Bonding, Packaging, and Sacrificial Processes
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Sacrificial Processes
• Materials
  – Photoresist
  – Silicon dioxide
  – Entire wafers
  – Metals
  – Glasses
• Problems
  – Diffusion limits
    • Geometry
  – Sticking
    • Phase change can eliminate
    • Geometry

Sacrificial Processes
• Dissolved wafer processes
  – SOI wafers
  – Membranes
  – Moving structures
• Sacrificial processes
  – Channels, cavities
  – Release moving structures
• HEXSIL
• Membranes
• Cantilevers

Bonding
• Why?
  – Create channels or cavities
  – Create isolation layers (SOI wafers)
  – Reduce complexity on each chip
  – Packaging
• Methods
  – Anodic bonding
  – Silicon fusion bonding
  – Photosigners
  – Eutectic bonding
  – Others
    • Press
    • Thermocompression metallic
    • Ultrasonic welding
    • Seam welding
    • Laser welding
    • Low-temp glass bonding

Anodic Bonding
• Also called electrostatic bonding
• Bonds glass to silicon
• Used to reduce temp to reasonable levels
• Performed at about 400 C with about 1.2 kV
• Positive ions in glass drift toward silicon causing high field at interface
• Pull silicon and glass close together
• Silicon positive, glass negative
• Use glass with similar thermal expansion coefficient
• Cleanliness critical to prevent voids
• Thin metal lines can pass through bond
• Using deposited glass (thin layers) reduce voltage significantly
• Works with e-beamed, sputtered, and spin-on glass
Silicon Fusion Bonding

- Silicon to silicon bond, oxides also work
- High physical strength
- Require hydroxyl groups on surface
- 300 to 800°C required for bond with higher anneals temps sometimes required
- Use of low-melting glass allows lower temp bond

Epoxy or Polyimide Bonding

- Both conductive and non-conductive types
- Inexpensive and simple
- Lower bond strength
- Can form insulating layer
- Potential decomposition

Eutectic Bonding

- Uses silicon metal alloy (other alloys also) such as Si-Ag, Si-Au, Si-Al
- Silicon dissolves in gold at about 370°C and up
- Relatively low temperature
- Microstructure change allows high reliability, strong bond, good heat dissipation, and thermal stability
- Problems with bonding large areas

Eutectic Point for Si - Au

Other Bonding Methods

- Hardware store methods
- Glues, silicones, etc
- UV Curable materials
- Photoresists
- Waxes
- Chemical bonding
- Hydrophilic bonding
- The simpler the better!!!