321, 1457, 1309, 1150, 1087, 722 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 11.0 min, (*1R,2S)* isomer 12.9 min, other diastereomer 21.7 min and 44.4 min; $[\alpha]_D^{22}$ = -25.6 (*c* = 0.1 in THF), dr: 97.7:2.3, major diastereomer 89% ee; ^{1}H NMR (DMSO-d_6, 500 MHz): δ 8.15 (d, 1H, J = 9.6 Hz), 7.25 (d, 2H, J = 8.2 Hz), 7.19 (d, 2H, J = 8.5 Hz), 7.14 (d, 2H, J = 8.4 Hz), 7.11 (s, 5H), 7.06 (d, 2H, J = 8.0 Hz), 5.45 (d, 1H, J = 5.0 Hz), 4.58-4.56 (m, 1H), 4.23 – 4.20 (m, 1H), 2.29 (s, 3H); ^{13}C{^{1}H} NMR (DMSO-d_6, 126 MHz): δ 142.3, 142.1, 134.0, 139.0, 132.0, 129.4, 129.1, 128.6, 127.9, 127.7, 127.1, 126.5, 75.1, 63.7, 21.2; m/z (ESI) 424.2 [(M+Na)$^+$, 100%], 426.2 [(M+2+Na)$^+$, 35%].

N-((*1S,2R*)-2-Hydroxy-1-(2-methoxyphenyl)-2-phenylethyl)-4-methylbenzenesulfonamide 18g.

This compound is novel and was prepared following the general procedure **F** using N-(1-(2-methoxyphenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide **14g** (0.198 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 48h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **18g** as a colourless semi solid (0.170 g, 0.428 mmol,

85.6%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc) less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 420.1242, $C_{22}H_{23}NNaO_4S$ requires $[M+Na]^+$ 420.1240 (error 0.4 ppm); υ_{max} 3392, 2926, 1493, 1244, 1155, 1001, 750 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 34.9 min, (*1R,2S)* 40.7 min, other diastereomer 74.5 min and 122.3 min; $[\alpha]_D^{22}$ = -30 (*c* = 0.1 in $CHCl_3$), dr: 94.8: 5.2, major diastereomer 80% ee; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.43 (d, 2H, J = 7.9 Hz), 7.20-7.19 (m, 3H), 7.11 (t, 1H, J = 7.8 Hz), 7.04 (s, 2H), 6.99 (d, 2H, J = 7.9 Hz), 6.77 (d, 1H, J = 7.4 Hz), 6.70 (t, 1H, J = 7.4 Hz), 6.59 (d, 1H, J = 8.2 Hz), 5.70 (d, 1H, J = 9.8 Hz), 4.94 (t, 1H, J = 5.2 Hz), 4.81-4.78 (m, 1H), 3.51 (s, 3H), 2.64 (d, 1H, J = 5.2 Hz), 2.28 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 156.5, 143.0, 139.9, 137.3, 130.2, 129.2, 129.1, 128.0, 127.9, 127.0, 126.9, 124.3, 120.6, 110.7, 76.1, 61.2, 55.3, 21.5; m/z (ESI) 420.37 [$(M+Na)^+$, 100%].

N-((*1S,2R*)-2-Hydroxy-1-(4-methoxyphenyl)-2-phenylethyl)-4-methylbenzenesulfonamide 18h.

This compound is novel and was prepared following the general procedure **F** using N-(1-(4-methoxyphenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide **14h** (0.198 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and obtained solid material was filtered and dried to give **18h** as a brown solid (0.189 g, 0.476 mmol, 95.2%). TLC: R_f ca 0.3 (7:3, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 201-203 ºC; HRMS (ESI): found $[M+Na]^+$ 420.1238, $C_{22}H_{23}NNaO_4S$ requires $[M+Na]^+$ 420.1240 (error 0.4 ppm); υ_{max} 3480, 3321, 2972, 1513, 1303, 1151, 1055, 540 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 25.8 min, (*1R,2S)* 33.9 min, other diastereomer 60.0 min; $[\alpha]_D^{22}$ = -27.6 (*c* = 0.1 in $CHCl_3$), dr: 98.2:1.8, major diastereomer 90% ee; ^1H NMR ($CDCl_3$, 500 MHz): δ 7.48 (d, 2H, J = 8.0 Hz), 7.21-7.20 (m, 3H), 7.09 (d, 2H, J = 7.8 Hz), 6.96 (d, 2H, J = 6.3 Hz), 6.75 (d, 2H, J = 8.3 Hz), 6.60 (d, 2H, J = 8.2 Hz), 5.21 (d, 1H, J = 7.4 Hz), 4.95 (s, 1H), 4.49-4.47 (m, 1H), 3.73 (s, 3H), 2.35 (s, 3H), 2.31 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 159.2, 143.2, 139.3, 137.3, 129.5, 129.3, 128.4 128.2, 128.0, 127.2, 126.7, 113.5, 76.9, 62.8, 55.3, 21.6; m/z (ESI) 420.4 [$(M+Na)^+$, 100%].

