

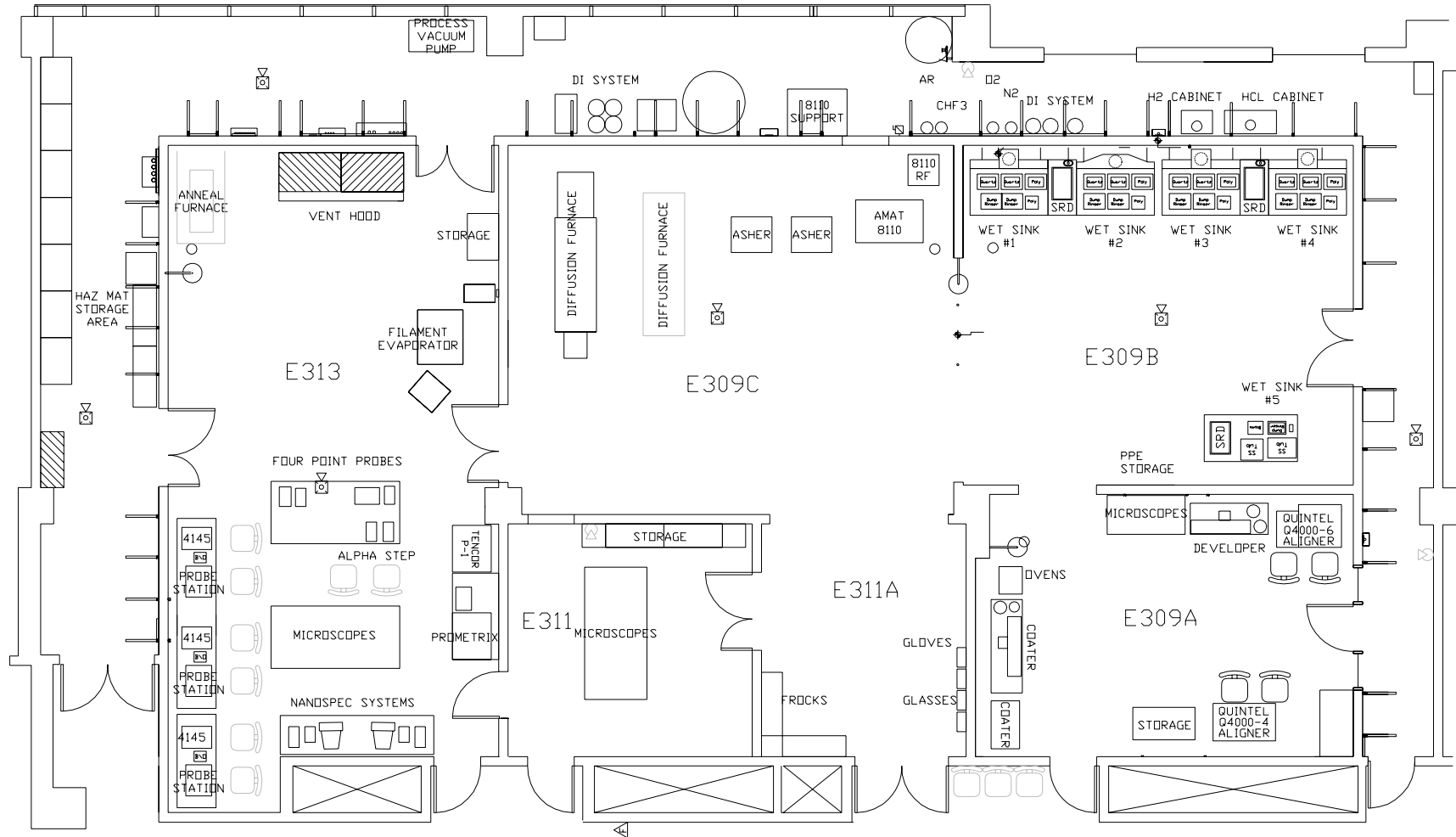
# Safety in the Microelectronics Process Engineering Laboratory

Microelectronics Process Engineering Laboratory  
College of Engineering  
San José State University

# Rules of Lab Processing

1. Be safe
2. Strictly obey Rule #1
3. Plan, execute, and document methodically
4. Keep things clean

# SJSU Microelectronics Process Engineering Lab



# Achieving Safety

- How do we achieve safe work practice?
- Real Safety Achieved through:
  - Engineered Procedures
  - Personal Protective Equipment
  - Training

