IC Redesign Obsolescence: Assembly Options And Solutions

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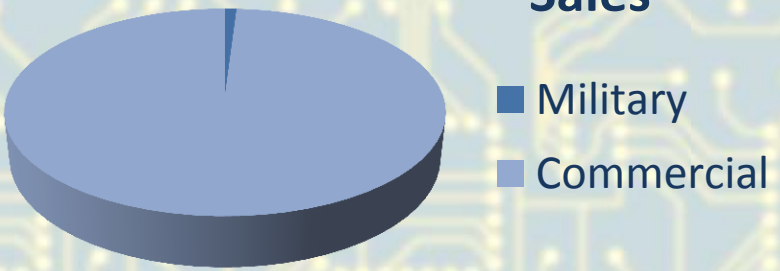
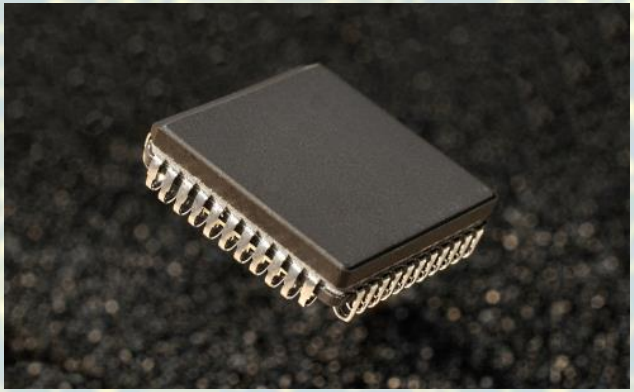
Semiconductor Market Drivers

- Commercial Drives Market
  - Rapid Innovation
  - Economies of Scale
    - Volume feeds the Fabs
  - Die Designed for Low Cost Assembly
  - Trade-offs in IC Design Affect Hi-Rel Versions Effectively Obsoleting Certain Devices