N-((*1S,2R*)-1-(2-Chlorophenyl)-2-hydroxy-2-phenylethyl)-4-methylbenzenesulfonamide 18i.

This compound is novel and was prepared following the general procedure **F** using N-(1-(2-chlorophenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide **14i** (0.100 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**2** (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 48h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 X 10 mL) for extraction to generate the crude product which was purified by column chromatography (20% EtOAc in petroleum ether (40-60)) to give **18i** as a white solid (0.070 g, 0.174 mmol, 69.8%). TLC: R_f ca 0.2 (7:3, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 143- 146 ºC; HRMS (ESI): found $[M+Na]^+$ 424.0744, $C_{21}H_{20}ClNNaO_3S$ requires $[M+Na]^+$ 424.0745 (error 0.2 ppm); υ_{max} 3502, 3356, 2954, 1297, 1152, 1065, 535 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 15.9 min, (*1R,2S)* 17.8 min, other diastereomer 25.3 min and 38.1 min; $[\alpha]_D^{22}$ = -17.6 (*c* = 0.1 in $CHCl_3$), dr: 88: 12, major diastereomer 80% ee, minor diastereomer 18% ee; ^1H NMR ($CDCl_3$, 600 MHz): δ 7.51 (d, 2H, J = 8.1 Hz), 7.24-7.20 (m, 1H), 7.19-7.16 (m, 2H), 7.11 (d, 1H, J = 7.9 Hz), 7.08-7.06 (m, 3H), 7.00-6.92 (m, 4H), 5.34 (d, 1H, J = 8.4 Hz), 5.15 (d, 1H, J = 7.6 Hz), 5.07-5.06 (m, 1H), 2.37 (d, 1H, J = 3.6 Hz), 2.32 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 151 MHz): δ 143.4, 138.5, 136.8, 134.2, 133.6, 129.8, 129.5, 129.2, 128.9, 128.5, 128.3, 127.2, 127.0, 126.9, 126.5, 125.8, 75.7, 74.6, 21.6; m/z (ESI) 424.2 [$(M+Na)^+$, 100%], 426.3 [$(M+2+Na)^+$, 35%].

N-((*1S,2R*)-1-(4-Chlorophenyl)-2-hydroxy-2-phenylethyl)-4-methylbenzenesulfonamide 18j.

This compound is novel and was prepared following the general procedure **F** using N-(1-(4-chlorophenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide **14j** (0.200 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.6 mg, 7.5 µmol, 0.015 eq), DABCO (0.280g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by 1H NMR), water (30 mL) to quench and obtained solid material was filtered and dried to give **18j** as a white solid (0.170 g, 0.424 mmol, 84.8%). TLC: R_f ca 0.2 (7:3, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 232-236 ºC; HRMS (ESI): found $[M+Na]^+$ 424.0747, $C_{21}H_{20}ClNNaO_3S$ requires $[M+Na]^+$ 424.0745 (error -0.7 ppm); υ_{max} 3462, 3323, 1314, 1150, 1057, 537 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 11.2 min, (*1R,2S)* 13.9 min, other diastereomer 23.8 min and 45.8 min; $[\alpha]_D^{22}$ = -114.6 (*c* = 0.1 in THF), dr: 97.7:2.3, major diastereomer 92% ee; minor diastereomer >99% ee ^1H NMR (DMSO-d_6, 500 MHz): δ 8.15 (d, 1H, J = 8.8 Hz), 7.28 (d, 2H, J = 7.8 Hz), 7.23 – 7.19 (m, 3H), 7.14 (d, 2H, J = 7.2 Hz), 7.07-7.06 (m, 4H), 6.99 (d, 2H, J = 8.1 Hz), 5.45 (d, 1H, J = 4.5 Hz), 4.64 – 4.62 (m, 1H), 4.28 (t, 1H, J = 7.5 Hz), 2.28 (s, 3H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 126 MHz): δ 142.5, 141.8, 138.4, 137.7, 131.2, 130.1, 128.9, 127.6, 127.1, 126.9, 126.7, 126.2, 75.1, 62.7, 20.8; m/z (ESI) 424.2 [$(M+Na)^+$, 100%], 426.3 [$(M+2+Na)^+$, 35%].

N-((*1S,2R*)-2-(4-Chlorophenyl)-2-hydroxy-1-(4-methoxyphenyl)ethyl)-4-methylbenzenesulfonamide 18k.

