Enantiomerically Pure α-Amino Acid Synthesis via Hydroboration−Suzuki Cross-Coupling

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The Garner aldehyde-derived methylene alkene **5** and the corresponding benzyloxycarbonyl compound **25** undergo hydroboration with 9-BBN-H followed by palladium-catalyzed Suzuki coupling reactions with aryl and vinyl halides. After one-pot hydrolysis−oxidation, a range of known and novel nonproteinogenic amino acids were isolated as their *N*-protected derivatives. These novel organoborane homoalanine anion equivalents are generated and transformed under mild conditions and with wide functional group tolerance: electron-rich and -poor aromatic iodides and bromides (and a vinyl bromide) all undergo efficient Suzuki coupling. The extension of this methodology to prepare *meso*-DAP, *R*,*R*-DAP, and *R*,*R*-DAS is also described.

Introduction

The development of new synthetic routes to enantiopure, nonproteinogenic α-amino acids and their derivatives is an area of great current interest.[1−9] Such compounds have considerable potential as building blocks in natural product and pharmaceutical syntheses and as ligands in a wide range of asymmetric processes. In addition, a number of nonnatural α-amino acids have important biological functions:[7] the ACE inhibitor Zestril, for example, is a derivative of homophenylalanine.[8] Although α-amino acids can be obtained in enantiomerically pure form by a number of procedures, including biotransformations,[2] the use of chiral auxiliaries,[1,3] and catalytic asymmetric approaches,[1,4] there is a continuing need to devise milder routes that are compatible with a range of functionalities and well-suited to the demands of library synthesis.

Perhaps the most direct method to obtain novel amino acids is by modification of readily available, proteinogenic amino acids. To this end, much research has been undertaken to develop radical, cationic, and anionic alanine, homoalanine, and bishomoalanine equivalents.[5−7] In terms of anionic amino acid equivalents, the organozinc reagents **1** introduced by Jackson et al.[6] have proved particularly versatile and have been successfully adopted by other groups for the preparation of natural products and medicinally active compounds.[9]

We decided to investigate the preparation and synthetic potential of the corresponding organoboron reagents **2** and **3**. We felt that such reagents should be readily available, easy to handle, and straightforward to elaborate using Suzuki cross-coupling procedures.[10] We

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(6) For lead references, see: (a) Jackson, R. F. W.; James, K.; Wythes, M. J.; Wood, A. *J. Chem. Soc., Chem. Commun.* **1989**, 644−645. (b) Jackson, R. F. W.; Wythes, M. J.; Wood, A. *Tetrahedron Lett.* **1989**, *30*, 5941−5944. (c) Jackson, R. F. W.; Wishart, N.; Wood, A.; James, K.; Wythes, M. J. *J. Org. Chem.* **1992**, *57*, 3397−3404. (d) Jackson, R. F. W.; Fraser, J. L.; Wishart, N.; Porter, B.; Wythes, M. J. *J. Chem. Soc., Perkin Trans. 1* **1998**, 1903−1912. (e) Jackson, R. F. W.; Moore, R. J.; Dexter, C. S.; Elliott, J.; Mowbray, C. E. *J. Org. Chem.* **1998**, *63*, 7875−7884 and references therein.

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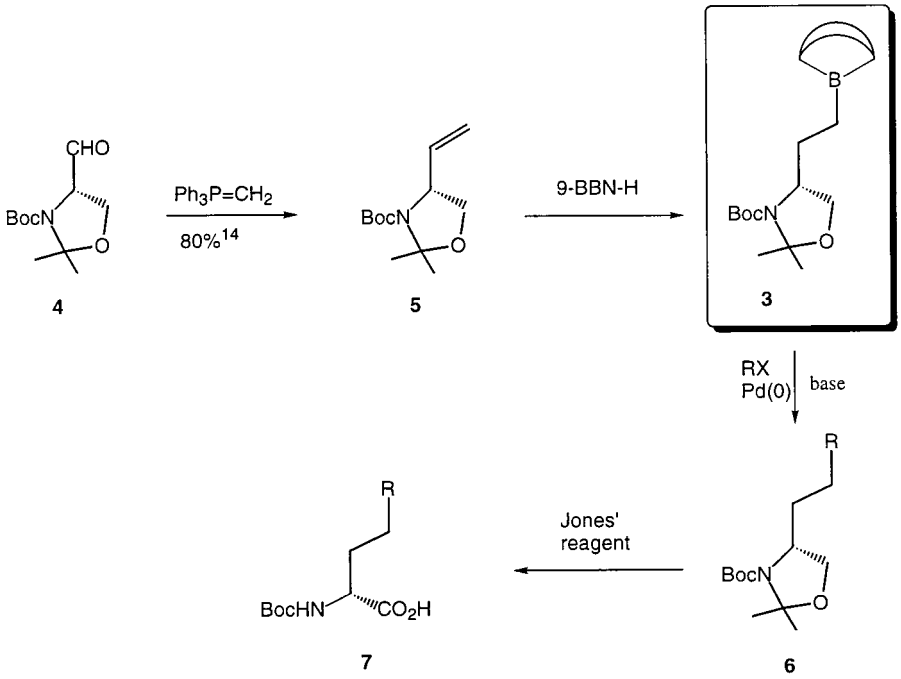
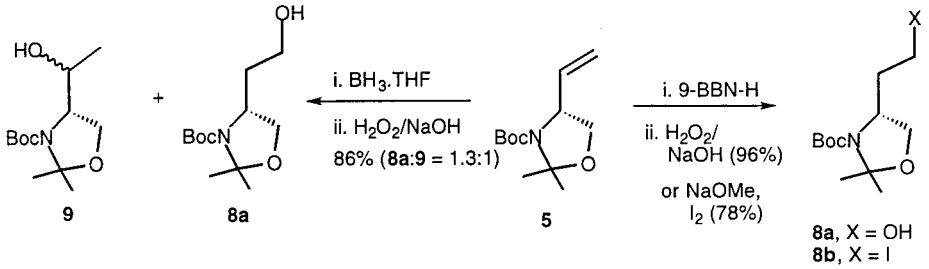
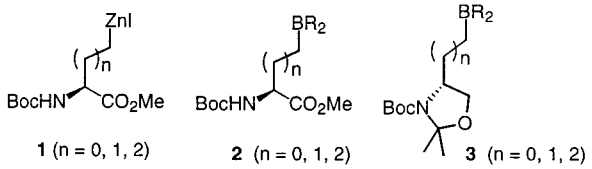
Scheme 1



Scheme 2



recently communicated our results with reagent **2** (n = 2).[11] Herein we elaborate on our preliminary communications[12] concerning homoalanine anion equivalent **3** (n = 1); Sabat and Johnson subsequently reported related Suzuki couplings, although they employed a biotransformation approach to prepare the hydroboration precursors.[13]



Results and Discussion

The overall approach to novel amino acid synthesis, summarized in Scheme 1, utilizes our recently described high yielding and practically facile procedure for the preparation of the Garner aldehyde **4** and the derived alkene **5** (available in 88% and 70% yield, respectively, from L- or D-serine).[14] We envisaged preparing the key intermediate organoborane reagent **3** by hydroboration of **5** using 9-BBN-H: 9-BBN-derived organoboranes have proved valuable in Csp^3-Csp^2 Suzuki couplings.[15,16] We would then be in a position to investigate the scope of reagent **3** (n = 1) in palladium-catalyzed coupling procedures and thus establish its potential as a homoalanine anion equivalent. The resultant products **6** should then be easily converted into *N*-Boc amino acids **7** in a one-pot cleavage−oxidation procedure using Jones reagent.[5c(vi)]

We first wanted to confirm that alkene **5** underwent efficient hydroboration in a regioselective manner. Thus, hydroboration using BH_3·THF followed by oxidative workup gave a 1.3:1 mixture of the required primary alcohol **8a** together with secondary alcohol **9**, obtained as a 6:1 mixture of diastereomers (Scheme 2). However, the use of 9-BBN-H followed by oxidation of the intermediate organoborane **3** gave alcohol **8** as a single regioisomer in almost quantitative yield. These studies

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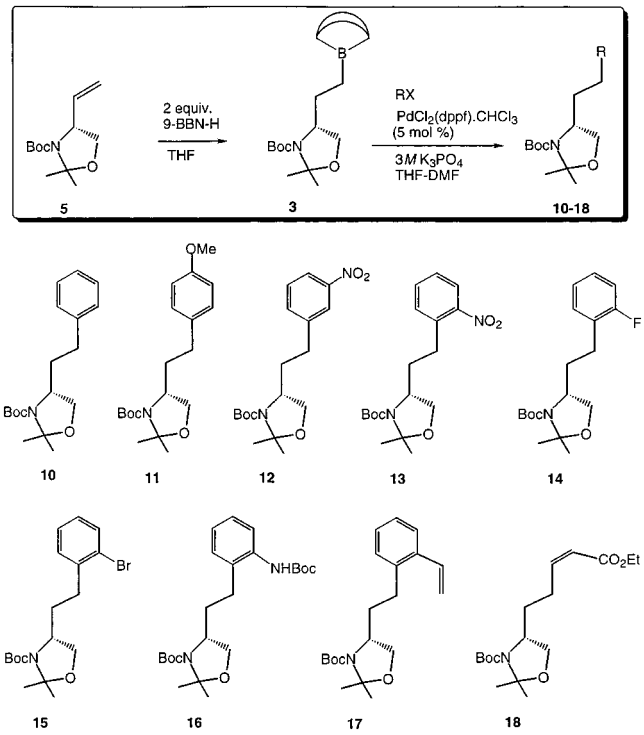
(14) Campbell, A. D.; Raynham, T. M.; Taylor, R. J. K. *Synthesis* **1998**, 1707- 1709. Alkenes **5** and **25** are also available from commercially available vinyl glycinol (Lancaster Synthesis) and via other straightforward routes (see ref 13 and Trost, B. M.; Bunt, R. C. *Angew. Chem., Int. Ed. Engl.* **1996**, *35*, 5, 99−102).

(15) (a) Miyaura, N.; Ishiyama, T.; Sasaki, H.; Ishikawa, M.; Satoh, M.; Suzuki, A. *J. Am. Chem. Soc.* **1989**, *111*, 314−321. (b) Johnson, C. R.; Johns, B. *Synlett* **1997**, 1406−1408.

(16) Other successful hydroboration reagents in terms of subsequent Csp^3-Csp^2 Suzuki couplings are disiamylborane and dicyclohexylborane: see ref 15a and Miyaura, N.; Suginome, H.; Suzuki, A. *Tetrahedron Lett.* **1984**, *25*, 761−764.

Scheme 3



Scheme 4

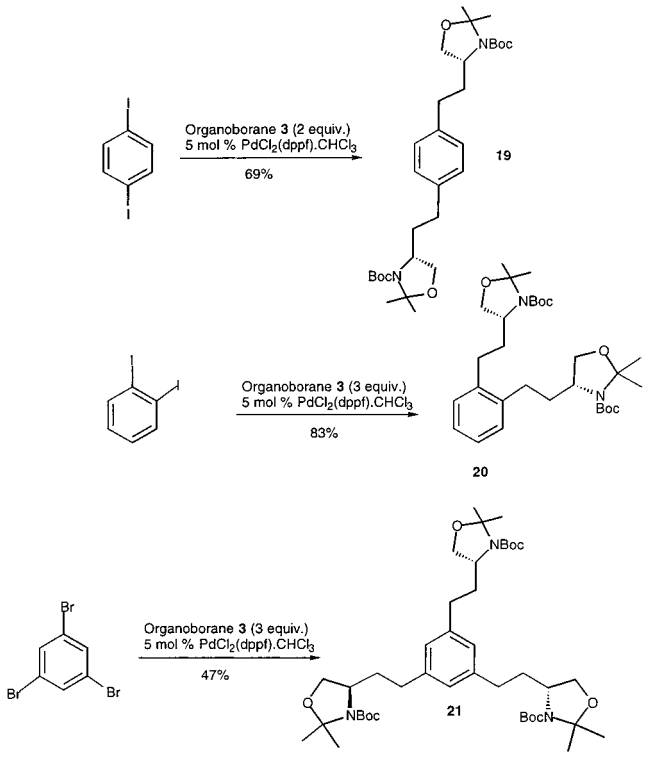


Table 1. Suzuki Coupling of Trialkylborane 3

entry	halide	R	product	yield (%)[a]
i	PhI	Ph	**10**	79
ii	PhBr	Ph	**10**	71
iii	4-$MeOC_6H_4I$	4-$MeOC_6H_4$	**11**	71[b]
iv	3-$NO_2C_6H_4I$	3-$NO_2C_6H_4$	**12**	69
v	2-$NO_2C_6H_4I$	2-$NO_2C_6H_4$	**13**	84
vi	2-FC_6H_4I	2-FC_6H_4	**14**	77
vii	2-BrC_6H_4I	2-BrC_6H_4	**15**	76
viii	2-(BocHN)C_6H_4I	2-(BocHN)C_6H_4	**16**	70[c]
ix	2-vinylC_6H_4Br	2-vinylC_6H_4	**17**	76
x	(*Z*)-BrCH=$CHCO_2Et$	(*Z*)-CH=$CHCO_2Et$	**18**	68

[a] Yields based on alkene **5**. [b] Coupling with the corresponding triflate gave **11** in only 11% yield. [c] Approximate yield due to inseparable impurity: taken on to next step without further purification.

confirmed the observations reported by Kawate et al.[17] Alternatively, the 9-BBN-derived organoborane **3** could be iodinated to produce iodide **8b**, a potentially useful asymmetric building block {$[\alpha]^{20}_D$ −16.2 (*c* 2.6, $CHCl_3$)}.