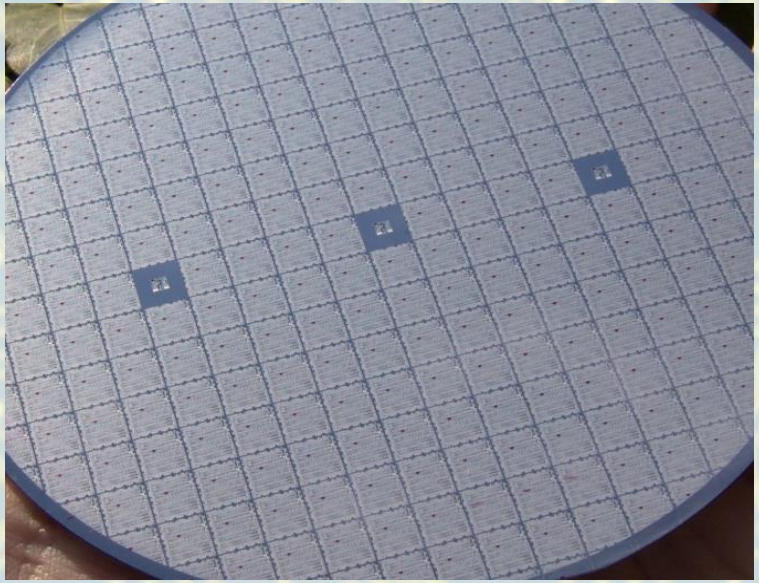


- Assembly Areas of Concern
  - Die Preparation
  - Bonding
  - Sealing



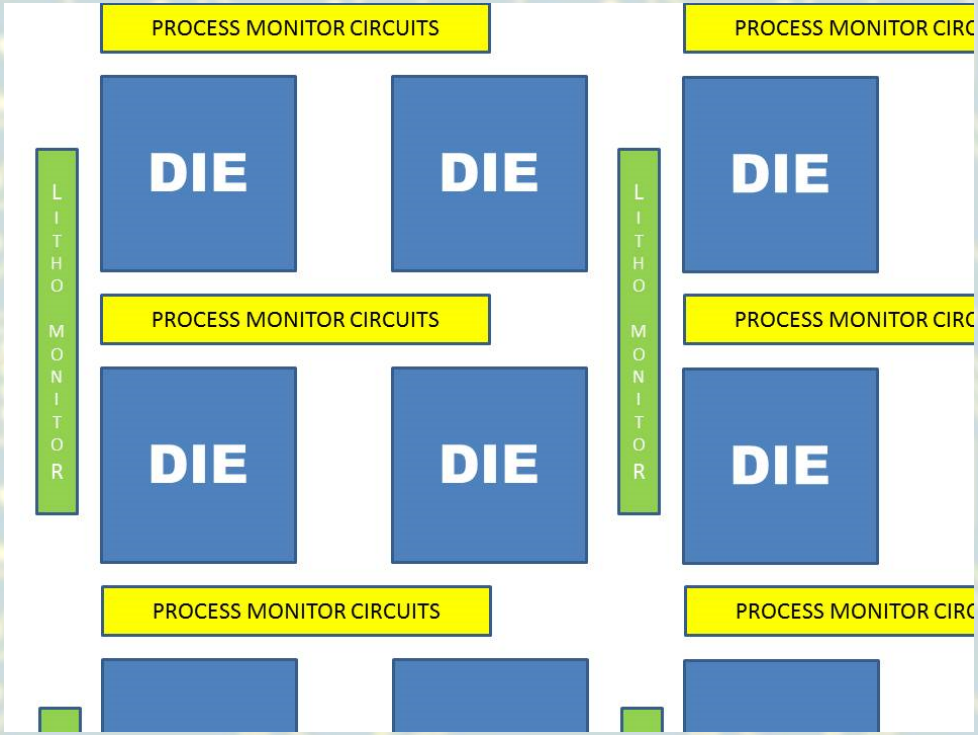
Semiconductor Manufacturing

- Size is Key!
  - Smaller Lithographies
    - Reduced Power Consumption
    - Higher Speeds
  - Larger Wafers
    - Greater Throughput
  - Reduced Unit Price
  - Fab Process Monitors Take Real Estate
  - No Wasted Space



Process Control Monitors (PCMs)

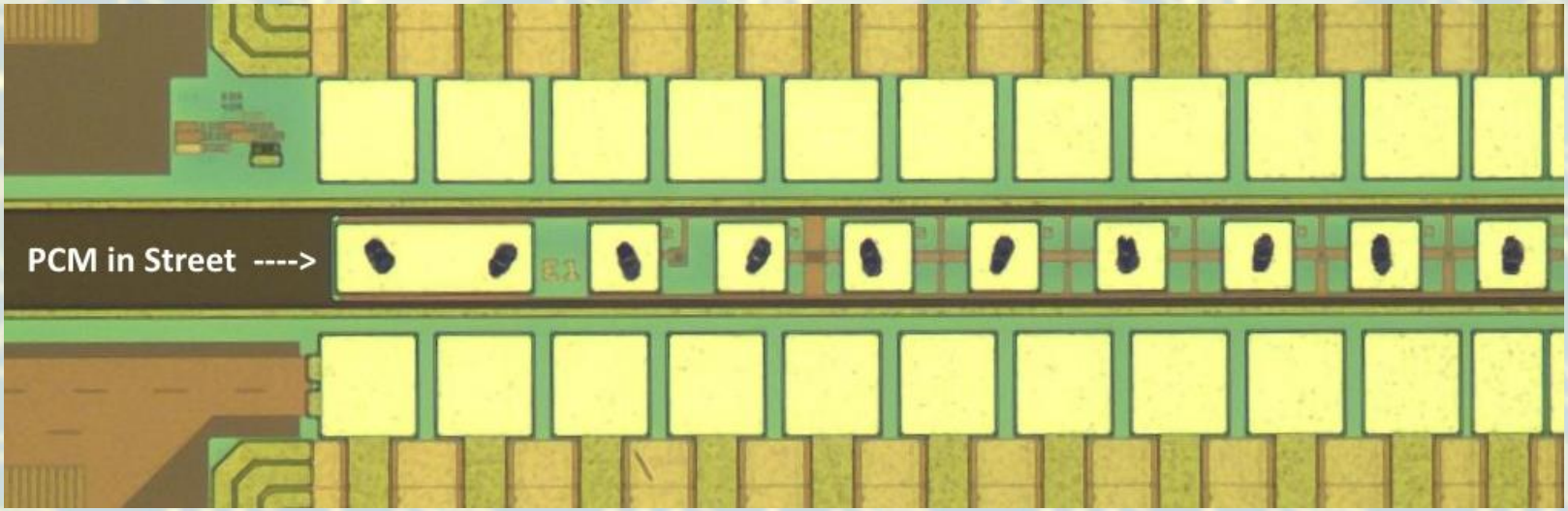
- Test Circuitry Placed in the Streets on the Wafer
  - Used at the Wafer Level to Monitor the Fabrication Process



