Solid State Sensors

Tour of Auburn’s Broun Hall Microfabrication Lab

9/5/14

Microfabrication Lab Safety

- Dangerous chemicals and equipment used
- Safety is VERY important
  - Poisoning
  - Burns
  - Cuts
  - Electrocution
  - Irradiation
  - Death

- Chemical safety
  - Acids – severe burns
  - Toxic liquids and gases
  - Flammable liquids
  - Explosive potential
- Equipment safety
  - High voltage
  - UV / X-ray radiation
  - High pressure
  - High/low temperatures
  - Glassware (sharp if broken)
- Proper clothing required
  - Clean room suit
  - Protective gloves
  - Safety goggles

A Microlab when Safety is Ignored

Cleanliness

- Very important in microfabrication
- 100μm width human hair: 10μm device feature
- Class X cleanroom: less than X 0.5μm particles per cubic foot
  - Ex: Class 10,000: > 10,000 0.5μm particles per ft^3
- AU microlab:
  - Class 1000/2000 in open areas
  - Class 100/200 in photolithography room

Typical Cleanroom Clothing

Low particulate cleanroom suit

Protective gloves

Hair net

Safety glasses required when working with chemicals

Booties

Oxidation and Diffusion Furnace

- For thermally growing Silicon Dioxide (SiO_2) on Si wafers
  - Uses an oxygen torch and a hydrogen torch
  - Oxidation process
- For diffusion doping of Si wafers
  - To make n-type or p-type regions
  - Such as piezoresistors

Oxidation and Diffusion Furnace

LPCVD System

- "Low Pressure Chemical Vapor Deposition"
- For growing a layer of polysilicon on a wafer
- Also for growing a layer of silicon nitride on a wafer
- Typically thin films, $\leq 5\mu m$ thick

