NEW MATERIAL EH&S CHALLENGES: A SUPPLIER’S PERSPECTIVE

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Engineering Research Center for Environmentally Benign Semiconductor Manufacturing
The semiconductor industry’s rapid pace of technology advances.

Use of existing chemicals is close to optimization from technology perspective.

New materials must be introduced to semiconductor manufacturing to achieve future technology advances.
Data gaps may exist

Discomfort due to unfamiliarity with new materials

Suitability of existing facilities
   - Equipment
   - Processes (i.e. compatibility of by-products)

Potential need for regulatory approvals
NEW MATERIAL EH&S CONCERNS

Acceptable Risk?
- Inherent material hazards

- Worker exposure controls
  - Engineering controls
  - PPE

Intellectual Property (IP) Concerns
NEW PRODUCT DEVELOPMENT PROCESS

NEW PRODUCT DEVELOPMENT PROCESS

ELECTRONIC CHEMICALS

➢ Initial Interest
  ■ Originates with
    — In-house technology group
    — OEM tool manufacturer
    — Device manufacturer
  ■ Research available information
  ■ Assess/address data gaps
    — If air/moisture sensitive consider use of information on by-products.
    — Consider use of attributes common to the chemical family.
    — Perform small scale qualitative experiments in-house.
    — Confirm with technology group that hazard assessment makes sense.
NEW PRODUCT DEVELOPMENT PROCESS

Electronic Chemicals

- **Initial Interest**
  - Consider capabilities of manufacturing facility.
    - Open/closed system
    - Adequacy of engineering/administrative controls
    - Building codes
    - PPE
  - Global regulatory Status and related issues
REGULATORY ISSUES FOR NEW CHEMICALS

Key Domestic Regulatory Agencies

- EPA
  - Risk Management Program (CAA)
  - SARA Title III
  - TSCA
- OSHA
  - Process Safety Management
  - Hazard Communication Standard
- Department of State
  - Chemical Weapons Convention
- Drug Enforcement Administration
- State Agencies
REGULATORY ISSUES FOR NEW CHEMICALS

- United States - TSCA
  - Low Volume Exemption - 30 day review
  - Pre-manufacturing Notice - 90 day review
  - Various rules exist which EPA may utilize.

- Different levels of notification are volume based.
- Levels of notification include:
  - Annex VIIC
    - Supply at 10 - 100 kg/year
    - 2-3 months
  - Annex VIIB
    - Supply at 100 - 1000 kg/year
    - 9-12 months
  - Annex VIIA (The Base Set of data points required)
    - Supply at > 1000 kg/year
    - 12-18 months
  - Level 1 and Level 2 - Cumulative volume triggers
    - The quantity supplied
    - The results of the base set tests
    - The degree of exposure to man and the environment
European Union - 67/548/EEC (con’t.)

- All levels of notification require a risk assessment.

- Toxicity, physico-chemical data requirements vary with the level of notification.

- Several exemptions exist.
Chemical Control Regulations

- Japan
  - MITI’s Shin-Kashin-ho (New chemical substances control law)
    - Biodegradation scheme
  - MOL’s Roan-ho
    - Modified Ames

Other Countries with Chemical Control Regulations include:

- Korea
- China
- Australia
- New Zealand
- Phillipines
Industry Concerns

PFOS: Traditional chemicals may also be subject to increased scrutiny.

- Proposed SNUR
- EU White Paper proposes a testing scheme for existing chemicals, similar to that of HPV/NCSN (EU)
COMMERCIAL CONCERNS

Cost vs. Opportunity Assessment

Balance

Proprietary position?  Cost of testing
Potential Sales volume?  Cost of characterization
Probability of commercialization?  Time required for testing and characterization
Example: Hi K Precursors

- Low volume
- Low cost
- Multiple candidates
Product Risk

- Risk (Defined by APCI): The likelihood and severity of adverse effects occurring.
- The magnitude of Risk is a function of Hazard (H) and Exposure (E)

Risk = (hazard) (exposure)
Exposure Assessment:
Most probable operations to result in exposure?
What type of exposure?

- Manufacturing
- Transport
- Point of Use Handling
Handling at Facility
- Closed system
- IH monitoring shows no detectable exposure.

Handling at End Use
- No exposure expected during routine handling.
- Worker exposure during equipment PM would be an area of consideration.

Most Common Studies Sponsored for CVD Precursors
- Acute toxicity
- Flammability Studies
  - Flash Point
  - AIT (Autoignition Temperature)
  - LEL/UEL (Lower Explosive Limit/Upper Explosive Limit)
- Materials Compatibility Experiments
- Joint Work with Detector / Glove Manufacturers
WRAP UP: CRITICAL FACTORS TO DATA DEVELOPMENT

➢ **Time**
  - Product Testing
  - Preparation of Product related documents
    - MSDSs
    - Training packages
    - Promotional literature
  - Preparation of Regulatory Application
  - Gov’t review of application

➢ **Cost**
  - Product Testing
  - Manpower in testing and coordination, document preparation.
  - Manpower in application submissions
Time

- Coordination of obtaining EH&S info in a manner that allows the semiconductor industry to keep up with technology advances and still allow for good EH&S decision making.
More and more dialogue is occurring with stakeholders on how to address these issues.

Supplier/End-User Dialogue
- one-on-one
- mediated by industry groups

Must be multi-disciplinary effort
- EH&S
- Technology
- Process
- Commercial
New Product Development Takes Team Work!
Partnering with Colleagues is very valuable.