

DESCRIPTION

CVD APPARATUS

5 TECHNICAL FIELD

The present invention relates to a CVD apparatus generating reduced particles by surface-treating the inside of the apparatus.

10 BACKGROUND ART

In film-forming apparatuses such as a CVD apparatus, when forming a thin film on a substrate to be film-formed in a chamber, a thin film may adhere also to the inner surface of the chamber, and particle pollution may be caused on the
15 substrate to be film-formed, by the peeling-off of the adhered thin film.

Consequently, as a countermeasure for preventing the particle pollution, a blast treatment is provided on the inner surface of a chamber, or an adhesion-preventing plate
20 having been subjected to a blast treatment is attached to the inner surface of a chamber. It is such a countermeasure that, when a thin film adheres to the inner surface of the chamber or the adhesion-preventing plate, the provision of the blast treatment improves the close adherence to the thin
25 film to thereby suppress the particle pollution. However, even when the countermeasure is provided, the particle pollution cannot be sufficiently suppressed.

In addition, as a countermeasure for preventing the particle pollution, there is also a method of attaching a particle getter onto the inner surface of a chamber. However, there are problems in the countermeasure in which the particle getter is expensive, attachment of the getter onto an electrode surface of a plasma CVD apparatus causes abnormal electrical discharge, and attachment of the getter onto a substrate to be treated, having a fine structure such as an introduction port for introducing gas in a shower state into a chamber, is not possible.

DISCLOSURE OF THE PRESENT INVENTION

An object of one aspect of the present invention is to provide a CVD apparatus that can reduce particle pollution on a substrate.

Each of (1) to (12) below is a CVD apparatus according to one aspect of the present invention.

(1) A CVD apparatus for forming a film on a substrate by a CVD method, the apparatus including:

a chamber;

a substrate holder that is disposed in the chamber and holds the substrate; and

a gas introduction mechanism that introduces raw material gas into the chamber,

wherein a film formed of any material of metal, ceramics, plastic and cermet is formed on at least one of an inner surface of the chamber, the substrate holder, an

adhesion-preventing plate disposed in the chamber, a jig disposed in the chamber, and a gas shower member that introduces the raw material gas into the chamber in a shower state.

5 (2) The CVD apparatus according to the above (1), wherein the material contains at least one of Cr, W and Mo in an amount of 10% by weight or more.

 (3) The CVD apparatus according to the above (1) or (2),

10 wherein the material contains Cr in an amount of 1% by weight or more to 50% by weight or less, WC in an amount of 0% by weight or more to 49% by weight or less, Mo in an amount of 0% by weight or more to 49% by weight or less, Cr, WC and Mo in an amount of 50% by weight or less in total,
15 Fe, Si, C, B, Al and Cu in an amount of 0% by weight or more to 50% by weight or less in total, and a residue includes Ni and unavoidable impurity.

 (4) The CVD apparatus according to the above (3), wherein the material contains the Fe in an amount of
20 0% by weight or more to 10% by weight or less, the Si in an amount of 0% by weight or more to 10% by weight or less, the C in an amount of 0% by weight or more to 3% by weight or less, the B in an amount of 0% by weight or more to 7% by weight or less, the Al in an amount of 0% by weight or more
25 to 15% by weight or less and the Cu in an amount of 0% by weight or more to 5% by weight or less.

 (5) The CVD apparatus according to the above (3) or

(4),

wherein the material contains Cr in an amount of 9% by weight or more to 20% by weight or less.

(6) The CVD apparatus according to any one of the above
5 (3) to (5),

wherein the material contains Mo in an amount of 3% by weight or more to 10% by weight or less.

(7) The CVD apparatus according to any one of the above
(3) to (6),

10 wherein the material contains WC in an amount of 30% by weight or more to 40% by weight or less.

(8) The CVD apparatus according to the above (2),
wherein the material contains Mo in an amount of 80% by weight or more, and a residue includes an impurity and
15 an unavoidable impurity.

