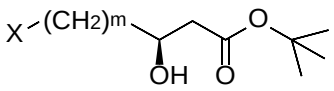
WHAT IS CLAIMED IS:

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

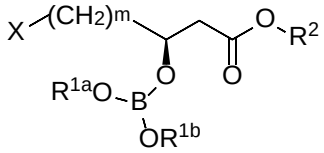


(I)

wherein X is a halogen and m is an integer between 2 and 6.

2. The compound of claim 1, wherein X is Cl and m is 2.

3. 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

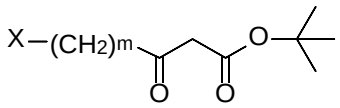
R^{1a} and R^{1b} together with intervening atoms optionally form a 5-7 membered boron ester ring, and

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.

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

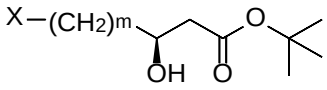
5. A method of making a compound of Formula (B), comprising the steps of:

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



(A)

to form a compound of Formula (B):



(B)

wherein:

X is a halogen, and

m is 2 to 6.

6. The method of claim 5, wherein X is Cl and m is 2.

7. The method of claim 5, wherein the ketone group in the compound of Formula (A) is reduced using a Ruthenium based catalyst.

8. The method of claim 7, wherein the Ruthenium based catalyst has the structure of Formula (III):

$$R^3Ru(X^1)_2$$

(III),

wherein:

X^1 is a halogen, benzene, cymene, or an acetyl (OAc) group; and

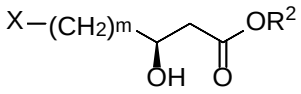
R^3 is a ligand selected from the group consisting of (S)-BINA, (R)-BINAP, (R)-H_8-BINAP, (R)-SegPhos, (R)-DM-SegPhos, (S)-SegPhos, (R)-tolyl-BINAP, (R)-xylyl-BINAP, (S)-tolyl-BINAP, (S)-BINAPHANE, (S)-PhanePhos, JosiPhos-2-1, (R)-SolPhos SL-A001-1, (S)-MeOBiPhep, (*S*)-P-Phos, and (S)-(+)-DTBM-SEGPHOS.

9. The method of claim 5, comprising reducing the ketone group in the compound of Formula (A) with an alcohol dehydrogenase system.

10. The method of claim 9, wherein the alcohol dehydrogenase system comprises a reduced nicotinamide adenine dinucleotide (NADH), a reduced nicotinamide adenine dinucleotide phosphate (NADPH), and an alcohol.

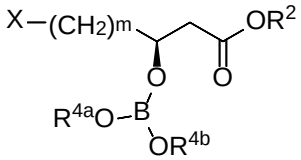
11. A method of making a compound of Formula (C), comprising:

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

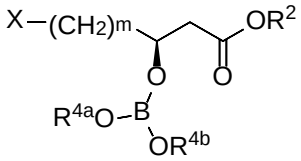
R^{4a} and R^{4b} together with intervening atoms optionally form a 5-8 membered boron ester ring; and

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.

12. The method of claim 11, wherein X is Cl, m is 2, and R^2, R^{4a}, and R^{4b} are each independently a butyl group.

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

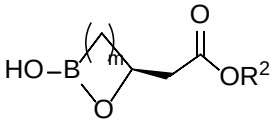
reacting magnesium with a compound of Formula (C):



(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

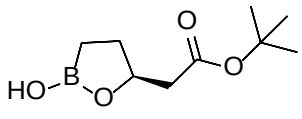
R^2 is selected from the group consisting of an optionally substituted C_1-C_{12} alkyl, optionally substituted C_3-C_8 cycloalkyl, optionally substituted C_2-C_{12} alkenyl, optionally substituted C_2-C_{12} alkynyl, optionally substituted aryl, and optionally substituted heteroaryl, and

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.

