

METHOD, REAGENT AND APPARATUS FOR TREATING
EMISSIONS CONTAINING CHLORINE TRIFLUORIDE AND
OTHER INORGANIC HALOGENATED GASES

BACKGROUND OF THE INVENTION

5 This invention relates to a method and apparatus for
treating emissions containing chlorine trifluoride (ClF_3)
and other inorganic halogenated gases. In the process of
semiconductor fabrication, the inner surfaces of equipment
and other parts are subjected to dry cleaning with ClF_3 and
10 the resulting emissions contain inorganic halogenated gases
such as ClF_3 , SiF_4 , SiCl_4 , BF_3 , BCl_3 , PF_3 , PCl_3 , F_2 and Cl_2 .
The present invention particularly relates to a method and
apparatus for rendering such emissions harmless.

As the feature size of ultra-large-scale integration
15 (LSI) has increased recently together with the need to
further improve the production efficiency of IC chips,
manufacturers are employing an auto-cleaning method in
which the thin film forming components that stick to the
inner surfaces of the vessel and piping on thin film
20 forming equipment such as Chemical Vapor Deposition (CVD)
and Physical Vapor Deposition (PVD) apparatuses are cleaned
with chlorine trifluoride (ClF_3) and other gases. With the
growing need to process wafers of larger diameter,
increased amounts of ClF_3 gas must be supplied and longer
25 cleaning times are required. However, ClF_3 is an extremely
toxic substance with a TLV (Threshold Limit Value) of 0.1
ppm. What is more, the emissions from the auto-cleaning
step contain not only ClF_3 , but also other harmful inorganic

halogenated gases such as SiF_4 , SiCl_4 , BF_3 , BCl_3 , PF_3 , PCl_3 , F_2 and Cl_2 that are simultaneously discharged as by-products from the cleaning of thin film forming components.

Common methods for treating ClF_3 include wet scrubbing
5 with aqueous alkalis and dry neutralization with soda-lime or activated alumina. However, the sole use of reagents such as soda-lime and activated alumina is not effective in removing ClF_3 to levels below its TLV and, in addition, chlorine is liberated in the reaction with the reagents and
10 inorganic halide gases such as SiF_4 , SiCl_4 , BF_3 , BCl_3 , PF_3 , PCl_3 , F_2 and Cl_2 cannot be fully removed.

Under these circumstances, the present inventors proposed a method of treatment in which iron oxides were used in combination with alkali reagents such as calcium
15 hydroxide in order to prevent liberation of chlorine and remove ClF_3 to levels below its TLV while ensuring that other inorganic halogenated gases could also be fully removed (see JP 6-177 B). As it turned out, however, there was still room for improvement in order to treat large
20 amounts of ClF_3 by the method in a satisfactory manner.

Hence, with a view to treating large amounts of ClF_3 in a satisfactory manner, the present inventors proposed a method of treatment in which the emission containing ClF_3 was first brought into contact with an iron oxide or
25 synthetic zeolite, then into contact with an anion-exchange resin (JP 11-70319 A). However, as a longer cleaning time was required, increased amounts of the reagents had to be used and the process temperature increased from the heat of

reaction between the reagents and the emission, so that after a prolonged treatment, the performance of the anion-exchange resin dropped, making it necessary to perform N₂ purge for cooling the reagent after the cleaning step.

5 Nitrogen purge requires at least 6 hours to complete, so switching from the cleaning step to the deposition step is delayed to lower the production efficiency. As a further problem, the equipment must be retrofitted to incorporate a N₂ purge line for cooling purposes.

10 SUMMARY OF THE INVENTION

An object, therefore, of the present invention is to provide a method capable of efficient treatment of emissions containing not only large amounts of chlorine trifluoride that is used in a prolonged cleaning step of
15 the semiconductor fabrication process but also large amounts of other acidic inorganic halogenated gases that result as by-products.

Another object of the invention is to provide an apparatus and a reagent with which emissions containing not
20 only chlorine trifluoride but also other acidic inorganic halogenated gases can be treated efficiently without suffering significant drop in performance after prolonged treatment.