(9) The CVD apparatus according to the above (8),
wherein the impurity is at least one of Fe, Si and C.

(10) The CVD apparatus according to any one of the above
(1) to (9),

20 wherein the film including the material is formed by heat spraying.

(11) The CVD apparatus according to any one of the above
(1) to (10),

wherein the film to be formed on the substrate is a
25 carbon film.

According to one aspect of the present invention, a CVD apparatus that can reduce particle pollution on a

substrate can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view schematically showing
5 the plasma CVD apparatus according to one aspect of the
present invention.

Fig. 2 is a cross-sectional view schematically showing
the plasma CVD apparatus according to one aspect of the
present invention.

10 Fig. 3 shows photographs of results obtained by
subjecting samples 1 to 4 in Example to a tape peeling test.

Fig. 4 shows a photograph of a result obtained by
subjecting a sample 5 in Example to a tape peeling test.

Fig. 5 shows photographs of results obtained by
15 subjecting samples 6 to 9 in Comparative Example to a tape
peeling test.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, embodiments of the present invention will
20 be explained in detail using the drawings. However, a person
skilled in the art would understand easily that the present
invention is not limited to the explanation below, but the
forms and details thereof can be modified variously without
departing from the purport and the range of the present
25 invention. Accordingly, the present invention should not be
construed as being limited to descriptions of embodiments
shown below.

(First embodiment)

Fig. 1 is a cross-sectional view schematically showing the plasma CVD apparatus according to one aspect of the present invention.

5 The plasma CVD apparatus has a film-forming chamber 101, and a cover 102 is disposed in an upper part of the film-forming chamber 101. By placing the cover 102 on the film-forming chamber 101, a film-forming room 103 is formed in the film-forming chamber 101.

10 In a lower part in the film-forming room 103, a stage electrode 104 that holds a substrate to be film-formed (not shown) is disposed and the stage electrode 104 is electrically connected to a high-frequency power source 106. The stage electrode 104 acts also as an RF application
15 electrode and functions also as a substrate holder. The circumference and the lower part of the stage electrode 104 are shielded with an earth shield 105.

 In an upper part in the film-forming room 103, a gas shower electrode 107 is disposed in a position facing the
20 stage electrode 104 and parallel to the stage electrode 104. They serve as a pair of parallel flat type electrodes. The circumference and the upper part of the gas shower electrode 107 are shielded with an earth shield 108. Furthermore, the gas shower electrode 107 is connected to the ground potential.
25 The gas shower electrode 107 functions also as a gas shower member that introduces, in a shower state, raw material gas into the film-forming chamber 101.

In the lower part of the gas shower electrode 107 (the upper surface side of the stage electrode), a plurality of introduction ports (not shown) that introduces raw material gas in a shower state onto the front surface side of the substrate to be film-formed are formed. Inside the gas shower electrode 107, a gas introduction pathway (not shown) is provided. One side of the gas introduction pathway is linked to the introduction port, and the other side of the gas introduction pathway is connected to a supply mechanism of raw material gas (not shown). In addition, in the film-forming chamber 101, an exhaust port 110 for vacuum-exhausting the inside of the film-forming room 103 is provided. The exhaust port 110 is connected to a vacuum pump (not shown).

A thermal spray film formed of any material of metal, ceramics, plastic and cermet is formed on each of the inner surface of the film-forming chamber 101, the inner surface of the cover 102, the stage electrode 104 and the gas shower electrode 107. The thermal spray film is formed by thermal spraying and films described below can be used. Meanwhile, the thermal spraying is a surface treatment method for forming a film by spraying, on an object surface, particles put into a molten state or into a state close to the molten state by heating.

A first thermal spray film is a film formed of a material containing at least one of Cr, W and Mo in an amount of 10% by weight or more.

