ROCHESTER INSTITUTE OF TECHNOLOGY
MICROELECTRONIC ENGINEERING

Particulate Contamination Studies "Blue Booties Don't Help"

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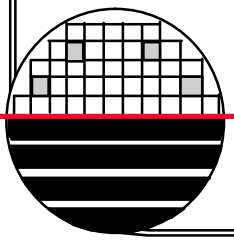

OUTLINE

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Measuring Particles Added
Furnace and LPCVD
Dirty tubes from process
Dirty tubes from dirty pull rod, profile tubes, boats
Dirty tubes from mechanical sources
Tube 12 is cleanest
Conclusions
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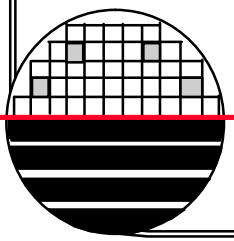
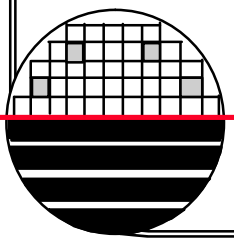
Homework



INTRODUCTION

The students in the Microelectronics Manufacturing class are doing a unit on particulate contamination in the clean room. We have in the past looked at airborne particle counts, particles added to wafers setting out in the lab or in storage boxes and particles added by the equipment and processes itself. In general the clean room is fairly clean. The tools are the problem. Several tools add thousands of particles to wafers each time they are used.

This includes Dryteck Quad, LPCVD Tubes, CVC Sputter Tool and Tegal Asher. The ion implanter is the cleanest tool in the lab.



MEASURING PARTICLES ADDED

Particles added are measured using the Tencore Surfscan.

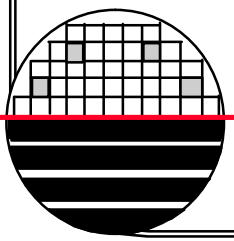
Measure first
Place wafers in tool
Do everything except deposit or etch
Measure second time
Take the difference
Repeat several times

FURNACE AND LPCVD TUBES

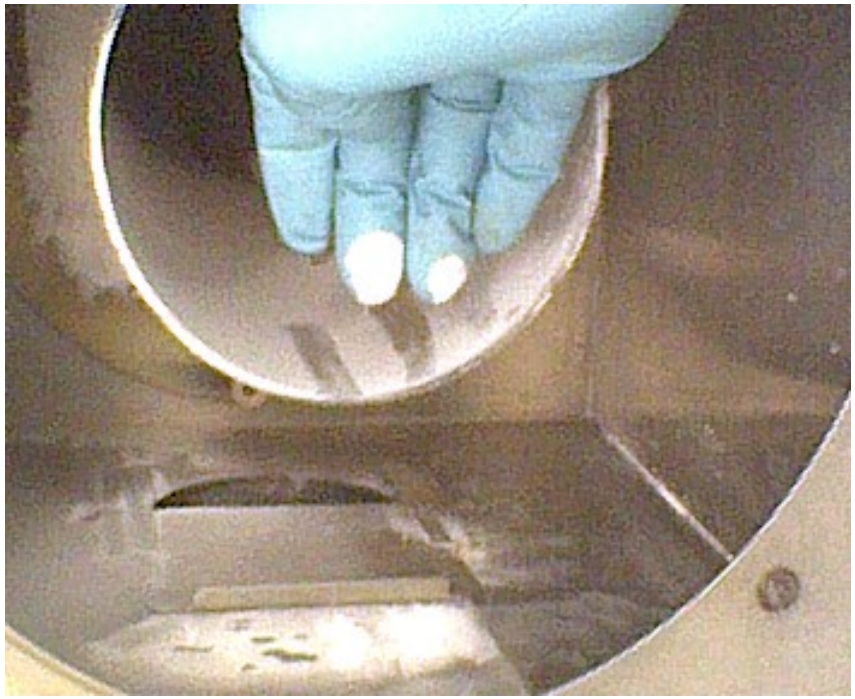
This study focuses on the furnace tubes including LPCVD.
All tubes were found to be dirty and add hundreds of particles to each wafer.