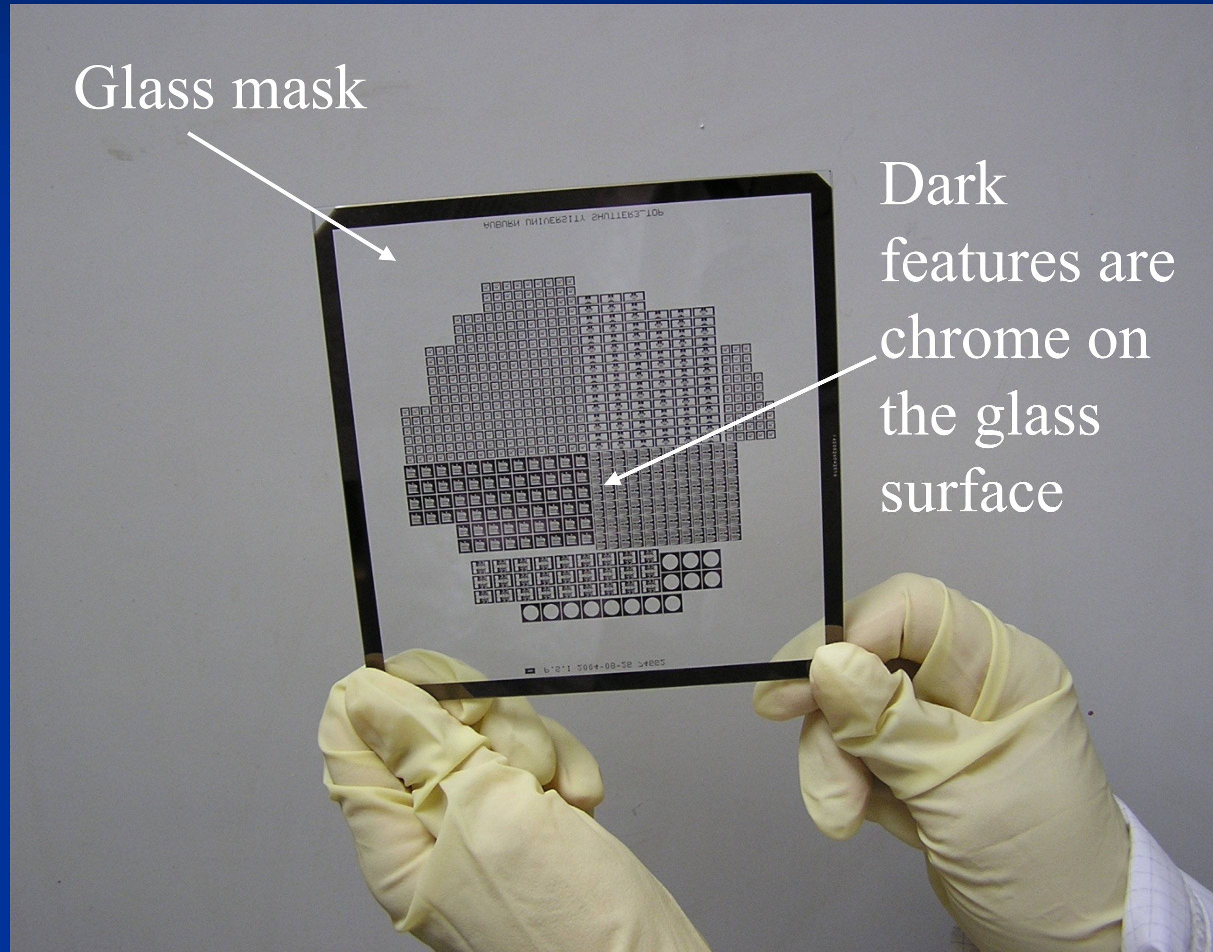
LPCVD System

PECVD System

- "Plasma Enhanced Chemical Vapor Deposition"
- Low temp Si dioxide (LTO) deposition
- Low temp silicon nitride (SiN) deposition
- Deposition of other conformal thin film coatings via plasma processing