This compound is novel and was prepared following the general procedure **F** using N-(2-(4-chlorophenyl)-1-(4-methoxyphenyl)-2-oxoethyl)-4-methylbenzenesulfonamide **14k** (0.107 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-**2** (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 48h when 100% conversion of ketone achieved (determined by 1H NMR), water (20 mL) to quench and obtained solid material was filtered and dried to give **18k** as a white solid (0.095 g, 0.220 mmol, 88.2%). TLC: R_f ca 0.2 (7:3, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 240-243

ºC; HRMS (ESI): found $[M+Na]^+$ 454.0850, $C_{22}H_{22}ClNNaO_4S$ requires $[M+Na]^+$ 454.0850 (error 0.0 ppm); υ_{max} 3527, 3235, 1512, 1311, 1238, 1157, 1029, 815, 664, 573, 536 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 15.8 min, (*1R,2S)* isomer 19.3 min, other diastereomer 34.9 min and 68.3 min; $[\alpha]_D^{22}$ = -139.2 (*c* = 0.05 in THF), dr: >99.9:<0.1, 98% ee; ^1H NMR (DMSO-d_6, 600 MHz): δ 8.05 (d, 1H, J = 9.5 Hz), 7.26 (d, 2H, J = 8.1 Hz), 7.20 (d, 2H, *J* = 8.3 Hz), 7.13 (d, 2H, J = 8.4 Hz), 7.06 (d, 2H, J = 8.0 Hz), 6.98 (d, 2H, J = 8.5 Hz), 6.64 (d, 2H, J = 8.5 Hz), 5.42 (d, 1H, J = 4.9 Hz), 4.57-4.55 (m, 1H), 4.18-4.15 (m, 1H), 3.67 (s, 3H), 2.29 (s, 3H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 151 MHz): δ 158.1, 141.9, 141.6, 138.6, 131.5, 131.3 129.3, 128.9, 128.6, 127.5, 126.1, 112.7, 74.7, 62.7, 55.0, 20.9; m/z (ESI) 454.2 $[(M+Na)^+$, 100%], 456.3 $[(M+2+Na)^+$, 35%].

N-((*1S,2S*)-2-(Furan-2-yl)-2-hydroxy-1-phenylethyl)-4-methylbenzenesulfonamide 18l

This compound is novel and was prepared following the general procedure **F** using N-(2-(furan-2-yl)-2-oxo-1-phenylethyl)-4-methylbenzenesulfonamide **14l** (0.178 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 48h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (40% EtOAc in petroleum ether (40-60)) to give **18l** as a white solid (0.165 g, 0.462 mmol, 92.4%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 380.0926, $C_{19}H_{19}NNaO_4S$ requires $[M+Na]^+$ 380.0927 (error 0.4 ppm); υ_{max} 3460, 1414, 1318, 1156, 1089, 1060, 809, 698, 663, 564 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S, 2S*) 23.4 min, (*1R,2R)* isomer 27.3 min, other diastereomer 35.3 min and 49.1; dr: 55:45, major diastereomer 72% ee, minor diastereomer 98% ee; ^1H NMR ($CDCl_3$, 500 MHz) **Diastereomer 1:** δ 7.54 (d, 2H, J = 8.3 Hz), 7.32-7.30 (m, 1H), 7.14-7.06 (m, 5H), 6.86 (d, 2H, J = 7.2 Hz), 6.22 (d, 1H, J = 1.9 Hz), 6.00 (d, 1H, J = 3.3 Hz), 5.75 – 5.66 (m, 1H), 4.92-4.89 (m, 1H), 4.77 – 4.75 (m, 1H), 2.67-2.59 (m, 1H), 2.32 (s, 3H); **Diastereomer 2:** δ 7.48 (d, 2H, J = 8.3 Hz), 7.24 (s, 1H), 7.14-7.06 (m, 5H), 7.01 (d, 2H, J = 8.0 Hz), 6.19 (d, 1H, J = 5.0 Hz), 6.13 (d, 1H, J = 3.3 Hz), 5.75-5.66 (m, 1H), 4.81 – 4.79 (m, 1H), 4.68 (t, 1H, J = 6.4 Hz), 2.71 (d, 1H, J = 4.9 Hz), 2.33 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz) **both diastereomers:** δ 152.2, 152.1, 143.3, 143.1, 142.4, 142.3, 137.5, 137.2, 137.2, 136.2, 129.5, 129.4, 129.4, 128.2, 127.9, 127.8, 127.4, 127.3, 127.2, 127.2, 110.5, 110.4, 108.7, 108.4, 71.5, 71.1, 61.8, 61.6, 21.5; m/z (ESI) 380.2 $[(M+Na)^+$, 100%].

N-((*1S,2R*)-2-Hydroxy-1,2-diphenylethyl)methanesulfonamide 23.