The particles come from

- dirty tubes from process
- dirty tubes from mechanical sources
  - (wheels on paddles, sliding boats in/out)
- dirty push rods
- dirty push rod storage tubes
- dirty profile tube (4” LPCVD)
- dirty profile tube storage tube
- dirty flaking boats (LPCVD)



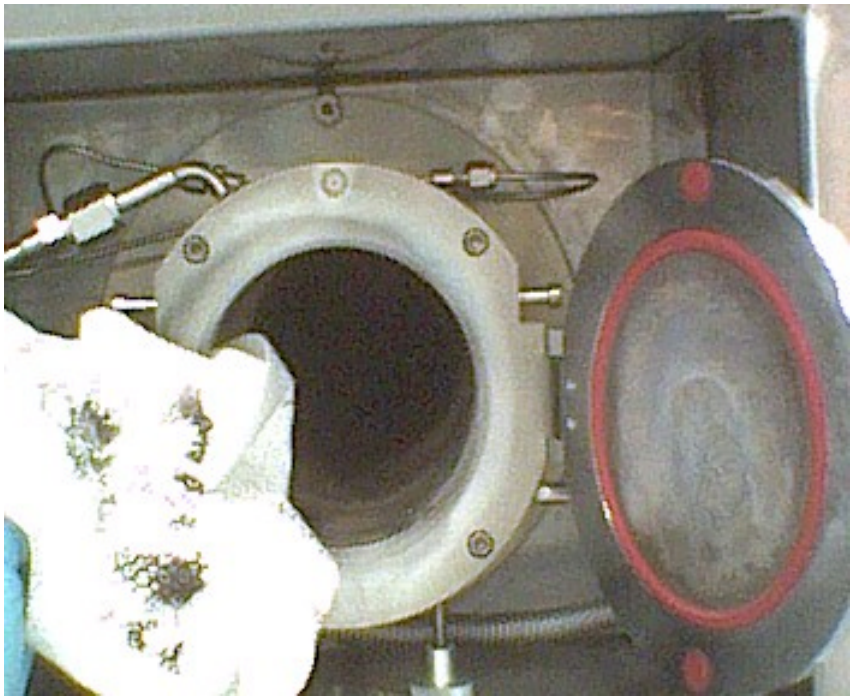
