

DESCRIPTION

Title of Invention: ETCHING GAS

Technical Field

5 [0001]

The present disclosure relates to etching gases.

Background Art

[0002]

PTL 1 discloses etching gases CF_3COCF_3
10 (hexafluoroacetone) and $\text{C}_3\text{F}_6\text{O}$ (hexafluoropropene oxide), and an
etching method in which these etching gases and argon gas are
introduced into a processing chamber at a flow rate ratio of 1:10
to 30, and an oxide silicon-based material layer on a substrate
to be processed is etched in a plasma atmosphere in the
15 processing chamber.

Citation List

Patent Literature

[0003]

20 PTL 1: JPH09-129612A

Summary of Invention

Technical Problem

[0004]

25 An object of the present disclosure is to newly provide
an etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$).

Solution to Problem

[0005]

30 The present disclosure includes the following subject
matter.

[0006]

Item 1. An etching gas comprising 1,2-difluoroethylene
($\text{CHF}=\text{CHF}$).

35 [0007]

Item 2. A method for etching a substrate for producing a semiconductor using the etching gas of Item 1.

[0008]

Item 3. A semiconductor production apparatus comprising a gas
5 ejection port for the etching gas of Item 1.

[0009]

Item 4. A method for producing a semiconductor, comprising etching a substrate for producing a semiconductor using the etching gas of Item 1.

10 [0010]

Item 5. Use of the etching gas of Item 1 in the production of a semiconductor, wherein etching is performed on a substrate for producing a semiconductor.

15 Advantageous Effects of Invention

[0011]

The present disclosure newly provides an etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$).

20 Description of Embodiments

[0012]

In the present specification, the term "comprising" includes the concepts of comprising, consisting essentially of, and consisting of. In the present specification, a numerical
25 range indicated as "A to B" means A or more and B or less. In the present specification, units such as parts and % represent parts by mass, parts by weight, mass%, or weight% (wt%).

[0013]

1. Etching Gas

30 In traditional semiconductor production, the microfabrication process poses a high environmental impact, using gases with high global warming potential (GWP), such as $\text{c-C}_4\text{F}_8$ (GWP: 10,300), CF_4 (GWP: 7,390), SF_6 (GWP: 24,300), CHF_3 (GWP: 14,800), and CH_2F_2 (GWP: 675).

35 [0014]

The present disclosure encompasses an etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$) used for etching a substrate for producing a semiconductor during semiconductor production.

5 [0015]

1,2-Difluoroethylene

The etching gas of the present disclosure can perform etching in an excellent manner on a substrate for producing semiconductors due to the use of 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$),
10 which is a low-GWP gas.

[0016]

In the etching gas of the present disclosure, from the viewpoint of etching rate (ER), the 1,2-difluoroethylene for use is preferably at least one selected from the group consisting of
15 trans-1,2-difluoroethylene (HFO-1132(E)) and cis-1,2-difluoroethylene (HFO-1132(Z)), and more preferably trans-1,2-difluoroethylene (HFO-1132(E), GWP: 0.0036).

[0017]

The etching gas of the present disclosure for use may
20 be a single type of 1,2-difluoroethylene or a combination (blend) of two or more types.

[0018]

Other Etching Gases

The etching gas of the present disclosure may contain
25 other etching gases, including hydrofluorocarbon compounds (HFCs), such as CH_2F_2 , CHF_3 , $\text{C}_2\text{H}_2\text{F}_2$ (1,1-difluoroethylene), $\text{C}_2\text{H}_4\text{F}_2$, and $\text{C}_3\text{H}_2\text{F}_4$; perfluorocarbon compounds (PFCs), such as CF_4 , C_2F_6 , C_3F_8 , C_4F_8 , C_3F_6 , C_4F_6 , and C_5F_8 ; iodides, such as CF_3I , $\text{C}_2\text{F}_5\text{I}$, and $\text{C}_3\text{F}_7\text{I}$; and SF_6 .