Not to scale

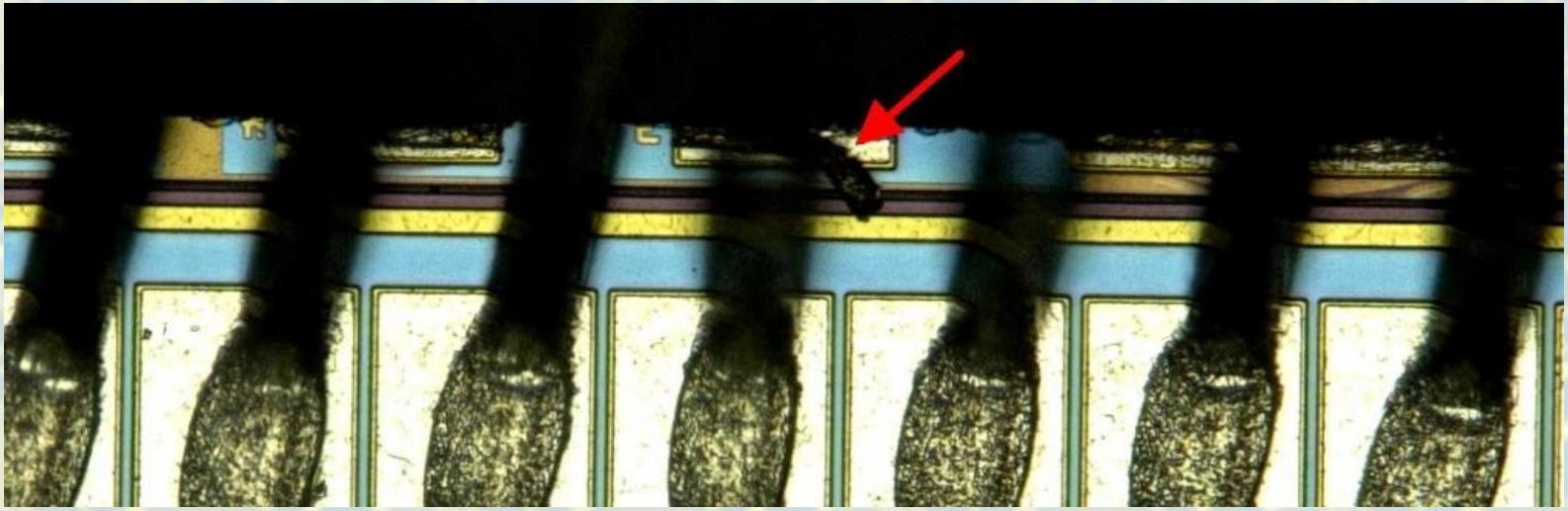
Process Control Monitors (PCMs)

- Small Metal Probe Pads Allow Connection to Standardize Test Circuits
- Placed Close as Possible to Die Edge
- One Cut Along Each Street (X & Y) to Singulate

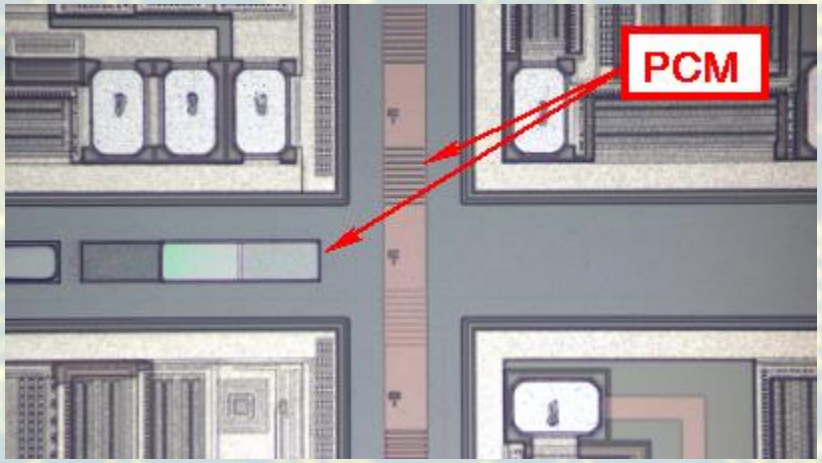


Process Control Monitors (PCMs)

