

Non-CO₂ Greenhouse Gases: High-GWP Gases

Source/Sectors: Semiconductor Sector

Technology: Thermal destruction or processing units (C.3.4)

Description of the Technology:

Thermal destruction technology can be applied to reduce PFCs emissions from both the CVD chamber cleaning and etching processes. It is installed downstream of the process tool so that it does not affect the manufacturing process and performances.

High GWP emissions are oxidized in a natural gas-fired burner before the combustion products are removed by the on-site waste treatment systems. Burner system requires pretreatment of inlet streams to reduce the loads of unused deposition/etchant gases and particles that can block the system. Hydrofluoric acid formed in thermal destruction systems may be removed via POU scrubbers to prevent exceeding scrubber design limits (US Climate Change, 2005; USEPA, 2001).

Effectiveness: Good

Implementability: The Edwards TPU 4214 (oxidation with advanced burner technology) is applicable for all high GWP emissions and achieves more than 99% destruction efficiency.

Reliability: Several PFC thermal destruction systems can effectively abate some PFCs, but only a few have been proven to abate all PFCs at greater than 90% destruction efficiency.

Maturity: Several PFC thermal destruction systems are commercially available, but the Edwards TPU 4214 is the only thermal-destruction device in commercial use and represents a favored POU solution for chemical vapor deposition cleaning processes (US Climate Change, 2005).

Environmental Benefits: High-GWP gas emission reduction

Cost Effectiveness:

Technology	Lifetime (yrs)	MP (%)	RE (%)	TA (%)	Capital cost	Annual cost	Benefits
Thermal destruction or processing units ¹	5	20	90	40	\$93.39	\$8.98	\$0.00

Note: MP: market penetration; RE: reduction efficiency; TA: technical applicability; costs are in year 2000 US\$/MT_{CO₂-Eq.}
1: CEC (2005) & USEPA (2001)

Industry Acceptance Level: This option is technologically matured and well adopted, despite of other preferable abatement options such as process improvements.

Limitations: The thermal destruction system requires a combustion fuel and use significant amounts of cooling water that creates an additional waste stream. In addition, it produces NO_x emissions, which are regulated air pollutants. (Applied Materials, 1999).

Sources of Information:

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15. U.S. Environmental Protection Agency (2006b) "Global Mitigation of Non-CO₂ Greenhouse Gases", Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-005, June 2006.