

# SC Research Opportunities

ERC Workshop - 2011

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# Fab Odor

- Fab Odor
- Large Scale PFC abatement
- Nano toxicology
- Ergonomics
- Problem chemical

# Fab Odor

- Fab Odor
  - Concern: As the use of remote plasma NF3 CVD cleans increases, so does a mysterious odor
  - What we think we know
    - This maybe due to some fluorine breakdown or recombination products
    - Increasing thermal oxidation capacity far above regulatory need resolves the issue
    - It seems that the human odor threshold is more sensitive than regulations require reduction
    - While not a regulatory issue, it is a perception concern
  - We have not been able to characterize the molecule that is the odiferous offender.
    - What is it?
    - What concentration can be detected by human olfactory receptors?
    - Is there a toxicity concern and at what level does it become a concern?

# End of Pipe PFC abatement

- Concern
  - Currently small amounts of high Global Warming Potential residues are passing through our processes
  - We minimized uses, replaced chemistries with lower GWP alternatives and converted much of our manufacturing process equipment to convert PFCs to fluorine more effectively
  - Current point of use emission controls are effective but resource and cost intensive
- Need
  - End of pipe abatement that is:
    - Highly effective (high DRE)
    - Resource efficient
    - Reliable operation
    - Easy to maintain

# New materials

- Nanomaterials and particles
  - Where to focus
    - CNT's
    - Graphene
    - Nanosilver
    - CMP slurry
  - What we need to know
    - Toxicity test methods
    - Human and Eco-toxicity results and causes
    - Purification criteria for new material specifications
    - SC product toxicity in use phase and at end of life

# Ergonomics

- Psychophysical study of 300mm wafer container handling.
  - 300mm machine interfaces were originally developed with the intention of using automated or semi-automated handling systems; however, 300mm wafer containers are handled manually at some processes in automated wafer fabs.
  - What are the effects of manual handling?
- Minimum light levels for wafer fabs.
  - Reducing light levels in wafer fabs is a way to reduce energy costs but this needs to be done intelligently. Increased automation and paperless processes have reduced the need for bright work areas in automated fabs; however, reducing light levels too much may have a negative impact on employee and product safety.
  - What is the appropriate lighting levels for optimal human performance?
- Comfort levels in cleanroom jumpsuits.
  - As temperature settings are increased so do some complaints of discomfort.
  - What is the right level?

# Ergonomics

- Psychophysical lifting, pushing and pulling data for an Asian worker population.
  - Psychophysical data is:
    - used to determine safe material handling limits for working populations.
    - well established for US and European worker populations but only a few studies exist for Asian worker populations and these studies only covered limited activities with small samples.
    - Need: data would be collected using a worker population in a laboratory setting using standard psychophysical testing protocols.
- Eye fatigue associated with microscope use.
  - Scanning electron microscopes and other metrology tools are used in advanced wafer fabs but optical microscopes are still used on legacy wafer fabs.
  - Visual inspection relies on the vigilance of the inspector to identify defects or problems. 12-hour shifts are common in the semiconductor industry so some wafer inspectors may experience visual and physical fatigue when performing this task for extended periods which may affect performance.
  - Need: Recommended rest break and job rotation schedules would help with the design of these jobs. Inspection oversights could be counted over time using defective wafers in a controlled study and the results could be used to determine time limits.

# Ergonomics

- Optimum work in process (WIP) storage heights for wafer and semiconductor device containers based on frequency of use.
  - Need: A laboratory study using standard wafer and semiconductor device containers could be set up where the variables would be the lifting heights and frequencies based on standard psychophysical testing protocols.
- A cross-sectional study of ergonomic risk factors in the Semiconductor industry similar to the one that was performed in 1995.
  - Need: Survey questionnaires would be sent to wafer fab employees at participating companies and the results would be analyzed and compared to ergonomics related injury rates for the participating wafer fabs.
    - McCurdy, S. A., Pocekay, D., Hammond, S. K., Woskie, S. R., Samuels, S. J. & Schenker, M. B. 1995, 'A Cross-Sectional Study of Musculoskeletal Symptoms and Risk Factors in Semiconductor Workers', American Journal of Industrial Medicine, vol. 28, no. 6, pp. 861-871.
- Other questions needing answers
  - Validation of recommend heights for single and multiple computer displays to accommodate the largest number of international users.
  - Studies on standing and walking fatigue in a cleanroom environment.
  - Impact of cleanroom gloves on grip strength and security of grip when holding various materials.



# Silicon Nitride Etch

- SF6 or CF4 are the gases of choice to etch Silicon Nitride
- Both are potent GWP compounds
- They need to be replaced