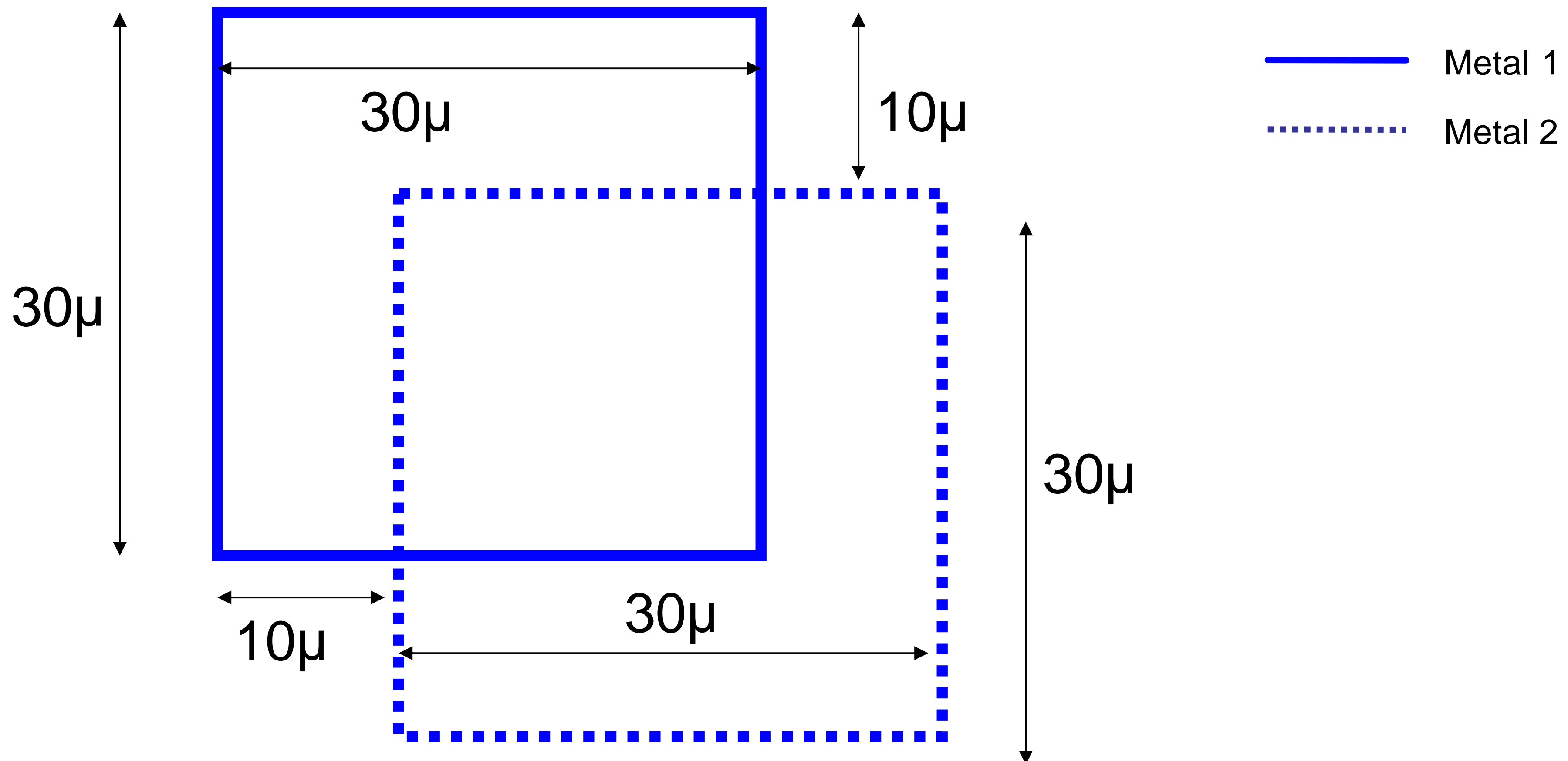
EE 434
Lecture 10

Process Flow (animated)
Backend Processing Steps

Quiz 8

Two metal layers, Metal 1 and Metal 2, are shown. Both are above field oxide. Determine the capacitance between Metal 1 and Metal 2. Assume the process has capacitance densities from M_1 to substrate of $.05fF/u^2$, from M_1 to M_2 of $.07fF/u^2$ and from M_2 to substrate of $.025fF/u^2$.



And the number is ….