We were now in a position to investigate the palladium-catalyzed Suzuki coupling reactions of organoborane **3** with vinyl and aryl halides (Scheme 3, Table 1). Our initial studies indicated that the optimum catalyst was [1,1′-bis(diphenylphosphino)ferrocene]dichloropalladium-(II) [$PdCl_2$(dppf)][15a] with aqueous K_3PO_4 as base in THF−DMF at room temperature. Subsequently, Sabat and Johnson reported the use of more vigorous conditions [Pd-$(PPh_3)_4$/NaOH/toluene at 99 °C] for similar conversions.[13]

The coupling of organoborane **3** to iodobenzene was studied first (entry i), and we were delighted to observe efficient formation of adduct **10** after stirring the reaction overnight: a similar yield was observed with bromobenzene (entry ii; 71% vs 79%). Adduct **11** was obtained from 4-iodoanisole in 71% yield (entry iii), establishing that electon-rich systems also undergo efficient coupling (the corresponding triflate coupled in only 11% yield).

We next established that the reaction proceeds efficiently with electron-poor systems, and as can be seen (entries iv and v), nitroaryl adducts **12** and **13** were obtained in satisfactory yield. Table 1, entries iii, iv, and v, also demonstrate that *ortho*-, *meta*-, and *para*-disubstituted systems can all be accessed using this methodology. The successful preparation of the *o*-nitro aryl adduct **13** (entry v) and the *o*-fluoro derivative **14** (entry vi) was especially gratifying in light of the low yields obtained with the competing Jackson methodologies.[6] We therefore explored couplings with a range of 2-substituted aryl iodides and bromides (entries vii−ix) and observed efficient formation of adducts **15**−**17** with both electron-donating and electron-withdrawing ortho substituents. We also demonstrated that the reaction proceeds in good yield with a vinyl bromide[18] (entry x) and established that the *Z*-stereochemistry was retained in adduct **18** (J = 11.5 Hz).

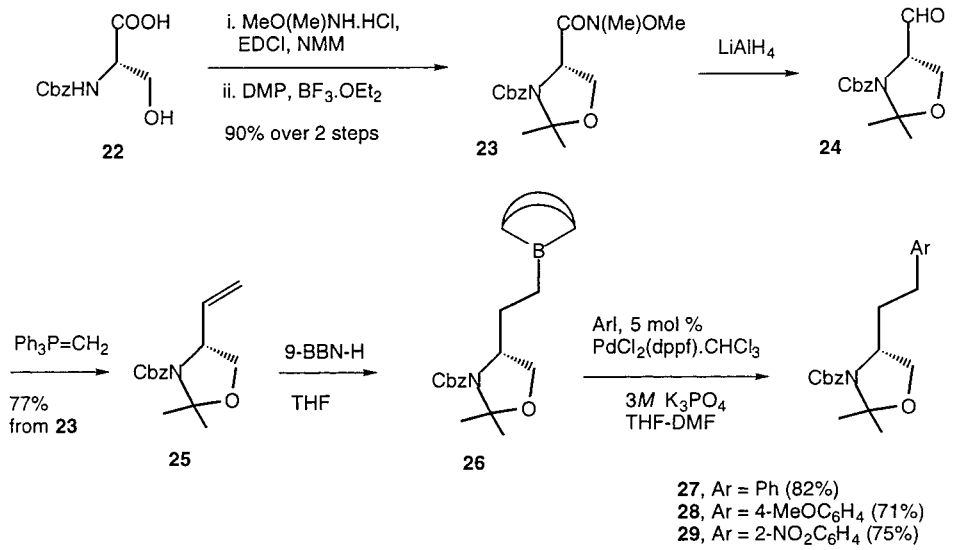
This novel Suzuki methodology was also employed in double and triple coupling processes to generate the potentially useful aryl-scaffolded systems **19**, **20**, and **21**[13] (Scheme 4).

We also investigated the corresponding sequence with the oxazolidine amine in the Cbz-protected form (Scheme 5), as it was felt that the greater acid stability conferred by Cbz (rather than Boc) protection could give greater flexibility in terms of adduct elaboration. The requisite vinyl oxazolidine **24** was simply prepared using a similar procedure to that described[14] for the *N*-Boc derivative using Weinreb amide methodology. Thus, commercially available *N*-Cbz (L)-serine **22** was converted into Weinreb amide **23** using *N*,*O*-dimethylhydroxylamine hydrochloride, *N*-(3-dimethylaminopropyl)-*N*′-ethylcarbodiimide hy-

(17) Kawate, T.; Fukata, N.; Nishida, A.; Nakagawa, M. *Chem. Pharm. Bull.* **1997**, *45*, 2116−2118.

(18) Ma, S.; Lu, X.; Li, Z. *J. Org. Chem.* **1992**, *57*, 709−713.

Scheme 5



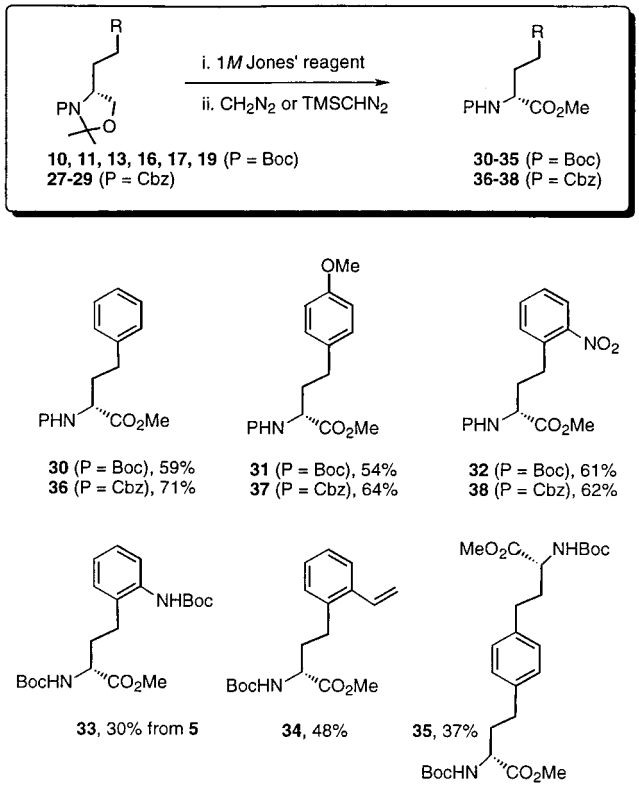
drochloride (EDCI), and *N*-methylmorpholine (NMM) followed by treatment with 2,2-dimethoxypropane (DMP)/$BF_3{\cdot}Et_2O$ in 90% yield over two steps. Lithium aluminum hydride reduction to the corresponding aldehyde **24** followed by Wittig methylenation gave the known[13,19] vinyl oxazolidine **25**[14] in 77% yield over the two steps. The alkene **25** displayed spectroscopic data consistent with those published[13] and corresponded well in terms of polarimetry {$[\alpha]^{24}_D$ +20.8 (*c* 0.8, $CHCl_3$); lit.[13] +19.6 (*c* 1.6, $CHCl_3$)}, thus confirming stereochemical conservation.

With alkene **25** available in multigram quantities, we next investigated the corresponding hydroboration−Suzuki coupling sequence (Scheme 5). We were pleased to establish that the *N*-Cbz oxazolidine **25** underwent smooth hydroboration and that **26**, generated in situ, gave efficient Suzuki coupling with electron-neutral, -rich, and -deficient aryl iodides producing adducts **27**−**29**, respectively, in 71−82% yield.

We next investigated the conversion of the coupled products into *N*-protected α-amino acids via a one-pot cleavage-oxidation procedure using Jones reagent. The cleavage and oxidation of similar oxazolidines have previously been reported by Dondoni et al.[5c(vi)] and later by our own group in the synthesis of *C*-glycosyl amino acids.[20] Nine of the above oxazolidines were studied, and the results are summarized in Scheme 6. Treatment with freshly prepared 1 M Jones reagent gave hydrolysis−oxidation to the corresponding acids which were esterified to aid purification and characterization.

All types of aryl-substituted (electron-neutral, -rich, and -deficient) oxazolidines were smoothly converted into the *N*-protected amino acids in a single step. The yields of the methyl esters over three steps were respectable (37−71%). It was noticeable that where a direct comparison could be made between *N*-Boc and *N*-Cbz analogues, in two out of three cases the latter form of protection gave ca. 10% higher yields: this presumably reflects the acid-lability of the Boc group during the Jones oxidation.[13]

Scheme 6



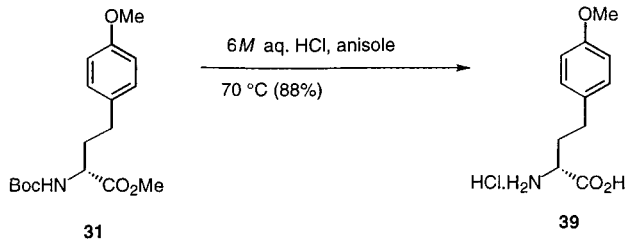
As can be seen from Scheme 6, a range of known and novel α-amino acids were prepared in protected form. Homophenylalanine derivative **30** displayed spectroscopic data consistent with those published[6e] and corresponded well in terms of polarimetry {$[\alpha]^{20}_D$ +14.5 (*c* 0.8, MeOH); lit.[6e] (*ent*-**30**), −14.7 (*c* 1.2, MeOH)}, thus demonstrating the conservation of stereochemical integrity.

These protected amino acids can be easily hydrolyzed. Thus, treatment of the *N*-Boc amino ester **31** with 6 M HCl at 70 °C for 5 h gave the hydrochloride salt of homoanisyl alanine **39** in 88% yield (Scheme 7). The optical rotation was in good agreement with the published value {$[\alpha]^{20}_D$ −33.4 (*c* 0.7, 1 M HCl); lit.[21] (*ent*-**39**), +34.6 (*c* 1.2, 1 M HCl)}.

(19) Reginato, G.; Mordini, A.; Capperucci, A.; Degl'Innocenti, A.; Manganiello, S. *Tetrahedron* **1998**, *54*, 10217−10226.

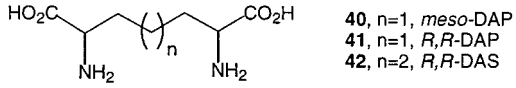
(20) Campbell, A. D.; Paterson, D. E.; Raynham, T. M.; Taylor, R. J. K. *J. Chem. Soc., Chem. Commun.* **1999**, 1599−1600.

Scheme 7



Application to DAP and DAS Synthesis. We then turned our attention to the utility of the novel organoborane reagent **3** for the synthesis of α,α′-diamino diacids (DADs, Figure 1),[12b] compounds that have attracted considerable recent attention.[22] *S,S*-2,6-Diaminopimelic acid (DAP) plays a key role in the metabolism of Gram positive and many Gram negative bacteria. It is epimerized by L,L-DAP epimerase to form *meso*-DAP **40** which is converted into L-lysine by the action of *meso*-DAP decarboxylase. *meso*-DAP **40** also confers structural rigidity to many bacteria by cross-linking the polysaccharides of the peptidoglycan units of their cell walls.[23] Mammals lack the DAP/lysine pathway, and thus inhibitors of this pathway could provide potential antibacterial agents with low mammalian toxicity.[24] 2,7-Diaminosuberic acid (DAS) **42** has also attracted considerable interest and has been used as a replacement for cystine in analogues of biologically active peptides.[25]

Our strategy for the synthesis of the DAP stereoisomers involved Suzuki coupling of organoborane homoalanine anion equivalent **3** with a suitably functionalized alkenyl halide **45**; asymmetric hydrogenation and oxazolidine unmasking would then deliver the natural products in protected forms. This approach is illustrated in Scheme 8 for the synthesis of *meso*-DAP **40**. The key vinyl bromide **45** was prepared from *N*-Boc (L)-serine methyl ester **43**[26] by modification of published procedures.[27] Mesylation and elimination of alcohol **43** gave dehydroamino acid **44** in 80% yield from **43**.[27a] Enamide **44** was brominated with NBS and treated with triethylamine to give vinyl bromide **45** in 85% yield.[27b] The *Z*-configuration of **45** was assigned on the basis of the $^3J_{CH}$ coupling constant of 3.1 Hz between the ester carbonyl carbon and the vinylic proton (after selective decoupling of the ester methyl group and NH exchange with D_2O).[27]



40, n=1, *meso*-DAP
41, n=1, *R,R*-DAP
42, n=2, *R,R*-DAS

Figure 1.

Suzuki coupling between organoborane **3** and vinyl bromide **45** gave the desired dehydroamino acid derivative **46** {$[\alpha]^{20}_D$ −4.6 (*c* 2.3, $CHCl_3$)} in 76% yield (Scheme 8). Asymmetric hydrogenation of **46** using Burk's Rh(I)-(*S,S*)-Et-DuPHOS catalyst[28] at 40 °C and 250 psi of hydrogen gave the *R,S*-diastereomer **47** in 94% yield as a single product (when the reaction was performed at 60 °C, the desired product **47** was obtained in 79% yield, along with 15% of the alcohol **48**).

Hydrogenation of **46** was also carried out under standard H_2−Pd/C conditions to produce a mixture of **47** and the corresponding *R*-amino acid diastereomer (99%, 52:48). The *R*-diastereomer could not be observed in the asymmetric hydrogenation product by 270 MHz ^{1}H NMR spectroscopy.

Oxazolidine **47** was converted into alcohol **48** in 88% yield by careful treatment with trifluoroacetic acid. Oxidation of alcohol **48** with PDC in DMF and subsequent esterification using (trimethylsilyl)diazomethane proceeded smoothly in 75% yield. This two-step oxazolidine deprotection−PDC oxidation route was found to give a higher overall yield (66% vs 40%) for the conversion of **47** into **49** compared to the direct conversion using Jones oxidation. *meso*-Diester **49** was hydrolyzed with 5 M HCl at 70 °C and on treatment with propylene oxide in ethanol, *meso*-DAP **40** crystallized from the reaction mixture. The product displayed physical and spectroscopic properties consistent with those published[22b] (see Experimental Section).

This procedure can be easily adapted to prepare other DAP stereoisomers by varying the starting amino acid used for production of organoborane **3** and/or the asymmetric hydrogenation catalyst. Scheme 9 illustrates the preparation of *R,R*-DAP **41**.