PECVD System

Photograph of a Photolithography Mask



Spinner for Applying Photoresist to a Wafer

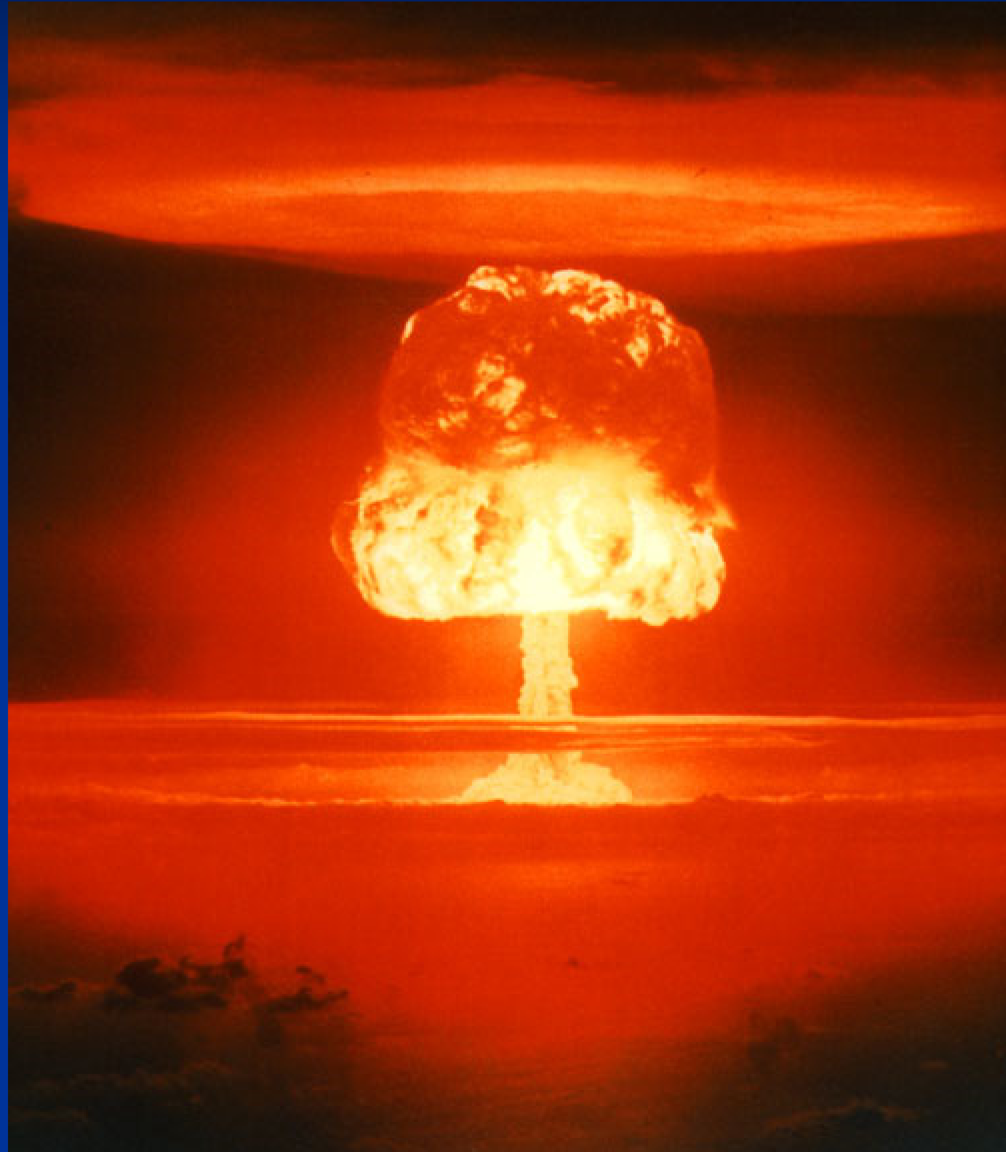
Photograph of a MA/BA6 Mask Aligner

Wet Chemical Processing

Vapors are pulled up and out of the lab through a ventilation hood

Acids and solvents processed separately

When Acids and Solvents Mix



Removing Used Photoresist

- Can be removed chemically using solvents such as acetone
- Can be removed by Ashing
  - An oxygen plasma treatment that burns organics off the surface

Matrix Asher

Sputtering and Electron Beam Deposition

- Has 2 electron guns a one sputtering gun
- Holds 1 sputter target and 7 E-beam targets
  - Can deposit 8 different materials without breaking vacuum
- With the 2 E-guns, can co-deposit 2 materials at the same time
  - Can deposit alloys on a substrate