- Nominal Cut Through the Middle of PCM
  - Single Pass with a Narrow Blade
  - Leaves Disturbed Metal from Probe Pads
- Plastic Encapsulation Traps this Metal
- Not Acceptable for Cavity Packaging



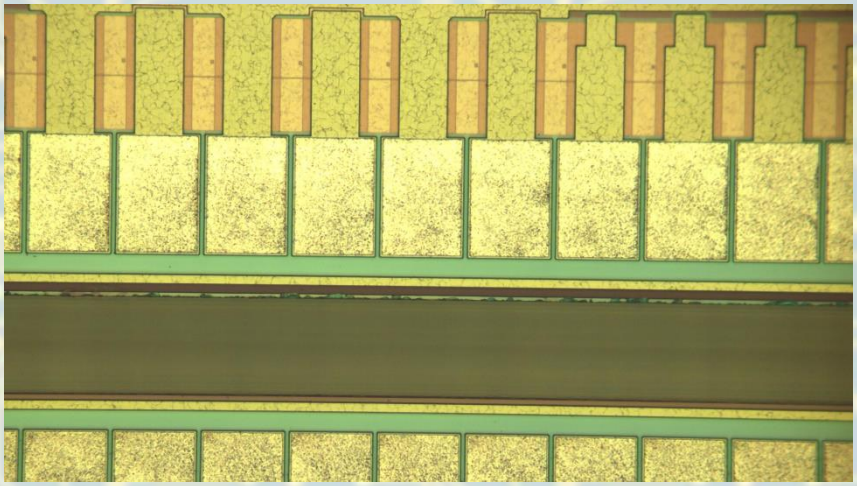
Wafer Sawing Options

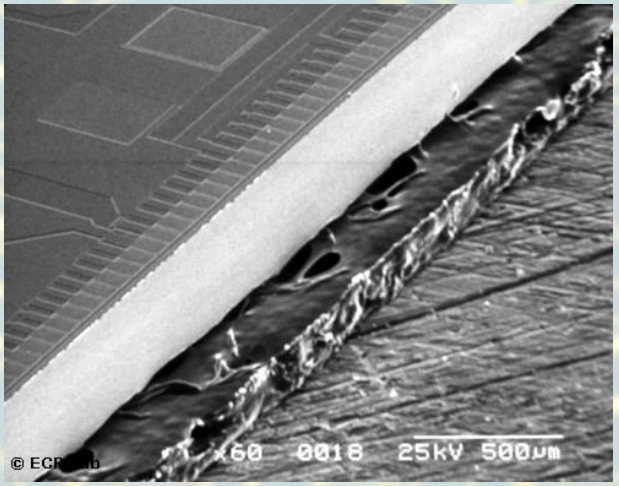


- Single v. Multiple Cuts
  - Single Cut with Thin Blade
    - Disturbed Metal Remains
  - Multiple Cuts with Thin Blade
    - Removes Metal
    - Hard to Control Alignment of Both Cuts
  - Single Cut with Wide Blade
    - Removes Metal
    - Effectively Controlled Double Cut