A second thermal spray film is a film formed of a material containing Cr in an amount of 1% by weight or more to 50% by weight or less (preferably 5% by weight or more to 50% by weight or less, more preferably 1% by weight or more to 20% by weight or less, further more preferably 5% by weight or more to 15% by weight or less, or 9% by weight or more to 20% by weight or less, further more preferably 9.50% by weight or more to 16.2% by weight or less, or 1% by weight or more to 10% by weight or less, more preferably 5% by weight or more to 10% by weight or less), containing WC in an amount of 0% by weight or more to 49% by weight or less (preferably 0.01% by weight or more to 49% by weight or less, more preferably 20% by weight or more to 49% by weight or less, further preferably 30% by weight or more to 40% by weight or less, further more preferably 30% by weight or more to 35% by weight or less, or 20% by weight or more to 35% by weight or less), containing Mo in an amount of 0% by weight or more to 49% by weight or less (preferably 1% by weight or more to 20% by weight or less, more preferably 1% by weight or more to 10% by weight or less, further preferably 3% by weight or more to 10% by weight or less, further more preferably 3% by weight or more to 6% by weight or less, additionally further more preferably 3.83% by weight or more to 6% by weight or less), and containing Cr, WC and Mo in an amount of 50% by weight or less in total, impurities in an amount of 0% by weight or more to 50% by weight or less, and a material in which a residue includes Ni and unavoidable

impurities.

The impurities here are Fe, Si, C, B, Al and Cu. In the second thermal spray film, Fe may be contained in an amount of 0% by weight or more to 10% by weight or less (or 0.01% by weight or more to 10% by weight or less, or 0.01% by weight or more to 7% by weight or less, or 2.90% by weight or more to 7% by weight or less), Si may be contained in an amount of 0% by weight or more to 10% by weight or less (or 0.01% by weight or more to 10% by weight or less, or 0% by weight or more to 5% by weight or less, or 0.01% by weight or more to 5% by weight or less, or 3.89% by weight or less, or 0.01% by weight or more to 3.89% by weight or less, or 1% by weight or more to 3.89% by weight or less, or 2.9% by weight or less, or 0.01% by weight or more to 2.9% by weight or less, or 1% by weight or more to 2.9% by weight or less), C may be contained in an amount of 0% by weight or more to 3% by weight or less (or 1.5% by weight or less, or 0.75% by weight or less, or 0.5% by weight or less), B may be contained in an amount of 0% by weight or more to 7% by weight or less (or 0.01% by weight or more to 7% by weight or less, or 4.5% by weight or less, or 0.01% by weight or more to 4.5% by weight or less, or 3.28% by weight or less, or 0.01% by weight or more to 3.28% by weight or less, or 2.3% by weight or less), Al may be contained in an amount of 0% by weight or more to 15% by weight or less (or 9% by weight or less, or 0.01% by weight or more to 9% by weight or less), and Cu may be contained in an amount of 0% by weight or more to 5% by weight or less

(or 0.01% by weight or more to 5% by weight or less, or 1.9% by weight or less, or 0.01% by weight or more to 1.9% by weight or less).

A third thermal spray film is a film formed of a material
5 containing Mo and a material in which a residue includes unavoidable impurities.

A fourth thermal spray film is a film formed of a material containing Mo in an amount of 80% by weight or more and a material in which a residue includes impurities and
10 unavoidable impurities. Here, the impurities are Fe, Si, and C.

Next, a film-forming method using the plasma CVD apparatus will be explained.

A substrate to be film-formed (not shown) is inserted
15 into the film-forming room 103 of the plasma CVD apparatus, and the substrate to be film-formed is held on the stage electrode 104 in the film-forming room.