DIRTY TUBES FROM PROCESS



Tube 15 TEOS Process

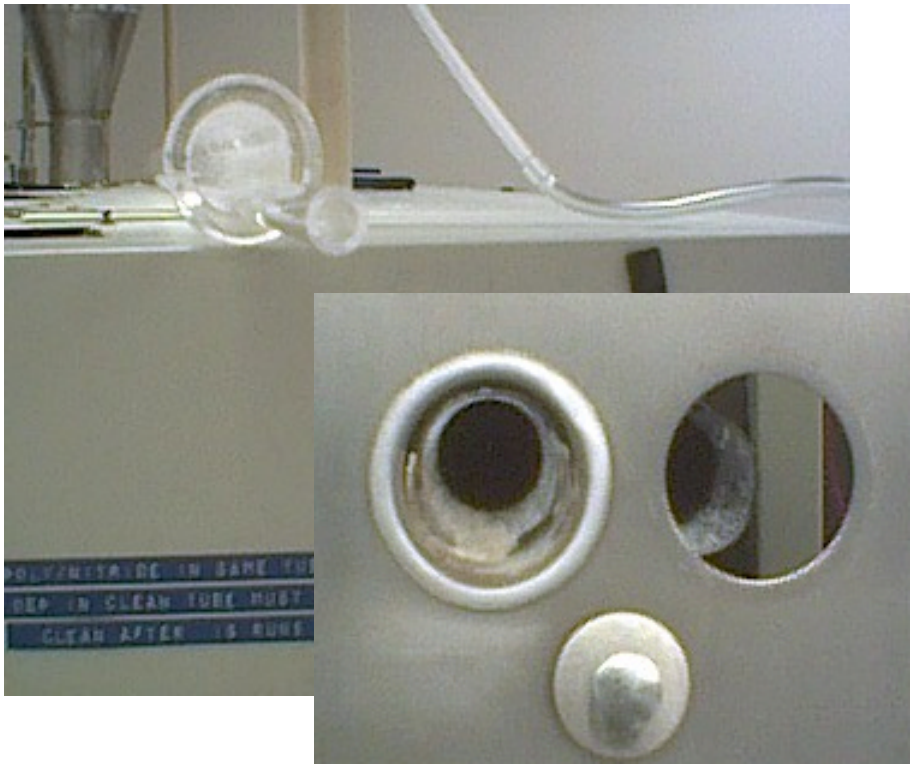
DIRTY TUBES FROM PROCESS

Tube 17

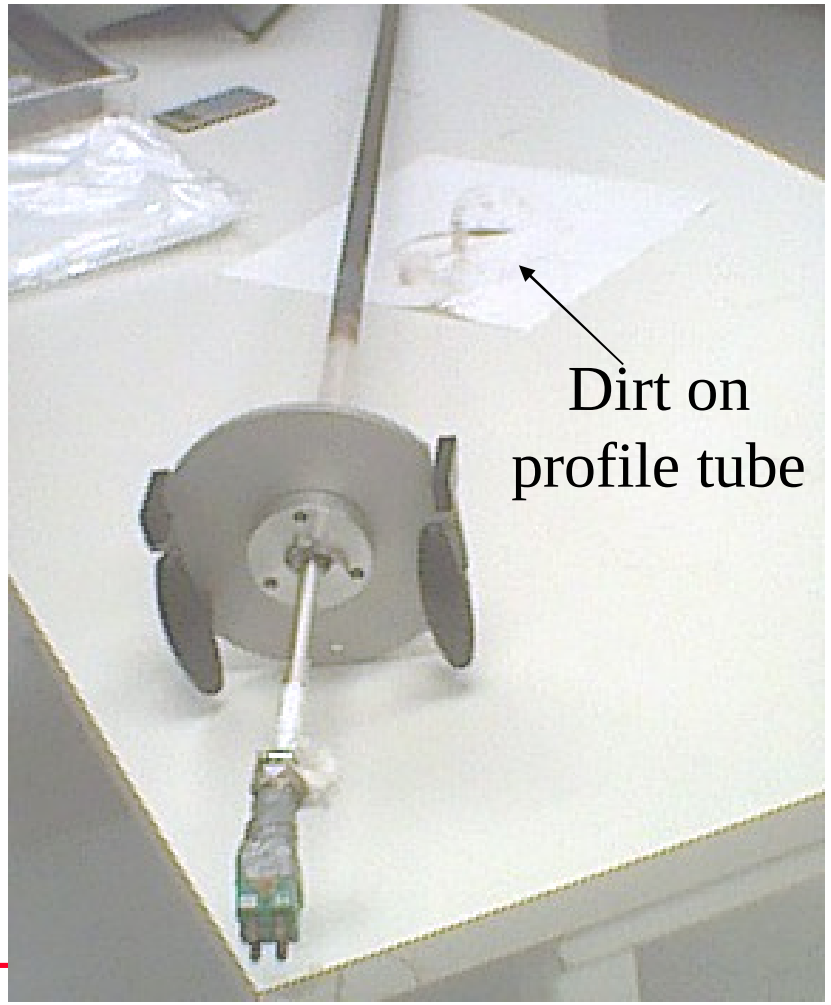


Dirt on inside walls of
4” LPCVD Tube

DIRTY PULL RODS, PROFILE TUBES AND STORAGE TUBES FOR PULL RODS AND PROFILE TUBES

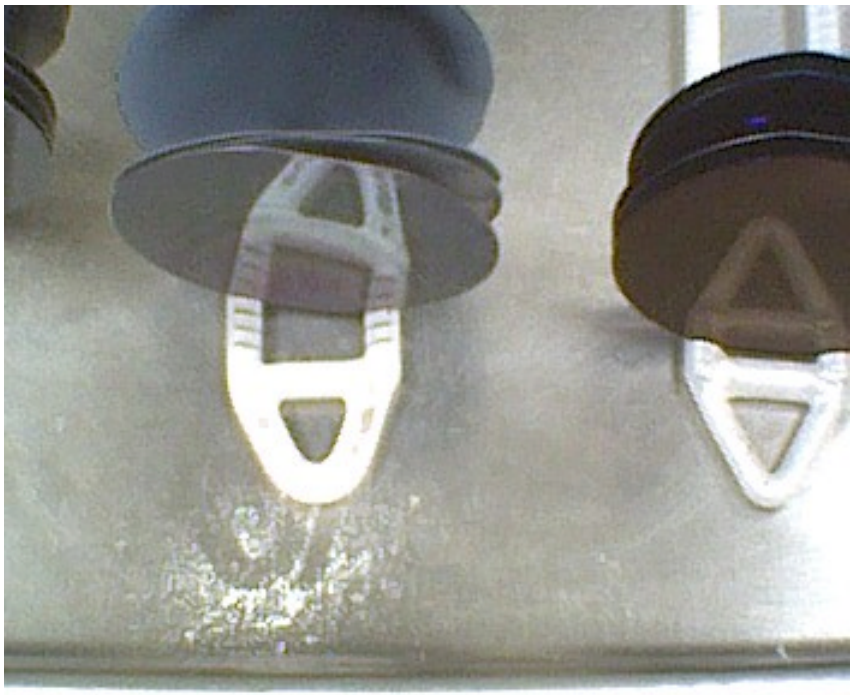