This compound is known and has been previously characterised.[41] This compound was prepared following the general procedure **F** using N-(2-oxo-1,2-diphenylethyl)methanesulfonamide (0.144 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **23** as a white solid (0.110 g, 0.395 mmol, 79.0%). TLC: R_f ca 0.4 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; MP: 152-155 ºC; HRMS (ESI): found $[M+Na]^+$ 314.0823, $C_{15}H_{17}NNaO_3S$ requires $[M+Na]^+$ 314.0921 (error -0.5 ppm); υ_{max} 3486, 3320, 1455, 1407, 1301, 1145, 1056, 981, 159, 696 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 13.9 min, (*1R,2S)* 16.4 min, other diastereomer 30.8 min; $[\alpha]_D^{22}$ = -68.3 (*c* 0.1 in $CHCl_3$), dr: 97.4: 2.6, major diastereomer 95% ee; lit[b above] $[\alpha]_D^{20}$ = -22.5 (c 0.98, $CHCl_3$); ^1H NMR (DMSO-d_6, 500 MHz): δ 7.70 (d, 1H, J = 9.7 Hz), 7.32 – 7.26 (m, 8H), 7.24-7.21 (m, 2H), 5.49 (d, 1H, J = 4.9 Hz), 4.75 – 4.73 (m, 1H), 4.36 – 4.33 (m, 1H), 2.18 (s, 3H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 126 MHz): δ 143.2, 140.3, 128.3, 127.7, 127.7, 127.2, 127.1, 127.0, 75.3, 63.4, 40.8; m/z (ESI) 314.3 $[(M+Na)^+$, 100%]. The data matches the reported data.

N-((*1R,2S*)-1-Hydroxy-1-phenylpropan-2-yl)-4-methylbenzenesulfonamide 25.

This compound is known and has been previously characterised.[42] This compound was prepared following the general procedure **F** using 4-methyl-N-(2-oxo-1-phenylpropyl)benzenesulfonamide (0.152 g, 0.5 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 48h when 93% conversion of ketone achieved (determined by ^1H NMR), water (30 mL) to quench and DCM (2 x10 mL) for extraction to generate the crude product which was purified by column chromatography (50% EtOAc in petroleum ether (40-60)) to give **25** as a white solid (0.130 g, 0.426 mmol, 85.2%). TLC: R_f ca 0.2 (8:2, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 328.0982, $C_{16}H_{19}NNaO_3S$ requires $[M+Na]^+$ 328.0978 (error -1.3 ppm); υ_{max} 3490, 3265, 2979, 1300, 1153, 1089, 1010, 698, 657, 535 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210 nm, T = 25 ºC), one diastereomer 12.9 min and 18.0 min, other diastereomer 31.2 min and 88.5 min; dr: 68:32, major diastereomer 36% ee, minor diastereomer >99% ee.; **Major diastereomer** ^1H NMR ($CDCl_3$, 500 MHz): δ 7.82-7.65 (m, 3H), 7.33-7.22 (m, 6H), 4.93-4.89 (m, 1H), 4.78-4.77 (m, 1H), 3.61-3.54 (m, 1H), 2.63 (d, 1H, J = 4.7 Hz), 2.42 (s, 3H), 0.84 (d, 3H, J = 6.9 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 143.6, 140.3, 137.9, 129.9, 128.5, 127.9, 127.2, 126.8, 126.2, 77.2, 75.8, 55.0, 21.6, 14.9; **Minor diastereomer** 1H NMR ($CDCl_3$, 500 MHz): δ 7.82-7.65 (m, 3H), 7.33-7.22 (m, 6H), 4.93-4.89 (m, 1H), 4.50-4.48 (m, 1H), 3.46-3.49 (m, 1H), 2.68 (d, 1H, J = 3.0 Hz), 2.42 (s, 3H), 0.96 (d, 3H, J = 6.9 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 143.5, 140.4, 137.5, 129.8, 128.6, 128.2, 127.2, 126.6, 126.2, 77.2, 75.8, 55.7, 21.7, 18.0; m/z (ESI) 328.2 $[(M+Na)^+$, 100%]. The data matches the reported data

N-((*1S,2R*)-2-Hydroxy-1-phenylpropyl)-4-methylbenzenesulfonamide 27.

