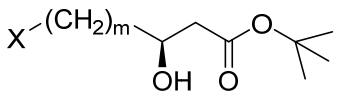
WHAT IS CLAIMED IS:

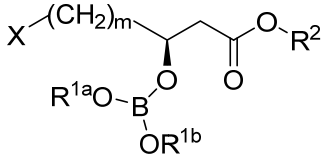
1. A compound having the structure of Formula (I):



(I)

wherein X is Cl and m is 2.

2. A compound having the structure of Formula (II):



(II)

or a salt thereof, wherein:

X is a halogen,

m is an integer between 2 and 6,

each of R^{1a} and R^{1b} is independently selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl, or

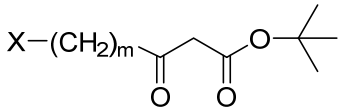
R^{1a} and R^{1b} together with intervening atoms optionally form a 5-7 membered boron ester ring, and

R^2 is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl.

3. The compound of claim 2, wherein X is Cl and each of R^{1a} and R^{1b} are a butyl group.

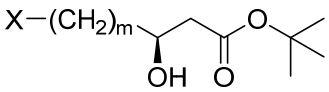
4. A method of making a compound of Formula (B), comprising the steps of:

reducing the ketone group of a compound of Formula (A):



(A)

to form a compound of Formula (B):



(B)

wherein:

X is Cl,

m is 2,

the ketone group in the compound of Formula (A) is reduced with an alcohol dehydrogenase system,

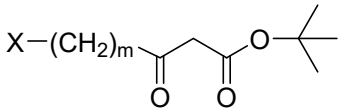
the alcohol dehydrogenase system comprises a reduced nicotinamide adenine dinucleotide (NADH), a reduced nicotinamide adenine dinucleotide phosphate (NADPH), and an alcohol,

the alcohol is isopropyl alcohol, and

wherein the reduction is performed at pH 6.

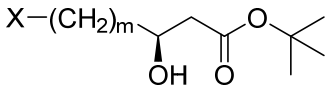
5. A method of making a compound of Formula (B), comprising the steps of:

reducing the ketone group of a compound of Formula (A):



(A)

to form a compound of Formula (B):



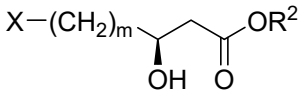
(B)

wherein:

the ketone group in the compound of Formula (A) is reduced using $Ru(OAc)_2$((R)-SegPhos) and methanol.

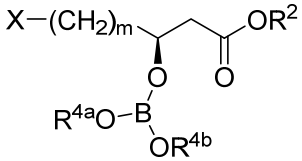
6. A method of making a compound of Formula (C), comprising:

reacting a boronate compound $B(OR^{4a})(OR^{4b})(OR^{4c})$ with a compound of Formula (B-1):



(B-1)

to form the compound of Formula (C):



(C)

wherein:

X is a halogen;

m is an integer between 2 and 6;

R^2 is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl;

R^{4a} and R^{4b} are independently selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl, or

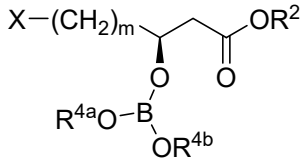
R^{4a} and R^{4b} together with intervening atoms optionally form a 5-8 membered boron ester ring; and

R^{4c} is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl.

7. The method of claim 6, wherein X is Cl, m is 2, and R^2, R^{4a}, and R^{4b} are each independently a butyl group.

8. A method of making a compound of Formula (D), comprising:

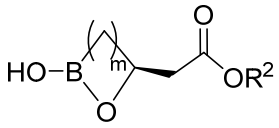
reacting magnesium with a compound of Formula (C):



(C)

to form a first reaction intermediate; and

hydrolyzing the first reaction intermediate to form the compound of Formula (D):



(D)

wherein:

X is a halogen,

m is an integer between 2 and 6, and

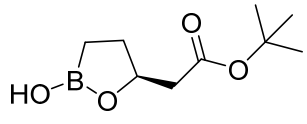
R^2 is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl, and

each of R^{4a} and R^{4b} are independently selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl, or

R^{4a} and R^{4b} together with intervening atoms optionally form a 5-8 membered boron ester ring.

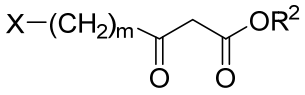
9. The method of claim 8, wherein X is Cl, m is 2, and R^2, R^{4a}, and R^{4b} are independently a butyl group.

10. The method of claim 8, wherein the compound of Formula (D)

is  .

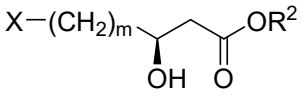
11. A method of making a compound of Formula (E), comprising

reducing the ketone group of a keto-ester compound of Formula (A-1):



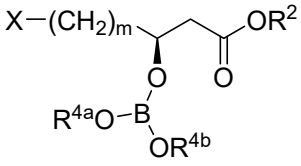
(A-1)

to form a compound of Formula (B-1):

 ;

(B-1)

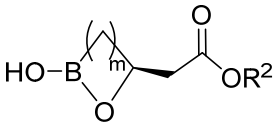
reacting a boronate compound $B(OR^{4a})(OR^{4b})(OR^{4c})$ with the compound of Formula (B) to form a compound of Formula (C):

 ;

(C)

reacting magnesium with the compound of Formula (C) to form a first reaction intermediate:

