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SEMI Industry Headwinds: European PFAS Restriction Proposal

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Welcome Remarks

James Amano
Senior Director EHS
SEMI

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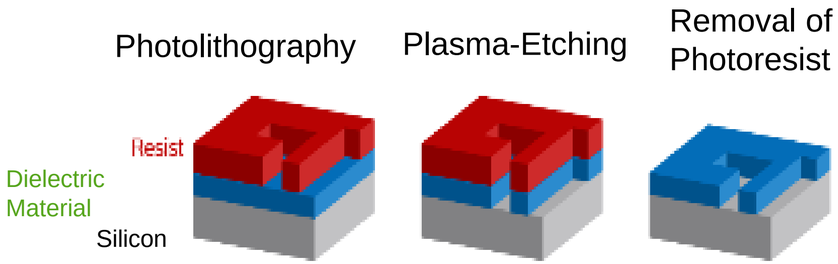
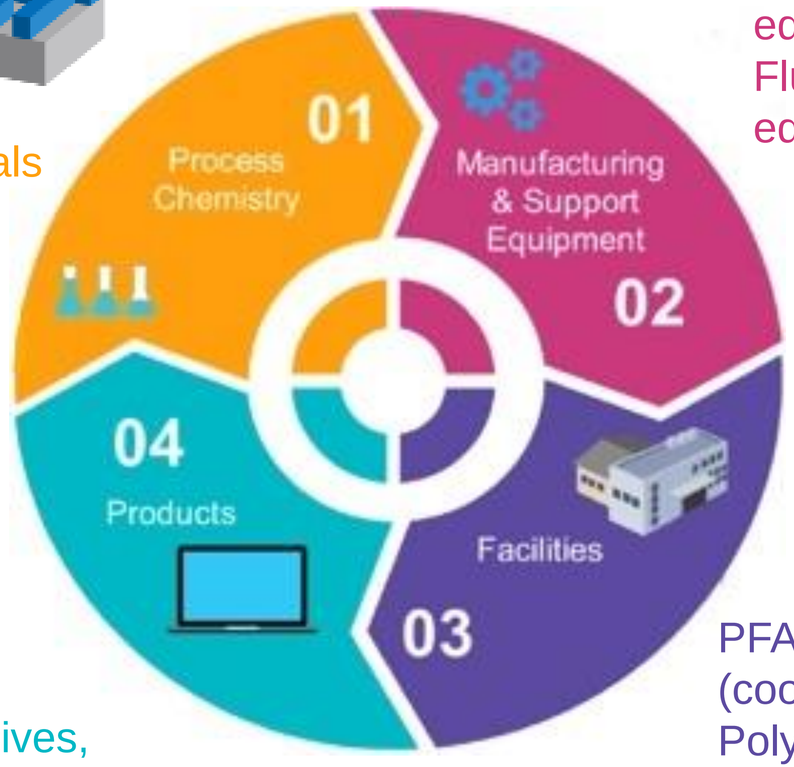
James Amano / Sr. Director, EHS

SEMI

PFAS Use by the Semiconductor industry



PFAS as Process Chemicals (photoresists, plasma etching gases, chamber cleaning)



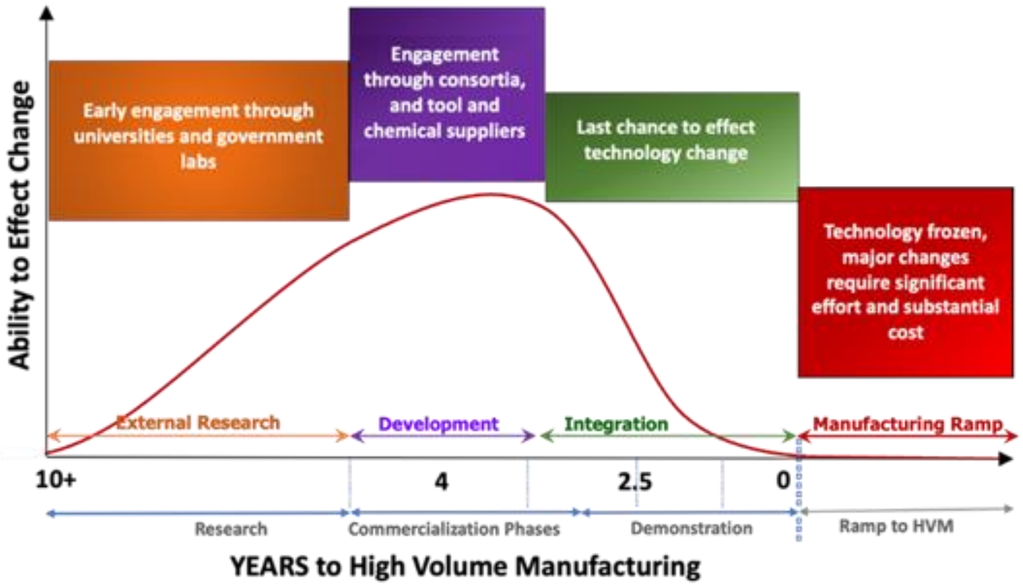
PFAS in Semiconductor Manufacturing related equipment (Heat Transfer Fluids, Fluoropolymer in equipment)