BRIEF DESCRIPTION OF THE DRAWINGS

25 Fig. 1 shows diagrammatically a first embodiment of the treatment apparatus of the invention; and

Fig. 2 shows diagrammatically a second embodiment of the treatment apparatus of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

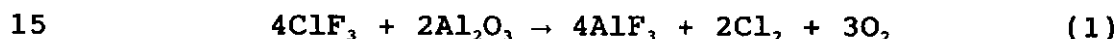
According to its first aspect, the present invention provides a method of treating an emission containing chlorine trifluoride (ClF_3) and other inorganic halogenated gases by bringing it into contact first with a chlorine trifluoride (ClF_3) decomposer and then with a chlorine remover. By bringing the emission containing chlorine trifluoride (ClF_3) and other inorganic halogenated gases into contact with the chlorine trifluoride (ClF_3) decomposer, the fluorine atoms undergo a chemical reaction on the decomposer to be fixed to it for subsequent removal. Other acidic gases in the emission are also fixed to the decomposer. The chemical reaction also liberates chlorine gas (Cl_2). Then, the emission containing the liberated chlorine gas is brought into contact with the chlorine remover, whereupon the free chlorine gas is removed and the chlorine atoms are rejected from the emission in the form a harmless salt.

The emission to be treated by the invention contains chlorine trifluoride (ClF_3) and preferably it further contains at least one acidic gas selected from the group consisting of silicon tetrafluoride (SiF_4), silicon tetrachloride (SiCl_4), boron trifluoride (BF_3), boron trichloride (BCl_3), phosphorus trifluoride (PF_3), phosphorus trichloride (PCl_3), fluorine gas (F_2) and chlorine gas (Cl_2). These emissions are preferably those which originate from the cleaning step in the semiconductor fabrication process, for example, the step of cleaning the

interior of the chamber in the semiconductor fabricating equipment after depositing poly-Si film or SiN film.

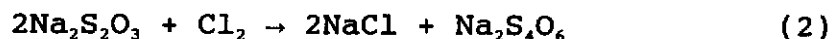
The treatment method of the invention is described below in detail with reference to the case where an
5 emission containing chlorine trifluoride (ClF_3) is first brought into contact with synthetic zeolite used as a chloride trifluoride decomposer, then into contact with a sulfureous reducing agent ($\text{Na}_2\text{S}_2\text{O}_3$) as a chlorine remover.

If the emission containing chlorine trifluoride is
10 brought into contact with the synthetic zeolite, the fluorine atoms react chemically with the Al_2O_3 portion of the synthetic zeolite to be fixed in it whereas the chlorine atoms are liberated as chlorine gas (Cl_2). This reaction is represented by the following scheme:



The emission is then brought into contact with the chlorine remover, whereupon the chlorine atoms react with the sulfureous reducing agent ($\text{Na}_2\text{S}_2\text{O}_3$) to generate a harmless salt (NaCl), which is rejected from the emission.

20 This reaction is represented by the following scheme:



In equation (1), the synthetic zeolite having the Al_2O_3 portion is used as the chlorine trifluoride decomposer and in equation (2), the sulfureous reducing agent ($\text{Na}_2\text{S}_2\text{O}_3$) is
25 used as the chlorine remover. It should, however, be noted that these are not the sole examples of the chlorine trifluoride decomposer and chlorine remover that can be employed in the present invention. Any compound that can

decompose chlorine trifluoride and fix the fluorine atoms may be used as the chlorine trifluoride decomposer in this invention and a preferred example is trivalent iron oxides chiefly composed of Fe_2O_3 . Synthetic zeolite is

5 particularly preferred for the following two reasons: it can decompose more of the chlorine trifluoride and hence is more powerful than the iron oxides; if chlorine trifluoride condenses and accumulates in a liquefied state within the reagent bed, a violent decomposing reaction will occur to
10 cause a rapid increase in temperature and pressure but the synthetic zeolite can prevent these problems.