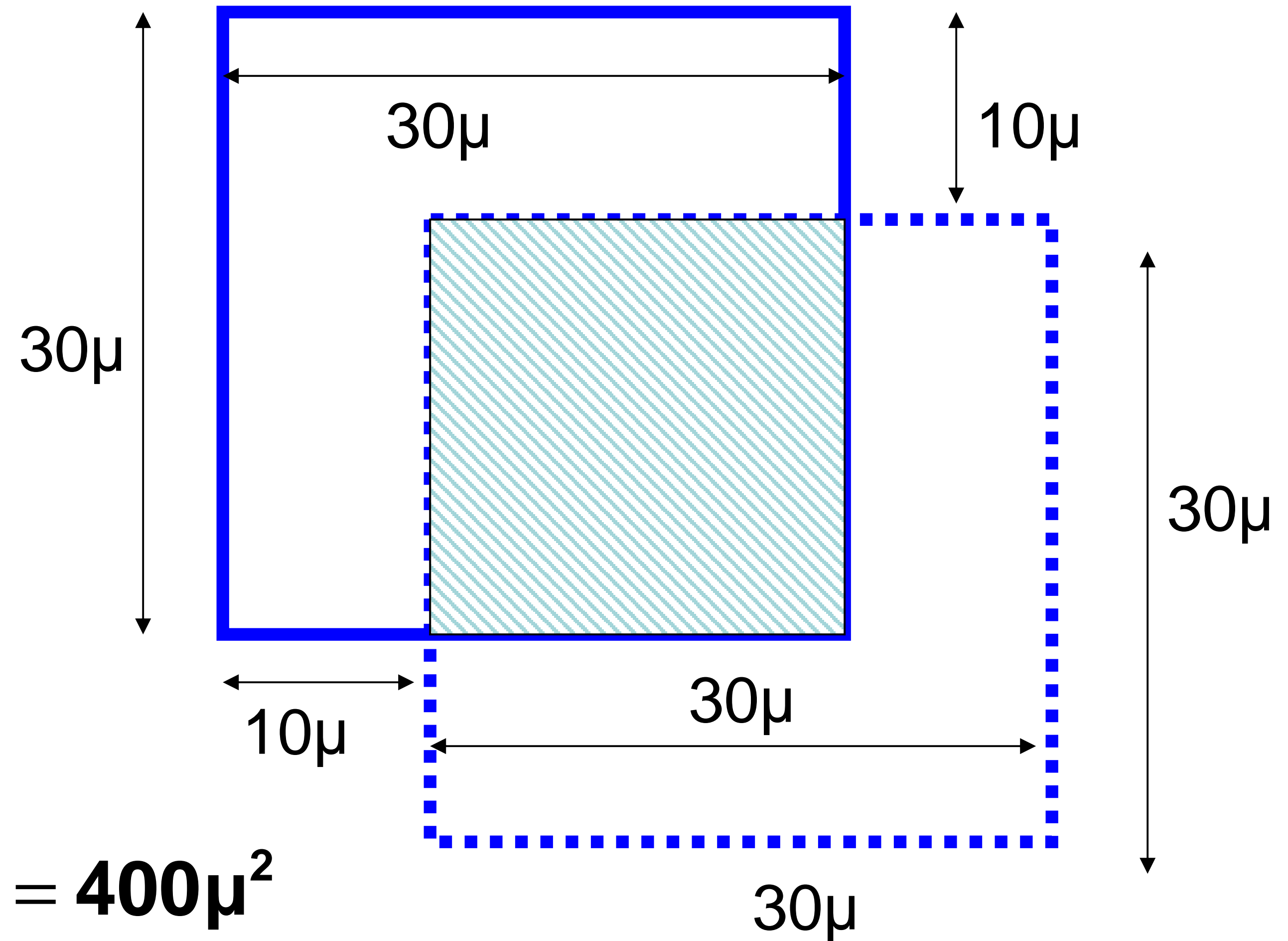
1 8 7 5 3

6 9 4 2

1

Quiz 8

Solution



$$A_{C1C2} = (20\mu)^2 = 400\mu^2$$

The capacitance density from M_1 to M_2 is .07fF/u^2

$$C_{12} = A_{C1C2} \bullet C_{D12} = 400\mu^2 \bullet 0.07\text{fF}/\mu^2 = 28\text{fF}$$

Review from Last Time

- Diffusion is used to force migration of impurity atoms into substrate
  - Time and temperature dependent
  - Type of grading can be controlled
  - Subject to subsequent movement when other warm processing steps are done
- Epitaxy
  - Single crystalline extension of substrate
  - Grows slowly to maintain crystalline structure
- Polysilicon
- Used for gates of transistors
  - Comprised of many small crystals
  - Makes good conductor if heavily doped
  - Makes good resistor if moderately doped