This compound is known and has been previously characterised.[43] This compound was prepared following the general procedure **F** using 4-methyl-N-(2-oxo-1-phenylpropyl)benzenesulfonamide (0.152 g, 0.50 mmol, 1.0 eq) in MeCN (5 mL), catalyst (*R,R*)-**2** (4.7 mg, 7.5 µmol, 0.015 eq), DABCO (0.280 g, 2.50 mmol, 5.0 eq) and formic acid (56 µL, 1.50 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (30 mL) to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to give **27** as a white solid (0.125 g, 0.390 mmol, 78.4%). TLC: R_f ca 0.2 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 328.0978, $C_{16}H_{19}NNaO_3S$ requires $[M+Na]^+$ 328.0978 (error 1.3 ppm); υ_{max} 3539, 3310, 2971, 1316, 1153, 1087, 1054, 807, 701, 566 cm^{-1}; Enantiomeric excess determined by HPLC analysis (Chiralpak AD-H, 250 mm x 4.6 mm column, iPrOH: hexane 10:90, 1 mL/min, 210 nm, T = 25 ºC), (*1S,2R*) 25.3 min, (*1R,2S)* 30.3 min, other diastereomer 32.5 min and 35.1 min; dr: 75.4:24.6, major diastereomer 97% ee, minor diastereomer 61% ee; **Major diastereomer** ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.53-7.51 (m, 2H), 7.16-7.03 (m, 7H), 5.63-5.61 (m, 1H), 4.28-4.26 (m, 1H), 4.10-4.06 (m, 1H), 2.33 (s, 3H), 1.84 (d, 1H, J = 6.3 Hz), 1.01 (d, 3H, J = 6.4 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 143.2, 137.4, 136.4, 129.4, 128.6, 127.9, 127.8, 127.2, 70.4, 62.9, 21.6, 19.6; **Minor diastereomer** 1H NMR ($CDCl_3$, 500 MHz): δ 7.53-7.51 (m, 2H), 7.16-7.03 (m, 7H), 5.63-5.61 (m, 1H), 4.14-4.11 (m, 1H), 3.91-3.90 (m, 1H), 2.33 (s, 3H), 2.22 (s, 1H), 1.08 (d, 3H, J = 6.4 Hz); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 143.2, 138.6, 137.4, 129.4, 128.4, 127.8, 127.3, 71.1, 64.3, 21.6, 20.1; m/z (ESI) 328.2 [$(M+Na)^+$, 100%].The data matches the reported data.

***t*-Butyl-(2-(3-chlorophenyl)-1-(4-chlorophenyl)-2-oxoethyl)carbamate 28.**

This compound is known and has been previously characterised.[18a] This compound was prepared following the general procedure **B** using *tert*-Butyl ((4-chlorophenyl)(benzenesulfonyl)methyl)carbamate (2.50 g, 6.56 mmol, 1.0 eq) in DCM (50 mL), 3-chlorobenzaldehyde (1.38 g, 9.84 mmol, 1.5 eq), 3-Benzyl-5-(2-hydroxyethyl)-4-methylthiazolium chloride (0.531 g, 1.96 mmol, 0.3 eq) and triethylamine (9.96 g, 14 mL, 98.4 mmol, 15 eq) for 24 h, water (100 mL) to quench and was washed twice with 5% aqueous HCl (250 mL) to generate the crude product which was purified by column chromatography (10% EtOAc in petroleum ether (40-60)) to give **28** as a white solid (1.66 g, 4.38 mmol, 66.7%). R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 402.0633, $C_{19}H_{19}Cl_2NNaO_3$ requires $[M+Na]^+$ 402.0634 (error 0.4 ppm); υ_{max} 3379, 1710, 1678, 1519, 1494, 1219, 1164, 722, 699, 570 cm^{-1}; ^{1}H NMR ($CDCl_3$, 500 MHz): δ 7.92 (s, 1H), 7.78 (d, 1H, *J* = 7.8 Hz), 7.49 (d, 1H, J = 7.8 Hz), 7.36 – 7.27 (m, 5H), 6.19 (d, 1H, J = 7.3 Hz), 6.00 (d, 1H, J = 6.9 Hz), 1.43 (s, 9H); ^{13}C{^{1}H} NMR ($CDCl_3$, 126 MHz): δ 194.8, 155.0, 136.0, 135.6, 135.3, 134.7, 133.9, 130.2, 129.6, 129.6, 129.1, 127.1, 80.4, 59.6, 28.4; m/z (ESI) 402.2 [$(M+Na)^+$, 100%], 404.1 [$(M+Na)^+$, 60%], 406.0 [$(M+2+Na)^+$, 10%]. The data matches the reported data.

***t*-Butyl ((*1S,2R*)-2-(3-chlorophenyl)-1-(4-chlorophenyl)-2-hydroxyethyl)carbamate 29.**

This compound is known and has been previously characterised in racemic form.[18a] This compound was prepared following the general procedure **F** using *tert*-butyl (2-(3-chlorophenyl)-1-(4-chlorophenyl)-2-oxoethyl)carbamate **28** (0.379 g, 1.00 mmol, 1.0 eq) in MeCN (10 mL), catalyst (*R,R)*-**20** (10.7 mg, 0.015 mmol, 0.015 eq), DABCO (0.560 g, 5.00 mmol, 5.0 eq) and formic acid (113 µL, 3.00 mmol, 3.0 eq) for 24 h when 100% conversion of ketone was achieved (determined by ^{1}H NMR), water (50 mL) was dded to quench to quench and the solid material was filtered and dried to give **29** as a white solid (0.340 g, 0.890 mmol, 89.2%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 404.0778, $C_{19}H_{21}Cl_2NNaO_3$ requires $[M+Na]^+$ 404.0777 (error -0.2 ppm); Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 5:95, 1 mL/min, T = 25 ºC), (*1S,2R*) 11.0 min, (*1R,2S)* 21.4 min, other diastereomer 25.5 min and 35.0 min; $[\alpha]_D^{22}$ = –86.6 (*c* = 0.05 in THF), dr: 99.7:0.3, ee 96.4%; ^{1}H NMR (DMSO-d_6, 600 MHz): δ 7.40-7.27 (m, 9H), 5.53 (d, 1H, J = 4.9 Hz), 4.61 (d, 1H, J = 8.2 Hz), 4.53 (t, 1H, J = 9.0 Hz), 1.20 (s, 9H); ^{13}C{^{1}H} NMR (DMSO-d_6, 151 MHz): δ 154.5, 145.9, 140.4, 132.3, 131.4, 129.9, 129.5, 127.6, 126.9, 125.7, 77.9, 74.5, 59.4, 28.1; m/z (ESI) 404.2 [$(M+Na)^+$, 100%], 406.1 [$(M+2+Na)^+$, 60%]. The data matches the reported data.