PFAS in articles (semiconductor products, adhesives, cables, printed circuit boards)

PFAS in Facilities (cooling/heating systems, Polymers in infrastructure: filters, tubing, linings, o-rings)

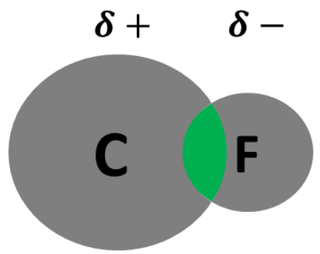
Reasons for a Comprehensive Derogation

- Annex XV dossier does not fully capture latest state of knowledge on PFAS uses in the semiconductor industry (Table A.49 is not complete)
- R&D efforts are ongoing across the industry
- Most applications have no known alternatives today. There is no guarantee that all applications can be substituted.
- Development cycles in the semiconductor industry are significantly longer than the proposed derogation (between and 10 and +-25 years)
- PFAS restrictions will affect the entire value chain: material, manufacturing equipment, manufacturing, servicing and imports.



Example Applications in Semiconductors

- Reasons for the use of PFAS in Semiconductor Industry:
  - Chemically resistant to aggressive media (acidic, caustic, oxidative)
  - High thermal stability (>260°C)
  - Low friction, very little abrasion (very little particle-emission)
  - Source for highly reactive fluorine species in plasma, which reacts with Silicon, forming gaseous molecules such as SiF4
  - Source of strong acids via optical amplification (Photoacid Generators)
  - Low refractive index, good UV-Transmission
  - Very low Surface energy
  - Hydrophobic and oleophobic properties enabling multi-barrier role
  - Good mechanical stability
  - Favorable electric properties (good isolation, low κ dielectric)
- Due to the numerous special properties of PFAS there are no known equivalent PFAS-free alternatives in most applications.



Strongest single-bond in organic chemistry!

Atom-bonding	Binding energy
C-F (in CF_2-R1-R2)	503 kJ/mol
C-O (single Bond)	358 kJ/mol
C-N (single Bond)	305 kJ/mol
C-C (in Ethane)	376 kJ/mol

Semiconductors are Crucial for EU Policy Objectives

Failure to secure a comprehensive derogation will effectively stop the value chain. Several EU policy priorities would be affected:

- **The EU industrial strategy**
  - Supporting the EU's global competitiveness
  - Making the EU climate neutral by 2050
  - Shaping Europe's digital future
- **Chips Act**: EU goal to reach 20% of global production from currently 9%.
- **Net Zero Industry Act** the deployment of clean energy and its associated technologies
  - Achieving European climate neutrality by 2050, will be harder, if not impossible to achieve
  - 55% reduction in greenhouse gas emissions by 2030 could be in jeopardy

Example: Semiconductors and the green transition:

- Green energy generators have high-power semiconductor content :
  - Wind: ~3,000 €/MW
  - Solar: ~4,000 €/MW

Accelerated conversion from fossil to electrical in mobility

- Roughly 80% of car sales in 2030 will be EV (up from ~15% in 2021)
- Semiconductor content in cars more than doubles from traditional to EV
  - BEV: ~$1,000 per vehicle

(2021, Source: Gartner; Strategy Analytics; BCG semiconductor supply-demand forecast)

The Way Forward

- Without an appropriate derogation covering the entire semiconductor supply and value chains, the semiconductor industry in Europe will be in jeopardy.
- The derogation should provide a clear path for renewal to account for technology development times and possible impossibility of substitution.
- Need for support to enable semiconductor industry R&D to replace PFAS wherever possible.

SEMI PFAS Initiative

- The Initiative will support and accelerate industry efforts to reduce PFAS dependency, mitigate PFAS-related semiconductor supply chain disruption, and encourage environmentally responsible risk management in cases where there are no alternatives to PFAS.
- Initial Working Groups
  - Industry Transition Strategy/Risk Mapping:
    - Identify and investigate long-term supply chain vulnerabilities
  - Transparency:
    - Enable standardized communication on the presence of PFAS
  - Supply Chain Resiliency:
    - Promote near-term business continuity and stability
- The Initiative will strive to align with related industry efforts such as the existing SEMI PFAS Working Group and the SIA Semiconductor PFAS Consortium.
- WG meetings to commence Nov 27
- Contact ehs@semi.org to get involved.

Questions? ehs@semi.org

Thank you!