30 [0019]

The etching gas of the present disclosure may contain other etching gases singly or in a combination (blend) of two or more types.

[0020]

35 Inert Gas

The etching gas of the present disclosure may contain an inert gas as needed from the viewpoint of etching rate (ER). The inert gas may be one or more types such as noble gases and nitrogen. Noble gases include helium, neon, argon, xenon, and krypton, with argon being preferably used. These inert gases may be used singly or in a combination (blend) of two or more types. [0021]

Etching Gas

The etching gas of the present disclosure has a high etching rate (ER) for substrates for producing semiconductors. [0022]

The etching gas of the present disclosure is a low-GWP gas that enables environmentally low-impact and sustainable microfabrication technology for substrates for producing semiconductors. [0023]

2. Method for Performing Etching

The present disclosure encompasses a method for etching using the etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$) of the present disclosure as a gas supplied to generate plasma for a substrate for producing semiconductors. [0024]

3. Semiconductor Production Apparatus

The present disclosure encompasses a semiconductor production apparatus comprising a gas ejection port for the etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$) of the present disclosure. [0025]

4. Method of Producing Semiconductor

The present disclosure encompasses a method for producing a semiconductor, comprising etching a substrate for producing a semiconductor by using the etching gas containing 1,2-difluoroethylene ($\text{CHF}=\text{CHF}$) of the present disclosure. [0026]

5. Use for Semiconductor Production

The present disclosure encompasses use of the etching gas containing 1,2-difluoroethylene (CHF=CHF) of the present disclosure in the production of a semiconductor, wherein etching is performed on a substrate for producing a semiconductor.

5 [0027]

The etching gas of the present disclosure has a favorable etching rate (ER) for substrates such as Si used in the production of semiconductors, leading to improved productivity of substrates for producing semiconductors.

10 [0028]

The above describes an embodiment of the present disclosure. Various modifications in form and details can be made without departing from the spirit and scope of the claims.

15 Examples

[0029]

The following explains the present disclosure in detail with reference to Examples and Comparative Examples. The present disclosure is not limited to only these Examples.

20 [0030]

Plasma Treatment Method in Examples and Comparative Examples

(1) Etching

Etching performance was evaluated using a gas containing 1,2-difluoroethylene (CHF=CHF). Etching was performed on deposition films (P-TEOS film, P-SiN film, PolySi film, and ACL film) using a capacitively coupled plasma (CCP) apparatus and a gas containing CHF=CHF.

[0031]

Etching Conditions

30 HF (High Frequency): 1,000 W (40 MHz)

LF (Low Frequency): 2,000 W (13.56 MHz)

Pressure: 20 mTorr

Top temp: 80°C

Wall temp: 80°C

35 ESC: 40°C

Etching time: 30 s

Gas containing CHF=CHF: 10 sccm

Ar: 100 sccm

[0032]

5 Table 1

Table 1: Etching Performance			
Etching Rate (ER) (nm/min)			
P-TEOS Film	P-SiN Film	PolySi Film	ACL Film
145.4	81.7	64.6	30.4

[0033]

10 In the Examples (etching using CHF=CHF), etching could be performed on deposition films such as a P-TEOS film, a P-SiN film, a PolySi film, and an ACL film in the plasma treatment method. The etching gas containing 1,2-difluoroethylene (CFH=CFH) of the present disclosure has a favorable etching rate (ER) and is useful as an etching gas.

15

CLAIMS

[Claim 1]

An etching gas comprising 1,2-difluoroethylene
(CHF=CHF) .

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[Claim 2]

A method for etching a substrate for producing a
semiconductor using the etching gas of claim 1.

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[Claim 3]

A semiconductor production apparatus comprising a gas
ejection port for the etching gas of claim 1.

[Claim 4]

15

A method for producing a semiconductor, comprising
etching a substrate for producing a semiconductor using the
etching gas of claim 1.

[Claim 5]

20

Use of the etching gas of claim 1 in the production of
a semiconductor, wherein etching is performed on a substrate for
producing a semiconductor.