***t*-Butyl-((*1R,2S*)-2-(3-chlorophenyl)-1-(4-chlorophenyl)-2-hydroxyethyl)carbamate 29.**

This compound is known and has been previously characterised.[18a] This compound was prepared following the general procedure **F** using *tert*-butyl (2-(3-chlorophenyl)-1-(4-chlorophenyl)-2-oxoethyl)carbamate **28** (0.379 g, 1.00 mmol, 1.0 eq) in MeCN (10 mL), catalyst (*S,S)*-**20** (10.7 mg, 0.015 mmol, 0.015 eq), DABCO (0.560 g, 5.00 mmol, 5.0 eq) and formic acid (113 µL, 3.00 mmol, 3.0 eq) for 24 h when 100% conversion of ketone achieved (determined by ^{1}H NMR), water (50 mL) to quench and obtained solid material was filtered and dried to give **29** as a white solid (0.363 g, 0.952 mmol, 95.2%). TLC: R_f ca 0.3 (6:4, Hexane: EtOAc), less UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 404.0778, $C_{17}H_{19}Cl_2N_4NaO_2$ requires $[M+Na]^+$ 404.0777 (error -0.2 ppm); Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 5:95, 1 mL/min, T = 25 ºC), (*1S,2R*) 11.0 min, (*1R,2S)* 21.4 min, other diastereomer 25.5 min and 35.0 min; dr: >99.9:<0.1, ee 96.4%;

***(4S,5S)*-5-(3-Chlorophenyl)-4-(4-chlorophenyl) oxazolidin-2-one 30.**

This compound is known and has been previously characterised.[18a] Carbamate (*1S,2R*)-**29** (product of reduction by (*R,R*)-**20**, 300 mg, 0.787 mmol, 1.0 eq) was dissolved in pyridine (3 mL) followed by addition of mesic anhydride (411 mg, 2.36 mmol, 3.0 eq) and the resulting mixture was heated to 70 ºC. After 18 h, the mixture was diluted with water (50 mL) and the resulting solid was filtered. The filtrate was checked on TLC but no trace of product was obtained. The obtained solid was dissolved in DCM (50 mL) and the organic layer was dried with $MgSO_4$, filtered and concentrated under reduced pressure to generate the crude product which was further purified by

column chromatography (30% EtOAc in petroleum ether (40-60)) to afford (*4S,5S*)-**30** as a yellow liquid. (0.180 g, 0.586 mmol, 74.5%). TLC: R_f ca 0.3 (Hexane: EtOAc 8:2), strong UV active; HRMS (ESI): found $[M+Na]^+$ 330.0054, $C_{15}H_{11}Cl_2NNaO_2$ requires $[M+Na]^+$ 330.0059 (error 1.5 ppm); ^1H NMR ($CDCl_3$, 500 MHz): δ 7.42-7.31 (m, 5H), 7.26-7.25 (m, 2H), 7.13 (d, 1H, J = 7.6 Hz), 6.07 (s, 1H), 5.20 (d, 1H, J = 7.4 Hz), 4.72 (d, 1H, J = 7.4 Hz); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 158.4. 139.1, 136.5, 135.4, 135.3, 130.5, 129.7, 129.6, 127.9, 126.1, 124.1, 85.3, 64.4; m/z (ESI) 330.3 [$(M+Na)^+$, 100%], 332.2 [$(M+2+Na)^+$, 60%], 334.4 [$(M+4+Na)^+$, 10%]. The data matches the reported data.

larger-scale reactions (synthesis of compounds 17e and 18h).