Thus, by employing Rh(I)-(*R,R*)-Et-DuPHOS as catalyst for the asymmetric hydrogenation of **46**, the *R,R*-diastereomer **50** was prepared in 96% yield, again as a single diastereomer {$[\alpha]^{20}_D$ −19.3 (*c* 0.9, $CHCl_3$). Following the same sequence of transformations as before gave *R,R*-DAP **41** {$[\alpha]^{25}_D$ −20.2 (*c* 1.0, H_2O)}; lit.[29] (*ent*-**41**), {$[\alpha]^{25}_D$ +20.0 (*c* 0.5, H_2O)}.

DAS analogues can be prepared by a simple modification of this route (Scheme 10). Thus, Suzuki coupling of organoborane homoalanine anion equivalent **3** with the novel homoalanine cation equivalent **53** (obtained by a

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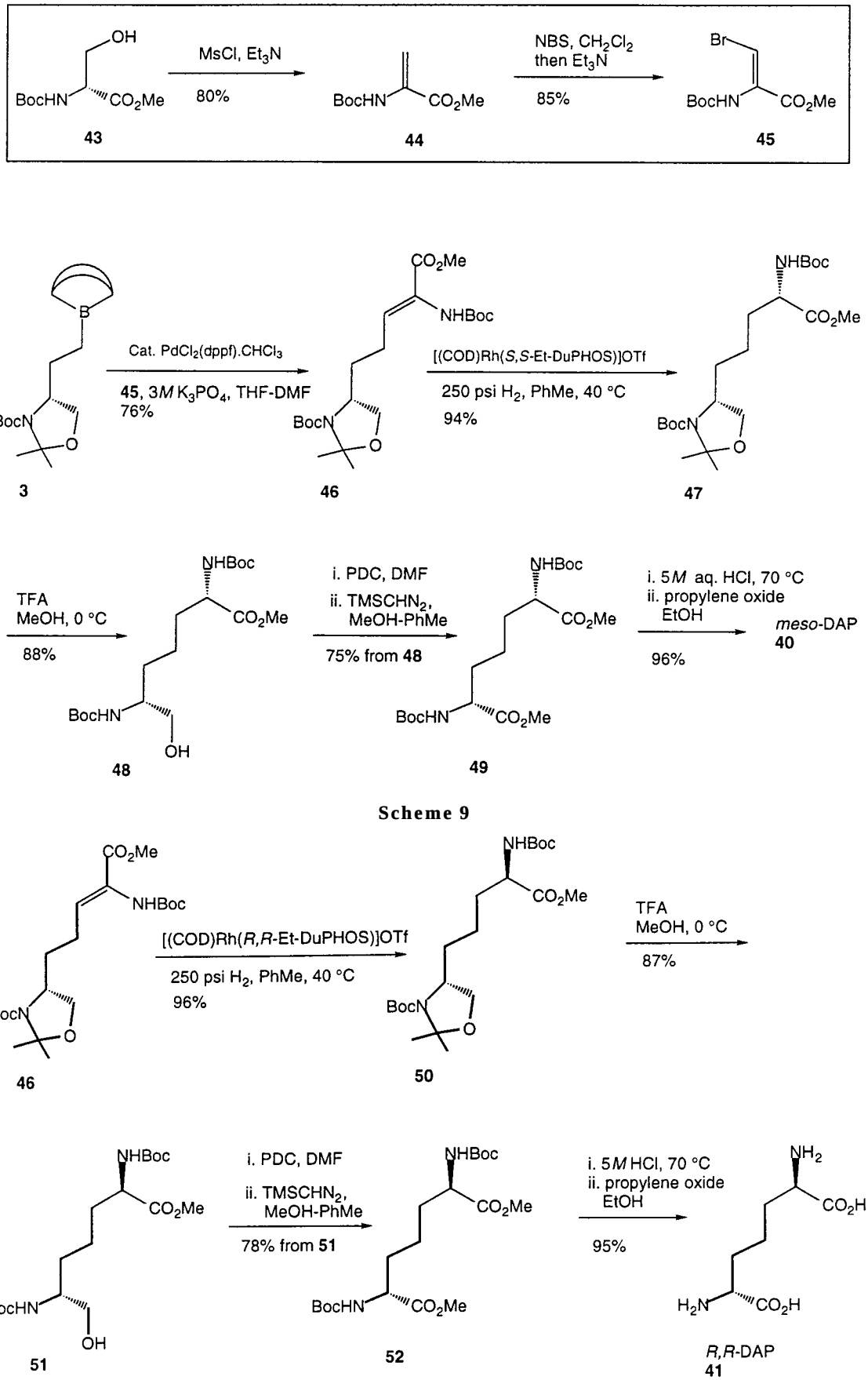
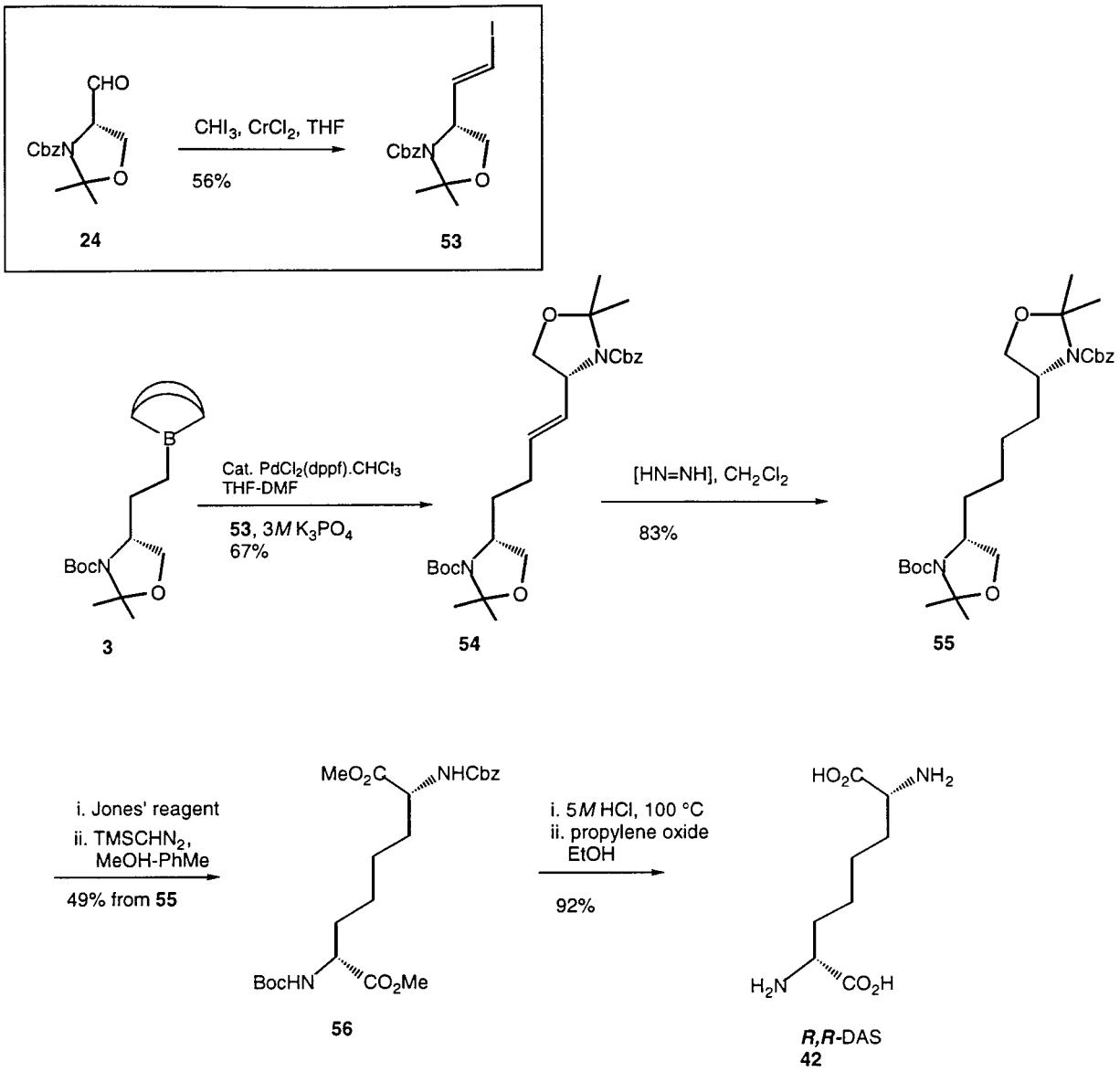
Scheme 8



Scheme 9

Takai reaction on **24**)[20] produced adduct **54** in 67% yield. Reduction of alkene **54** was performed with diimide generated from 2,4,6-triisopropylbenzenesulfonyl hydrazide to give **55** in 83% yield. Hydrolysis−oxidation of **55** with Jones reagent followed by methylation with (trimethylsilyl)diazomethane gave diester **56** in 49% yield

Scheme 10



from **55**. Amino acid derivative **56** is differentially protected at the amino groups and could therefore be useful in peptide synthesis. *R,R*-DAS **42** was obtained in 92% yield after deprotection of **56** with 5 M HCl followed by treatment with propylene oxide {$[\alpha]^{25}_D$ −24.5 (*c* 0.1, H_2O); lit.[29] (*ent*-**42**), $[\alpha]^{25}_D$ +24.8 (*c* 0.25, H_2O)}.

Conclusions

In summary, we have established that organoborane reagents **3** and **26**, which are readily available from serine, undergo efficient palladium-catalyzed Suzuki coupling reactions under mild conditions and with wide functional group tolerance. The adducts can be easily transformed into a range of known and novel nonproteinogenic amino acids, including *meso*-DAP, *R,R*-DAP, and *R,R*-DAS, in enantiopure form. We are currently optimizing the use of these new homoalanine anion equivalents and also exploring the potential of this methodology in library synthesis. In addition, we are exploring related Suzuki-coupling processes with reagents **2**.[11]

Experimental Section

General Methods. All reagents used were purchased from commercial sources or prepared according to standard literature methods using references given in the text and purified as necessary prior to use by standard literature procedures. Et_2O and THF were dried over sodium−benzophenone ketyl and distilled prior to use. Dry dichloromethane (DCM) was distilled from calcium hydride. TLC analysis was performed on Merck 5554 aluminum backed silica gel plates and compounds visualized by ultraviolet light (254 nm), phosphomolybdic acid solution (5% in EtOH), or 1% ninhydrin in EtOH. Column chromatography was performed using Fisons Matrex silica 70−200 μm or ICN 33−63 (60 Å) silica gel. Infrared spectra were recorded using sodium chloride plates on ATI Mattson Genesis FT-IR. Mass spectrometry were carried out using a Fisons Analytical (VG) Autospec instrument. High-resolution masses are within 5 ppm of theoretical values. ^{1}H NMR spectra were recorded at 270 MHz using a JEOL EX270 spectrometer and at 500 MHz using a Brucker AMX500 spectrometer. ^{13}C NMR spectra were recorded using a JEOL EX270 operating at 67.9 MHz and a Brucker AMX500 operating at 125 MHz. Several of the NMR spectra were complicated due to line broadening—the rotameric effects were minimized by performing the NMR experiments at the elevated temper-

atures indicated. However, in certain cases in the ^{13}C NMR spectra even at 80 °C some rotameric doubling of signals was observed: rotameric pairs are indicated by an r in brackets after the signals. Melting points were recorded on an electrothermal IA9000 Digital Melting Point Apparatus and are uncorrected. Optical rotations were recorded on a Jasco DIP-370 digital polarimeter at the indicated concentrations at 20 °C (unless otherwise stated). Drying of organic extracts during workup was performed over dried $MgSO_4$.

***tert*-Butyl (4*R*)-4-(2-Hydroxyethyl)-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (8a).** To alkene **5**[14] (50 mg, 0.22 mmol) in THF (2 mL) at 0 °C under nitrogen was added 9-BBN-H (0.5 M in THF, 0.88 mL, 0.44 mmol), and the mixture was stirred for 2 h. NaOH (1 M, 0.5 mL) and then H_2O_2 (60% in H_2O, 0.2 mL) were added, and stirring was continued for a further 30 min. The reaction was diluted with Et_2O (30 mL) and sat. $NaHCO_3$(aq) (10 mL), and the organic layer was dried, filtered, and concentrated in vacuo to give the crude product as a colorless oil which was purified by flash column chromatography, eluting with light petroleum−EtOAc (1:1), to afford alcohol **8a** as a white solid (52 mg, 96%). mp 75−76 °C; $[\alpha]_D$ +12.1 (*c* 1.5, $CHCl_3$); ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.67 (s, 9H), 1.73 (s. 3H), 1.85 (s, 3H), 1.88−2.01 (m, 2H), 3.72−3.83 (m, 3H), 3.94 (dd, J = 8.7, 5.8 Hz, 1H), 4.17−4.36 (m, 1H). The spectoscopic data were consistent with those reported. Melting point and $[\alpha]_D$ have not previously been reported.[30]

***tert*-Butyl (4*R*)-4-(2-Iodoethyl)-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (8b).** To alkene **5** (200 mg, 0.88 mmol) in THF (4 mL) at 0 °C under nitrogen was added 9-BBN-H (0.5 M in THF, 3.52 mL, 1.76 mmol). The reaction was warmed to room temperature and stirred for 2 h. Sodium methoxide in MeOH (4.63 M. 1.14 mL, 5.28 mmol) was added and then I_2 (671 mg, 2.64 mmol) as a solid at 0 °C, and the reaction was warmed to room temperature and stirred for 2 h. The reaction was diluted with Et_2O (80 mL) and saturated aqueous sodium thiosulfate (20 mL). The organic layer was dried, filtered, and concentrated in vacuo to give the crude product as a colorless oil which was purified by flash column chromatography eluting with light petroleum−EtOAc (4:1) to afford iodide **8b** as a colorless oil (244 mg, 78%). R_f = 0.45 (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −16.2 (*c* 2.6, $CHCl_3$); IR (NaCl) 2977, 1694, 1388 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.70 (s, 9H), 1.73 (s, 3H), 1.84 (s, 3H), 2.08−2.21 (m, 1H), 2.36−2.42 (m, 1H), 3.00−3.21 (m, 2H), 3.61 (dd, J = 9.0, 1.5 Hz, 1H), 3.84 (dd. J = 9.0, 5.8 Hz, 1H), 3.93−4.03 (m, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 1.1, 25.0, 28.3, 29.6, 39.3, 59.5, 67.7, 80.7, 94.9, 152.5; MS (CI, NH_3) *m*/*z* (rel intensity) 356 (M^+ + 1, 100); HRMS found for M^+ + 1, 356.0735. $C_{12}H_{23}NO_3I$ requires 356.0723.