Typical cleanroom suit

Mark 50

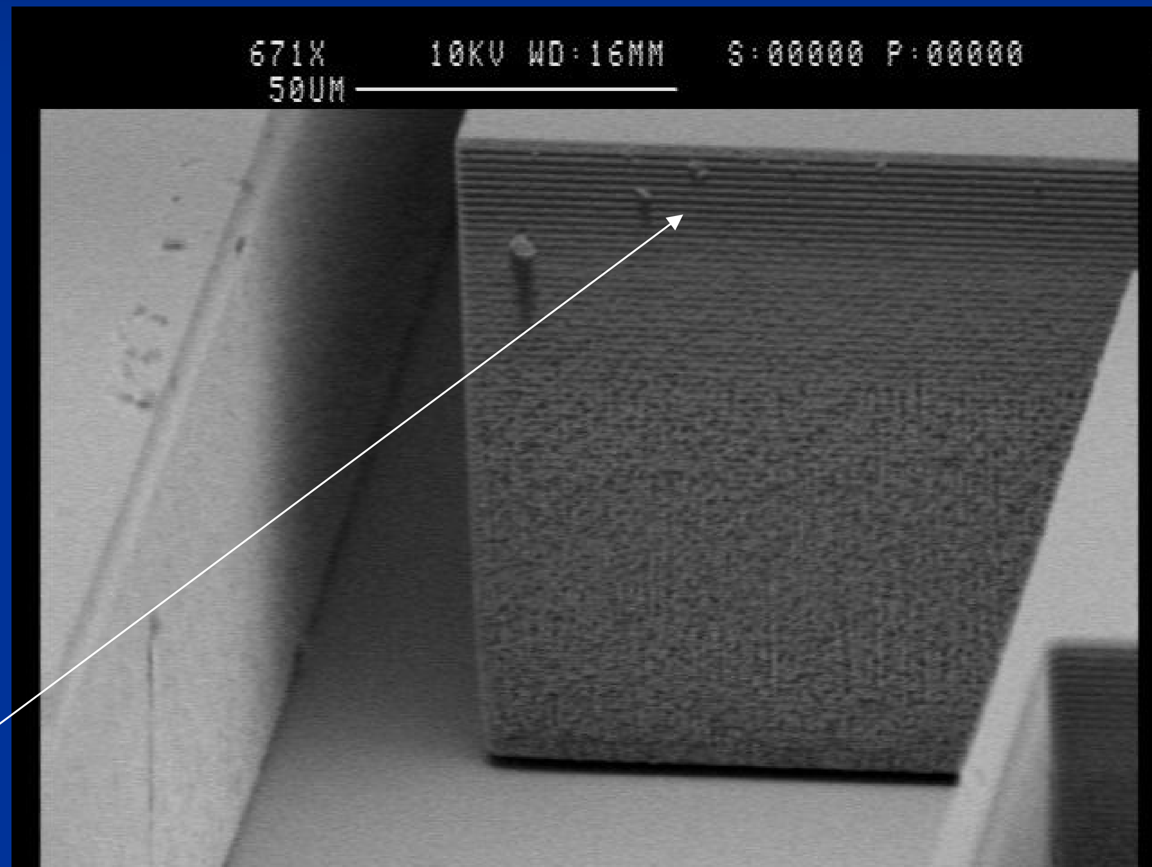
STS Advanced Silicon Etcher

- Bosch process DRIE etcher for Si wafers
- Holds 4” diameter wafers
- Can obtain a 10:1 aspect ratio when etching through a Si wafer
- Real “workhorse” for most MEMS fabrication projects at Auburn

STS ASE Bosch Process Si DRIE Etcher

A Dry Etched Si Wall

Bosch dry etching process results in horizontal micro trenches on vertical surfaces



STS Advanced Oxide Etcher

- Non-Bosch process RIE system for non-Si materials:
  - Glass
  - Titanium thin films
  - plastics