The synthetic zeolite suitable for use as a chlorine trifluoride decomposer in the present invention preferably has high aluminum content. For example, it preferably
15 contains 0.5-10 mole parts of SiO_2 per mole part of Al_2O_3 . More preferably, it contains 1-5 mole parts of SiO_2 per mole part of Al_2O_3 . Most preferably, it contains 2.5 mole parts of SiO_2 per mole part of Al_2O_3 . A preferred example of such synthetic zeolite is zeolite X having high
20 capability of decomposing chlorine trifluoride. Specific examples of synthetic zeolites that can be used in the invention include zeolite X having the chemical formula $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2-3\text{SiO}_2 \cdot n\text{H}_2\text{O}$, with zeolite X having the chemical formula $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2.5\text{SiO}_2 \cdot n\text{H}_2\text{O}$ being particularly preferred.
25 If desired, the sodium oxide in the formula may be replaced by another alkali metal oxide such as potassium oxide or an alkaline earth metal oxide such as calcium oxide to form zeolites Li-X, K-X, Mg-X, Ca-X and Ba-X, which may also be

used in the invention.

The synthetic zeolite used as a chlorine trifluoride decomposer in the present invention has preferably an average pore size of 4-100 Å, more preferably 4-20 Å, most preferably 10 Å. The synthetic zeolite has preferably a specific surface area of 600-900 m²/g, more preferably 600-700 m²/g, most preferably 650 m²/g. In the case that the average pore size and specific surface area of the synthetic zeolite are within the stated ranges, it offers the advantage of exhibiting higher activity and achieving efficient decomposition of chlorine trifluoride.

Any material may be used as a chlorine remover in the invention as long as it can reduce free chlorine gas to generate a harmless salt and a preferred example is an anion-exchange resin. More preferred is a sulfurous reducing agent since it can treat more chlorine and is more heat-resistant than the anion-exchange resin to assure higher throughput at elevated temperatures.

Preferred examples of the sulfurous reducing agent that may be used as the chlorine remover in the present invention include sulfites, dithionites, tetrathionates and thiosulfates, which may be used either alone or in admixture. For example, combinations of sulfites and thiosulfates may preferably be used. Particularly preferred for use are sodium sulfite, potassium sulfite, sodium thiosulfate, potassium thiosulfate, etc.

The shapes of the chlorine trifluoride decomposer and chlorine remover to be used in the invention are not

limited in any particular way and as long as they are easy to handle and permit efficient operation, they may assume any morphologies including pellet, bar and plate.

The chlorine trifluoride decomposer and the chlorine
5 remover to be used in the invention have preferably large areas of contact with the halogen atoms in the emission so that the chemical reaction with chlorine trifluoride proceeds efficiently to assure efficient fixation of the fluorine and chlorine atoms. It is also preferred that
10 their contact areas are within such ranges that they will not increase the resistance to the passage of the emission. To satisfy these conditions, the synthetic zeolite to be used as the chlorine trifluoride decomposer is preferably in the form of spheres or cylinders having sizes of 4-20
15 mesh, more preferably in the form of spheres or cylinders having sizes of 8-20 mesh, and most preferably in the form of spheres having sizes of 14-20 mesh. The sulfurous reducing agent as the chlorine remover is preferably in the form of cylinders having sizes of 1.6-3.2 mm ϕ , more
20 preferably in the form of cylinders having sizes of 1.6-2.4 mm ϕ , and most preferably in the form of cylindrical pellets having a size of 1.6 mm ϕ .

In the treatment method of the present invention, the temperature for the treatment of the emission is preferably
25 between ordinary temperature and 150°C, more preferably between ordinary temperature and 200°C, most preferably at ordinary temperature. Increasing the temperature for the emission treatment to a level that exceeds 200°C is not

economical since this brings out the need to make the treating equipment of heat-resistant materials to have a heat-resistant construction. Decreasing the temperature for the emission treatment to a level below ordinary

5 temperature is also undesired since a cooling apparatus must be used to lower the temperature but then the cost of treatment increases.