General Procedure for Hydroboration−Suzuki Coupling. To the alkene **5** or **25** (0.22 mmol) in THF (1 mL) at 0 °C under nitrogen was added 9-BBN-H (0.5 M in THF, 0.88 mL, 0.44 mmol). The mixture was warmed to room temperature and stirred for 2 h. The flask was covered with foil, and K_3PO_4 (3 M in H_2O, 0.15 mL. 0.44 mmol) was added carefully (H_2 evolution) followed quickly by addition of the aromatic halide (0.24 mmol) in dry degassed DMF (1 mL) and finally $PdCl_2$(dppf). $CHCl_3$ (9.4 mg, 5 mol %) under nitrogen. The reaction was stirred overnight, and then the solvent was removed in vacuo using an oil pump rotary evaporator. The residue was taken up in Et_2O (25 mL) and saturated aqueous $NaHCO_3$ (10 mL). The aqueous layer was re-extracted with Et_2O (25 mL), and the combined organic layers were dried, filtered, and concentrated in vacuo to give the crude product which was purified by flash column chromatography, eluting with light petroleum−EtOAc mixtures to afford the Suzuki coupling product. In some cases, the product was accompanied by a 9-BBN-H derived impurity which could be removed by the following procedure: the crude reaction product was dissolved in THF (3 mL), NaOH (1 M, 1 mL) was added followed subsequently by aqueous H_2O_2 (60% w/v, 0.2 mL), and the mixture was stirred vigorously for 10 min at 0 °C. The reaction was diluted with Et_2O (20 mL) and saturated aqueous $NaHCO_3$ (10 mL), the aqueous layer was re-extracted with Et_2O (25 mL), and the combined organic layers were dried, filtered, and concentrated in vacuo.

***tert*-Butyl (4*R*)-2,2-Dimethyl-4-(2-phenylethyl)-l,3-oxazolidine-3-carboxylate (10). Method A.** The title compound **10** was prepared according to the general hydroboration−Suzuki-coupling procedure outlined above by reaction with iodobenzene (49 mg, 0.24 mmol). Purification by column chromatography, eluting with light petroleum−EtOAc (9:1), afforded **10** as a white solid (53 mg, 79%). mp 51−53 °C; R_f = 0.50 (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −40.1 (*c* 2.5, $CHCl_3$); IR (NaCl) 2977, 1695, 1389 cm^{-1}; ^1H NMR (270 MHz, C_6D_5-CD_3, 80 °C) δ 1.59 (s, 9H), 1.68 (s, 3H), 1.83 (s, 3H), 1.95−2.06 (m, 1H), 2.20−2.35 (m, 1H), 2.63−2.71 (m, 2H), 3.71 (dd, J = 9.0. 2.0 Hz, 1H), 3.85 (dd, J = 9.0, 6.0 Hz, 1H), 3.90−4.00 (m, 1H), 7.17−7.34 (m, 5H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.3, 28.4, 29.6, 34.0, 36.5, 58.7, 68.2, 80.2, 94.9, 127.1, 129.6 (× 2), 143.0, 153.0; MS (CI, NH_3) *m*/*z* (rel intensity) 306 (M^+ + 1, 15), 206 (100); HRMS found for M^+ + 1, 306.2071. $C_{18}H_{28}$-NO_3 requires 306.2069.

Method B. The title compound **10** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with bromobenzene (38 mg, 0.24 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (9:1) afforded **10** as a white solid (48 mg, 71%), with spectral data identical to the product from Method A.

***tert*-Butyl (4*R*)-4-[2-(4-Methoxyphenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3- carboxylate (11). Method A.** The title compound **11** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 4-iodoanisole (57 mg, 0.24 mmol). Purification by column chromatography, eluting with light petroleum−EtOAc (9:1), afforded **11** as a colorless oil (53 mg, 71%). $[\alpha]^{24}_D$ −27.9 (*c* 1.9, $CHCl_3$), lit.[13] $[\alpha]^{24}_D$ −37.0 (*c* 0.3, $CHCl_3$); ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.62 (s, 9H), 1.71 (s, 3H), 1.86 (s, 3H), 1.94−2.10 (m, 1H), 2.20−2.35 (m, 1H), 2.57−2.76 (m, 2H), 3.64 (s, 3H), 3.75 (dd J = 8.5, 1.5 Hz, 1H), 3.88 (app t, J = 8.5 Hz, 1H), 3.92−4.06 (br s, 1H), 6.95 (d, J = 8.5 Hz, 2H), 7.18 (d, J = 8.5 Hz, 2H). The spectroscopic data were consistent with those reported.[13]

Method B. The title compound **11** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 4-(trifluoromethanesulfonyloxy)anisole (62 mg, 0.24 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (9:1) afforded **11** as a white solid (8 mg, 11%), with spectral data identical to the product from Method A.

***tert*-Butyl (4*R*)-4-[2-(3-Nitrophenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3- carboxylate (12).** The title compound **12** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1-iodo-3-nitrobenzene (60 mg, 0.24 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (4:1) afforded **15** as a colorless oil (53 mg, 69%). R_f = 0.40 (light petroleum−EtOAc, 4:1); $[\alpha]_D$ −28.1 (*c* 2.5, $CHCl_3$); IR (NaCl) 2931, 1693, 1530, 1390 cm^{-1}; ^1H NMR(270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.69 (s, 9H), 1.77 (s, 3H), 1.92 (s, 3H), 1.93−2.07 (m, 1H), 2.12−2.33 (m, 1H), 2.63−2.71 (m, 2H), 3.73 (app d, J = 7.0 Hz, 1H), 3.91−4.08 (m, 2H), 7.17 (app t, J = 8.5 Hz, 1H), 7.30 (d, J = 8.5 Hz, 1H), 8.04 (d, J = 8.5 Hz, 1H), 8.16 (s, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 24.1 + 25.5 (r), 27.9 + 28.8 (r), 29.2, 31.2 + 33.0 (r), 37.5, 57.6 + 58.3 (r), 67.5, 80.1 + 80.6 (r), 94.2 + 95.0 (r), 122.0, 124.1, 133.0, 134.9, 144.5, 149.6, 152.5; MS (CI, NH_3) *m*/*z* (rel intensity) 368 (M^+ + 1 + 17, 4), 221 (100); HRMS found for M^+ + 1 + 17, 368.2198. $C_{18}H_{30}N_3O_5$ requires 368.2185.

***tert*-Butyl (4*R*)-4-[2-(2-Nitrophenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (13).** The title compound **13** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1-iodo-2-nitrobenzene (213 mg, 0.86 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (9:1)

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afforded **13** as a light yellow oil (229 mg, 84%). $R_f = 0.40$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −53.6 (*c* 0.3, $CHCl_3$); IR (NaCl) 2979, 1698, 1610, 1525, 1389 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.73 (s, 9H), 1.78 (s, 3H), 1.93 (s, 3H), 2.05−2.20 (m, 1H), 2.22−2.39 (m, 1H), 3.02 (m, 2H), 3.80−4.20 (m, 3H), 7.12−7.40 (m, 3H), 7.83 (d, $J = 7.5$ Hz, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 24.2, 27.5, 28.6, 29.7, 35.0, 57.6, 67.3, 79.6, 94.1, 124.7, 127.1, 131.9, 132.6, 136.9, 150.4, 152.2; MS (CI, NH_3) *m*/*z* (rel intensity) 368 ($M^+ + I + 17$, 10), 351 ($M^+ + 1$, 35); HRMS found for $M^+ + 1$, 351.1921. $C_{18}H_{27}N_2O_5$ requires 351.1920.

***tert*-Butyl (4*R*)-4-[2-(2-Fluorophenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (14).** The title compound **14** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1-fluoro-2-iodobenzene (192 mg, 0.87 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (7:1) afforded **14** as a colorless oil (196 mg, 77%). $R_f = 0.39$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −40.5 (*c* 0.3, $CHCl_3$); IR (NaCl) 2981, 1698, 1493, 1455, 1390 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.73 (s, 9H), 1.82 (s, 3H), 1.97 (s, 3H), 2.10−2.22 (m, 1H), 2.30−2.47 (m, 1H), 2.88 (app t, $J = 7.5$ Hz, 2H), 3.88 (dd $J = 9.0$, 1.5 Hz, 1H) 4.00 (ddd, $J = 9.0$, 5.5, 0.5 Hz, 1H), 4.03−4.15 (m, 1H), 7.08−7.39 (m, 3H), 7.41−7.44 (m, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 21.3, 27.0, 28.4, 29.5, 35.3, 58.5, 68.1, 80.2, 94.9, 116.4 (d, $J = 21.8$ Hz), 125.2 (d, $J = 4.0$ Hz), 125.7, 128.7, 131.8 (d, $J = 5.4$ Hz), 153.0, 162.7 (d, $J = 243.4$ Hz); MS (CI, NH_3) *m*/*z* (rel intensity) 324 ($M^+ + 1$, 9), 224 (100): HRMS found for $M^+ + 1$, 324.1978. $C_{18}H_{27}FNO_3$ requires 324.1975.

***tert*-Butyl (4*R*)-4-[2-(2-Bromophenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (15).** The title compound **15** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1-bromo-2-iodobenzene (343 rmg, 1.22 mmol, 1.3 equiv). Purification by column chromatography eluting with light petroleum−EtOAc (7:1) afforded **15** as a colorless oil (273 mg, 76%). $R_f = 0.37$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −35.4 (*c* 0.2, $CHCl_3$); IR (NaCl) 2979, 1698, 1472, 1387, 1259 cm^{-1}: ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.73 (s, 9H), 1.82 (s, 3H), 1.97 (s, 3H), 2.10−2.17 (m, 1H), 2.32−2.44 (m, 1H), 2.98 (app t, $J = 8.0$ Hz, 2H), 3.93−4.12 (m, 3H), 7.02−7.42 (m, 3H), 7.67 (d, $J = 7.0$ Hz, 1H); ^{13}C NMR (67.9 MHz. $C_6D_5CD_3$, 80 °C) δ 25.1, 28.4, 29.5, 34.1, 35.2, 58.4, 68.2, 80.2, 94.9, 125.8, 128.6, 128.7, 131.5, 134.2, 142.6, 153.0; MS (CI, NH_3) *m*/*z* (rel intensity) 384 ($M^+ + 1$, 2), 284 (74); HRMS found for $M^+ + 1$, 384.1190. $C_{18}H_{27}NO_3{}^{79}Br$ requires 384.1174.

***tert*-Butyl (4*R*)-4-(2-{2-[(*tert*-Butoxycarbonyl)amino]phenyl}ethyl)-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (16).** Please refer to compound **33**.

***tert*-Butyl (4*R*)-4-[2-(2-Vinylphenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3- carboxylate (17).** The title compound **17** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 2-bromostyrene (44 mg, 0.24 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (9:1) afforded **17** as a colorless oil (55 mg, 76%). $R_f = 0.50$ (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −44.3 (*c* 2.6, $CHCl_3$); IR (NaCl) 2978, 1696, 1388 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.73 (s, 9H), 1.83 (s, 3H), 1.96 (s, 3H), 2.03−2.20 (m, 1H), 2.22−2.40 (m, 1H), 2.90 (app t, $J = 8.0$ Hz, 2H), 3.86 (app d, $J = 7.0$ Hz, 1H), 3.95−4.18 (m, 2H), 5.49 (dd, $J = 11.0$, 1.5 Hz, 1H), 5.85 (dd, $J = 17.5$, 1.5 Hz, 1H), 7.20−7.43 (m, 4H), 7.65−7.74 (m, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.1, 28.4, 29.5, 31.2, 36.3, 58.7, 68.3, 80.2, 94.9, 116.3, 127.4, 127.5, 128.6, 130.6, 136.3, 138.0, 140.5, 153.0; MS (CI, NH_3) *m*/*z* (rel intensity) 332 ($M^+ + 1$, 10), 232 (100); HRMS found for $M^+ + 1$, 332.2229. $C_{20}H_{30}NO_3$ requires 332.2226.

***tert*-Butyl (4*R*)-4-[(3*Z*)-5-Ethoxy-5-oxo-3-pentenyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (18).** The title compound **18** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with *Z*-3-bromoacrylic acid ethyl ester[18] (44 mg, 0.25 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (4:1) afforded **18** as a colorless oil (50 mg, 68%). $R_f = 0.20$ (light petroleum−EtOAc, 4:1); $[\alpha]_D$ +10.1 (*c* 2.4, $CHCl_3$); IR (NaCl) 2980, 1719, 1697, 1388 cm^{-1}: ^1H NMR (270 MHz, $C_6D_5CD_3$, 60 °C) δ 1.01 (t, $J = 7.0$ Hz, 3H), 1.42 (s, 9H), 1.47 (s, 3H), 1.63 (s, 3H), 1.53−1.90 (m, 2H), 2.40−2.61 (m, 1H), 2.63−2.80 (m, 1H), 3.55−3.82 (m, 3H), 3.96 (q, $J = 7.0$ Hz, 2H), 5.71 (dt, $J = 11.5$, 1.5 Hz, 1H), 5.86−5.98 (m, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 14.3, 22.5, 26.0, 27.5, 28.5, 32.5 + 33.0 (r), 57.4, 59.6, 67.1, 79.2, 93.8, 120.7, 128.0, 152.0, 165.9; MS (CI, NH_3) *m*/*z* (rel intensity) 328 ($M^+ + 1$, 20), 228 (100): HRMS found for $M^+ + 1$. 328.2124. $C_{17}H_{30}NO_5$ requires 328.2124.