Dirty storage tubes for
Pull rods and Profile tubes



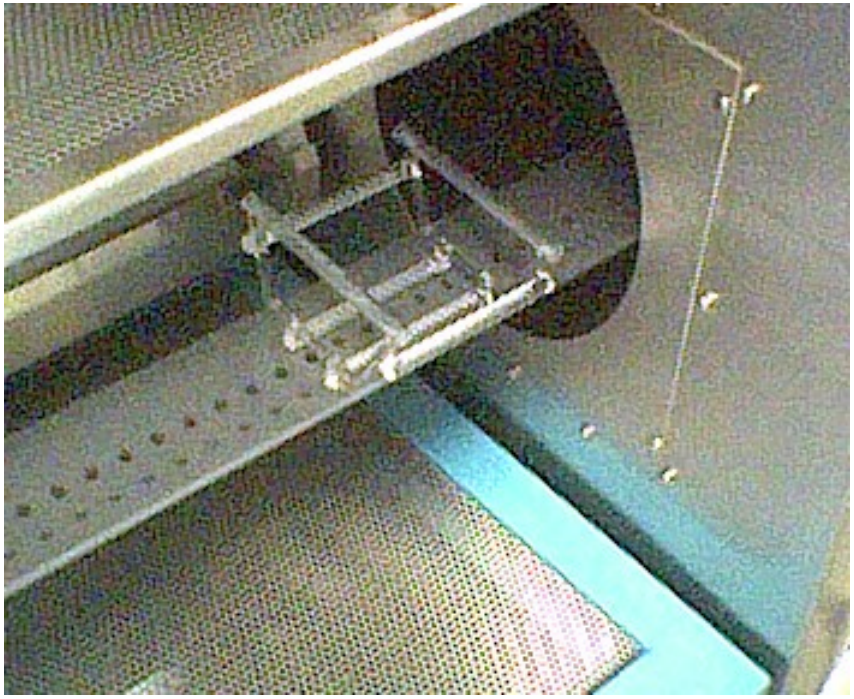
DIRTY FLAKING BOATS

Dirty boats in Tube 3 and dirt on paddle
also wheels leave quartz dust in tube



Flakes from 4” LPCVD Boats

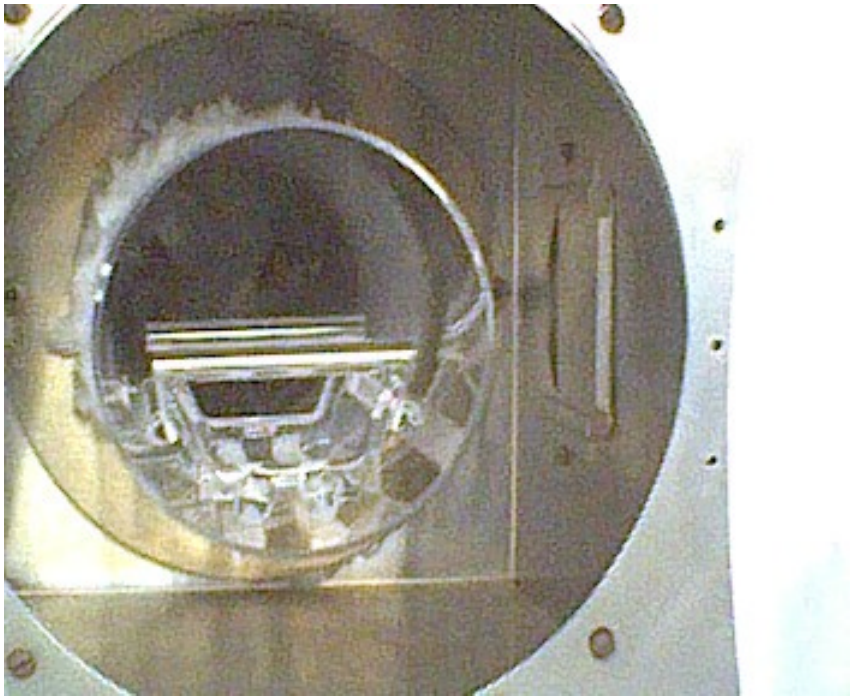
CANTILEVER, SLIDING BOATS, PADDLE WHEELS