Subsequently, the substrate to be film-formed is fixed onto the stage electrode 104, and the film-forming chamber
20 101 is closed with the cover 102 and is vacuum-exhausted with a vacuum pump. Then, raw material gas in a shower state is introduced to the front surface side of the substrate to be film-formed in the film-forming room 103 from the introduction port of the gas shower electrode 107. As the
25 raw material gas, a gas containing carbon is used. Then, by performing control so as to be a prescribed pressure, flow rate of the raw material gas and the like, the inside of the

film-forming room is set to be an intended atmosphere, and plasma is generated by application of a radio frequency wave (RF) through the use of the high-frequency power source 106, and thus a carbon film is formed on the substrate to be
5 film-formed.

According to the present embodiment, a thermal spray film formed of any material of metal, ceramics, plastic and cermet is formed on each of the inner surface of the film-forming chamber 101, the inner surface of the cover 102,
10 the stage electrode 104 and the gas shower electrode 107. Therefore, although a carbon film adheres to the inner surface or the like of the film-forming chamber 101 when the carbon film is to be formed on the substrate to be film-formed in the film-forming chamber 101, the adherence between the
15 adhered carbon film and the thermal spray film is good. Therefore, the adhered carbon film does not peel off easily. As the result, the particle pollution on the substrate to be film-formed can be reduced. In addition, a thermal spray film formed of a material containing at least one of Cr, W
20 and Mo in an amount of 10% by weight or more has good adherence to the carbon film. Furthermore, a thermal spray film formed of a material containing Cr in an amount of 1% by weight or more to 50% by weight or less, WC in an amount of 0% by weight or more to 49% by weight or less and Mo in an amount of 0%
25 by weight or more to 49% by weight or less and containing Cr, WC and Mo in an amount of 50% by weight or less in total has further good adherence to the carbon film. Moreover, a

thermal spray film formed of a material containing Mo in an amount of 80% by weight or more also has further good adherence to the carbon film.

Meanwhile, in the present embodiment, the thermal
5 spray film is formed on each of the inner surface of the film-forming chamber 101, the inner surface of the cover 102, the stage electrode 104 and the gas shower electrode 107, but the thermal spray film may be formed on at least one of the inner surface of the film-forming chamber 101, the inner
10 surface of the cover 102, the stage electrode 104 and the gas shower electrode 107, or may be formed on something other than these, for example, an adhesion-preventing plate disposed in the film-forming chamber or a jig or the like disposed in the film-forming chamber. That is, by forming
15 previously the thermal spray film on a part to which a carbon film may adhere in a film-forming treatment, the particle pollution for the substrate to be film-formed can be reduced.

The adhesion-preventing plate is a plate for preventing the adhesion of a carbon film to the inner surface
20 of the chamber, and is disposed on, for example, each of inner faces of the film-forming chamber 101 and the cover 102.

The jig is a collective term of instruments used for fixing and mounting a component, and is a processed product for disposing or fixing a substrate to be film-formed such
25 as a silicon wafer to a specified position.

Furthermore, in the present embodiment, an example of a plasma CVD apparatus is included as one aspect of the present

invention, but as another aspect of the present invention, another CVD apparatus (such as a thermal CVD apparatus) may be used.

(Second embodiment)

5 Fig. 2 is a cross-sectional view schematically showing the plasma CVD apparatus according to one aspect of the present invention. The plasma CVD apparatus has a right-left symmetrical structure relative to a substrate to be film-formed (such as a disc substrate) 111, and is an
10 apparatus that is capable of forming simultaneously films on both surfaces of the substrate to be film-formed 111, but, in Fig. 2, the left-hand side relative to the substrate to be film-formed 111 is shown and the right-hand side is omitted.

15 The plasma CVD apparatus has a chamber 112, and a hot cathode (cathode electrode) 113 is formed in the chamber 112. The both ends of the hot cathode 113 are electrically connected to an alternating-current power source 115 positioned outside the chamber 112. An end of the
20 alternating-current power source 115 is electrically connected to an earth 116.

 In the chamber 112, a horn anode 114 having a funnel-like shape is disposed, and the horn anode 114 is electrically connected to a DC power source 117. The plus
25 potential side of the DC power source 117 is electrically connected to the horn anode 114, and the minus potential side of the DC power source 117 is electrically connected to the

earth 116.