According to its second aspect, the present invention provides a reagent for treating emissions containing
10 chlorine trifluoride and other inorganic halogenated gases which comprises the combination of a chlorine trifluoride decomposer and a chlorine remover. Preferably, the chlorine trifluoride decomposer and the chlorine remover are not mixed together so that they can be applied
15 separately in the emission treatment.

The chlorine trifluoride decomposer as one component of the reagent according to the second aspect of the invention is preferably the synthetic zeolite already described above, with zeolite X being particularly
20 preferred. The chlorine remover is most preferably the aforementioned sulfureous reducing agent.

The proportions of the chlorine trifluoride decomposer and the chlorine remover in the reagent according to the second aspect of the invention vary with the amount of
25 chlorine trifluoride to be treated and are preferably within the range of from 1:1 to 1:0.6.

According to its third aspect, the present invention provides an apparatus for treating emissions containing

chlorine trifluoride and other inorganic halogenated gases, which comprises a first section of treatment packed with a chlorine trifluoride decomposer and a second section of treatment packed with a chlorine remover, the first section
5 being provided upstream of the second section. In the apparatus for treating emissions according to the third aspect of the invention, the first and second sections of treatment suffice to be arranged such that the emission is passed through the first section before it is passed
10 through the second section. If the first section is provided as a stage on top of the second section, the stream of the emission suffices to be supplied as a descending flow. Conversely, if the first section is provided as a stage underlying the second section, the
15 stream of the emission suffices to be supplied as an ascending flow. If the first and second sections are arranged parallel, the emission suffices to be passed through the second section after passing through the first section.

20 Preferably, a heat insulating section is additionally provided between the first and second sections. The heat insulator may be a porous and inert substance such as silica gel, natural zeolite or alumina. If the concentration of the influx of the emission increases or if
25 it is continuously passed for a prolonged period of time, the reaction with the chlorine trifluoride decomposer in the first section causes a marked increase in temperature to nearly 200°C; even if this occurs, the insulating

section can prevent thermal deterioration of the chlorine remover in the second section.

According to its fourth aspect, the present invention provides an apparatus for treating emissions containing
5 chlorine trifluoride and other inorganic halogenated gases, which is in the form of a column having an entrance for the emission treatment and an exit of the treated gas, said column further comprising a first section of treatment provided closer to the entrance for the emission treatment
10 and packed with a chlorine trifluoride decomposer and a second section of treatment provided closer to the exit of the treated gas and packed with a chlorine remover, and a heat insulating section being provided between the first and second sections as packed with a heat insulator.

15 The loading of the chlorine trifluoride decomposer in the first section varies with the amount of the chlorine trifluoride to be treated; typically, it ranges from 50 vol% to 70 vol% and is preferably about 60 vol%. The loading of the chlorine remover in the second section
20 typically ranges from 25 vol% to 45 vol% and is preferably about 35 vol%. In the case that the loadings of the chlorine trifluoride decomposer and the chlorine remover are within the stated ranges, one benefits from the high performance in the treatment of inorganic halogenated gases
25 that are concomitant to chlorine trifluoride.

The apparatus and method of the present invention for treating emissions containing chlorine trifluoride and other inorganic halogenated gases are described below with

reference to the embodiments shown in the accompanying drawings but the invention is by no means limited to those embodiments.

Fig. 1 shows a first embodiment of the treating apparatus of the invention. In this embodiment, two packed columns are employed and a single packed bed is provided in the interior of each packed column. Stated specifically, the apparatus for treating emissions generally indicated by 1 in Fig. 1 comprises a first column 10 as the first section of treatment which is packed with a chlorine trifluoride decomposer and a second column 20 as the second section of treatment which is packed with a chlorine remover, and the first column 10 as the first section of treatment is provided upstream of the second column 20 as the second section of treatment. The first column 10 has an inlet 12 through which the emission coming from its source via L_{IN} flows into the column, a chlorine trifluoride decomposer bed 14 packed with the chlorine trifluoride decomposer, and an outlet 16 through which the gas obtained by subjecting the emission to a primary treatment in the chlorine trifluoride decomposer bed 14 flows out of the column. The second column 20 has an inlet 22 for receiving the gas as it flows out of the first column 10 through the outlet 16, a chlorine remover bed 24 packed with the chlorine remover, and an outlet 26 through which the gas obtained by secondary treatment of the emission in the chlorine remover bed 24 flows out of the second column 20. A line L for the gas from the primary treatment is provided

between the outlet 16 on the first column 10 and the inlet 22 on the second column 20 so that the gas from the primary treatment that has been freed of fluorine atoms by adsorption on the first column 10 is introduced into the
5 second column 20.