***t*-Butyl-((*1S,2R*)-2-(3-chlorophenyl)-2-hydroxy-1-phenylethyl)carbamate phenylethyl)carbamate 17e.** This was prepared following the general procedure F using *tert*-butyl (2-(3-chlorophenyl)-2-oxo-1-phenylethyl)carbamate **13e** (1.0 g, 2.89 mmol, 1.0 eq) in MeCN (25 mL), catalyst (*R,R*)-**20** (31 mg, 0.043 mmol, 0.015 eq), DABCO (1.62 g, 14.5 mmol, 5.0 eq) and formic acid (328 µL, 8.67 mmol, 1.5 eq) for 24 h. When100% conversion of ketone was achieved (determined by TLC), water (100 mL) was added to quench and DCM (3 x 30 mL) for extraction to generate the crude product which was purified by column chromatography (20-60% EtOAc in petroleum ether (40-60)) to give **17e** as a white solid (0.890 g, 2.56 mmol, 88.7%). Enantiomeric excess determined by HPLC analysis (Chiralpak IG, 250 mm x 4.6 mm column, iPrOH: hexane 7:93, 0.5 mL/min, 210nm, T = 25 ºC), (*1S,2R*) 20.9 min, (*1R,2S*) 27.0 min, other diastereomer 37.6 min and 45.4 min; dr: >99.9:<0.1, 95% ee; ^1H NMR (DMSO-d_6, 500 MHz): δ 7.37 – 7.20 (m, 10H), 5.45 (d, 1H, J = 5.3 Hz), 4.64-4.62 (m, 1H), 4.53 (t, 1H, J = 9.1 Hz), 1.20 (s, 9H); $^{13}C\{^1H\}$ NMR (DMSO-d_6, 126 MHz): 154.4, 146.1, 141.3, 132.2, 129.4, 128.1, 127.6, 126.9, 126.7, 126.6, 125.7, 77.7, 74.7, 59.9, 28.0.

N-((*1S,2R*)-2-Hydroxy-1-(4-methoxyphenyl)-2-phenylethyl)-4-methylbenzenesulfonamide 18h. This compound is novel and was prepared following the general procedure F using N-(1-(4-methoxyphenyl)-2-oxo-2-phenylethyl)-4-methylbenzenesulfonamide **14h** (0.500 g, 1.26 mmol, 1.0 eq) in MeCN (10 mL), catalyst (*R,R*)-**2** (12 mg, 0.019 mol, 0.015 eq), DABCO (0.705 g, 6.30 mmol, 5.0 eq) and formic acid (174 µL, 3.78 mmol, 3.0 eq) for 24 h. When 100% conversion of ketone achieved (determined by TLC), water (50 mL) was added to quench and the solid product was filtered and dried to give **18h** as a brown solid (0.455 g, 1.14 mmol, 90.5%). Enantiomeric excess determined by HPLC analysis (Chiralpak IC, 250 mm x 4.6 mm column, iPrOH: hexane 20:80, 1 mL/min, 210nm, T = 25 ºC), (*1S,2R*) 19.5 min, (*1R,2S*) 24.1 min, other diastereomer 46.6 min; dr: 95:5, major diastereomer 89% ee. ^1H NMR ($CDCl_3$, 500 MHz): δ 7.48 (d, 2H, J = 8.0 Hz), 7.21-7.20 (m, 3H), 7.09 (d, 2H, J = 8.0 Hz), 6.96 (d, 2H, J = 5.7 Hz), 6.75 (d, 2H, J = 8.5 Hz), 6.59 (d, 2H, J = 8.5 Hz), 5.30 (d, 1H, J = 7.2 Hz), 4.95 (m, 1H), 4.49-4.46 (m, 1H), 3.72 (s, 3H), 2.38(d, 1H, J = 4.0 Hz) 2.34 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz): δ 159.2, 143.2, 139.3, 137.2, 129.4, 129.3, 128.3, 128.1, 128.0, 127.2, 126.7, 113.4, 76.8, 62.8, 55.3, 21.6.

Synthesis and reduction of N-methylated derivative 14aMe.