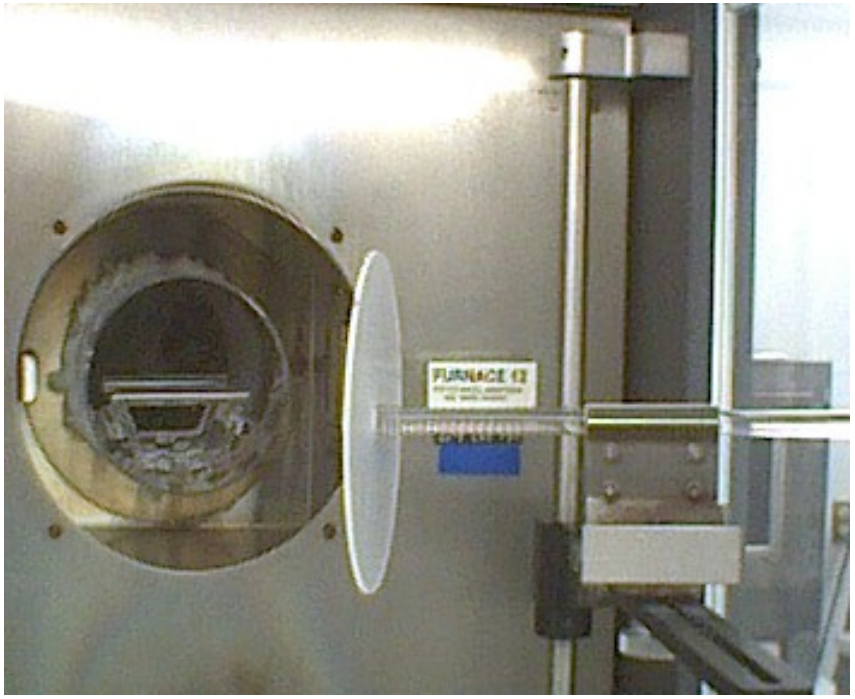


The cantilever in tube 1 and 4 avoids wheel marks, but this paddle on tube 4 is dirty itself

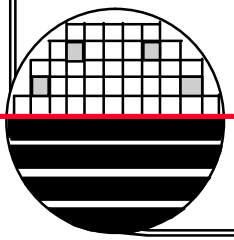
Boats slide in/out creating quartz dust

TUBE 12 IS THE CLEANEST





Tube 12, Clean
4” Gate Oxide Tube



LARGE NUMBERS OF PEOPLE IN THE CLEANROOM

CLEANING

Cleaning needs to be done regularly

The blue booties are reused at RIT and sometimes are quite dirty

FIXING EQUIPMENT

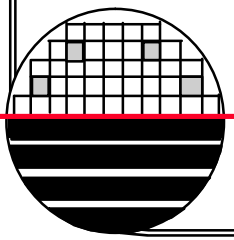
Fixing equipment must be done but often results in lots of particles in the area

WORKING IN THE SERVICE CHASE, TOOL CARTS

Microelectronic Engineering

CONCLUSION

1. There are lots of opportunities to introduce particles in any cleanroom.
2. There is a lot of dirt in the furnace and LPCVD tubes at RIT
3. Wafers inserted into these tools show hundreds of added particles on each wafer
4. A cleaning schedule should be set up.



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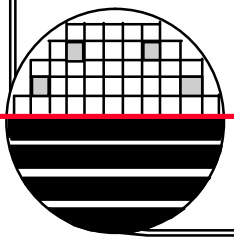

HOMEWORK – DIRTY FURNACE AND LPCVD

1. Obtain a clean wafer, count surface particles, push into furnace, pull from furnace, count surface particles and calculate added particles.