The emission from its source flows over L_{IN} to get into the first column 10 through the inlet 12 and forms an ascending flow that passes through the chlorine trifluoride decomposer bed 14. As the emission passes through the
10 chlorine trifluoride decomposer bed 14, the fluorine atoms in the emission are fixed to the bed 14 and rejected from within the emission, whereupon a gas from the primary treatment of the emission is formed which is free of the fluorine atoms. The gas from the primary treatment which
15 has passed through the bed 14 leaves the first column 10 through the outlet 16 and subsequently flows via the line L until it is introduced into the second column 20 through the inlet 22. Within the second column 20, the gas from the primary treatment forms an ascending flow that passes
20 through the chlorine remover bed 24 and, in the meantime, the chlorine atoms are removed by adsorption on the chlorine remover, whereupon a gas from the secondary treatment is formed which is free of the chlorine atoms. Subsequently, the gas from the secondary treatment leaves
25 the second column 20 through the outlet 26 to be discharged to the outside via L_{OUT} .

Fig. 2 shows a second embodiment of the treating apparatus of the invention. In this embodiment, two packed

beds are provided in the interior of a single packed column. Stated specifically, the apparatus for the treatment of emissions which is generally indicated at 100 is a column having both an entrance for the emission
5 treatment and an exit of the treated gas, said column further comprising a first section of treatment 110 provided closer to the entrance for the emission treatment and packed with a chlorine trifluoride decomposer and a second section of treatment 120 provided closer to the exit
10 of the treated gas and packed with a chlorine remover, and a heat insulating section 130 being provided between the first and second sections 110, 120 as packed with a heat insulator.

The emission from its source flows through L_{IN} to be
15 introduced into the column 100, where it forms an ascending flow that passes through the first section of treatment 110, the heat insulating section 130 and the second section of treatment 120, from which it is discharged to the outside via L_{OUT} . The fluorine atoms in the emission are
20 removed by being fixed to the chlorine trifluoride decomposer in the first section of treatment 110. The gas from the primary treatment which has been freed of fluorine atoms passes through the heat insulating section 130 to be introduced into the second section of treatment 120, where
25 it is freed of chlorine atoms by adsorption.

The following examples and comparative examples are provided for further illustrating the present invention but are in no way to be taken as limiting.

Example 1

Two SUS mini-columns of 42 mm ϕ were provided. One of them was packed with synthetic zeolite (MIZUKASIEVES 13X-1420B of MIZUSAWA INDUSTRIAL CHEMICALS, LTD.; particle size, 14-20 mesh) in an amount of 260 mL to give a bed height of 190 mm, thus preparing the first section of treatment. The other column was packed with a sulfurous reducing agent (ECL-3 of SÜD-CHEMIE CATALYSTS JAPAN, INC. as pellets with a grain size of 1.6 mm ϕ and a composition consisting of 25% basic zinc carbonate, 17% sodium thiosulfate, 56% alumina and 2% clay) in an amount of 260 mL to give a bed height of 190 mm, thus preparing the second section of treatment. The two packed columns were assembled in a treatment apparatus of the setup shown in Fig. 1. The emission under test was simulated by N₂-diluted ClF₃, which was used in a treatment experiment as follows.

The treatment apparatus shown in Fig. 1 was supplied with the N₂-filled ClF₃ at an influx concentration of 1.0% and at a flow rate of 667 mL/min and the gas emerging from the second section of treatment after secondary treatment was analyzed. Analyses of ClF₃ and Cl₂ were made by a mass spectrometer (Questor GP of ABB Extrel); analyses of HCl and HF were made by an ion chromatograph (AI-450 of Dionex Corporation); analysis of SO₂F₂ was made by a gas chromatograph/mass spectrometer (QP-5050A of Shimadzu Corporation). The results are shown in Table 1 below.