Wafer Sawing Options

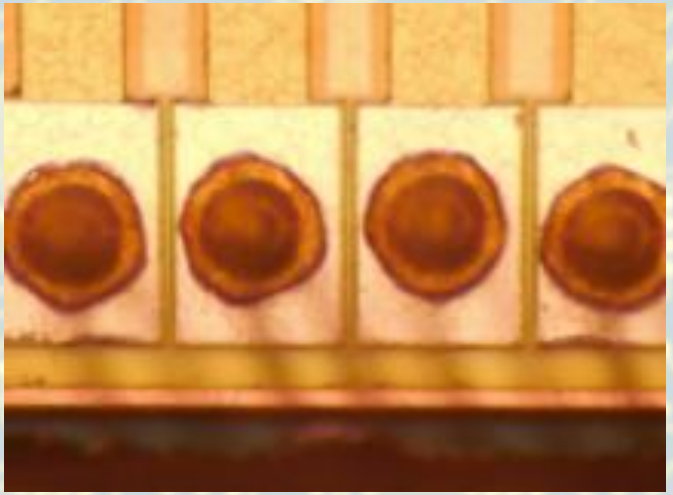
- Single Cut with Wide Blade
  - Blade and Travel Speed Critical
  - Alignment Tight between Die
  - Wider Blade Generates Far More Silicon Dust than Other Options
    - Surfactant and Water Pressure are Key

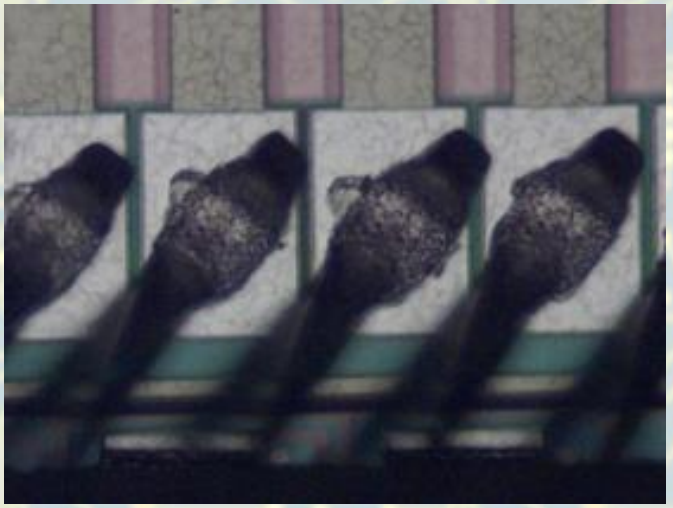




Bonding Issues

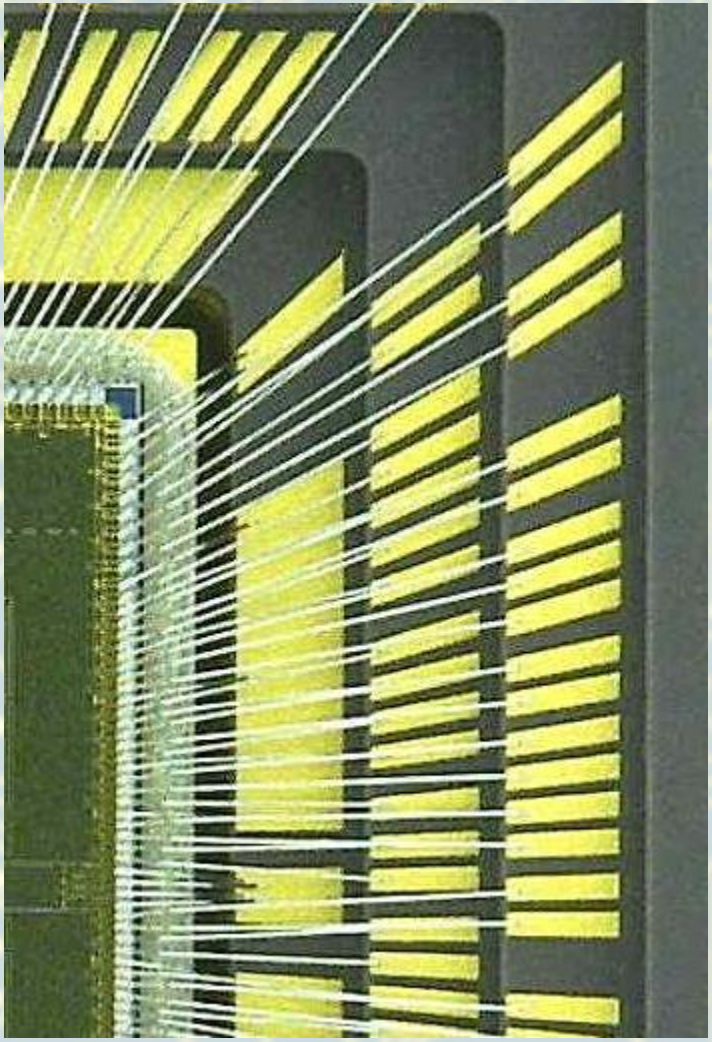
- Types of Wire Bonds
  - Ball v. Wedge
- Ball Bonds Allow the Bond Wire Complete Freedom Regarding Angle
- Wedge Bonds Have Rigid Egress Angle Requirements
- Pad Pitch
  - Designers of High Pad Count Devices Push Pad Pitch Limits