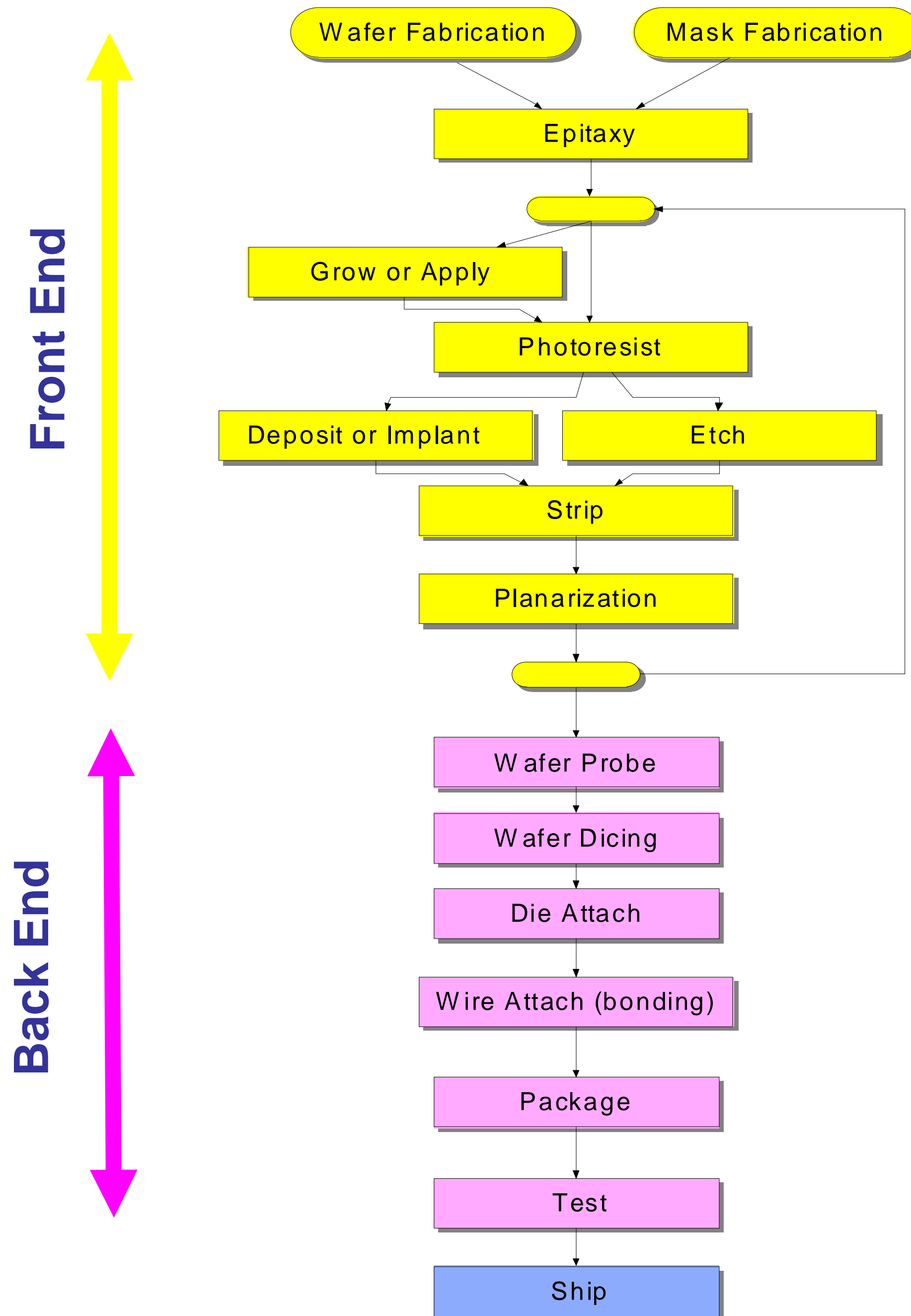
Basic Devices

- Standard CMOS Process
  - MOS Transistors
    - n-channel
    - p-channel
  - Capacitors
  - Resistors
  - Diodes
  - BJT (in some processes)
    - npn
    - pnp
- Niche Devices
  - Photodetectors
  - MESFET
  - Schottky Diode (not Shockley)
  - MEM Devices
  - ….