***tert*-Butyl (4*R*)-4-[2-(4-{2-(4*R*)-3-(*tert*-Butoxycarbonyl)-2,2-dimethyl-1,3-oxazolidin-4-yl]ethyl}phenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (19).** The title compound **19** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1,4-diiodobenzene (36 mg, 0.11 mmol, 0.5 equiv). Purification by column chromatography eluting with light petroleum−acetone (5:1) afforded **19** as a colorless oil (40 mg, 69%). $R_f = 0.10$ (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −30.6 (*c* 1.9, $CHCl_3$); IR (NaCl) 2927, 1695, 1389 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.48 (s, 18H), 1.56 (s, 6H), 1.71 (s, 6H), 1.76−1.96 (m, 2H), 2.10−2.24 (m, 2H), 2.46−2.65 (m, 4H), 3.55−3.64 (m, 2H), 3.68−3.92 (m, 4H), 7.08 (br s, 4H); ^{13}C NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 23.6 + 25.2 (r), 27.8 + 28.4 (r), 29.6, 33.6, 36.6, 58.7, 68.2, 80.2, 94.9, 129.8, 140.5, 153.0; MS (CI, NH_3) *m*/*z* (rel intensity) 550 ($M^+ + 1 + 17$, 2), 377 (100); HRMS found for $M^+ + 1 + 17$, 550.3854. $C_{30}H_{52}N_3O_6$ requires 550.3856.

***tert*-Butyl (4*R*)-4-[2-(2-{2-[(4*R*)-3-(*tert*-Butoxycarbonyl)-2,2-dimethyl-1,3-oxazolidin-4-yl]ethyl}phenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (20).** The title compound **20** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1,2-diiodobenzene (54 mg, 0.16 mmol, 0.33 equiv). Purification by column chromatography, eluting with light petroleum−EtOAc (7:1), afforded **20** as a colorless oil (72 mg, 83%). $R_f = 0.30$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −50.4 (*c* 0.3, $CHCl_3$); IR (NaCl) 2979, 1698, 1455, 1390 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.73 (s, 18H), 1.82 (s, 6H), 1.97 (s, 6H), 2.09−2.23 (m, 2H), 2.28−2.43 (m, 2H), 2.87−2.93 (m, 4H), 3.94−4.25 (m, 6H), 7.29−7.41 (m, 4H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.2, 28.4, 29.5, 30.7, 36.4, 58.9, 68.3, 80.4, 94.8, 127.5, 130.5, 140.7, 153.0; MS (CI, NH_3) *m*/*z* (rel intensity) 533 ($M^+ + 1$, 28), 433 (100); HRMS found for $M^+ + 1$, 533.3585. $C_{30}H_{49}N_2O_6$ requires 533.3591.

***tert*-Butyl (4*R*)-4-[2-(3,5-Bis{2-[(4*R*)-3-(*tert*-butoxycarbonyl)-2,2-dimethyl-1,3-oxazolidin-4-yl]ethyl}phenyl)ethyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (21).** The title compound **21** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1,3,5-tribromobenzene (46 mg, 0.148 mmol, 0.33 equiv). In addition to the standard procedure. the reaction was heated at 80 °C for 6 h. Purification by column chromatography, eluting with light petroleum−EtOAc (4:1), yielded **21** as a colorless oil in ≅90% purity (53 mg, 47%). $R_f = 0.20$ (light petroleum−EtOAc (4:1); ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.62 (s, 27H), 1.69 (s, 9H), 1.84 (s, 9H), 1.82−1.95 (m, 3H), 1.98−2.14 (m, 3H), 2.65−2.79 (m, 6H), 3.78 (dd, $J = 8.5$. 1.5 Hz, 3H), 3.91 (dd, $J = 8.5$, 6.0 Hz, 3H), 3.96−4.09 (m, 3H), 7.08 (s, 3H). The spectroscopic data were consistent with those reported.[13]

Benzyl (4*S*)-4-{[Methoxy(methyl)amino]carbonyl}-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (23). (i) Cbz-L-Serine **22** (24.4 g, 102 mmol) was dissolved in DCM (400 mL) and cooled to −15 °C, and then *N*,*O*-dimethylhydroxylamine hydrochloride (10.5 g, 105 mmol) and then *N*-methylmorpholine (11.8 mL, 105 mmol) were added. 1-(3-Dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (20.1 g, 105 mmol) was then added as a solid in five portions over 30 min. The reaction was stirred for 1h at the same temperature and then ice cold 1 M HCl was added (60 mL). The layers were separated, the aqueous layer was extracted with DCM (200 mL), and the combined organics washed with sat. $NaHCO_3$-(aq) (60 mL). The aqueous layer was again washed with DCM (200 mL), the combined organic layers were dried and filtered,

and the solvent was removed in vacuo to give a colorless oil which was used without purification.

(ii) The crude product was dissolved in a mixture of acetone (320 mL) and 2,2- dimethoxypropane (100 mL). $BF_3{\cdot}OEt_2$ (0.8 mL) was added until there was a permanent change in color (colorless to orange), and the reaction was stirred for 2 h under nitrogen. NEt_3 (1 mL) was added to quench the reaction, and the solvent was removed in vacuo to give a colorless oil. Purification by column chromatography eluting with light petroleum−EtOAc (3:1) gave the title compound **23** as a colorless oil (29.6 g, 90%), $R_f = 0.37$ (light petroleum−EtOAc, 1:3): $[\alpha]_D$ −5.0 (*c* 0.6, $CHCl_3$); IR (NaCl) 2982, 1715, 1681, 1455, 1416, 1353 cm^{-1}; ^1H NMR(270 MHz, DMSO-d_6 90 °C) δ 1.52 (s, 3H), 1.62 (s, 3H), 3.11 (s, 3H), 3.60 (s, 3H), 3.89 (dd, *J*= 9.0, 3.5 Hz, 1H), 4.24 (dd, *J* = 9.0, 7.5 Hz, 1H), 4.87 (dd, *J* = 7.5, 3.5 Hz, 1H), 5.06 (br s, 2H), 7.25−7.41 (m, 5H); ^{13}C NMR (67.9 MHz, DMSO-d_6, 90 °C) δ 24.1 (× 2), 32.0, 56.7, 60.5, 65.5, 65.6, 93.9, 127.0, 127.3, 127.8, 136.1, 151.0, 169.7; MS (CI, NH_3) *m*/*z* (rel intensity) 340 ($M^+ + 1 + 17$, 5), 323 ($M^+ + 1$, 63), 265 (100); HRMS found for $M^+ + 1$, 323.1617. $C_{16}H_{23}N_2O_5$ requires 323.1607.

Benzyl (4*R*)-2,2-Dimethyl-4-vinyl-1,3-oxazolidine-3-carboxylate (25). (i) Hydroxamate **23** (11.28 g, 35.0 mmol) was dissolved in dry THF (150 mL) and cooled to 0 °C. Lithium aluminum hydride (1 M in THF, 17.5 mL, 17.5 mmol) was added dropwise, and the mixture was stirred for 30 min. The reaction was cooled to −15 °C, and sat. $KHSO_4$(aq) (100 mL) was added carefully. The solution was diluted with Et_2O (250 mL) and stirred vigorously for 30 min. The organic layer was separated, dried and filtered, and the solvent was evaporated in vacuo to give a pale yellow oil which was used without further purification. (ii) Methyltriphenylphosphonium bromide (21.2 g, 59.5 mmol) was suspended in THF (300 mL) at room temperature, and KHMDS (0.5 M solution in PhMe, 114 mL, 57.1 mmol) was added under nitrogen. The resultant yellow suspension was stirred at room temperature for 1 h and then cooled to −78 °C, and a solution of unpurified aldehyde **24** (8.94 g, 34 mmol) in THF (60 mL) was added dropwise. The cooling bath was removed, and the mixture was allowed to warm to room-temperature overnight. The reaction was quenched with MeOH (30 mL), and the resulting mixture was poured into sat. $NaHCO_3$(aq) (500 mL). After extraction with Et_2O (2 × 400 mL), the organic layer was dried, filtered, and concentrated in vacuo to give the crude product which was subsequently purified by column chromatography eluting with light petroleum−EtOAc (3:1) to yield the title compound **25** as a colorless oil (7.00 g, 77%). $[\alpha]^{24}_D$ +20.8 (*c* 0.8, $CHCl_3$), lit.[13] $[\alpha]^{24}_D$ +19.6 (*c* 1.6, $CHCl_3$); ^1H NMR (270 MHz. DMSO-d_6, 80 °C) δ 1.47 (s, 3H), 1.54 (s, 3H), 3.75 (dd. *J* = 8.5. 2.0 Hz. 1H), 4.06 (dd, *J* = 8.5. 6.0 Hz, 1H), 4.43 (m, 1H), 5.09 (s, 2H), 5.14 (m, 2H), 5.85 (ddd, *J* = 16.5, 10.5, 6.5 Hz, 1H), 7.25−7.41 (m, 5H). The spectroscopic data were consistent with those reported.[13]

Benzyl (4*R*)-2,2-Dimethyl-4-(2-phenylethyl)-1,3-oxazolidine-3-carboxylate (27). The title compound **27** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with iodobenzene (386 mg, 0.21 mL, 1.89 mmol). Purification by column chromatography, eluting with light petroleum−EtOAc (5:1), afforded **27** as a colorless oil (479 mg, 82%). $R_f = 0.43$ (light petroleum−EtOAc. 3:1); $[\alpha]_D$ −29.9 (*c* 0.5, $CHCl_3$); IR (NaCl) 2936, 1698, 1406, 1350 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) 61.47 (s, 3H), 1.63 (s. 3H), 1.68−1.84 (m, 1H), 1.90−2.12 (m, 1H), 2.30−2.52 (m, 2H), 3.44−3.53 (m, 1H), 3.55−3.66 (m, 1H), 3.70−3.81 (m, 1H), 4.98 (d, *J* = 12.0 Hz, 1H), 5.08 (d, *J* = 12.0 Hz, 1H), 6.89−7.20 (m, 10H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 24.1, 27.3, 32.9, 35.5, 57.8, 66.9, 67.4, 94.3, 126.2 (× 2), 128.1, 128.2, 128.4, 128.6, 128.7, 141.8, 152.6; MS (CI, NH_3) *m*/*z* (rel intensity) 357 ($M^+ + 1 + 17$, 1), 340 ($M^+ + 1$, 12), 282 (100); HRMS found for $M^+ + 1$, 340.1904. $C_{21}H_{26}NO_3$ requires 340.1913.

Benzyl (4*R*)-2,2-Dimethyl-4-[2-(4-methoxyphenyl)ethyl]-1,3-oxazolidine-3- carboxylate (28). The title compound **28** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 4-iodoanisole (101 mg, 0.43 mmol). Purification by column chromatography eluting with light petroleum−EtOAc (5:1) afforded **28** as a colorless oil (103 mg, 71%). $R_f = 0.35$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −26.9 (*c* 0.6, CHC_{13}); IR (NaCl) 2951, 1704, 1698, 1513 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.47 (s, 3H), 1.64 (s, 3H), 1.70−1.83 (m, 1H), 1.93−2.05 (m, 1H), 2.29−2.48 (m, 2H), 3.42 (s, 3H), 3.51 (dd, *J* = 8.5, 1.5 Hz, 1H), 3.63 (m, 1H), 3.77 (m, 1H), 4.98 (d, *J* = 12.5 Hz, 1H), 5.07 (d, *J* = 12.5 Hz, 1H), 6.69 (app d, *J* = 8.5 Hz, 2H), 6.88 (app d, *J* = 8.5 Hz, 2H), 6.96−7.21 (m, 5H); ^{13}C NMR (67.9 MHz, C_6D_5-CD_3, 80 °C) δ 24.1, 27.3, 32.0, 35.7, 55.0, 57.8, 66.9, 67.4, 94.3, 114.6, 128.2, 128.5, 128.7, 128.9, 129.5, 133.8, 152.6, 158.9; MS (Cl, NH_3) *m*/*z* (rel intensity) 387 ($M^+ + 1 + 17$, 4), 370 ($M^+ + 1$, 18), 312 (100); HRMS found for $M^+ + 1$, 370.2006. $C_{22}H_{28}NO_4$ requires 370.2018.

Benzyl (4*R*)-2,2-Dimethyl-4-[2-(2-nitrophenyl)ethyl]-1,3-oxazolidine-3-carboxylate (29). The title compound **29** was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with 1-iodo-2-nitrobenzene (98 mg, 0.39 mmol). Purification by column chromatography, eluting with light petroleum−EtOAc (5:1), afforded **29** as a colorless oil (103 mg. 75%). $R_f = 0.26$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −39.8 (*c* 0.8, CHC_{13}); IR (NaCl) 2936, 1701, 1526, 1406 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.45 (s, 3H), 1.63 (s, 3H), 1.68−1.84 (m, 1H), 1.85−2.05 (m, 1H), 2.62 (t, *J* = 7.5 Hz, 2H), 3.55−3.67 (m, 2H), 3.68−3.78 (m, 1H), 5.00 (d, *J* = 12.0 Hz, 1H), 5.07 (d, *J*= 12.0 Hz, 1H), 6.66−7.20 (m, 8H), 7.46 (dd, *J* = 8.0, 1.5 Hz, 1H); ^{13}C NMR (67.9 MHz, DMSO-d_6, 80 °C) δ 23.1, 26.3, 27.9, 33.6, 56.2, 65.6, 66.3, 92.9, 123.8, 127.1, 127.3, 127.4, 128.0, 131.3, 132.7, 135.2, 136.4, 148.9, 151.5; MS (CI, NH_3) *m*/*z* (rel intensity) 402 ($M^+ + 1 + 17$, 17), 385 ($M^+ + 1$, 20), 327 (100); HRMS found for $M^+ + 1$, 385.1758. $C_{21}H_{25}N_2O_5$ requires 385.1763.