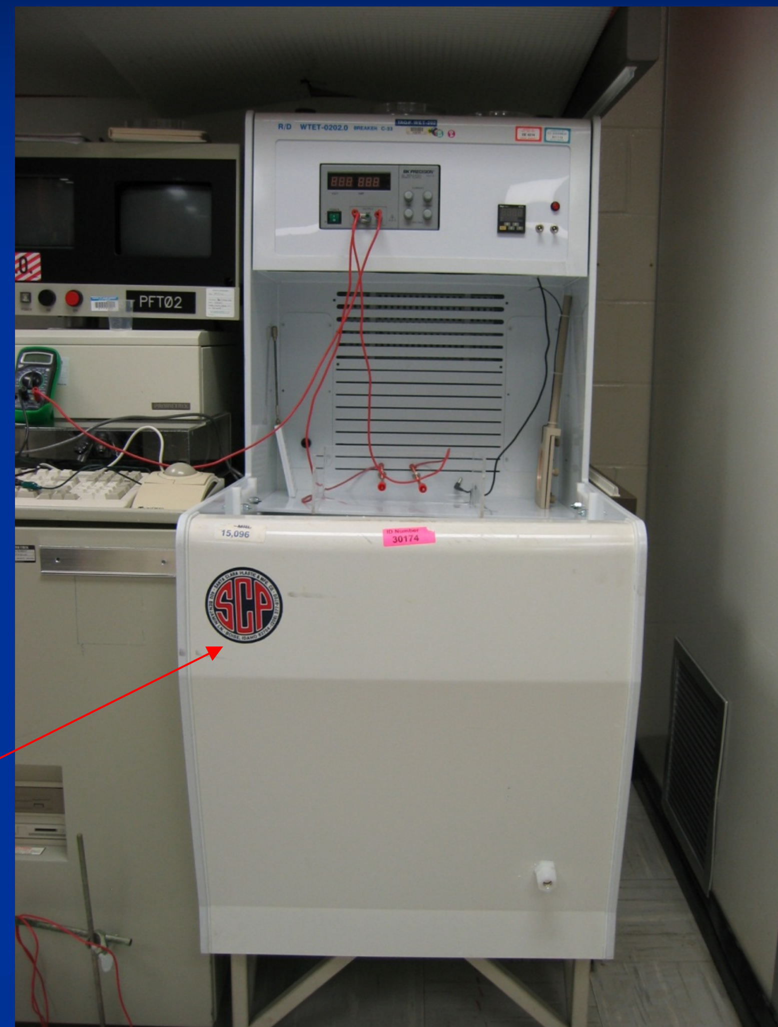
STS AOE RIE Etcher

Profilometer

- Measures the depth of etched features
- Used along with RIE to determine when the desired etch depth has been reached