Primary Consideration in This Course

Limited Consideration in This Course

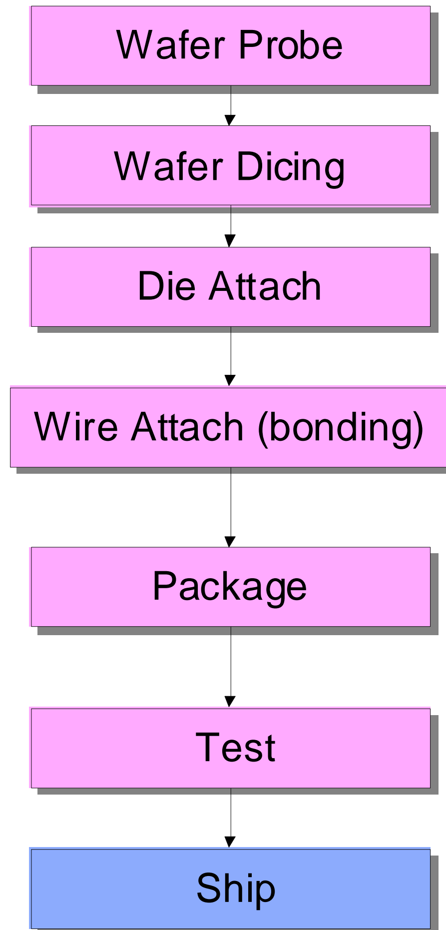
Generic Process Flow



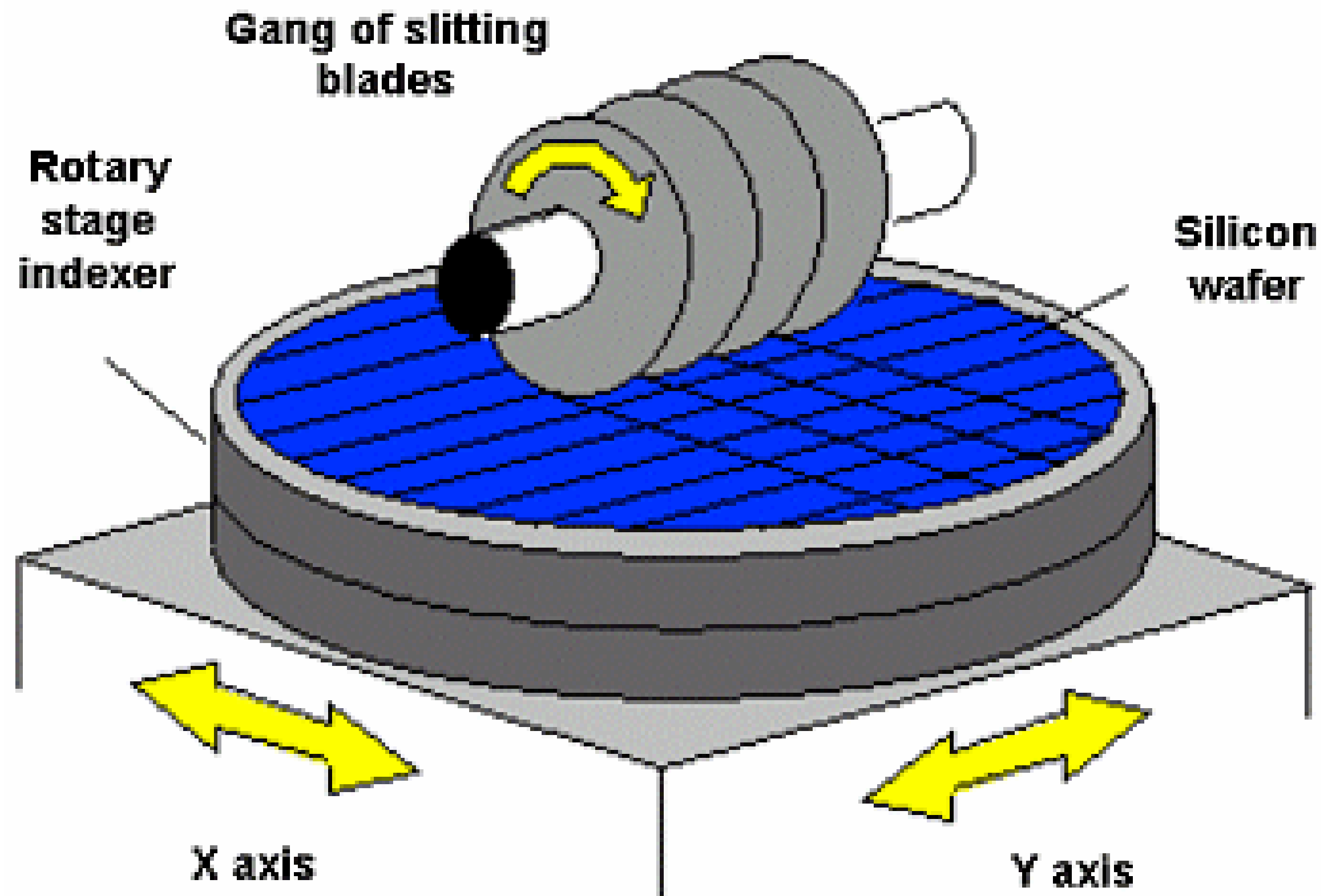
Front-End Process Flow

- Front-end processing steps analogous to a "recipe" for manufacturing an integrated circuit
- Recipes vary from one process to the next but the same basic steps are used throughout the industry
- Details of the recipe are generally considered proprietary