In the chamber 112, a substrate holder (not shown) is disposed, and the substrate to be film-formed 111 is held on the substrate holder. The substrate to be film-formed 111
5 is electrically connected to a DC power source (direct-current power source) 122 as a power source for ion acceleration. The minus potential side of the DC power source 122 is electrically connected to the substrate to be film-formed 111, and the plus potential side of the DC power
10 source 122 is electrically connected to the earth 116.

In the chamber 112, a plasma wall 118 is disposed so as to cover spaces between each of the hot cathode 113 and the horn anode 114, and the substrate to be film-formed 111. The plasma wall 118 has a cylindrical shape and is
15 electrically connected to a floating potential (not shown).

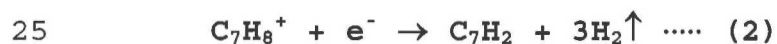
A thermal spray film is formed on each of the inner surface of the chamber 112, the substrate holder, the horn anode 114 and the plasma wall 118. The same method and the same material as those in the first embodiment can be used
20 for the thermal spray film.

Next, a method for forming a Diamond Like Carbon (DLC) film on the substrate to be film-formed 111 by using the plasma CVD apparatus shown in Fig. 2 will be explained.

First, the inside of the chamber 112 is put into a
25 predetermined vacuum state, and for example, toluene (C_7H_8) gas is introduced into the inside of the chamber 112 as film-forming raw material gas. After the inside of the

chamber 112 has reached a prescribed pressure, the supply of alternating current to the hot cathode 113 by the alternating-current power source 115 heats the hot cathode 113. Furthermore, direct current is supplied to the horn anode 114 by the DC power source 117, and direct current is supplied to the substrate to be film-formed 111 by the DC power source 122.

A large number of electrons are emitted from the hot cathode 113 toward the horn anode 114 by the heating of the hot cathode 113, and glow discharge is started between the hot cathode 113 and the horn anode 114. By a large number of electrons, the toluene gas as film-forming raw material gas inside the chamber 112 is ionized and made into a plasma state. At this time, a reaction represented by formula (1) is generated. Then, film-forming raw material molecules in a plasma state are directly accelerated by the minus potential of the substrate to be film-formed 111, fly and run toward the substrate to be film-formed 111, and adhere to the surface of the substrate to be film-formed 111. Consequently, on the substrate to be film-formed 111, a thin DLC film is formed. At this time, on the surface of the substrate to be film-formed 111, a reaction represented by formula (2) below is generated.



According to the present embodiment, the thermal spray film is formed on each of the inner surface of the chamber

112, the substrate holder, the horn anode 114 and the plasma wall 118. Consequently, when a DLC film is to be formed on the substrate to be film-formed 111 in the chamber 112, the DLC film also adheres to the inner surface or the like of the chamber 112, but since the adherence between the adhered DLC film and the thermal spray film is good, the adhered DLC film becomes difficult to be peeled off. As the result, particle pollution on the substrate to be film-formed 111 can be reduced.

Meanwhile, in the present embodiment, the thermal spray film is formed on each of the inner surface of the chamber 112, the substrate holder, the horn anode 114 and the plasma wall 118, but the thermal spray film may be formed on at least one of the inner surface of the chamber 112, the substrate holder, the horn anode 114 and the plasma wall 118, or may be formed on something other than these, for example, a jig disposed in the chamber, a gas shower member or the like that introduces raw material gas into the chamber 112 in a shower state. That is, by forming previously the thermal spray film on a part to which a DLC film may adhere in a film-forming treatment, the particle pollution on the substrate to be film-formed can be reduced.

Furthermore, in the present embodiment, an example of a plasma CVD apparatus is included as one aspect of the present invention, but another CVD apparatus (such as a thermal CVD apparatus) may be used as another aspect of the present invention.