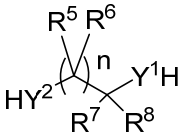
hydrolyzing the first reaction intermediate to form a compound of Formula (D):



; and

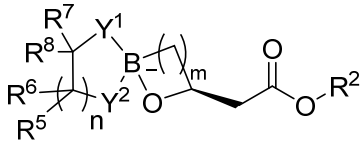
(D)

reacting the compound of Formula (D) with a complexing agent of Formula (CL):



(CL)

to form the compound of Formula (E):



(E)

wherein:

X is a halogen,

m is an integer between 2 and 6,

n is an integer between 0 and 6,

Y^1 is O or $N^+R^9R^{10}$,

Y^2 is O or NR^{11};

R^2 is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl;

each R^5 and R^6 are independently selected from the group consisting of H, optionally substituted phenyl, and optionally substituted C_{1-4} alkyl, or R^5 and R^6 together with the atom to which they are attached, form =O;

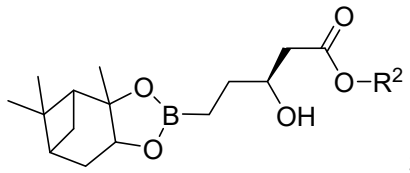
each R^7 and R^8 are independently selected from the group consisting of H, optionally substituted phenyl, and optionally substituted C_{1-4} alkyl, or R^5 and R^7 together with the atom to which they are attached form an aryl or heteroaryl ring; or R^7 and R^8 together with the atom to which they are attached, form =O; and

each R^9, R^{10}, and R^{11} are independently selected from the group consisting of H, optionally substituted phenyl, and optionally substituted C_{1-4} alkyl.

12. The method of claim 11, wherein X is Cl, m is 2, and R^2 is a butyl group.

13. The method of claim 11, wherein the complexing agent of Formula (CL) is $NH_2(CH_2)_2OH$.

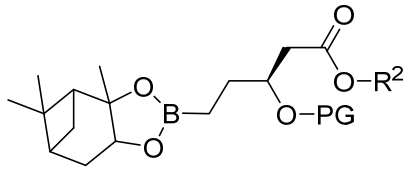
14. The method of claim 11, further comprising reacting the compound of Formula (E) with pinanediol to form a compound of Formula (F):



;

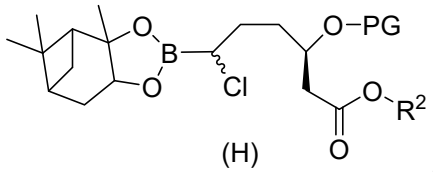
(F)

protecting the hydroxy group of the compound of Formula (F) with a PG group to form a compound of Formula (G):



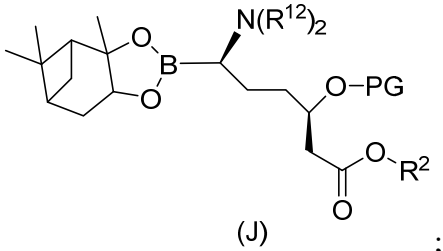
(G) ;

reacting the compound of Formula (G) with n-butyllithium and dichloromethane to form a compound of Formula (H):



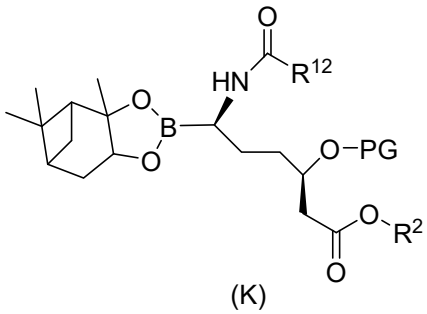
(H) ;

reacting the compound of Formula (H) with an $LiN(SiR^{12})_2$ to form a compound of Formula (J):



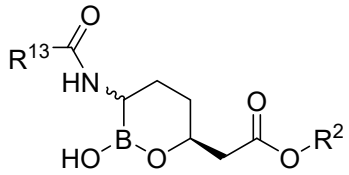
(J) ;

reacting the compound of Formula (J) with R^{13}-COCl to form a compound of Formula (K):



(K) ; and

removing the PG group on the compound of formula (K) to form a compound of formula (L):



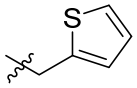
(L)

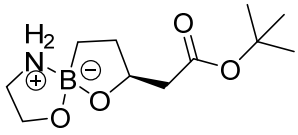
wherein:

PG is a hydroxy protection group,

R^{12} is optionally substituted phenyl or optionally substituted C_{1-8} alkyl, and

R^{13} is selected from optionally substituted C_{1-8} alkyl, optionally substituted C_{0-4} alkyl–C_{6-10} aryl, optionally substituted C_{0-4} alkyl–5-10 membered heteroaryl, optionally substituted C_{0-4} alkyl–C_{3-10} carbocyclyl, and C_{0-4} alkyl–4-10 membered heterocyclyl.

15. The method of any one of claims 14 and 16-19, wherein R^{13} is .

16. The compound of claim 11, wherein the compound of Formula (E) is .

17. The method of claim 14, wherein the compound of Formula (G) reacts with the n-butyllithium and dichloromethane at a temperature lower than -90˚C to form the compound of Formula (H).

18. The method of claim 14 or 17, wherein the PG group is a *tert*-Butyldimethylsilyl group.

19. The method of any one of claims 14 and 17-18, wherein R^2 is t-butyl group.

20. The method of any one of claims 8 to 10, further comprising mixing $ZnCl_2$ with magnesium and reacting with the compound of Formula (C).