***N*,4-Dimethyl-N-(2-oxo-1,2-diphenylethyl)benzenesulfonamide 14aMe.** To a stirred solution of 2-bromo-1,2-diphenylethan-1-one (0.360 g, 1.29 mmol, 1.0 eq) in DCM (20 mL) was added triethylamine (0.156 g, 0.2 mL, 1.54 mmol, 1.2 eq) and the mixture was cooled to 0 ˚C in an ice salt bath. Methylamine (0.087 g, 0.13 mL, 2.58 mmol, 2 eq) was added dropwise to the reaction mixture which was stirred at the same temperature for 30 minutes. Once the reaction mixture started to become a suspension, water (50 mL) was added and the organic layer was separated. The organic layer was washed with water (3 x 50 mL) and dried over $MgSO_4$. The organic layer was cooled to to 0 ˚C in an ice salt bath followed by addition of TEA (0.156 g, 0.2 mL, 1.54 mmol, 1.2 eq) and tosyl chloride (0.280g, 1.00 mmol, 0.7 eq) in DCM and the resulting solution was stirred at RT for 24h. Once the reaction was complete (assessed by TLC), water (150 mL) and DCM (50 mL) were added and the organic layer was separated. The aqueous layer was extracted with DCM (3 x 50 mL). The combined organic layers were washed with brine (50 mL), dried over $MgSO_4$ and concentrated under reduced pressure to give the crude product. The crude material was purified by column chromatography (30% EtOAc in petroleum ether (40-60)) to afford **14aMe** as a white solid (0.180 g, 0.474 mmol, 36.8%). TLC: R_f ca 0.3 (8:2, Hexane: EtOAc), strong UV active; HRMS (ESI): found $[M+Na]^+$ 402.1124, $C_{22}H_{21}NNaO_3S$ requires $[M+Na]^+$ 402.1134 (error 2.6 ppm); ^1H NMR ($CDCl_3$, 500MHz): δ 7.79 (d, 2H, J = 7.3 Hz), 7.63 (d, 2H, J = 8.2 Hz), 7.51 (t, 1H, J = 7.4 Hz), 7.39-7.36 (t, 2H, J = 7.8 Hz), 7.32-7.31 (m, 3H), 7.26 – 7.21 (m, 4H), 6.80 (s, 1H), 2.82 (s, 3H), 2.40 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126MHz): δ 190.7, 143.4, 136.6, 135.5, 134.3, 133.6, 129.9, 129.6, 129.2, 128.9, 128.8, 128.7, 127.4, 64.5, 31.6, 21.7; m/z (ESI) 402.2 [$(M+Na)^+$, 100%].

N-(2-Hydroxy-1,2-diphenylethyl)-N,4-dimethylbenzenesulfonamide 18aMe.

This compound is novel and was prepared following the general procedure F using N,4-dimethyl-N-(2-oxo-1,2-diphenylethyl)benzenesulfonamide **14aMe** (0.095 g, 0.25 mmol, 1.0 eq) in MeCN (2.5 mL), catalyst (*R,R*)-2 (2.3 mg, 3.8 µmol, 0.015 eq), DABCO (0.140 g, 1.25 mmol, 5.0 eq) and formic acid (28 µL, 0.750 mmol, 3.0 eq) for 72h. When 50% conversion of ketone was achieved (determined by ^1H NMR), water (30 mL) was added to quench and DCM (2 x 10 mL) for extraction to generate the crude product which was purified by column chromatography (50% EtOAc in petroleum ether (40-60)) to give **18aMe** as a white semi solid (0.045 g, 0.118 mmol, 47.2%). TLC: R_f ca 0.2 (6:4, Hexane: EtOAc), weak UV active, strong $KMnO_4$ & PMA reactive; HRMS (ESI): found $[M+Na]^+$ 404.1293, $C_{22}H_{23}NNaO_3S$ requires $[M+Na]^+$ 404.1296 (error -0.4 ppm); Enantiomeric excess determined by HPLC analysis (Chiralcel OD-H, 250 mm x 4.6 mm column, iPrOH: hexane 25:75, 1 mL/min, 210nm, T = 25 ºC), One diastereomer 10.3 min and 11.8, other diastereomer 25.6 min and 62.1 min; dr: 83:17, major diastereomer 90% ee, minor diastereomer 35% ee; ^1H NMR ($CDCl_3$, 500MHz): Major diastereomer δ 7.58 (d, 2H, J = 8.2 Hz), 7.25 (d, 2H, J = 7.1 Hz), 7.20 – 7.16 (m, 5H), 7.11-7.10 (d, 2H, J = 7.7 Hz), 7.02 – 7.00 (m, 2H), 5.24 (d, 1H, J = 9.7 Hz), 5.13 (d, 1H, J = 9.7 Hz), 2.89 (s, 3H), 2.37 (s, 3H), 1.61 (br.s., 1H), Minor diastereomer: δ 7.79-7.00 (m, 14H), 5.42 (d, 1H, J = 8.5 Hz), 5.29 (d, 1H, J = 8.5 Hz), 2.59 (s, 3H), 2.34 (s, 3H), 1.61 (br.s., 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 126 MHz) both diastereomers: δ 143.5, 143.0,141.2, 140.4, 136.6, 136.4, 135.6,

134.8, 133.6, 129.6, 129.5, 129.4, 129.2, 128.8, 128.7, 128.4, 128.3, 128.2, 128.1, 127.6, 127.5, 127.4, 127.2, 66.90, 65.21, 31.05, 31.31, 21.6, 21.5; m/z (ESI) 404.2 [$(M+Na)^+$, 100%].

ASSOCIATED CONTENT

Supporting Information

The Supporting Information contains details of the optimization reactions, NMR spectra, chiral HPLC spectra and X-ray crystallographic data for structures CCDC 1988253 and 1988254. The Supporting Information is available free of charge on the ACS Publications website. Experimental procedures, NMR and HPLC spectra and X-rays.

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The manuscript was written through contributions of all authors.

Notes

The authors declare no conflicting interests.

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