Non-CO_2 Greenhouse Gases: High-GWP Gases

Source/Sectors: Semiconductor Sector

Technology: PFC recapture/recovery (C.3.6)

Description of the Technology:
PFC recapture/recovery is a feasible option for treating the waste streams of entire fabrications. This technology separates un-reacted and/or process-generated PFCs from other gases using a membrane for further processing; the reprocessed PFCs are either reused or concentrated for subsequent off-site disposal (IEA, 2003; USEPA, 2001). Currently available capture systems are guaranteed to remove 90 % of emissions; in general, removal efficiency of C_2F_6, CF_4, SF_6, and C_3F_8 is higher (more than 90%), and CHF_3 and NF_3 removal efficiencies is lower (50 - 60%). In addition to membrane separation, Praxair/Ecosys cryogenic capture system and, MEGASORB and BOC pressure swing absorption systems are reported as new recapture technologies; these systems have shown low capture efficiencies so far. DuPont is investigating a technological option for the disposition of C_2F_6-containing mixture; the research is ongoing for the repurification and the off-site destruction of C_2F_6 (US Climate Change, 2005; USEPA, 2001). One example of process optimization is to use end-point detectors and/or process parameter variation to determine the optimal fluorocarbon utilization to reduce excess emissions.

Effectiveness: Good

Implementability: The technology can be applied to both sources of emissions: the etching and the CVD chamber cleaning processes.

Reliability: Good

Maturity: The technologies including Praxair/Ecosys and Edwards cryogenic capture systems have already commercialized, but have not been widely adopted worldwide; there are no published reports of commercial uses for the MEGASORB and BOC system (US Climate Change, 2005).

Environmental Benefits: High-GWP gas emission reduction

Cost Effectiveness:

Technology	Lifetime (yrs)	MP (%)	RE (%)	TA (%)	Capital cost	Annual cost	Benefits
PFC recapture/recovery[1]	5	8	90	100	$40.52	$13.20	$0.00

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

Industry Acceptance Level: This technology is currently low in demand because NF_3 cleaning systems do not leave sufficient PFCs in the stream to make gas recovery economically viable.

Limitations: All options require considerable pretreatment to remove undesirable substances such as corrosives particles and moisture from the exhaust gas stream.

Sources of Information:

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