EFFECTIVE MANAGEMENT OF PROCESS EXHAUST FROM LOW-K CVD PROCESSES

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Many of today's Low-k CVD processes use methylsilane and siloxane precursors. With the adoption of methylsilane precursors in the IC industry, the availability of high efficiency abatement solutions is important. Methylsilanes are insoluble in water and exhibit decreasing pyrophoricity and increasing flammability as the degree of methylation increases. From a practical point of view, utilization of these low-k precursors in the process tool during deposition is typically of the order of 15 – 20%. In addition, many low-k processes use nitrogen trifluoride (NF_3) based cleans, resulting in the generation of large quantities of fluorine during chamber cleaning [1]. The above factors combine to suggest controlled combustion as the most suitable mode of point of use abatement for methylsilane based low-k processes. However, since the methylsilanes are themselves fuels, combustion conditions must ensure the oxygen to fuel ratio is high enough to allow oxidation reactions to proceed to completion and avoid the generation of CO and NO_x. This is further complicated by the fact that significant levels of solids, which can cause blockages, are generated by combustion of methylsilanes.

In this report, we will discuss the results from a series of abatement tests carried out on samples of trimethylsilane (3MS) and tetramethylsilane (4MS) CVD Precursors from Dow Corning Corporation using a modified BOC Edwards Thermal Processing Unit (TPU). The tests were conducted to ascertain the feasibility of abating flows of Z3MS commonly experienced in high volume manufacturing processes.

Any abatement system must be capable of destroying species generated during both deposition and chamber cleaning processes. Abatement testing of NF_3 was therefore carried out on a TPU.

The TPU is configured as standard to give good DRE of a wide range of PFC gases including C_2F_6, C_3F_8, SF_6 and NF_3 using CH_4 and O_2 co-injection. In order to maintain the cost of ownership benefits of using CDA (as demonstrated for Z3MS), while optimizing emissions, a series of experiments were performed. These experiments identified that CDA can act as a suitable replacement for pure O_2, giving good NF_3 destruction coupled to low CO and NO_x emissions, providing the configuration of methane and CDA injects is carefully controlled. Thus, both the deposition and clean gases are completely abated without emissions of HAPs or other deleterious species.

References

1. Vartanian, V, et. al, "Impact Of Fluorine Emissions From NF_3-Based CVD Chamber Clean Processes", A Partnership for Semiconductor Emissions Reductions, Semicon Southwest, Austin, TX, 15 October 2001.