

ABATEMENT SYSTEM FOR ClF₃ CONTAINING EXHAUST GASES.**BACKGROUND OF THE INVENTION****1. Field of the Invention**

The invention relates to an abatement system for ClF₃ containing exhaust gases. It relates more particularly to a process for the abatement of a ClF_x containing gas such as an exhaust gas from reactor.

2. Description of the Related Art

ClF₃ gas has been widely used recently as a cleaning gas for the CVD reactors because of its high reactivity without the aid of a plasma or high thermal energy. However, the exhaust gas from the reactor after the cleaning of the same, contains various cleaning products and byproducts such as ClF, ClF₂, HF, Cl₂ in addition to ClF₃.

It is well known in the art to use sodalime to remove those toxic compounds from the exhaust gas of CVD reactor by chemisorption.

It is also well known by the man skilled in the art to use zeolite to adsorb toxic compounds by physisorption from the exhaust gas flowing out of these CVD reactors. Also, scrubbing with an alkaline solution is a widely known method for abatement of toxic compounds in these exhaust gases.

However, the problem of these conventional methods in their inability to totally abate those toxic compounds. The reason is essentially because of their poor efficiency and the generation of secondary toxic compounds by the reaction of the exhausted components and the adsorbent material. Such

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byproducts include as referred to hereabove, ClF, ClF₂, HF and Cl₂.

There is thus still a need for a system and method to substantially completely abate toxic compounds in the exhaust gases after cleaning a reactor with a ClFx gas or gas mixture.

SUMMARY OF THE INVENTION

According to the invention, it has been surprisingly found that the use of sodalime was exceptionally efficient to irreversibly remove any ClFx compound when it is dry which means when sodalime has a moisture content which is less than about 3% volume. In these conditions, substantially no generation of secondary products happen as long as the temperature of the adsorbent (sodalime) is kept below substantially about 60°C. When the temperature of the dry sodalime is raised above 60°C, Cl₂ is generated by the reaction of dry sodalime and ClF₃, which Cl₂ cannot be efficiently removed by the dry sodalime.

However, when using dry sodalime alone, other products resulting from the cleaning process in the CVD machine such as SiF₄, HF and Cl₂, cannot be removed totally with dry sodalime in an efficient way.

According to a preferred embodiment of the invention, the combination of dry sodalime and wet (or moist) sodalime, i.e. containing more than about 20% volume of moisture, can be used efficiently to remove all the ClFx products and any other byproducts from the exhaust gases of the CVD reactor after cleaning of such reactor with ClFx. More preferably, the abatement system according to the invention comprises two-layer

cartridge comprising a bottom layer of dry sodalime and an upper layer of moist sodalime, moist sodalime having in addition to the above effect the capability of maintaining the dry sodalime at a temperature below 60°C when the temperature of dry sodalime tends to increase due to the reaction of dry sodalime with byproducts. Most preferably the exhaust gas is diluted with an inert diluent gas such as nitrogen or any other well known inert gas including argon and other noble gases, which is helpful to avoid an increase of the temperature of dry sodalime above 60°C.

BRIEF DESCRIPTION OF THE DRAWING

The invention shall be better understood now with the following examples and the following figures wherein :

Fig 1 shows an example of realization of the system according to the invention,

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

On fig. 1, ClF₃/ into stream of gas mixture (throughing out from CVD reactor of the cleaning of the same with ClF₃) is sent to the dry sodalime bed 1 on top of which is placed the moist sodalime bed 2. After going through these two beds, the gas mixture 11 is sent to an analyzer/detector 3 for analyzing the composition of the gas after abatement and an adsorbent/scrubber 4 in order to remove and get rid of any of the remaining components before venting the substantially pure nitrogen.

Example 1:

Using a system as disclosed on fig. 1, a cartridge containing 250g each of dry sodalime 1 (<3% H₂O content by baking) on the bottom and moist sodalime 2 (>20% H₂O content) on the top. A gas mixture comprising 1% volume of ClF₃ in nitrogen was introduced into the system at velocity of 1 cm/sec. With the analyzer/detector (which consisted of a gas chromatograph) no toxic compounds were observed at the exit of this cartridge during 160mn which means a capacity of ClF₃ abatement of 17cc/g on pure ClF₃ basis. A color indicator is placed on the moist sodalime (e.g. curcumin if detection of Cl₂ is expected or D.740 for detection of HF) to detect when the cartridge is saturated (change of the color indicator which means that the cartridge must be changed).