Back-End Process Flow



Wafer Dicing



www.renishaw.com

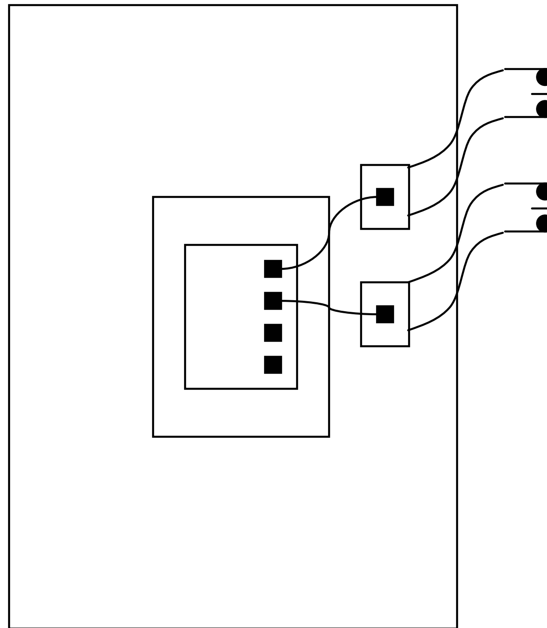
Die Attach

1. Eutectic
2. Pre-form
3. Conductive Epoxy

Electrical Connections (Bonding)

- Wire Bonding
- Bump Bonding

Wire Bonding



Wire – gold or aluminum
25 μ in diameter

Wire Bonding

Excellent Annimation showing process at :

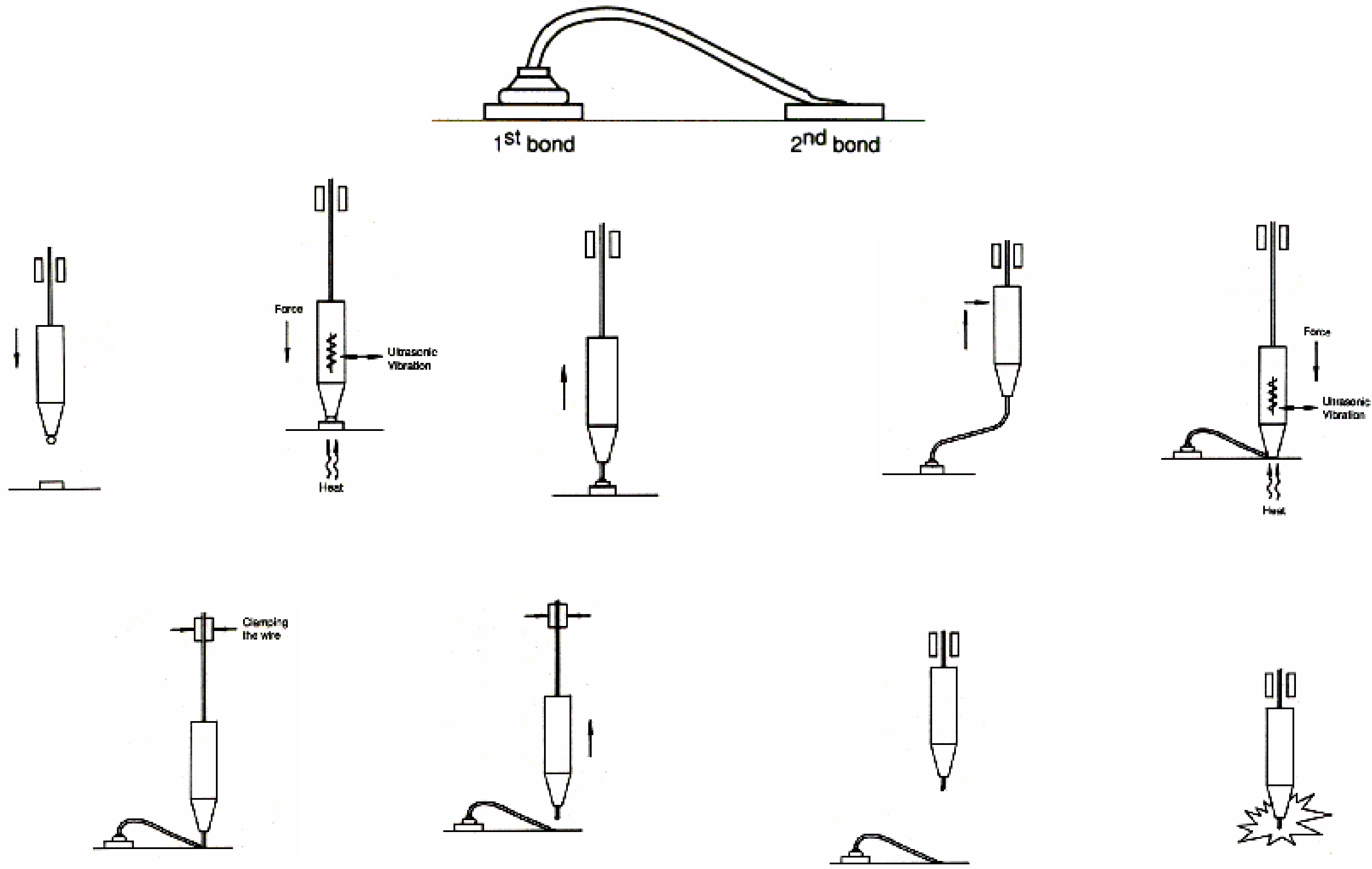
http://www.kns.com/_Flash/CAP_BONDING_CYCLE.swf