Methyl (2*R*)-2-[(*tert*-Butoxycarbonyl)amino]-4-phenylbutanoate (30). To the oxazolidine **10** (48 mg, 0.157 mmol) in acetone (3 mL) at 0 °C was added freshly prepared Jones reagent (1 M, 0.97 mL, 0.97 mmol), and the reaction was warmed to room temperature and stirred overnight under nitrogen. The reaction was quenched with isopropyl alcohol (1 mL) and then diluted with EtOAc (25 mL) and sat. NH_4-Cl(aq) (10 mL). The aqueous layer was separated and re-extracted with EtOAc (25 mL), and the combined organic layers were dried, filtered, and concentrated in vacuo to about 10 mL in volume. The solution of the crude acid was cooled to 0 °C. Excess ethereal diazomethane was added, and the reaction was stirred for 30 min. The diazomethane was blown off with nitrogen, the organic layer was washed with sat. $NaHCO_3$(aq) (10 mL) and then sat. NH_4Cl(aq) (10 mL), and the organic layer was dried, filtered, and concentrated in vacuo to give the crude product as a colorless oil which was purified by flash column chromatography, eluting with light petroleum−EtOAc (9:1), to afford **30** as a colorless oil (27 mg, 59%). $[\alpha]_D$ +14.5 (*c* 0.8, MeOH), lit.[6d] $[\alpha]_D$ (*ent*-**30**) −14.7 (*c* 1.2, MeOH); ^1H NMR (270 MHz, $CDCl_3$) δ 1.45 (s, 9H), 1.86−2.01 (m, 1H), 2.08−2.23 (m, 1H), 2.67 (app t, *J* = 8.0 Hz, 2H), 3.71 (s, 3H), 4.30−4.42 (m, 1H), 5.07 (br d, *J* = 7.0 Hz, 1H), 7.15−7.32 (m, 5H). The spectroscopic data were consistent with those reported.[6d]

Methyl (2*R*)-2-[(*tert*-Butoxycarbonyl)amino]-4-(4-methoxyphenyl)butanoate (31). Starting oxazolidine **11** (65 mg, 0.194 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **30** (stirring for 5 h) followed by treatment with diazomethane. Purification by column chromatography, eluting with light petroleum−EtOAc (9:1), afforded **31** as a colorless oil (34 mg, 54%). $R_f = 0.25$ (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −29.8 (*c* 1.6. $CHCl_3$); IR (NaCl) 3368, 2974, 1744, 1713, 1513 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.45 (s, 9H), 1.83−1.97 (m, 1H), 2.03−2.16 (m, 1H), 2.61 (app t, *J* = 8.0 Hz, 2H), 3.71 (s, 3H), 3.78 (s, 3H), 4.27−4.42 (m, 1H), 5.08 (br d, *J* = 8.0 Hz, 1H), 6.83 (d, *J* = 8.5 Hz, 2H), 7.10 (d, = 8.5 Hz, 2H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 28.3, 30.7, 34.6, 52.3, 53.2, 55.3, 79.9, 113.9, 129.3, 132.8, 155.4, 158.0, 173.2; MS (CI, NH_3) *m*/*z* (rel intensity) 324 ($M^+ + 1$, 10), 224 (100); HRMS found for $M^+ + 1$, 324.1813. $C_{17}H_{26}NO_5$ requires 324.1811.

Methyl (2*R*)-2-[(*tert*-Butoxycarbonyl)amino]-4-(2-nitrophenyl)butanoate (32). To the starting oxazolidine **13** (75 mg, 0.21 mmol) in acetone (3 mL) at 0 °C was added freshly prepared Jones reagent (1 M, 1.07 mL, 1.07 mmol), and the reaction was warmed to room temperature and stirred for 4 h under nitrogen. The reaction was quenched with isopropyl alcohol (1 mL) and then diluted with H_2O (25 mL) and EtOAc (25 mL), NH_4Cl (10 mL) was added, and the aqueous layer was re-extracted with EtOAc (2 × 30 mL). The combined organic layers were dried, filtered, and concentrated in vacuo to give the crude product. The crude acid was dissolved in a mixture of PhMe and MeOH (1:1, 2.5 mL total), (trimethylsilyl)diazomethane (2 M solution in hexanes, 0.21 mL, 0.43 mmol) was added at 0 °C under nitrogen, and the reaction mixture was stirred for 30 min. All volatiles were removed under reduced pressure, and the crude ester was purified by column chromatography, eluting with light petroleum−EtOAc (4:1), to afford **32** as a colorless oil (44 mg, 61%). R_f = 0.43 (light petroleum−EtOAc, 2:1); $[\alpha]_D$ −53.6 (*c* 0.3, $CHCl_3$); IR (NaCl) 3370, 2979, 1739, 1714, 1526, 1456 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.55 (s, 9H), 1.91−2.08 (m, 1H), 2.10−2.25 (m, 1H), 2.79−3.06 (m, 2H), 3.74 (s, 3H), 4.29−4.49 (m, 1H), 5.11−5.24 (br d, *J* = 7.0 Hz, 1H), 7.28−7.59 (m, 3H), 7.92 (d *J* = 7.5 Hz, 1H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 28.2, 29.1, 33.5, 52.4, 53.1, 80.0, 125.0, 127.4, 132.1, 133.2, 136.0, 149.0, 155.4, 172.7; MS (CI, NH_3) *m*/*z* (rel intensity) 356 (M^+ + 1 + 17, 4), 339 (M^+ + 1, 1), 239 (100); HRMS found for M^+ + 1 + 17, 356.1828. $C_{16}H_{26}N_3O_6$ requires 356.1822.

Methyl (2*R*)-2-(*tert*-Butoxycarbonyl)amino]-4-{2−1-(*tert*-butoxycarbonyl)amino]phenyl}butanoate (33). The general hydroboration−Suzuki coupling procedure of **5** outlined above was carried out with *tert*-butyl 2-iodophenylcarbamate[31] (77 mg, 0.24 mmol). Purification by column chromatography, eluting with light petroleum−EtOAc (6:1), afforded the expected oxazoline derivative **16** in quantitative yield but in ≅75% purity by NMR as a colorless oil. The impure product was used in the next reaction without any further purification.

The starting oxazolidine from above was treated with 1 M Jones reagent according to the general procedure outlined for ester **30** (stirring overnight) followed by treatment with diazomethane. Purification by column chromatography eluting with light petroleum−EtOAc (9:1) afforded **33** as a colorless oil (27 mg, 30% from **5**). R_f = 0.20 (light petroleum−EtOAc, 9:1); $[\alpha]_D$ −22.5 (*c* 1.2, $CHCl_3$); IR (NaCl) 3356, 2978, 1713, 1518 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.46 (s, 9H), 1.52 (s, 9H), 1.84−1.98 (m, 1H), 2.05−2.23 (m, 1H), 2.54−2.75 (m, 2H), 3.74 (s, 3H), 4.24−4.40 (br s, 1H), 5.05−5.24 (m, 1H), 6.46−6.55 (br s, 1H), 7.03−7.24 (m, 3H), 7.67 (d, *J* = 7.5 Hz, 1H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 27.0, 28.3, 28.4, 32.9, 52.5, 53.1, 80.2, 80.4, 123.3, 124.6, 127.2, 129.2, 131.6, 135.8, 153.6, 155.4, 173.0; MS (CI, NH_3) *m*/*z* (rel intensity) 409 (M^+ + 1, 10), 209 (100); HRMS found for M^+ + 1, 409.2336. $C_{21}H_{33}N_2O_6$ requires 409.2339.

Methyl (2*R*)-2-(*tert*-Butoxycarbonyl)amino]-4-(2-vinylphenyl)butanoate (34). Oxazolidine **17** (41 mg, 0.12 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)diazomethane. Purification by column chromatography eluting with light petroleum−EtOAc (9:1) afforded **34** as a colorless oil (19 mg, 48%). R_f = 0.40 (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −38.9 (*c* 0.8. $CHCl_3$); IR (NaCl) 3359, 2978, 1740, 1713, 1504, 1366 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.46 (s, 9H), 1.80−1.94 (m, 1H), 2.03−2.11 (m, 1H), 2.69−2.76 (m, 2H), 3.73 (s, 3H), 4.34−4.41 (m, 1H), 5.12 (br d, *J* = 8.0 Hz, 1H), 5.30 (dd, *J* = 11.0, 1.5 Hz, 1H), 5.65 (dd, *J* = 17.5, 1.5 Hz, 1H), 6.92 (dd, *J* = 17.5, 11.0 Hz, 1H), 7.11−7.48 (m, 4H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 28.3, 29.0, 33.8, 52.3, 53.3, 80.0, 115.9, 125.9, 126.6, 127.9, 129.4, 134.1, 136.5, 138.1, 155.4, 173.0; MS (CI, NH_3) *m*/*z* (rel intensity) 320 (M^+ + 1, 7), 220 (100); HRMS found for M^+ + 1, 320.1863. $C_{18}H_{26}NO_4$ requires 320.1862.

(31) Kelly, T. A.; McNeil, O. W. *Tetrahedron Lett.* **1994**, *35*, 9003−9006.

***tert*-Butyl 4-(4-{2-[(*tert*-Butoxycarbonyl)amino]-4-methoxy-4-oxobutyl}phenyl)-2-[(methoxycarbonyl)amino]butanoate (35).** Oxazolidine **19** (20 mg, 0.037 immol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **30** (stirring overnight) followed by treatment with diazomethane. Purification by column chromatography eluting with light petroleum−EtOAc (1:1) afforded **35** as a colorless oil (7 mg, 37%). R_f = 0.50 (light petroleum−EtOAc. 1:1); $[\alpha]_D$ −38.0 (*c* 0.3, $CHCl_3$); IR (NaCl) 3353, 2977, 1742, 1714, 1515, 1366 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.45 (s, 18H), 1.83−1.97 (m, 2H), 2.05−2.20 (m, 2H), 2.63 (app t, *J* = 8.0 Hz, 4H), 3.72 (s, 6H), 4.27−4.43 (m, 2H), 5.06 (br d, *J* = 9.0 Hz, 2H), 7.09 (s, 4H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 28.3, 31.2, 34.4, 52.3, 53.2, 79.9, 128.4, 138.5, 155.3, 173.1; MS (CI, NH_3) *m*/*z* (rel intensity) 509 (M^+ + 1, 4), 353 (100); HRMS found for M^+ + 1, 509.2868. $C_{26}H_{41}N_2O_8$ requires 509.2863).

Methyl (2*R*)-2-{[(Benzyloxy)carbonyl]amino}-4-phenylbutanoate (36). Oxazolidine **27** (16 mg, 0.47 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)diazomethane (2 M solution in hexanes, 47 μL, 94 μmol). Purification by column chromatography eluting with light petroleum−EtOAc (3:1) afforded **36** as a colorless oil (11 mg, 71%). $[\alpha]_D$ −16.5 (*c* 0.7. CH_2Cl_2), lit.[6d] (*ent*-**36**) $[\alpha]_D$ +14.4 (*c* 0.5. $CHCl_2$); ^1H NMR (270 MHz, $CDCl_3$) δ 1.95−2.07 (m, 1H), 2.14−2.27 (m, 1H), 2.69 (app t, *J* = 8.0 Hz, 2H), 3.72 (s, 3H), 4.40−4.52 (m, 1H), 5.15 (s, 2H), 5.48 (d, *J* = 8.0 Hz, 1H), 7.12−7.50 (m, 10H). The spectroscopic data were consistent with those reported.[6d]

Methyl (2*R*)-2-{[(Benzyloxy)carbonyl]amino}-4-(4-methoxyphenyl)butanoate (37). Oxazolidine **28** (45 mg, 0.12 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)diazomethane (2 M solution in hexanes, 0.24 mmol, 0.12 mL). Purification by column chromatography eluting with light petroleum−EtOAc (5:1) afforded **37** as a colorless oil (28 mg, 64%). R_f = 0.20 (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −19.7 (*c* 1.0, $CHCl_3$); IR (NaCl) 3346, 2953, 1723, 1715, 1513 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.85−2.08 (m, 1H), 2.10−2.25 (m, 1H), 2.61 (app t, *J* = 8.0 Hz, 2H), 3.72 (s, 3H), 3.78 (s, 3H), 4.28−4.48 (m, 1H), 5.13 (s, 2H), 5.33 (d, *J* = 7.5 Hz, 1H), 6.82 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 7.8 Hz, 2H), 7.22−7.42 (m, 5H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 30.5, 34.4, 52.4, 53.5, 55.2, 67.0, 113.9, 128.1, 128.2, 128.5, 129.3, 132.5, 136.2, 155.8, 158.0, 172.8; MS (CI, NH_3) *m*/*z* (rel intensity) 375 (M^+ + 1 + 17, 8), 358 (M^+ + 1, 13), 314 (100); HRMS found for M^+ + 1, 358.1644. $C_{20}H_{24}NO_5$ requires 358.1654.

Methyl (2*R*)-2-{[(Benzyloxy)carbonyl]amino}-4-(2-nitrophenyl)butanoate (38). Oxazolidine **29** (30 mg, 0.08 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)diazomethane (2 M solution in hexanes, 0.16 mmol, 0.08 mL). Purification by column chromatography eluting with light petroleum−EtOAc (3:1) afforded **38** as a colorless oil (18 mg, 62%). R_f = 0.24 (light petroleum−EtOAc, 2:1); $[\alpha]_D$ −42.9 (*c* 0.6, $CHCl_3$); IR (NaCl) 3345, 2953, 1723, 1525, 1456, 1349 cm^{-1}; ^1H NMR (270 MHz, DMSO-d_6) δ 1.88−2.13 (m, 2H), 2.90 (t, *J* = 7.5 Hz, 2H), 3.64 (s, 3H), 4.06−4.15 (m, 1H), 5.07 (s, 2H), 7.29−7.70 (m, 9H), 7.90 (d, *J* = 8.0 Hz, 1H); ^{13}C NMR (67.9 MHz, DMSO-d_6) δ 27.8, 31.3, 51.4, 53.3, 65.3, 123.8, 127.2, 127.3, 127.4, 127.9, 131.4, 132.7, 134.7, 136.6, 149.0, 155.6, 171.8; MS (CI, NH_3) *m*/*z* (rel intensity) 390 (M^+ + 1 + 17, 100), 373 (M^+ + 1, 41); HRMS found for M^+ + 1, 373.1394. $C_{19}H_{21}N_2O_6$ requires 373.1400.