Example

(Samples 1 to 5 in Example)

On a surface of substrates formed of SUS, five thermal
5 spray films shown in Table 1 are formed respectively by a
thermal spraying method. The thermal spraying method at this
time is a gas flame thermal spraying method using powder.
In this way, samples 1 to 5, in which each of five thermal
spray films was formed on the substrate surface, were
10 prepared (see Table 1).

(Samples 6 to 9 in Comparative Example)

Samples 6 and 7 obtained by subjecting the surface of
substrate made of each of SUS and Al to a blast treatment,
were prepared (see Table 2). In the blast treatment at this
15 time, an alumina material having a grain size of F36 was used.

Furthermore, by the same thermal spraying method as
for samples 1 to 5, each of Al and Cu thermal spray films
is formed on surfaces of substrates made of SUS. In this way,
samples 8 and 9, in which each of thermal spray films of Al
20 and Cu was formed on surfaces of substrates, were prepared
(see Table 2).

Next, under film-forming conditions described below,
a DLC film was formed on each of thermal spray films of samples
1 to 5, 8 and 9, and on each of substrates of samples 6 and
25 7.

Film-forming apparatus: plasma CVD apparatus shown in
Fig. 1

Starting raw material: toluene (C_7H_8)

Gas flow rate: 30 sccm

Gas pressure: 0.5 Pa

Frequency of high-frequency wave output: 13.56 MHz

5 High-frequency wave output: 300 W

Thickness of DLC film: 100 nm

Next, a tape peeling test was performed on each of samples 1 to 9 in which a DLC film had been formed, according to a test method described below.

10 The tape peeling test was in accordance with JIS K 5400, and the DLC film was incised in a grid shape at 1 mm intervals with a cutter knife, on which a tape was stuck and after that, the tape was peeled off.

HEAT SPRAY FILM	Ni	Cr	WC	Mo	Fe	Si	C	B	Al	Cu	RESULT OF TAPE PEELING TEST
SAMPLE 1: NiCr (CONTAINING WC)	46.40%	10.00%	35.00%		2.90%	2.90%	0.50%	2.30%			○
SAMPLE 2: NiCr (D MATERIAL)	76.00%	16.00%			7.00%	1.00%					△
SAMPLE 3: NiCr (CONTAINING Mo)	67.24%	16.20%		3.83%	2.91%	3.89%	0.75%	3.28%		1.90%	○
SAMPLE 4: NiCr (B MATERIAL)	62.50%	9.50%		6.00%	7.00%	3.50%		2.50%	9.00%		○
	46.4~ 76.00%	9.50~ 16.2%	0~35%	0~6%	2.90~7%	1~3.89%	0~0.75%	0~3.28%	0~9%	0~1.9%	
SAMPLE 5: Mo				99.791%	0.004%	0.005%	0.200%				○○

Table 1

Table 2

	RESULT OF TAPE PEELING TEST
SAMPLE 6: SUS (BLAST-TREATED)	×
SAMPLE 7: Al (BLAST-TREATED)	×
SAMPLE 8: Al HEAT SPRAYING/SUS	×
SAMPLE 9: Cu HEAT SPRAYING/SUS	△

Fig. 3 shows photographs of results obtained by
 subjecting samples 1 to 4 in Example to a tape peeling test.
 Fig. 4 shows a photograph of a result obtained by subjecting
 a sample 5 in Example to a tape peeling test. Fig. 5 shows
 photographs of results obtained by subjecting samples 6 to
 9 in Comparative Example to a tape peeling test.

As shown in Figs. 3 and 4 and Table 1, there were
 obtained a good result (○) of the adherence between the DLC
 film and the thermal spray film by samples 1, 3 and 4 in Example,
 a particularly good result (○○) of the adherence between the
 DLC film and the thermal spray film by the sample 5 in Example,
 and a result (△) that the adherence between the DLC film and
 the thermal spray film was inferior to that of samples 1,
 3 and 4, but there was a certain degree of adherence, by sample
 2 in Example.

