Claims

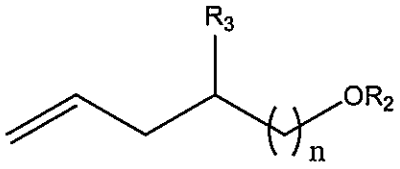
1. A method of forming a macrocyclic musk compound comprising the steps of:-

   i) cross-metathesizing a first terminal olefin and a second terminal olefin in the presence of a homogeneous transition metal catalyst comprising an alkylidene ligand, to form a statistical mixture of a hetero-dimer intermediate of said first and second terminal olefin, and homo-dimers

   ii) separating the hetero-dimer from the statistical mixture of hetero- and homo-dimers

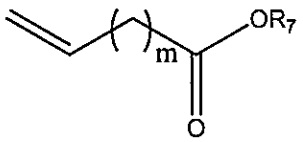
   iii) and cyclizing the hetero-dimer intermediate to form the macrocyclic musk compound.

2. A method according to claim 1 wherein the first olefin has the formula (I)



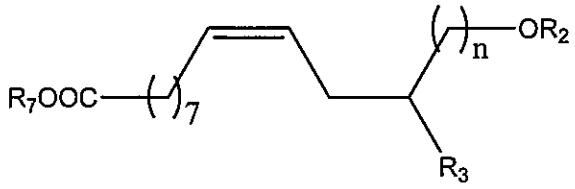
wherein OR_2 is a protected hydroxyl group, which may be selected from an alkyl ether group; an ester group; a silyl ether group; or a carbonate group; R_3 is H or methyl; and n is an integer from 1-8.

3. A method according to any of the proceeding claims wherein the second olefin has the formula

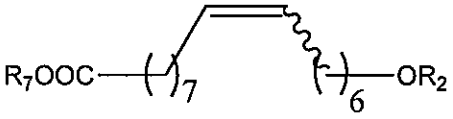


wherein R_7 is branched or non-branched alkyl moiety containing 1 to 5 carbon atoms, and preferably methyl or ethyl, and m is an integer from 1 to 10, preferably 7.

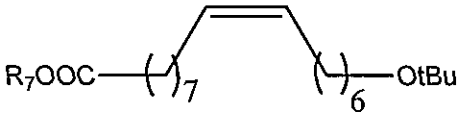
4. A method according to any of the preceding claims wherein the hetero-dimer has the formula



5. A method according to any of the preceding claims wherein the hetero-dimer has the formula



6. A method according to any of the preceding claims wherein the hetero-dimer has the formula



7. A method according to any of the preceding claims wherein the first olefin and second olefin are reacted in a 1:x molar ratio to produce a ratio of hetero-dimer : first homo-dimer : second homo-dimer of $2x : 1 : 1x^2$, wherein x is 1 or greater, and is an integer or a number having a fractional part.

8. A method according to any of the preceding claims wherein the hetero-dimer is formed in admixture with a protected alcohol homo-dimer and a carboxylic acid ester homo-dimer.

9. A method according to claim 8 wherein the mixture of hetero-dimer and each homo-dimer is formed in a molar ratio of 2: 1: 1.

10. A method according to any of the preceding claims wherein the hetero-dimer is separated from the homo-dimers by distillation at a temperature of 100 to 220 degrees centigrade and a pressure of 1 to 10 mbar.

11. A method according to any of the preceding claims wherein the homo-dimers are recycled by metathesis with ethylene to regenerate the first and second olefins.

12. A method according to claim 11 wherein the homo-dimers are treated with 1 bar to 20 bar of ethylene gas.

13. A method according to any of the preceding claims wherein the hetero-dimer is cyclised by trans-esterification.

14. A method according to claim 13 wherein if the hetero-dimer contains a protected alcohol group, it is first de-protected by hydrolysis before being subjected to cyclisation by tran-esterification.

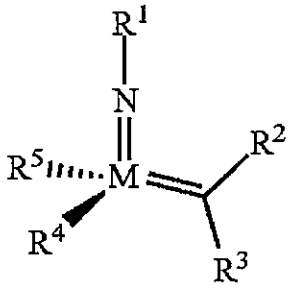
15. A method of forming E/Z 9-ambrettolide according to any of the preceding claims.

16. A method of forming E/Z 9-ambrettolide according to claim 15 wherein the E/Z ratio is from 80:20 to 90:10.

17. A method according to claim 15 or claim 16 wherein the E/Z ratio is 85:15.

18. A method according to any of the preceding claims wherein the catalyst is a molybdenum or tungsten catalyst containing an alkylidene ligand.

19. A method according to any of the preceding claims wherein the catalyst is selected from a compound according to the formula



wherein

M = Mo or W; R^1 is aryl, heteroaryl, alkyl, or heteroalkyl; optionally substituted; R^2 and R^3 can be the same or different and are hydrogen, alkyl, alkenyl, heteroalkyl, heteroalkenyl, aryl, or heteroaryl; which are optionally substituted;

R^5 is alkyl, alkoxy, heteroalkyl, aryl, aryloxy, heteroaryl, silylalkyl, silyloxy, optionally substituted; and R^4 is a residue R^6-X-, wherein

X = O and R^6 is aryl, which are optionally substituted; or

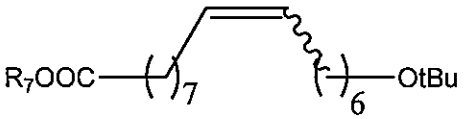
X = S and R^6 is aryl, which are optionally substituted; or

X = O and R^6 is (R^7, R^8, R^9)Si; wherein R^7, R^8, R^9 are alkyl or phenyl, which are optionally substituted; or

X = O and R^6 is (R^{10}, R^{11}, R^{12})C, wherein R^{10}, R^{11}, R^{12} are independently selected from phenyl, alkyl; which are optionally substituted;

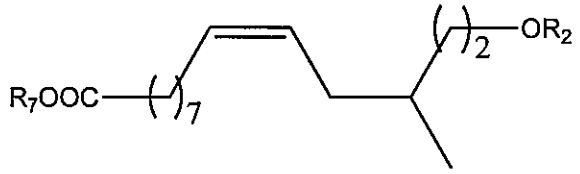
or R^4 and R^5 are linked together and are bound to M via oxygen

20. A hetero-dimer having the formula



wherein R_7 is a branched or non-branched alkyl moiety containing 1 to 5 carbon atoms.

21. A hetero-dimer having the formula



wherein OR_2 is a protected hydroxyl group and R_7 is a branched or non-branched alkyl moiety containing 1 to 5 carbon atoms.

22. The hetero-dimer according to claim 21, wherein OR_2 is selected from an alkylether group; an ester group; a silyl ether group; or a carbonate group.

23. The hetero-dimer according to claim 22 having the formula