(2*R*)-2-Amino-4-(4-methoxyphenyl)butanoic Acid Hydrochloride (39). To the protected amino acid **31** (27 mg, 0.084 mmol) and anisole (15 mg) was added 6 M HCl(aq) (1.5 mL), and the reaction was heated at 70 °C for 5 h under nitrogen. The reaction was diluted with H_2O (10 mL) and washed with EtOAc (2 × 10 mL), and the aqueous layer was azeotroped with PhMe (3 × 5 mL) in vacuo. The residue was triturated with Et_2O (1 mL) and the solvent was removed in vacuo affording **39** as a white solid (18 mg, 88%), mp 225 °C (dec); $[\alpha]_D$ −33.4 (*c* 0.7, 1 M HCl), lit.[21] $[\alpha]_D$ (*ent*-**39**) +34.6 (*c* 0.5, 1 M HCl); ^1H NMR (270 MHz, D_2O) δ 2.00−2.24 (m, 2H),

2.58−2.72 (m, 2H), 3.73 (s, 3H), 3.92 (app t, J = 6.5 Hz, 1H), 6.90 (d, J = 8.5 Hz, 2H), 7.18 (d, J = 8.5 Hz, 2H). The spectroscopic data were consistent with those reported. The melting point of this compound has not previously been reported.[21]

Methyl *2*-[(*tert*-Butoxycarbonyl)amino]-2-propenoate (44). Triethylamine (4.12 g, 40.7 mmol) was added to a stirred solution of alcohol **43**[26] (2.97 g, 13.6 mmol) and mesyl chloride (2.33 g, 20.3 mmol) in DCM (40 mL) at 0 °C under nitrogen, and the resulting solution was stirred at room temperature for 2 h. The reaction mixture was washed with sat. $NaHCO_3$-(aq) (40 mL) and dried, filtered, and concentrated in vacuo to give the crude product which was purified by column chromatography (light petroleum−EtOAc, 6:1) to give the title compound **44** as a colorless oil (2.18 g, 80%). ^{1}H NMR (270 MHz, $CDCl_3$) 1.47 (s, 9H), 3.82 (s, 3H), 5.71 (app d, J = 1.5 Hz, 1H), 6.15 (m, 1H), 7.01 (br s, 1H). The spectroscopic data were consistent with those reported.[32]

Methyl (2*Z*)-3-Bromo-2-[(*tert*-butoxycarbonyl)amino]-2-propenoate (45). NBS (0.55 g, 3.09 mmol) was added to a stirred solution of alkene **44**[32] (0.58 g, 2.89 mmol) in DCM (10 mL) under nitrogen at room temperature and stirred overnight. All volatile components were removed under reduced pressure. Hot hexane (20 mL) was added, and the solution was filtered and concentrated in vacuo to give a colorless oil. Triethylamine (585 mg, 5.78 mmol) was added to the product from above in DCM (10 mL). After 3 h at room temperature, the mixture was washed with H_2O (40 mL) and dried. Compound **45** was isolated after column chromatography (light petroleum−EtOAc, 6:1) as a colorless oil (687 mg, 85%). R_f = 0.29 (light petroleum−EtOAc, 3:1); IR (neat) 3336, 2978, 1720, 1481 cm^{-1}; ^{1}H NMR (270 MHz, $CDCl_3$) δ 1.48 (s, 9H), 3.82 (s, 3H), 6.14 (m, 1H), 6.87 (d, J = 1.0 Hz, 1H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 27.9, 52.6, 81.6, 109.2, 132.5, 151.8, 162.7; MS (CI, NH_3) m/z (rel intensity) 297 (M^++ 1 + 17, 75), 280 (M^+ + 1, 16), 49 (100); HRMS found for M^+ + 1 + 17, 297.0447. $C_9H_{18}NO_4{}^{79}Br$ requires 297.0450.

***tert*-Butyl (4*R*)-4-{(3*Z*)-4-[(*tert*-Butoxycarbonyl)amino]-5-methoxy-5-oxo-3-pentenyl}-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (46).** The title compound was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with **45** (0.43 g, 1.54 mmol, 1 equiv). Purification by column chromatography eluting with light petroleum−EtOAc (3:1) afforded **46** as a colorless oil (0.50 g, 76%). R_f = 0.19 (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −3.2 (*c* 1.1. $CHCl_3$); IR (NaCl) 3339, 2975, 2931, 1722, 1699, 1495, 1455, 1387, 1366, 1257, 1174 cm^{-1}; ^{1}H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.38 (s, 9H), 1.42 (s, 9H), 1.46 (s, 3H), 1.61 (s, 3H), 1.56−1.92 (m, 2H), 2.15 (app q, J = 7.5 Hz, 2H), 3.39 (s, 3H), 3.48−3.55 (m, 1H), 3.62−3.79 (m, 2H), 5.85−5.91 (s, 1H), 6.49 (t, J = 7.5 Hz, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.0, 26.3, 28.4, 29.2, 29.5, 33.6, 52.4, 58.3, 68.3, 80.3, 80.8, 94.8, 128.1, 136.2, 153.0, 154.2, 166.0; MS (CI, NH_3) m/z (rel intensity) 429 (M^+ + 1, 1), 55 (100): HRMS found for M^+ + 1, 429.2605. $C_{21}H_{37}N_2O_7$ requires 429.2601.

***tert*-Butyl (4*R*)-4-{(4*S*)-4-[(*tert*-Butoxycarbonyl)amino]-5-methoxy-5-oxopentenyl}-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (47).** A reaction vessel for a Parr hydrogenation apparatus was charged with dehydroamino acid derivative **46** (75 mg, 0.18 mmol) in degassed PhMe (1 mL) and (+)-1,2-bis((2*S*,5*S*)-2,5-diethylphospholano)benzene(cyclooctadiene)rhodium(I) trifluoromethanesulfonate (Strem, 1 mg, 1.38 μmol). The vessel was connected to the Parr apparatus and shaken under hydrogen (250 psi) at 40 °C for 6 h. The reaction mixture was concentrated in vacuo, and the residue purified by column chromatography (light petroleum−EtOAc, 3:1) to give **47** as a colorless oil (71 mg, 94%). R_f = 0.19 (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −4.6 (*c* 2.3, $CHCl_3$); IR (NaCl) 3383, 2980, 2935, 2870, 1747, 1716, 1697 cm^{-1}; ^{1}H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.12−1.64 (m, 6H), 1.37 (s, 9H), 1.38 (s, 9H), 1.42 (m, 3H), 1.55 (s, 3H), 3.32 (s, 3H), 3.37−3.44 (m, 1H), 3.57−3.68 (m, 2H), 4.21−4.32 (m, 1H), 4.80−4.92 (m, 1H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 23.4, 25.2, 28.5, 29.5, 29.6, 34.0, 34.8, 52.4, 55.1, 58.6, 68.4, 80.3 (× 2), 94.8, 153.1, 156.4, 173.9; MS (CI, NH_3) m/z (rel intensity) 431 (M^+ + 1, 4). 331 (100); HRMS found for M^+ + 1, 431.2760. $C_{21}H_{39}N_2O_7$ requires 431.2757.

Methyl (2*S*,6*R*)-2,6-Bis[(*tert*-butoxycarbonyl)amino]-7-hydroxyheptanoate (48). Trifluoroacetic acid (212 mg, 1.86 mmol) was added to oxazolidine **47** (40 mg, 93 μmol) in anhydrous MeOH (1.5 mL) at 0 °C under nitrogen. The reaction mixture was closely monitored by TLC and after 1 h was concentrated in vacuo. Purification by column chromatography (light petroleum−EtOAc. 1:1) gave **48** as a colorless oil (32 mg, 88%). R_f = 0.16 (light petroleum−EtOAc, 1:1); $[\alpha]_D$ +10.6 (*c* 0.4, $CHCl_3$): IR (NaCl) 3356, 2978, 2933, 2870, 1741, 1695, 1524, 1456, 1367, 1167 cm^{-1}: ^{1}H NMR (270 MHz, $CDCl_3$) δ 1.43 (s, 18H), 1.33−1.87 (m, 6H), 3.06 (br s, 1H), 3.52−3.65 (m, 3H), 3.73 (s, 3H), 4.25−4.34 (m, 1H), 4.94 (d, J = 5.8 Hz, 1H), 5.19 (d, J = 8.0 Hz, 1H): ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 21.4. 28.3, 28.4, 30.2, 33.0, 52.2, 52.3, 52.4, 64.4, 79.6, 80.2, 155.8, 156.4, 173.2; MS (CI, NH_3) m/z (rel intensity) 391 (M^+ + 1, 6), 217 (100); HRMS found for M^+ + 1, 391.2437. $C_{18}H_{35}N_2O_7$ requires 391.2444.

Dimethyl (2*R*,6*S*)-2,6-Bis[(*tert*-butoxycarbonyl)amino]-heptanedioate (49). Method A. Pyridinium dichromate (347 mg. 0.92 mmol) was added to alcohol **48** (36 mg, 92 μmol) in anhydrous DMF (1.5 mL) at room temperature under nitrogen. After stirring the reaction overnight, water (20 mL) was added and the mixture was extracted with DCM (3 × 20 mL). The organic layer was washed with brine (20 mL) and H_2O (2 × 20 mL) and then dried, filtered, and concentrated in vacuo to give the crude product which was esterified with (trimethylsilyl)diazomethane using the procedure as outlined for **32**. Column chromatography (light petroleum−EtOAc, 3:1) gave **49** as a colorless oil (29 mg, 75%). R_f = 0.20 (light petroleum−EtOAc, 3:1); IR (NaCl) 3356, 2978, 2954, 2870, 1747, 1714, 1687, 1529 cm^{-1}: ^{1}H NMR (270 MHz, CDC1$_3$) δ 1.25−1.92 (m, 6H), 1.44 (s, 18H), 3.74 (s, 6H), 4.20−4.37 (m, 2H), 5.09 (d, J = 7.5 Hz, 2H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 21.1, 28.3, 32.2, 52.3, 53.0, 79.9, 155.4, 173.0; MS (CI, NH_3) m/z (rel intensity) 436 (M^+ + 1 + 17, 100), 419 (M^+ + 1, 15); HRMS found for M^+ + 1 + 17, 436.2658. $C_{19}H_{38}N_3O_8$ requires 436.2659.

Method B. Oxazolidine **47** (18 mg, 41.9 mmol) was treated with 1 M Jones reagent according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)diazomethane. Purification by column chromatography eluting with light petroleum−EtOAc (3:1) afforded **49** as a colorless oil (7 mg, 40%) with spectral data identical to the product from method A.

***meso*-(2*R*,6*S*)-2,6-Diaminopimelic Acid (40).** A stirred mixture of diester **49** (9 mg, 22 μmol) and 5 M HCl (2 mL) was heated at 70 °C for 3 h. The volatile components were removed in vacuo. The crude product was dissolved in EtOH (1 mL) and treated with propylene oxide (12 mg, 0.42 mmol) and stirred for 10 h at room temperture during which time the product crystallized from solution. The white precipitate was filtered and then recrystallized (H_2O−EtOH) to give **40** as a white solid (4 mg, 98%). mp > 300 °C (dec), lit.[22b] mp > 300 °C (dec); ^{1}H NMR (270 MHz, D_2O) δ 1.45−1.60 (m, 1H), 1.60−1.75 (m, 1H), 1.88−2.12 (m, 4H), 4.02 (t, J = 5.8 Hz, 2H); ^{13}C NMR (67.9 MHz, D_2O) δ 20.9, 29.9, 53.5, 172.9. The spectroscopic data were consistent with those reported.[22b]

***tert*-Butyl (4*R*)-4-{(4*R*)-4-[(*tert*-Butoxycarbonyl)amino]-5-methoxy-5-oxopentenyl}-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (50).** A reaction vessel for a Parr hydrogenation apparatus was charged with dehydroamino acid derivative **46** (134 mg, 0.31 mmol) in degassed PhMe (1.5 mL) and (−)-1,2-bis((2*R*,5*R*)-2,5-diethylphospholano)benzene(cyclooctadiene)-rhodium(I) trifluoromethanesulfonate (Strem, 1 mg, 1.38 μmol). The vessel was connected to the Parr apparatus and shaken under hydrogen (250 psi) at 40 °C overnight. The reaction mixture was concentrated in vacuo and the residue purified by column chromatography (light petroleum−EtOAc, 3:1) to give **50** as a colorless oil (129 mg, 96%). R_f = 0.19 (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −19.3 (*c* 0.9, $CHCl_3$); IR (NaCl)

(32) Ferreira, P. M. T.; Maia, H. L. S.; Monteiro, L. S.; Sacramento *J. Chem. Soc., Perkin Trans. 1* **1999**, 3697−3704.

3373, 2977, 2936, 2868, 1746, 1699 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.12−1.64 (m, 6H), 1.36 (s, 9H), 1.37 (s, 9H), 1.41 (s, 3H), 1.55 (s, 3H), 3.33 (s, 3H), 3.35−3.44 (m, 1H), 3.55−3.70 (m, 2H), 4.19−4.31 (m, 1H), 4.90−5.00 (m, 1H): ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 23.4, 25.2, 28.5, 29.5, 29.6, 33.8, 34.8, 52.4, 55.2, 58.4, 68.4, 80.3 (× 2), 94.8, 153.1, 156.4, 174.0; MS (CI, NH_3) *m/2* (rel intensity) 431 ($M^+ + 1$. 33), 331 (100); HRMS found for $M^+ + 1$, 431.2755. $C_{21}H_{39}N_2O_7$ requires 431.2757.

