Foundations of Semiconductor Manufacturing

LAB ACTIVITY: HUMAN CONTAMINATION AND WAFER CLEANING PROTOCOLS

Name	Class/Period	Date

1. Overview

In this lab activity, you will intentionally contaminate a silicon surface to observe the destructive impact of human contact on semiconductor devices. You will press a bare finger onto a wafer, examine the resulting oils and salts under a digital microscope, and learn why human sweat is highly toxic to microscopic circuits. Finally, you will execute a standard chemical wipe-down procedure to clean the wafer and evaluate the effectiveness of your cleaning technique.

2. Performance Objectives

After completing this lab activity, you will be able to:

- Visually identify human fingerprint oils (sebum) and sweat residues on a highly polished surface using a digital microscope.
- Explain the chemical threat that sodium and organic oils pose to semiconductor metal interconnects.
- Execute a basic unidirectional wafer cleaning protocol using isopropyl alcohol and lint-free wipes.
- Evaluate the effectiveness of a cleaning procedure through post-cleaning microscopic inspection.

3. Required Materials

The following materials are required to complete this lab activity:

- Uncut silicon wafers (1 per team)
- High-magnification digital microscope (up to 2000X) (1 per team)
- Cleanroom gloves (1 pair per student)
- Lint-free cleanroom wipes (several per team)
- Isopropyl alcohol (IPA) in a small dispenser or dropper bottle (1 per team)
- Wafer handling tweezers (1 per team)

4. Preparation Checklist

Before beginning the lab activity, review this checklist and mark off each item as you complete it.

- ☐ All hardware components and cleaning chemicals are available at the workstation.
- ☐ The digital microscope is powered on, focused, and ready for observation.
- ☐ Cleanroom gloves are available but are not worn at the very start of the experiment.
- ☐ You have read through the entirety of this document to familiarize yourself with the requirements.

5. Lab Activity

5.1. Key Terms

Before beginning the lab activity, review these key terms:

- **Sebum:** The natural organic oil produced by human skin, which acts as a sticky trap for other particulate contaminants.
- **Sodium (Na):** A highly reactive chemical element found in human sweat that easily corrodes the aluminum and copper wiring on a microchip.
- **Unidirectional Wipe:** A cleaning technique where a surface is wiped in only one direction to sweep contaminants off the edge, rather than scrubbing in circles.

5.2. Intentional Contamination and Observation

You will now act as a source of contamination.

Perform the following:

1. Ensure your hands are bare (no gloves). Rub your thumb lightly against your forehead or the side of your nose to pick up natural skin oils.
2. Press your thumb firmly into the center of the silicon wafer.
3. Place the wafer under the digital microscope and focus on the fingerprint.
4. Observe the contamination. You will likely see thick ridges of oil, trapped dead skin cells, and potentially small crystalline structures from the salt in your sweat.
5. Discuss with your team: How many individual microscopic die would this single fingerprint cover and destroy on a modern silicon wafer?

5.3. Wafer Cleaning Protocol

You will now attempt to rescue the contaminated wafer. Perform the following:

1. Put on your cleanroom gloves to prevent any further contamination.
2. Take a cleanroom wipe and fold it into quarters to create a neat, slightly padded edge.

3. Apply a few drops of isopropyl alcohol (IPA) to the folded edge of the wipe. Do not soak it, but it should be damp.
4. Place the damp edge of the wipe at the very top of the wafer. Applying gentle, even pressure, pull the wipe straight down across the fingerprint in a single, smooth, unidirectional motion. Do not scrub back and forth.
5. Lift the wipe off the wafer. If a second pass is needed, fold the wipe to expose a completely fresh, clean surface, apply IPA, and repeat the single downward swipe.

5.4. Post-Cleaning Inspection

Perform the following:

1. Place the newly cleaned wafer back under the digital microscope.
2. Scan the area where the fingerprint used to be.
3. Analyze your cleaning technique: Are there remaining streaks of oil? Did the wipe itself leave behind any microscopic lint or fibers?
4. Discuss with your team why a fully automated chemical wash is preferred in modern foundries over manual human wiping.

6. Authentic Skill Assessment

Have your instructor verify that you have met the requirements for the performance objectives and sign below. Keep this lab activity sheet for future reference.

Instructor Signature	Date