Table 1

Time after emission's supply	~46.5 hr	47 hr	Allowable concentration
ClF_3	< 0.1 ppm	< 0.1 ppm	0.1 ppm
Cl_2	< 0.2 ppm	0.6 ppm	0.5 ppm
HCl	< 1 ppm	< 1 ppm	5 ppm
HF	< 1 ppm	< 1 ppm	3 ppm
SO_2F_2	< 1 ppm	< 1 ppm	5 ppm

Up to 46.5 hours after the start of the emission's supply, the whole species (ClF_3 , Cl_2 , HCl, HF and SO_2F_2) had
 5 always been treated to levels below their detection limits. After a lapse of 47 hours, Cl_2 began to leak out in an amount of 0.6 ppm which exceeds the allowable concentration (0.5 ppm as Cl_2), so the supply of the emission was stopped.

10 Example 1 shows that according to the treatment method of the invention employing the apparatus of the invention, all components of the emission could effectively be treated to levels below their allowable concentrations for a period as long as 46.5 hours after the start of the emission's
 15 supply.

Comparative Example 1

The first section of treatment was prepared as in Example 1, except that rather than being packed with the synthetic zeolite as the chlorine trifluoride decomposer,
 20 it was packed with 260 mL of a sulfurous reducing agent (ECL-3 of SUD-CHEMIE CATALYSTS JAPAN, INC. as pellets with a grain size of 1.6 mmφ and a composition consisting of 25%

basic zinc carbonate, 17% sodium thiosulfate, 56% alumina and 2% clay) as the chlorine remover. The simulated emission was supplied under the same conditions as in Example 1 to evaluate the performance of the synthetic zeolite as the chlorine trifluoride decomposer. The results are shown in Table 2 below.

Table 2

Time after emission's supply	~47 hr	47.5 hr	Allowable concentration
ClF_3	< 0.1 ppm	2.1 ppm	0.1 ppm
Cl_2	< 0.2 ppm	40 ppm	0.5 ppm
HCl	< 1 ppm	< 1 ppm	5 ppm
HF	< 1 ppm	< 1 ppm	3 ppm
SO_2F_2	100-400 ppm	380 ppm	5 ppm

Up to 47 hours after the start of the emission's supply, ClF_3 , Cl_2 , HCl and HF could be treated to concentrations below their detection limits but SO_2F_2 leaked out at very high concentrations between 100 and 400 ppm. After a lapse of 47.5 hours, ClF_3 and Cl_2 leaked out at concentrations exceeding their allowable levels.

Thus, it is clear from Comparative Example 1 that when synthetic zeolite was not packed in the first section of treatment, harmful SO_2F_2 was formed as a by-product in a large quantity exceeding its allowable concentration.

Example 2

The second section of treatment was prepared as in Example 1, except that rather than being packed with the

sulfureous reducing agent, it was packed with 260 mL of an anion-exchange resin (product of DOWEX; 20-50 mesh). The simulated emission was supplied under the same conditions as in Example 1 to evaluate the performance of the

5 sulfureous reducing agent as the chlorine remover. The results are shown in Table 3 below.

Table 3

Time after emission's supply	~41 hr	41.5 hr	Allowable concentration
ClF_3	< 0.1 ppm	< 0.1 ppm	0.1 ppm
Cl_2	< 0.2 ppm	0.5 ppm	0.5 ppm
HCl	< 1 ppm	< 1 ppm	5 ppm
HF	< 1 ppm	< 1 ppm	3 ppm
SO_2F_2	< 1 ppm	< 1 ppm	5 ppm

Up to 41 hours after the start of the emission's

10 supply, the whole species (ClF_3 , Cl_2 , HCl, HF and SO_2F_2) had always been treated to levels below their detection limits. After a lapse of 41.5 hours, Cl_2 began to leak out in an amount of 0.5 ppm which exceeds the allowable concentration (0.5 ppm as Cl_2), so the supply of the emission was

15 stopped.