Methyl (2*R*,6*R*)-2,6-Bis[(*tert*-Butoxycarbonyl)amino]-7-hydroxyheptanoate (51). Trifluoroacetic acid (626 mg, 5.49 mmol) was added to oxazolidine **50** (118 mg, 0.27 mmol) in anhydrous MeOH (2 mL) at 0 °C under nitrogen. The reaction mixture was closely monitored by TLC and after 1 h was concentrated in vacuo. Purification by column chromatography (light petroleum−EtOAc, 1:1) gave **51** as a colorless oil (93 mg, 87%). $R_f = 0.18$ (light petroleum−EtOAc, 1:1); $[\alpha]_D$ +5.1 (*c* 3.4, $CHCl_3$); IR (NaCl) 3372, 2979, 2934, 2870, 1745, 1699, 1520, 1456, 1367, 1170 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.44 (s, 18H), 1.33−1.86 (m, 6H), 2.45 (br s, 1H), 3.52−3.69 (m, 3H), 3.73 (s, 3H), 4.22−4.38 (m, 1H), 4.72−4.85 (m, 1H), 5.15 (d, *J* = 6.8 Hz, 1H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 21.7, 28.2, 28.3, 30.7, 32.3, 51.9, 52.1, 53.0, 65.7, 79.4, 79.8, 155.6, 156.5, 173.3; MS (Cl, NH_3) *m/z* (rel intensity) 391 ($M^+ + 1$, 18), 217 (100): HRMS found for $M^+ + 1$, 391.2444. $C_{18}H_{35}N_2O_7$ requires 391.2444.

Dimethyl (2*R*,6*R*)-2,6-Bis[(*tert*-butoxycarbonyl)amino]-heptanedioate (52). Pyridinium dichromate (579 mg, 1.54 mmol) was added to alcohol **51** (60 mg, 0.15 mmol) in anhydrous DMF (3 mL) at room temperature under nitrogen. After stirring the reaction overnight, H_2O (20 mL) was added and the mixture was extracted with DCM (3 × 20 mL). The organic layer was washed with brine (20 mL) and H_2O (2 × 20 mL) and then dried, filtered, and concentrated in vacuo to give the crude product which was esterified with (trimethylsilyl)diazomethane using the procedure as outlined for **32.** Column chromatography (light petroleum−EtOAc, 3:1) gave **52** as a colorless oil (50 mg, 78%). $R_f = 0.19$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −8.6 (*c* 0.4, $CHCl_3$); IR (NaCl) 3371, 2976, 2935, 1738, 1721, 1712, 1693, 1514 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.44 (s, 18H), 1.35−1.52 (m, 2H), 1.54−1.89 (m, 4H), 3.73 (s, 6H), 4.21−4.42 (m, 2H), 5.12 (m, 2H); ^{13}C NMR (67.9 MHz, $CDCl_3$) 21.3, 28.3, 32.1, 52.2, 52.9, 79.8, 155.5, 173.2; MS (CI, NH_3) *m/z* (rel intensity) 436 ($M^+ + 1 + 17$, 1), 419 ($M^+ + 1$, 6), 219 (100); HRMS found for $M^+ + 1$, 419.2391. $C_{19}H_{35}N_2O_8$ requires 419.2393.

(2*R*,6*R*)-2,6-Diaminopimelic Acid (41). A stirred mixture of diester **52** (37 mg, 88 μmol) and 5 M HCI (2 mL) was heated at 70 °C for 3 h. The volatile components were removed in vacuo. The crude product was dissolved in EtOH (1.6 mL) and treated with propylene oxide (103 mg, 1.77 mmol) and stirred for 10 h at room temperature during which time the product crystallized from solution. The white precipitate was filtered and then recrystallized (H_2O−EtOH) to give **41** as a white solid (16 mg, 95%), mp 308−310 °C (dec), lit.[22f] mp 309−312 °C; $[\alpha]^{25}_D$ −20.2 (*c* 1.0, H_2O), lit.[29] (*ent*-**41**) $[\alpha]^{25}_D$ +20.0 (*c* 0.5, H_2O); ^1H NMR (270 MHz, D_2O) δ 1.42−1.58 (m, 2H), 1.88−2.00 (m, 4H), 3.89 (t, *J* = 5.8 Hz, 2H); ^{13}C NMR (67.9 MHz, D_2O) δ 20.6, 30.2, 54.1, 173.8. The ^1H NMR spectroscopic data were consistent with those reported.[29]

Benzyl (4*S*)-4-[(*E*)-2-Iodoethenyl]-2,2-dimethyl-1,3-oxazolidine-3-carboxylate (53). To freshly opened $CrCl_2$ (5 g, 40.7 mmol) in THF (40 mL) at −78 °C in a foil-covered flask were added freshly prepared aldehyde **24** (1.78 g, 6.75 mmol) and iodoform (5.30 g, 13.5 mmol) in THF (30 mL) under nitrogen. The reaction was warmed to 0 °C, stirred for 1 h followed by warming to room temperature, and stirred for a further 2 h. The reaction was quenched with sat. NH_4Cl(aq) (40 mL) followed by dilution with Et_2O (80 mL). The aqueous layer was re-extracted with Et_2O (50 mL), and the combined organic layers were dried, filtered, and concentrated in vacuo to give the crude product which was purified by column chromatography (light petroleum−EtOAc, 9:1) to give **53** as a white solid (1.47 g, 56%). mp (light petroleum) 50−51 °C; R_f = 0.25 (light petroleum−EtOAc, 5:1); $[\alpha]_D$ −102 (*c* 0.9, $CHCl_3$); IR (NaCl) 2952, 1706, 1405, 1347, 1254, 1237, 1090 cm^{-1}; ^1H NMR (270 MHz, DMSO-d_6, 80 °C) δ 1.45 (s, 3H), 1.52 (s, 3H), 3.80 (dd, *J* = 9.2, 2.2 Hz, 1H), 4.02 (dd, *J* = 9.2, 6.3 Hz, 1H), 4.41-4.46 (m, 1H), 5.03 (d, *J* = 12.5 Hz, 1H), 5.15 (d, *J* = 12.5 Hz, 1H), 6.38 (d, *J* = 14.5 Hz, 1H), 6.54 (dd, *J* = 14.5, 6.8 Hz, 1H), 7.32−7.48 (m, 5H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.0, 27.8, 62.3, 68.0, 68.4, 79.6, 95.6, 129.2, 129.4, 129.7, 138.1, 145.6, 153.2; MS (CI, NH_3) *m/z* (rel intensity) 405 ($M^+ + 1 + 17$, 24), 388 ($M^+ + 1$, 30), 330 (100); HRMS found for $M^+ + 1$, 388.0408. $C_{15}H_{19}NO_3I$ requires 388.0410.

***tert*-Butyl (4*R*)-2,2-Dimethyl-4-{(3*E*)-4-[(4*R*)-{2,2-dimethyl-3-([{benzyloxy}carbonyl]amino)}-1,3-oxazolidin-4-yl]-3-butenyl}-1,3-oxazolidine-3-carboxylate (54).** The title compound was prepared according to the general hydroboration−Suzuki coupling procedure outlined above by reaction with iodide **53** (186 mg, 0.481 mmol, 1 equiv). Purification by column chromatography, eluting with light petroleum−EtOAc (5:1), afforded **54** as a colorless oil (157 mg, 67%). $R_f = 0.30$ (light petroleum−EtOAc. 3:1); $[\alpha]_D$ −30.0 (*c* 1.0, $CHCl_3$); IR (NaCl) 2981, 2935, 2871, 1695, 1390, 1365, 1348, 1255 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.40 (s, 9H), 1.47 (s, 3H), 1.50 (s, 3H), 1.61 (s, 3H), 1.65 (s, 3H), 1.20−1.41 (m, 2H), 1.84−1.92 (m, 2H), 3.44−3.53 (m, 2H), 3.61−3.75 (m, 3H), 4.17−4.22 (m, 1H), 4.97 (d, *J* = 12.6 Hz, 1H), 5.11 (d, *J* = 12.6 Hz, 1H), 5.39−5.59 (m, 2H), 6.95−7.23 (m, 5H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.3 (× 2), 28.0, 28.5, 29.6, 30.2, 34.4, 58.6, 60.5, 67.7, 68.3, 69.9, 80.3, 94.8, 95.5, 129.0, 129.3, 129.6, 131.2, 133.2, 138.8, 153.1, 153.6; MS (CI, NH_3) *m/z* (rel intensity) 489 ($M^+ + 1$, 35), 389 (100); HRMS found for $M^+ + 1$, 489.2966. $C_{27}H_{41}N_2O_6$ requires 489.2965.

***tert*-Butyl (4*R*)-2,2-Dimethyl-4-{(3*E*)-4-[(4*R*)-{2,2-dimethyl-3-([[benzyloxy}carbonyl]amino)}-1,3-oxazolidin-4-yl]butyl}-1,3-oxazolidine-3-carboxylate (55).** To alkene **54** (123 mg, 0.25 mmol) in DCM (2.5 mL) were added triethylamine (64 mg, 0.63 mmol) and 2,4.6-triisopropylbenzenesulfonyl hydrazide (376 mg, 1.26 mmol) at room temperature under nitrogen, and the mixture was stirred for 1 day. Saturated NH_4Cl(aq) (20 mL) was added and the mixture extracted with DCM (2 × 20 mL). The organic layer was dried, filtered, and concentrated in vacuo to give the crude product which was purified by column chromatography, eluting with light petroleum−EtOAc (6:1), to give **55** as a colorless oil (102 mg, 83%). R_f = 0.30 (light petroleum−EtOAc. 3:1); $[\alpha]_D$ −36.8 (*c* 1.6. $CHC1_3$); IR (NaCl) 2982, 2939, 2874, 1698, 1392, 1258, 1090 cm^{-1}; ^1H NMR (270 MHz, $C_6D_5CD_3$, 80 °C) δ 1.08−1.23 (m, 4H), 1.41 (s, 9H), 1.49 (s, 6H), 1.63 (s, 6H), 1.60−1.79 (m, 4H), 3.44−3.55 (m, 2H), 3.61−3.79 (m, 4H), 5.00 (d, *J* = 12.4 Hz, 1H), 5.09 (d, *J* = 12.4 Hz, 1H), 6.95−7.25 (m, 5H); ^{13}C NMR (67.9 MHz, $C_6D_5CD_3$, 80 °C) δ 25.3 (× 2), 27.4 (× 2), 28.2, 28.5, 29.6, 35.0 (× 2), 58.9 (× 2), 67.8, 68.4, 68.5, 80.2, 94.8, 95.2, 129.1, 129.4, 129.6, 138.5, 153.1, 153.6; MS (CI, NH_3) *m/z* (rel intensity) 491 ($M^+ + 1$, 6), 391 (100); HRMS found for $M^+ + 1$, 491.3112. $C_{27}H_{43}N_2O_6$ requires 491.3121.

Dimethyl (2*R*,7*R*)-2-{[(Benzyloxy))carbonyl]amino}-7-[(*tert*-butoxycarbonyl)amino}octanedioate (56). Oxazolidine **55** (90 mg, 0.18 mmol) was treated with 1 M Jones reagent (12 equiv) according to the general procedure outlined for ester **32** followed by treatment with (trimethylsilyl)-diazomethane. Purification by column chromatography eluting with light petroleum−EtOAc (3:1) afforded **56** as a colorless oil (42 mg, 49%). $R_f = 0.13$ (light petroleum−EtOAc, 3:1); $[\alpha]_D$ −19.1 (*c* 1.1, $CHCl_3$); IR (NaCl) 3354, 2953, 2864, 1714, 1518, 1454 cm^{-1}; ^1H NMR (270 MHz, $CDCl_3$) δ 1.28−1.40 (m, 4H), 1.43 (s, 9H), 1.55−1.88 (m, 4H), 3.72 (s, 3H), 3.73 (s, 3H), 4.24−4.40 (m, 2H), 5.04 (d, *J* = 8.3 Hz, 1H), 5.10 (s, 2H), 5.36 (d, *J* = 8.0 Hz, 1H), 7.30−7.40 (m, 5H); ^{13}C NMR (67.9 MHz, $CDCl_3$) δ 24.8, 25.0, 28.4, 32.6 (× 2), 52.4, 52.5, 53.3, 53.8, 67.1, 80.0, 128.2, 128.3, 128.7, 136.3. 155.5, 156.0, 173.0, 173.4: MS (FAB) *m/z* (rel intensity) 489 (M + Na, 100); HRMS found for M + Na, 489.2213. $C_{23}H_{34}N_2O_6Na$ requires 489.2213.

(2*R*,7*R*)-2,7-Diaminosuberic Acid (42). A stirred mixture of diester **56** (22 mg, 47 μmol) and 5 M HCI (2 mL) was heated at 100 °C overnight. The volatile components were removed in vacuo. The crude product was dissolved in EtOH (1.5 mL) and treated with propylene oxide (55 mg, 0.94 mmol) and

stirred for 10 h at room temperature during which time the product crystallized from solution. The white precipitatewas filtered and then recrystallized (H_2O−EtOH) to give **42** as a white solid (8.8 mg, 91%), mp 308 °C (dec); $[\alpha]^{25}_D$ −24.5 (*c* 0.1, H_2O), lit.[29] (*ent*-**42**) $[\alpha]^{25}_D$ +24.8 (*c* 0.25, H_2O); ^{1}H NMR (500 MHz, D_2O) δ 1.38−1.54 (m, 4H), 1.85−2.00 (m, 4H), 4.01 (t, J = 6.1 Hz, 2H); ^{13}C NMR (125 MHz, D_2O) δ 23.7, 29.2, 52.8, 172.2. The spectroscopic data were consistent with those reported.[25h] The melting point of this compound has not previously been reported.

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Supporting Information Available: ^{1}H NMR spectra of **8b**, **10**, **12**, **14**, **15**, **17**−**19**, **23**, **25**, **27**−**29**, **33**, **35**, **38**, **46**−**48**, **51**, **53**−**55**; ^{13}C NMR spectra of **13**, **20**, **31**, **32**, **34**, **37**, **41**, **42**, **45**, **49**, **50**, **52**, **56**. This material is available free of charge via the Internet at http://pubs.acs.org.

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