Wire Bonding

Ball Bond

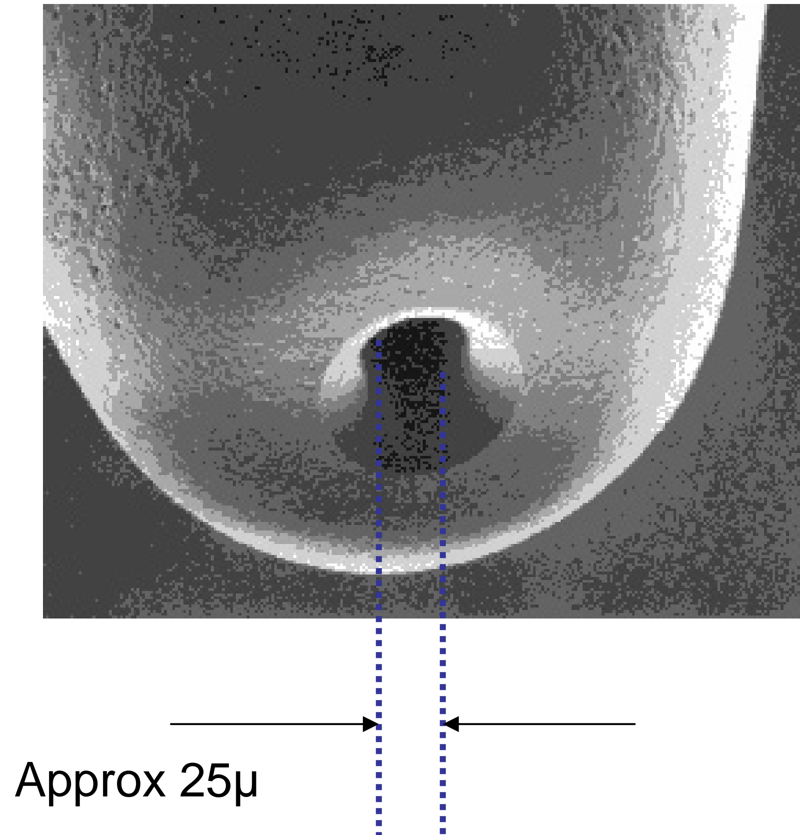
Wedge Bond

Ball Bonding Steps

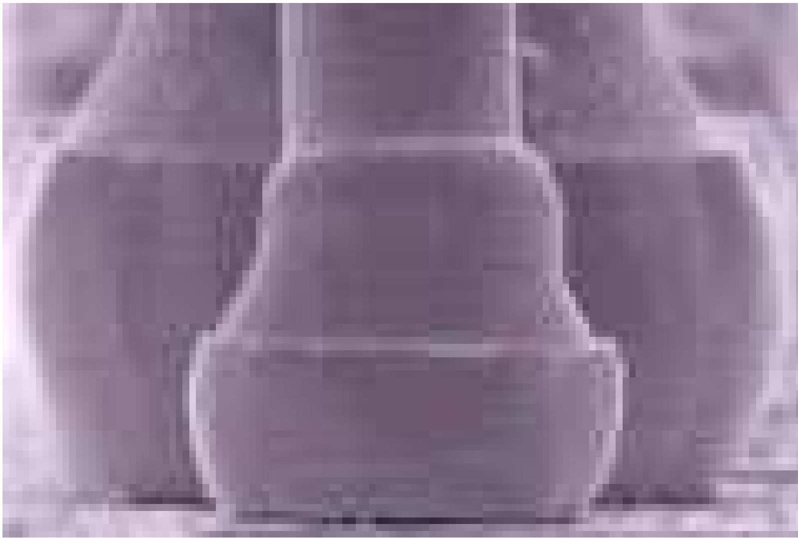


www.kns.com

Ball Bonding Tip

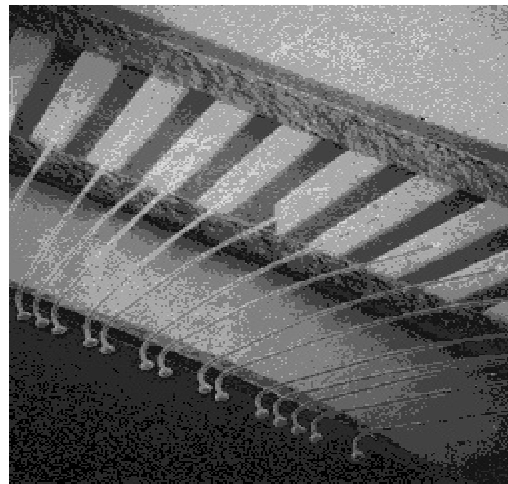


Wire Bonding



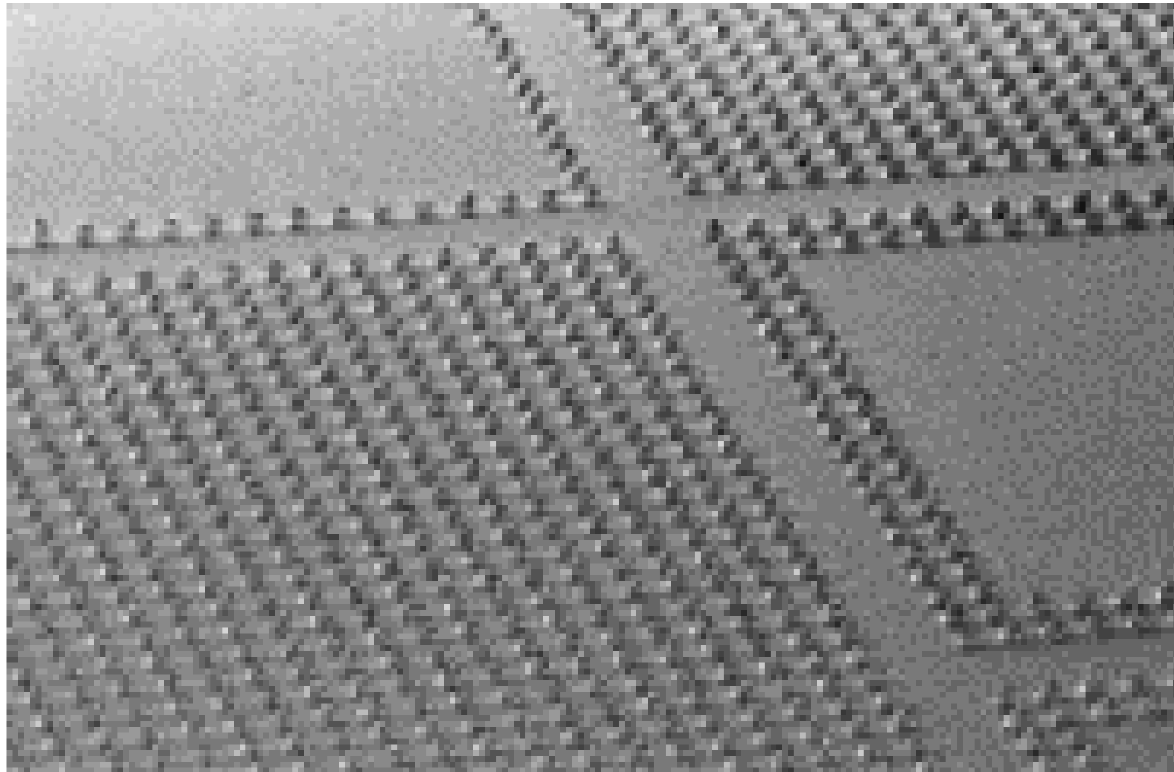
Ball Bond

Termination Bond