14. The method of claim 13, wherein X is Cl, m is 2, and R^2, R^{4a}, and R^{4b} are independently a butyl group.

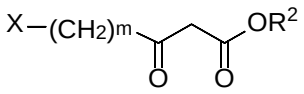
15. The method of claim 13, wherein the compound of Formula (D)

is 

.

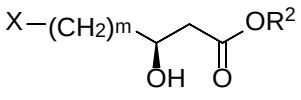
16. A method of making a compound of Formula (E), comprising

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



(A-1)

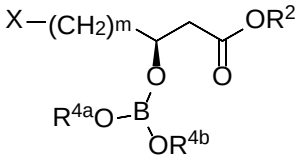
to form a compound of Formula (B-1):



;

(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):

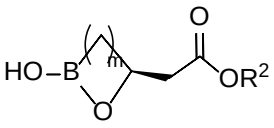


;

(C)

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

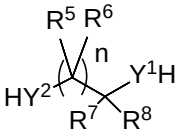
hydrolyzing the first reaction intermediate to form a compound of Formula (D):



; and

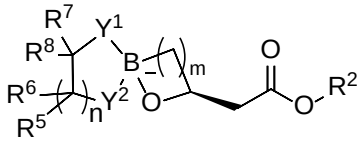
(D)

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;

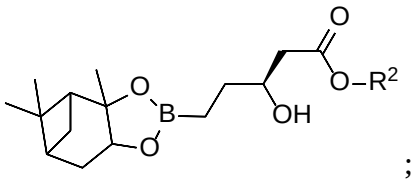
each R^7 and R^8 are independently selected from the group consisting of H, optionally substituted phenyl, and optionally substituted C_{1-4} alkyl, or R^5 and R^7 together with the atom to which they are attached form an aryl or heteroaryl ring; or R^7 and R^8 together with the atom to which they are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

17. The method of claim 16, wherein X is Cl, m is 2, and R^2 is a butyl group.

18. The method of claim 16, wherein the complexing agent of Formula (CL) is $NH_2(CH_2)_2OH$.

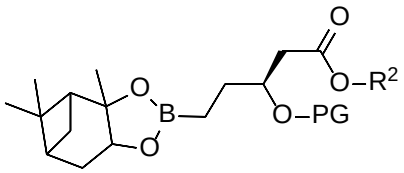
19. The method of claim 16, further comprising reacting the compound of Formula (E) with pinanediol to form a compound of Formula (F):



;

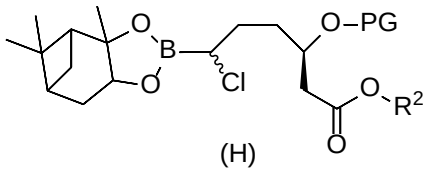
(F)

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



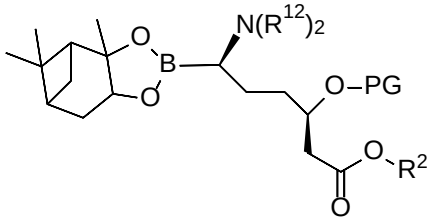
(G) ;

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



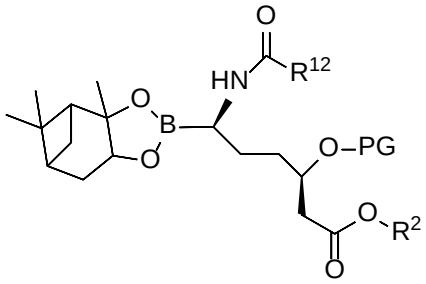
(H) ;

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



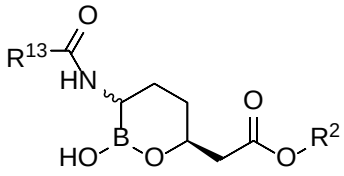
(J) ;

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):



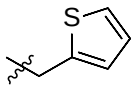
(L)

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.

20. The method of claim 19, wherein R^{13} is .