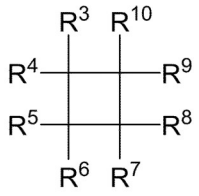
[0036a]

In one aspect, there is provided a method for producing an alkane compound represented by formula (1):

$R^1CHX^1CHX^2R^2$ (1)

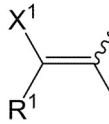
wherein X^1 and X^2 are fluorine atoms, and R^1 and R^2 are the same or different and each is an alkyl group or a fluoroalkyl group; the method comprising:

(IIA) reacting, in the presence of a catalyst and a cycloalkane compound represented by formula (3):



(3)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are the same and each is a fluorine atom, or a fluoroalkyl group; an alkene compound represented by formula (2):



(2)

wherein X^1, X^2, R^1, and R^2 are as defined above; and a hydrogen-containing gas to hydrogenate the alkene compound represented by formula (2).

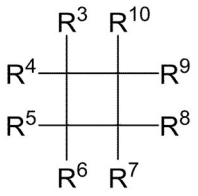
[0036b]

In another aspect, there is provided a method for producing an alkane compound represented by formula (1):

$R^1CHX^1CHX^2R^2$ (1)

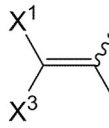
wherein X^1 and X^2 are fluorine atoms, and R^1 and R^2 are perfluoroalkyl groups; the method comprising:

(IB) reacting a cycloalkane compound represented by formula (3):



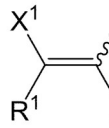
(3)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are the same and each is a fluorine atom, or a fluoroalkyl group; and an alkene compound represented by formula (4):



(4)

wherein X^1 and X^2 are as defined above, and X^3 and X^4 are fluorine atoms; to obtain a mixture comprising an alkene compound represented by formula (2):



(2)

wherein X^1, X^2, R^1, and R^2 are as defined above; and the cycloalkane compound represented by formula (3); and

(IIB) reacting the mixture obtained in step (IB) and a hydrogen-containing gas in the presence of a catalyst to hydrogenate the alkene compound represented by formula (2).

Advantageous Effects of Invention

[0037]

CLAIMS

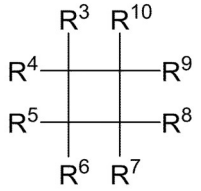
[Claim 1]

A method for producing an alkane compound represented by formula (1):

$R^1CHX^1CHX^2R^2$ (1)

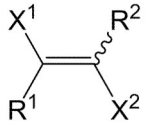
wherein X^1 and X^2 are fluorine atoms, and R^1 and R^2 are the same or different and each is an alkyl group or a fluoroalkyl group; the method comprising:

(IIA) reacting, in the presence of a catalyst and a cycloalkane compound represented by formula (3):



(3)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are the same and each is a fluorine atom, or a fluoroalkyl group; an alkene compound represented by formula (2):



(2)

wherein X^1, X^2, R^1, and R^2 are as defined above; and a hydrogen-containing gas to hydrogenate the alkene compound represented by formula (2).

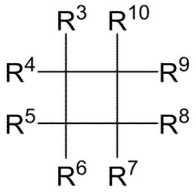
[Claim 2]

The production method according to claim 1, wherein the amount of the cycloalkane compound represented by formula (3) used in the hydrogenation step is 0.5 to 20 mol per mol of the alkene compound represented by formula (2).

[Claim 3]

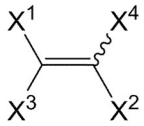
The production method according to claim 1 or 2, wherein the method comprises, before the hydrogenation step:

(IA) reacting a cycloalkane compound represented by formula (3):



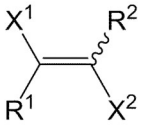
(3)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are as defined above; and an alkene compound represented by formula (4):



(4)

wherein X^1 and X^2 are as defined above, and X^3 and X^4 are fluorine atoms; to obtain an alkene compound represented by formula (2):



(2)

wherein X^1, X^2, R^1, and R^2 are as defined above.

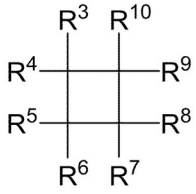
[Claim 4]

A method for producing an alkane compound represented by formula (1):

$R^1CHX^1CHX^2R^2$ (1)

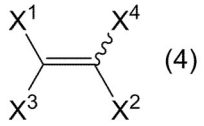
wherein X^1 and X^2 are fluorine atoms, and R^1 and R^2 are perfluoroalkyl groups; the method comprising:

(IB) reacting a cycloalkane compound represented by formula (3):



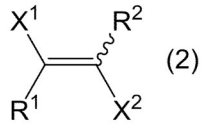
(3)

wherein R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are the same and each is a fluorine atom, or a fluoroalkyl group; and an alkene compound represented by formula (4):



(4)

wherein X^1 and X^2 are as defined above, and X^3 and X^4 are fluorine atoms; to obtain a mixture comprising an alkene compound represented by formula (2):



(2)

wherein X^1, X^2, R^1, and R^2 are as defined above; and the cycloalkane compound represented by formula (3); and

(IIB) reacting the mixture obtained in step (IB) and a hydrogen-containing gas in the presence of a catalyst to hydrogenate the alkene compound represented by formula (2).

[Claim 5]

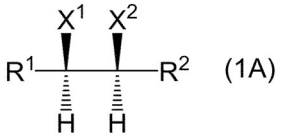
The production method according to claim 4, wherein in the hydrogenation step, the cycloalkane compound represented by formula (3) used as a raw material in the mixture is contained in an amount of 0.5 to 20 mol per mol of the alkene compound represented by formula (2).

[Claim 6]

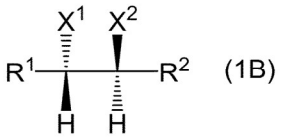
The production method according to any one of claims 1 to 5, wherein the hydrogenation step is performed in a gas phase.

[Claim 7]

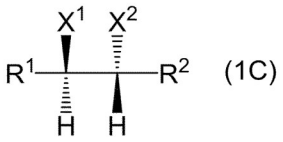
The production method according to any one of claims 1 to 6, wherein the alkane compound represented by formula (1) to be produced comprises 3 alkane compounds represented by formulas (1A), (1B), and (1C):



(1A)



(1B)



(1C)

wherein X^1, X^2, R^1, and R^2 are as defined above.

[Claim 8]

The production method according to claim 7, wherein 20 to 80 mol% of the alkane compound represented by formula (1A), 10 to 40 mol% of the alkane compound represented by formula (1B), and 10 to 40 mol% of the alkane compound represented by formula (1C) are obtained based on the total amount of a product obtained by the hydrogenation step, which is taken as 100 mol%.