Example 2 :

Various tests have been conducted in the same conditions as in example 1, except that the relative proportions of dried sodalime to moist sodalime (1:1 in example 1) have been varied.

For example, with a ratio of 7:3 (350g dry sodalime and 150g moist sodalime), saturation of the cartridge occurred after about 105mn. With a ratio of 3:2 (350g dry sodalime and 200g moist sodalime), saturation occurred after 115mn.

It is thus preferred to have a ratio dry to moist sodalime which is less than 1.5, most preferably about 1 or less.

In these various cases however, the temperature of dry sodalime raises from about 20°C to about 45°C (for a ratio of 3/2 or less), while for a ratio of 7/3, the temperature stabilizes a little bit higher (about 55°C).

By comparison, a combination of 250g dry sodalime topped with 250g of 13x molecular sieves was saturated (all other conditions similar to example 1) after 45 mn.

In all the comparative examples, the total weight of the adsorbents was at least equal to 500g.

Exemple 3 :

As a comparison also, sodalime as commercially available comprises about 20% weight of H₂O. When ClF₃ flow through it, there is an immediate reaction of H₂O and ClF₃ to generate HF.

When the sodalime adsorbent bed is dried according to the invention, i.e. comprising less than about 3% H₂O weight (500g), this dried sodalime bed was saturated (same gas mixture as in example 1) after 130mn, then Cl₂ was generated and the temperature (which was about 55°C after the initial 130mn) raises to about 65°C.

If ClF₃ is completely adsorbed by dry sodalime at low temperature, (below 60°C preferably below 50°C), this trapped ClF₃ may be released as Cl₂ when the temperature of the dry sodalime increases above about 50°C, preferably above about 40°C.

Without willing to be bound by any theory, the inventors believe that when the temperature is maintained below 40°C in the two layers cartridge (dry sodalime on the bottom where the gas enters the cartridge and moist sodalime on the top of it), ClF₃ is first adsorbed on the dry sodalime irreversibly. When the dry sodalime is full with ClF₃, ClF₃ enters into the moist sodalime layer. When ClF₃ reacts with moist sodalime, it probably generates HF and Cl₂ (and maybe other Cl or F

compounds, too), but Cl₂ (and other products) may be adsorbed in the moist sodalime better than HF. This is why HF comes out first and then Cl₂ follows later on. It may be inferred from the above that when HF breaks out first from the two-layers system, it means that ClF₃ completely saturated the dry layer and reached the moist layer. If Cl₂ breaks through first, it means that the temperature exceeded over the critical temperature before the dry layer is saturated.



WHAT IS CLAIMED IS:

1. A process for the abatement of a ClFx containing gas such as exhaust gases from a reactor wherein at least one step of the manufacture of integrated circuit is carried out, wherein said ClFx containing gas is passed through a bed of adsorbent comprising sodalime which moisture content is less than 3% weight, to substantially remove all of the ClFx compound from said ClFx containing gas with substantially no generation of byproduct.
2. A process according to claim 1, wherein the temperature of the sodalime bed is kept below 60°C, preferably below 50°C.
3. A process according to claim 1 or 2, wherein a bed of wet sodalime adsorbent is arranged next to the bed of dry sodalime in order to cool down such dry bed and substantially remove other toxic compounds such as HF, SiH₄, Cl₂ or the like, from the gas to be abated.
4. A process according to one of claims 1 to 3, wherein the dry sodalime bed is placed at the bottom of the cartridge and the wet sodalime bed is placed at the top of the cartridge in order to have the gas to be abated flowing through the dry bed first and the wet bed thereafter.
5. A process according to one of claims 1 to 4, wherein the cartridge comprises at least one color indicator to indicate that at least one of the adsorbents is saturated.



6. A system for abatement of a ClFx containing gas or gas mixture comprising essentially a dry sodalime bed, a moist sodalime bed placed thereupon, and means for maintaining the temperature of the dry sodalime bed below substantially 60°C.

7. A system according to claim 6, wherein it further comprises at least one color indicator located on top of the moist sodalime bed.