In Example 2 where the anion-exchange resin was substituted for the sulfureous reducing agent, all species (ClF_3 , Cl_2 , HCl, HF and SO_2F_2) could be effectively treated without giving rise to by-products. On the other hand, the

20 treating reagents remained effective for only 41.5 hours, about 6 hours shorter than the effective period of the

combination of the synthetic zeolite and the sulfurous reducing agent.

According to the treating method of the invention, emissions containing not only chlorine trifluoride but also
5 other acidic inorganic halogenated gases in large quantities can be effectively treated such that the concentrations of ClF_3 , Cl_2 , HCl , HF and SO_2F_2 are reduced to harmless levels.

Therefore, the method of the invention can effectively
10 be applied to treat emissions that originate from a prolonged cleaning step in the semiconductor fabrication process and which contain large amounts of inorganic halogenated gases including not only chlorine trifluoride (ClF_3) but also at least one additional acidic gas selected
15 from the group consisting of silicon tetrafluoride (SiF_4), silicon tetrachloride (SiCl_4), boron trifluoride (BF_3), boron trichloride (BCl_3), phosphorus trifluoride (PF_3), phosphorus trichloride (PCl_3), fluorine gas (F_2) and chlorine gas (Cl_2).

20 The present invention also provides a reagent of higher capacity and longer life for use in the treatment of emissions containing chlorine trifluoride and other inorganic halogenated gases.

The invention further provides an apparatus for
25 treating emissions containing chlorine trifluoride and other inorganic halogenated gases without suffering a significant drop in performance even if it is applied to prolonged treatment.

WHAT IS CLAIMED IS:

1. A method of treating an emission containing chlorine trifluoride (ClF_3) and other inorganic halogenated gases by bringing it into contact first with a chlorine trifluoride
5 (ClF_3) decomposer and then with a chlorine remover.
2. The method according to claim 1, wherein said chlorine trifluoride (ClF_3) decomposer is a synthetic zeolite and said chlorine remover is a sulfurous reducing agent.
3. The method according to claim 1 or 2, wherein said
10 emission further contains at least one acidic gas selected from the group consisting of silicon tetrafluoride (SiF_4), silicon tetrachloride (SiCl_4), boron trifluoride (BF_3), boron trichloride (BCl_3), phosphorus trifluoride (PF_3), phosphorus trichloride (PCl_3), fluorine gas (F_2) and
15 chlorine gas (Cl_2).
4. A reagent for treating emissions containing chlorine trifluoride (ClF_3) and other inorganic halogenated gases which comprises the combination of a chlorine trifluoride (ClF_3) decomposer and a chlorine remover.
- 20 5. The reagent according to claim 4, wherein said chlorine trifluoride (ClF_3) decomposer is a synthetic zeolite and said chlorine remover is a sulfurous reducing agent.
6. An apparatus for treating emissions containing
25 chlorine trifluoride (ClF_3) and other inorganic halogenated gases, which comprises a first section of treatment packed with a chlorine trifluoride (ClF_3) decomposer and a second section of treatment packed with a chlorine remover, the

first section being provided upstream of the second section.

7. The apparatus according to claim 6, wherein said chlorine trifluoride (ClF_3) decomposer is a synthetic
5 zeolite and said chlorine remover is a sulfurous reducing agent.

8. The apparatus according to claim 6 or 7, wherein a heat insulating section is additionally provided between the first and second sections.

10 9. An apparatus for treating emissions containing chlorine trifluoride (ClF_3) and other inorganic halogenated gases, which is in the form of a column having an entrance for the emission treatment and an exit of the treated gas, said column further comprising a first section of treatment
15 provided closer to the entrance for the emission treatment and packed with a chlorine trifluoride (ClF_3) decomposer and a second section of treatment provided closer to the exit of the treated gas and packed with a chlorine remover, and a heat insulating section being provided between the
20 first and second sections as packed with a heat insulator.