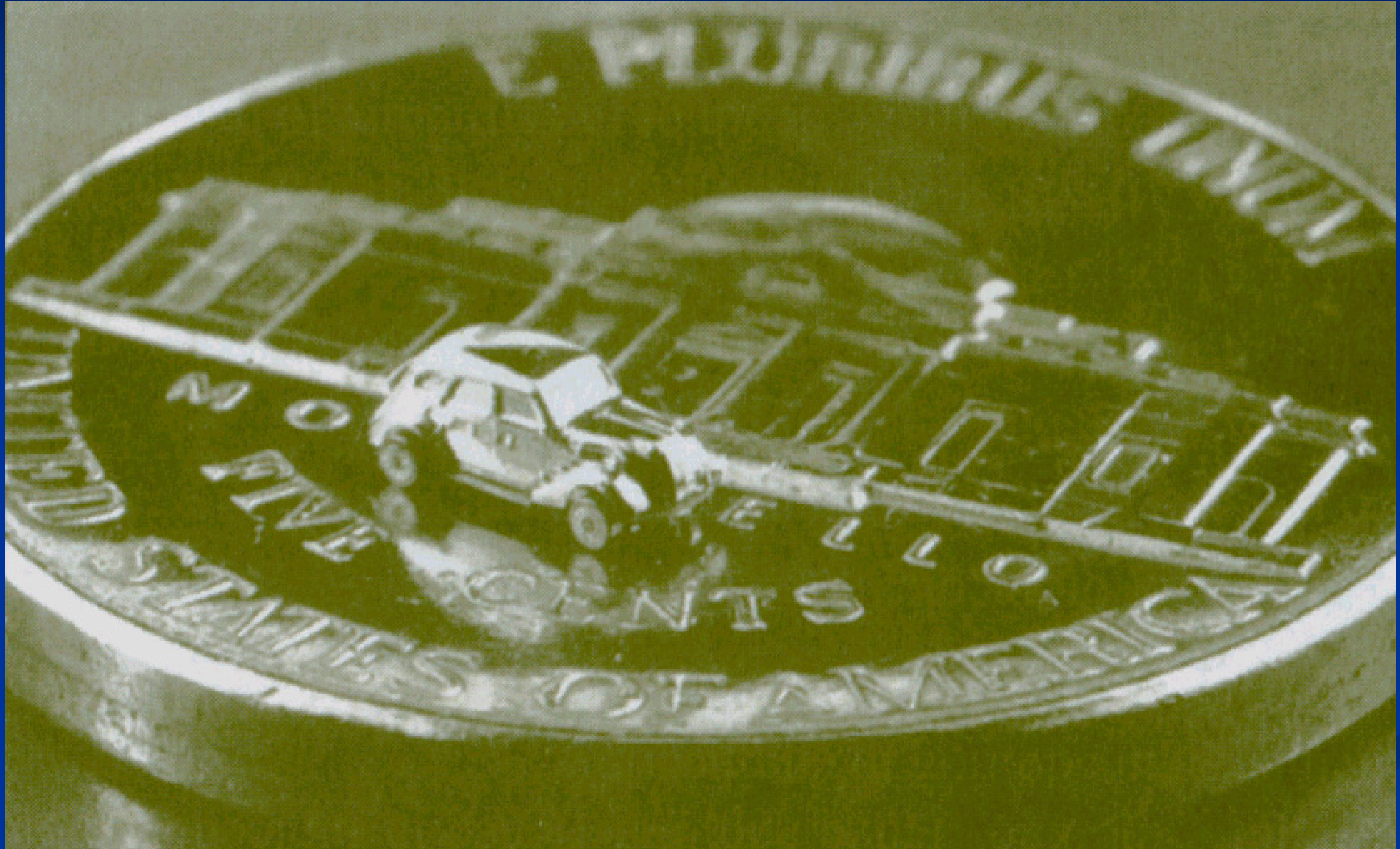
Electroplating System

- Electroplating used to grow metal micro-structures
- Cu, Ni, Au, Sn, etc. can be electroplated



Wafer Plating System

Plating Working Electric Car



Polyimide Processing

- Polyimides are special plastics
- Wafers can be coated with polyimide layers
- The polyimide can then be cured in this special vacuum furnace

Polyimide Vacuum Curing Oven

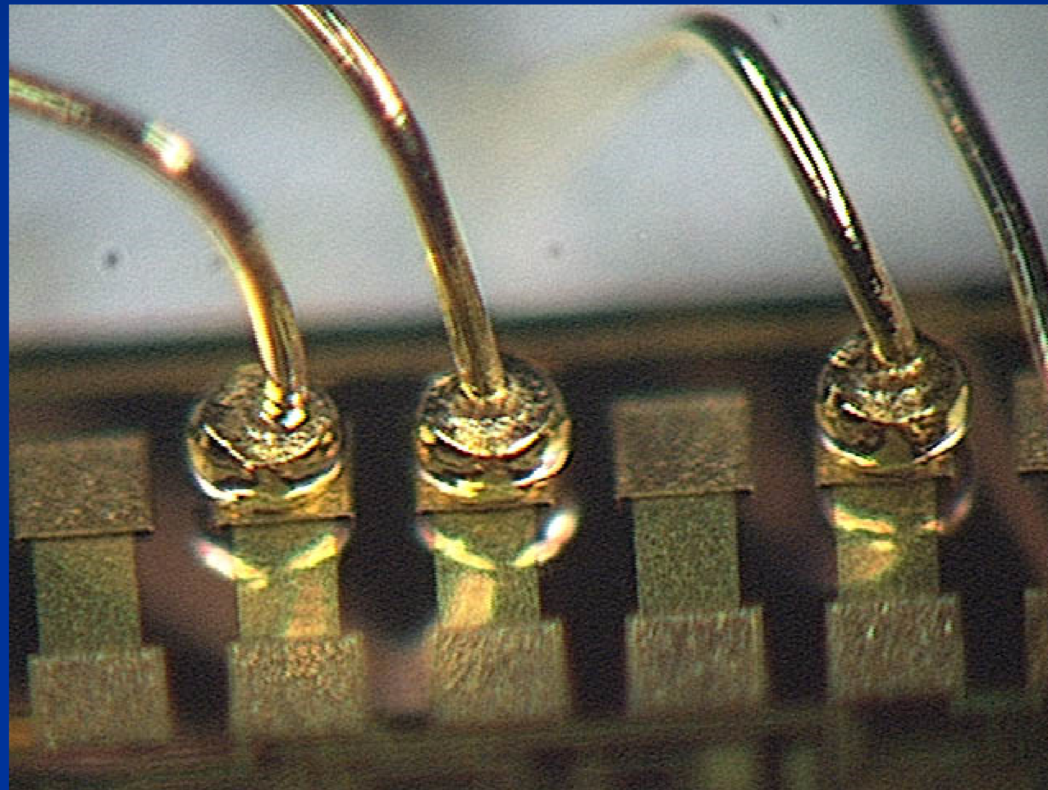
Automated Dicing Saw

- Dices a wafer into die
- Uses a diamond saw blade
- Water cooled
- Wafer attached to a tape told hold die in place

Automatic Thermosonic Wirebonder

- Die are wire bonded to package pads for electrical connections
- Gold wire bond wire is used (~25µm diameter)

Photo of Wire Bonds



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