# Basic Safety in Chemical Lab

# Chemical Hazards

## Routes of Entry

- Contact (through skin) -- “*Dermal Absorption*”
- Eye contact
- Eating/Drinking -- “*Ingestion*”
- Through cut/needle into blood stream -- “*Injection*”
- Breath in, mouth or nose -- “*Inhalation*”

# Types of Chemicals

- Acids
- Bases
- Solvents

# Chemicals

- Acids

- *Hydrofluoric Acid (HF)*

- Buffered Oxide Etch (BOE) [20:1 HF:NH<sub>3</sub>F<sub>4</sub>:H<sub>2</sub>O]

- Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>)

- *Phosphoric acid (H<sub>3</sub>PO<sub>4</sub>)*

- *Nitric acid (HNO<sub>3</sub>)*

- *Acetic acid (CH<sub>3</sub>COOH)*

- Hydrochloric acid (HCl)

# Effects of Chemical Exposure

- Acids (e.g., HCl, H<sub>2</sub>SO<sub>4</sub>, H<sub>3</sub>PO<sub>4</sub>, HNO<sub>3</sub>)

- Burning sensation felt immediately (except for HF)

- Rinsing with water removes the acid.

# Chemicals

- Bases or Caustics

- ➔ Potassium Hydroxide (KOH)

- (Developer)

- ➔ Ammonium Hydroxide (NH<sub>4</sub>OH)

# Effects of Chemical Exposure

- Bases (e.g.,  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ )
  - Feels Slippery (Makes Soap out of your skin!)
  - Delay in treatment will make injury worse
  - Rinsing with water removes the base

# Chemicals

- Solvents
  - Photoresist
  - Isopropyl Alcohol, Acetone
- Oxidizers
  - Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ )
  - Nitric Acid
- Mixes
  - Piranha ( $\text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2$ )

# Effects of Chemical Exposure

- Solvents (e.g., IPA, Acetone)
  - Feels cold on skin (removes oil from skin)
  - May cause dizziness, headaches, nausea
  - Wear Gloves when using IPA, Acetone
- Oxidizers
  - Burning sensation
  - May cause “bleaching” of skin by removing pigment

# Emergency Procedures

- In case of chemical exposure, immediately flush area with cool water ( $\geq 15$  min.)
  - Eyewash
    - Eyes must be held open for flushing to be effective
    - Buddy can hold eyes open for injured person
  - Shower
    - Remove all contaminated clothing
    - Cools the area and washes liquid chemical off affected area
    - Shower is COLD! (Why?)

# Personal Protection

- NEVER start a job if you are unsure of the hazards, procedures, or PPE
- Always assume the worst
  - Unknown liquid spills are hazardous
  - Unlabelled bottles contain surprises
  - USED PPE is contaminated or damaged

# Protection -- PLAN!

- ALWAYS USE THE BUDDY SYSTEM when working with hazardous materials
- BUDDY MUST BE IN THE WET LAB, --- either within sight or sound
- -- able to assist in seconds
  - Exception: Non-hazardous operations (e.g., wafer removal from ovens).

# Personal Protective Equipment

## PPE

- Eye and Face Protection
  - Faceshields are required when working at wet benches
  - Faceshields protect entire face from splash

# Personal Protective Equipment

## PPE

- GLOVES

- Chemical resistance is based on construction material

- Use special gloves for acids, bases

- Use special gloves for solvents

Beware choosing gloves by color --

Read the label!

# Personal Protective Equipment

## PPE

- GLOVES

- Leak check before each use
  - Use air gun away from sinks
- Worn on outside of apron, and cuffed
- Secondary gloves (over latex gloves)
- Rinse gloves prior to removal
- Avoid touching outside of glove with bare hands while removing

# Personal Protective Equipment

## PPE

- APRONS

- Ensure apron is clean before each use
- Apron should extend down to shoe tops
- Apron is open in back
- Wipe down apron prior to removing

- FOOT PROTECTION

- Closed-Toe work shoes
- Non-absorbent materials, no cloth

# Earthquake

- Chemicals may splash from baths
- Chemicals may fall off shelves
- Overhead objects may fall
- Chemical storage cabinets may open if not closed tightly
- **BEFORE** the earthquake occurs,  
**IDENTIFY** the safe place to escape
  - Get into the habit of checking exits!