In contrast to this, as shown in Fig. 5 and Table 2,
 there were obtained a poor result (×) of the adherence between
 the DLC film and the substrate or thermal spray film by samples
 6 to 8 in Comparative Example, and a result (△) that the

adherence between the DLC film and the thermal spray film was better than that of samples 6 to 8 and there was a certain degree of adherence, by sample 9 in Comparative Example.

According to the Example, it was confirmed that, when
 5 forming a DLC film on a substrate to be film-formed in a chamber, even if the DLC film adheres to the inner surface of the chamber, the adhered DLC film becomes difficult to be peeled off by forming a thermal spray film having good adherence to the DLC film as shown in Table 1 on the inner
 10 surface of the chamber or the like, and as the result, particle pollution on the substrate to be film-formed was able to be reduced.

Reference Signs List

- 15 101: film-forming chamber
- 102: cover
- 103: film-forming room
- 104: stage electrode
- 105,108: earth shield
- 20 106: high-frequency power source
- 107: gas shower electrode
- 110: exhaust port
- 111: substrate to be film-formed
- 112: chamber
- 25 113: cathode electrode (hot cathode)
- 114: anode electrode (horn anode)
- 115: alternating-current power source

116: earth

117: DC power source

118: plasma wall

122: DC power source

CLAIMS

1. A CVD apparatus for forming a film on a substrate by a CVD method, the apparatus comprising:

a chamber;

5 a substrate holder that is disposed in the chamber and holds the substrate; and

a gas introduction mechanism that introduces raw material gas into the chamber,

wherein a film formed of any material of metal, ceramics,
10 plastic and cermet is formed on at least one of an inner surface of the chamber, the substrate holder, an adhesion-preventing plate disposed in the chamber, a jig disposed in the chamber and a gas shower member that introduces the raw material gas into the chamber in a shower
15 state.

2. The CVD apparatus according to claim 1,

wherein the material contains at least one of Cr, W and Mo in an amount of 10% by weight or more.

20

3. The CVD apparatus according to claim 1 or 2,

wherein the material contains Cr in an amount of 1% by weight or more to 50% by weight or less, WC in an amount of 0% by weight or more to 49% by weight or less, Mo in an
25 amount of 0% by weight or more to 49% by weight or less, Cr, WC and Mo in an amount of 50% by weight or less in total, Fe, Si, C, B, Al and Cu in an amount of 0% by weight or more

to 50% by weight or less in total, and a residue includes Ni and unavoidable impurity.

4. The CVD apparatus according to claim 3,

5 wherein the material contains the Fe in an amount of 0% by weight or more to 10% by weight or less, the Si in an amount of 0% by weight or more to 10% by weight or less, the C in an amount of 0% by weight or more to 3% by weight or less, the B in an amount of 0% by weight or more to 7% by weight or less, the Al in an amount of 0% by weight or more to 15% by weight or less and the Cu in an amount of 0% by weight or more to 5% by weight or less.

5. The CVD apparatus according to claim 3 or 4,

15 wherein the material contains Cr in an amount of 9% by weight or more to 20% by weight or less.

6. The CVD apparatus according to any one of claims 3 to 5,

20 wherein the material contains Mo in an amount of 3% by weight or more to 10% by weight or less.

7. The CVD apparatus according to any one of claims 3 to 6,

25 wherein the material contains WC in an amount of 30% by weight or more to 40% by weight or less.

8. The CVD apparatus according to claim 2,
wherein the material contains Mo in an amount of 80%
by weight or more, and a residue includes an impurity and
an unavoidable impurity.

5

9. The CVD apparatus according to claim 8,
wherein the impurity is at least one of Fe, Si and C.

10. The CVD apparatus according to any one of claims 1 to
10 9,
wherein the film including the material is formed by
heat spraying.

11. The CVD apparatus according to any one of claims 1 to
15 10,
wherein the film to be formed on the substrate is a
carbon film.