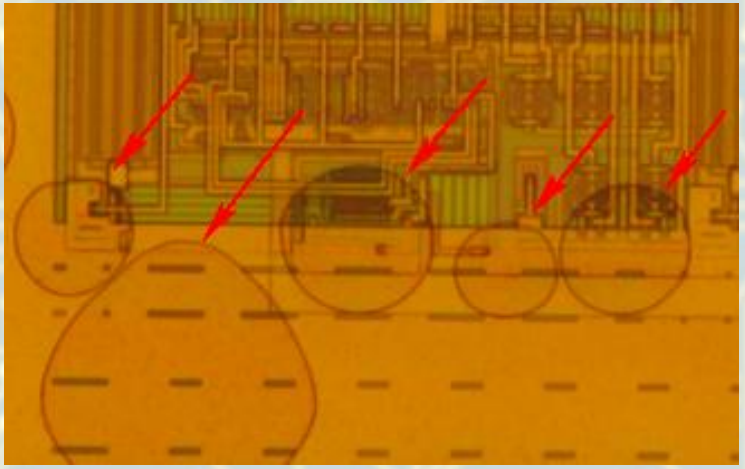
Bonding Issues

- Package Bonding Posts
  - Single v. Multi-Tier
- Single-Tier
  - Requires Greater Pad Egress Angle Freedom
- Multi-Tier
  - Allows Pad Egress Angles Closer to Perpendicular (90° to Die Edge)
  - Better Wire Length Control for Matched Pairs



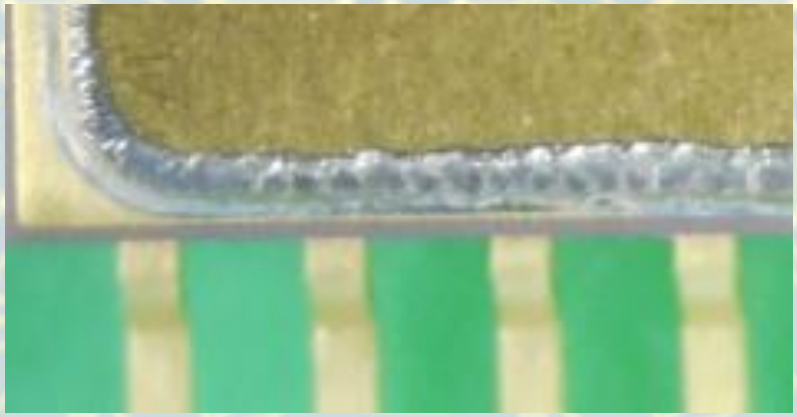
Package Sealing

- Die Coating
  - Added as Protection Against Mechanical Stress Caused by the Plastic Encapsulation Process
    - Analog Parts Susceptible to Characteristic Changes due to Mechanical Stress
  - Typical Lid Sealing Temperatures Can Cause Die Coat to Blister
    - Visual Defect Failure per MIL-STD-883, TM 2010



Package Sealing

- Seam Sealing
  - Use of Solder Preform Allows Sealing Packages Not Originally Designed for Welding
  - Localized Welding to Attach Lid to Package
  - Eliminated Need for High Temperatures Used in Solder and Glass Sealing Methods



Conclusion

- Commercial Arena Drives the IC Industry
  - Increase Functionality per Unit Area
  - Reduced Packaging Costs
- High Reliability Customers Follow Commercial Lead
- IC Physical Design Choices Often at Odds with Reliability Requirements
- Innovative Solutions in Die Preparation, Bonding Techniques and Packaging Essential to Meet High Reliability Expectations