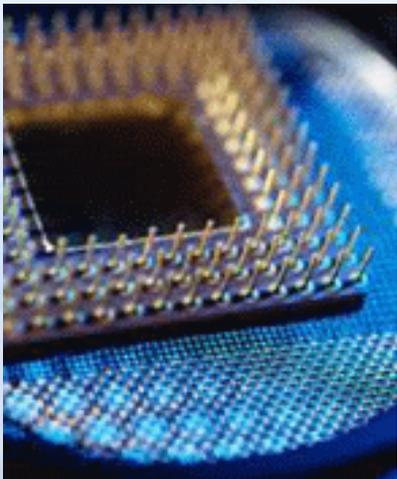


Semiconductor Fluorinated Gas Control Concepts



First Public Workshop

**California Air Resources Board
Sacramento, CA
January 10, 2008**

Outline

- Background
- Potential Options to Reduce Emissions
- Future Activities
- Comments

Background

California Global Warming Solutions Act of 2006 (AB32)

- The California Global Warming Solutions Act of 2006 (AB32) requires ARB to identify and publish a list of discrete early action greenhouse gas emission reduction measures.
- On October 25, 2007, the Board approved the Semiconductor Perfluorocarbon (PFC) Emissions Reduction Strategy as a discrete early action measure.
- This measure is scheduled to be adopted by the Board, and become enforceable by January 1, 2010.

Memorandums of Understanding

- 1996 Memorandum of Understanding with U.S. EPA
 - Data gathering
 - Emission reduction efforts
- 2001 Second MOU with U.S. EPA
 - Reduce PFC emissions to 10% below 1995 level by 2010
 - Three manufacturers in CA are currently participating

Current Requirements

- District VOC Rules
 - Antelope Valley, Bay Area, Placer, San Diego, South Coast and Ventura County District
- U.S. EPA
 - National Emission Standards for Hazardous Air Pollutants
 - hydrochloric acid (HCl), hydrogen fluoride (HF), methanol, glycol ethers, and xylene

Potential Options to Reduce Emissions

Fluorinated Gases In Use

Name	Formula	1996 100-Year IPCC GWP	2006 100-Year IPCC GWP
Hexafluoroethane	C_2F_6	9,200*	12,200
Octofluoropropane	C_3F_8	7,000	8,830
Tetrafluoromethane	CF_4	6,500	7,390
Trifluoromethane	CHF_3	11,700	14,800
Octofluorocyclobutane	C_4F_8	8,700	10,300
Nitrogen Trifluoride	NF_3	n/a	17,200
Sulfur Hexafluoride	SF_6	23,900	22,800

Also C_4F_8O and C_4F_6

*1 kg C_2F_6 = 9,200 kg CO_2

Fluorinated Gas Emission Sources

- Dry Etching
 - Removes material at a finer level than wet etching can achieve (3 microns)
- Chemical Vapor Deposition (CVD)
Chamber Cleaning
 - Removes chemical deposits from chamber walls that may contaminate wafers
- Others?

Four Semiconductor Emission Reduction Strategies

1. Process Optimization

- Reduces the use of fluorinated gases by reducing flow rate

2. Alternative Chemistries

- Substitute gases such as nitrogen trifluoride (NF₃) for hexafluoroethane (C₂F₆) in the chamber cleaning process

Four Semiconductor Emission Reduction Strategies (continued)

3. Emissions Abatement

- Commercially available technologies
- Performance of abatement systems varies

4. Recovery/Recycling

- More costly or require more maintenance than other measures
- Recovered compounds contain impurities

Recent Activities

- Literature Research
 - SIA White Paper
 - ISMI Report
 - 2006 IPCC Guidelines
- Emissions Inventory Update
- Fabrication Site Visits
- Survey Development

Survey in Progress

- Distributed last month
 - CA Semiconductor Facilities
 - Wafer Production
 - Fluorinated Gas Usage by Process
 - Current Emissions Reduction Strategies
- Due Date: February 15, 2008

Future Activities

Future Activities

- First Workshop: January 10, 2008
- Second Workshop: April 2008
- Third Workshop: July 2008
- Board Hearing: December 11, 2008
- Regulation effective: January 1, 2010

Stakeholder Participation

- Evaluate control options
- Form a working group
- Individual meetings

Reminder

- **Semiconductor website:**
<http://www.arb.ca.gov/cc/semiconductors/semiconductors.htm>
- **Please sign up on the semiconductor list serve by visiting the website:**
<http://www.arb.ca.gov/listserv/semiconductors.htm>

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