Ball Bond Photograph

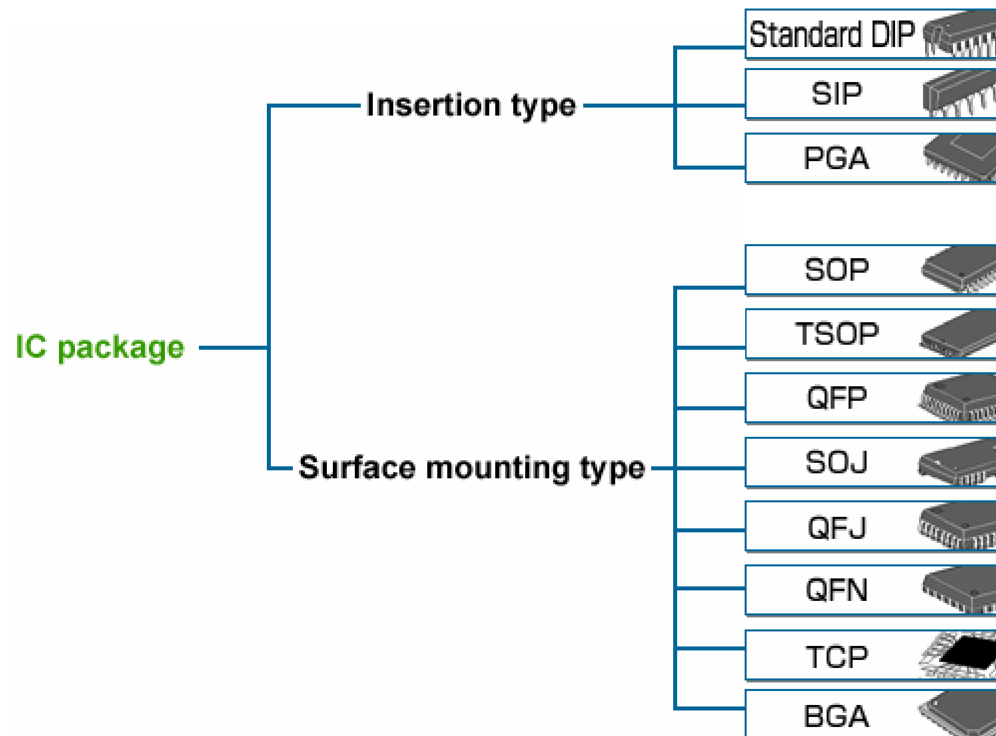
Bump Bonding



Packaging

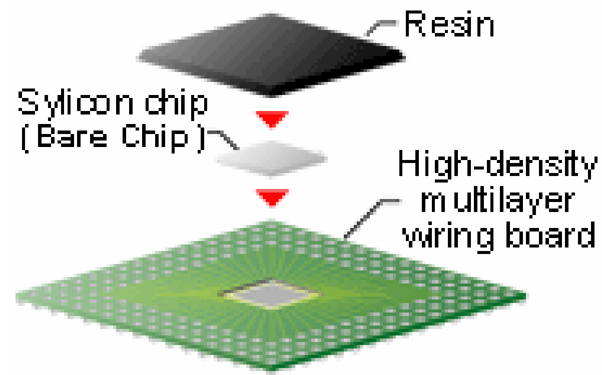
1. Many variants in packages now available
2. Considerable development ongoing on developing packaging technology
3. Cost can vary from few cents to tens of dollars
4. Must minimize product loss after packaged
5. Choice of package for a product is serious business
6. Designer invariably needs to know packaging plans and package models

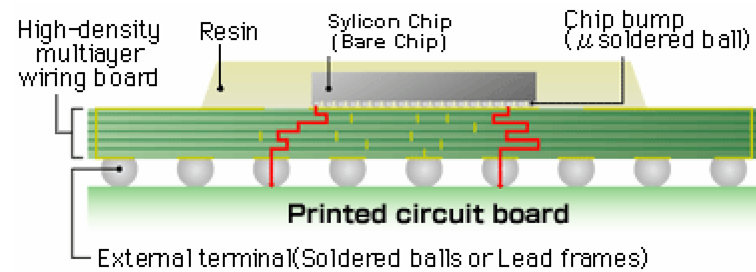
Packaging



www.necel.com

Packaging





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