formula (3):

$CR^1_2R^2-C\equiv C-CR^3R^4_2$ (3)

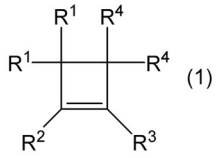
wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the method comprising: i) applying the method as described herein to obtain the perfluorocycloalkene compound; and ii) obtaining the perfluoroalkyne compound by using the obtained perfluorocycloalkene compound as a substrate.

[0024e]

In another aspect, the present disclosure refers to a composition comprising a perfluorocycloalkene compound and a perfluoroalkyne compound,

the perfluorocycloalkene compound being represented by formula (1):



(1)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the perfluoroalkyne compound being represented by formula (3):

$CR^1_2R^2-C\equiv C-CR^3R^4_2$ (3)

wherein $R^1$ to $R^4$ are as defined above, and

the composition containing the perfluorocycloalkene compound represented by formula (1) in an amount of 60 to 99.9 mol%, based on the total amount of the composition defined as 100 mol%.

## Advantageous Effects of Invention

[0025]

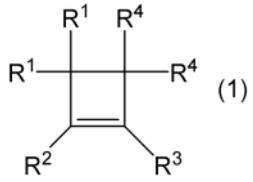
According to the present disclosure, a perfluorocycloalkene compound can be obtained with a high yield and a high selectivity, at a high reaction conversion rate.

## Description of Embodiments

CLAIMS

[Claim 1]

A method for producing a perfluorocycloalkene compound represented by formula (1):



(1)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the method comprising subjecting a perfluoroalkadiene compound to a cyclization reaction in the presence of a catalyst,

the perfluoroalkadiene compound being represented by formula (2):

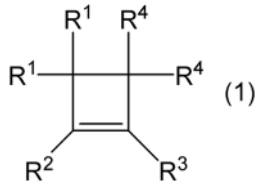
$CR^1_2=CR^2-CR^3=CR^4_2$ (2)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

wherein the catalyst is a fluoride containing at least one metal element that belongs to Groups 1 to 12 of the periodic table of elements.

[Claim 2]

A method for producing a perfluorocycloalkene compound represented by formula (1):



(1)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the method comprising subjecting a perfluoroalkadiene compound to a cyclization reaction in the absence or in the presence of a catalyst in a gas-phase continuous flow process,

the perfluoroalkadiene compound being represented by formula (2):

$CR^1_2=CR^2-CR^3=CR^4_2$ (2)

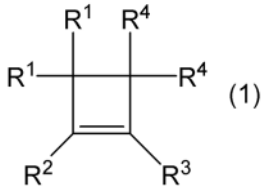
wherein $R^1$ to $R^4$ are the same or different and represent a

fluorine atom or a perfluoroalkyl group,

wherein the catalyst is a fluoride containing at least one metal element that belongs to Groups 1 to 12 of the periodic table of elements if the cyclization reaction is subjected in the presence of the catalyst.

[Claim 3]

A method for producing a perfluorocycloalkene compound represented by formula (1):




(1)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the method comprising subjecting a perfluoroalkadiene compound to a cyclization reaction in the presence of a catalyst in a gas-phase continuous flow process,

the perfluoroalkadiene compound being represented by formula (2):

$CR^1_2=CR^2-CR^3=CR^4_2$ (2)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

wherein the catalyst is a fluoride containing at least one metal element that belongs to Groups 1 to 12 of the periodic table of elements.

[Claim 4]

The method according to any one of claims 1 to 3, wherein the fluoride is a fluoride containing at least one member selected from the group consisting of alkali metals, alkaline earth metals, and metal elements that belong to Group 4 of the periodic table.

[Claim 5]

The method according to any one of claims 1 to 4, wherein the cyclization reaction is performed at 270°C or more.

[Claim 6]

The method according to any one of claims 1 to 5, wherein the cyclization reaction step produces, in addition to the perfluorocycloalkene compound represented by formula (1), a perfluoroalkyne compound represented by formula (3):

$CR^1_2R^2-C\equiv C-CR^3R^4_2$ (3)

wherein $R^1$ to $R^4$ are as defined above.

[Claim 7]

A method for producing a perfluoroalkyne compound represented by formula (3):

$CR^1_2R^2-C\equiv C-CR^3R^4_2$ (3)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the method comprising:

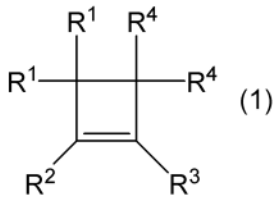
i) applying the method of any one of claims 1 to 6 to obtain the perfluorocycloalkene compound; and

ii) obtaining the perfluoroalkyne compound by using the obtained perfluorocycloalkene compound as a substrate.

[Claim 8]

A composition comprising a perfluorocycloalkene compound and a perfluoroalkyne compound,

the perfluorocycloalkene compound being represented by formula (1):



(1)

wherein $R^1$ to $R^4$ are the same or different and represent a fluorine atom or a perfluoroalkyl group,

the perfluoroalkyne compound being represented by formula (3):

$CR^1_2R^2-C\equiv C-CR^3R^4_2$ (3)

wherein $R^1$ to $R^4$ are as defined above, and

the composition containing the perfluorocycloalkene compound represented by formula (1) in an amount of 60 to 99.9 mol%, based on the total amount of the composition defined as 100 mol%.

[Claim 9]

The composition according to claim 8, which is for use as an etching gas or as a building block for organic synthesis.