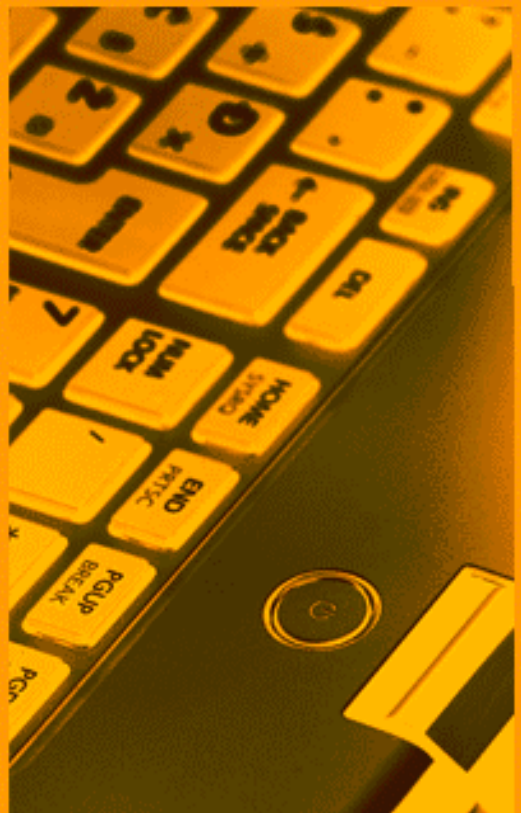
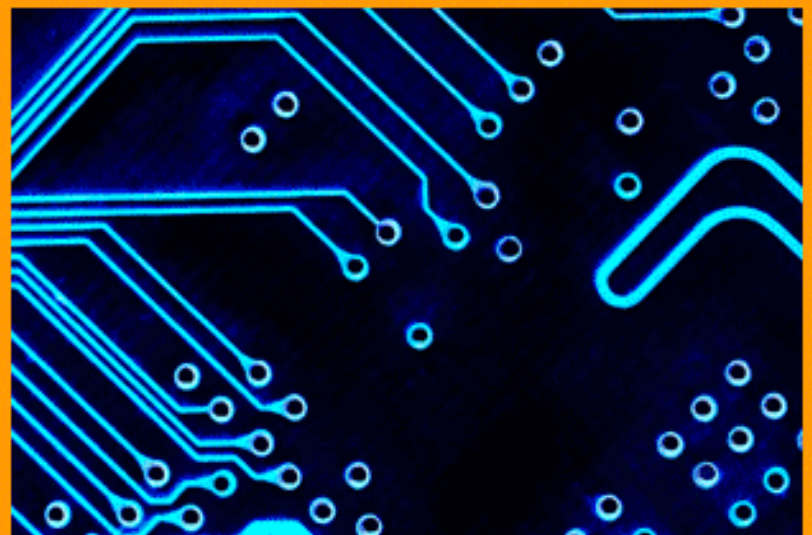
SGIA Printed Electronics Roundtable











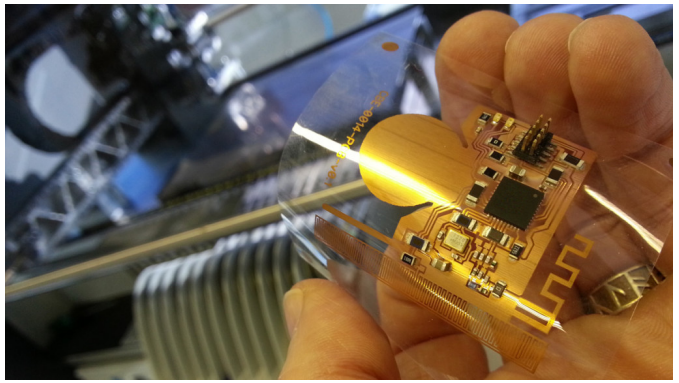
Flexible Hybrid Electronics (FHE) Assembly

Xiaoying Rong, Ph.D.
Graphic Communication Department
Cal Poly State University

Flexible Electronics

- Flexible PCB
  - Flexible substrate can withstand higher processing temperature – Polyimide
- Flexible electronics
  - Bendable
  - Stretchable
  - Low temperature substrates – PET, PEN, TPU





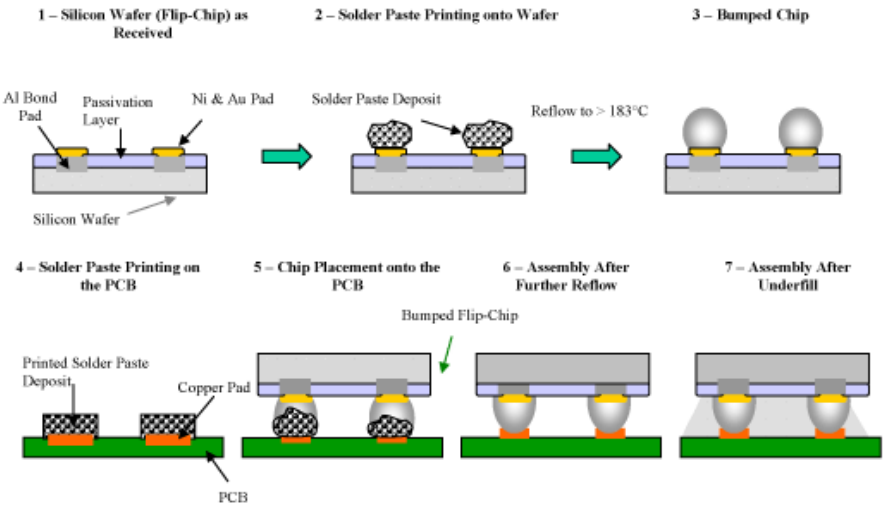
Challenges

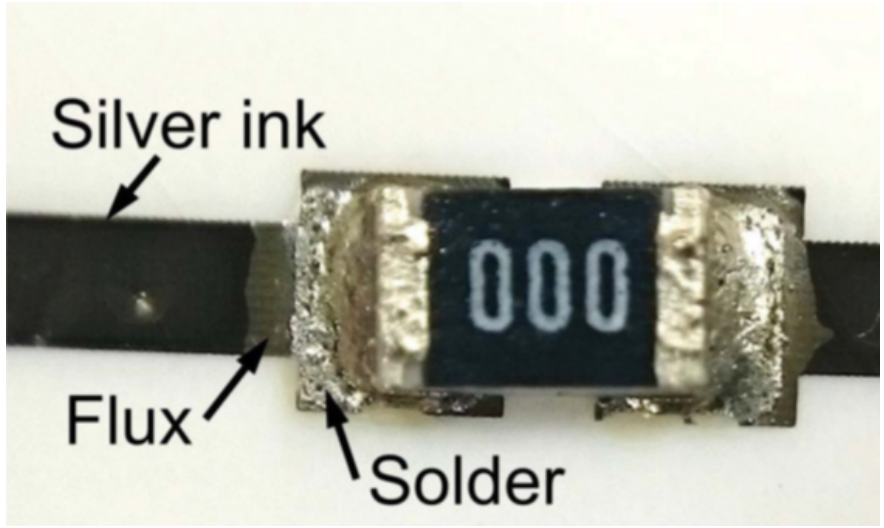
- Interconnection methods
  - Solder
  - Electric conductive adhesives
- Suitable for printed material
  - attach on printed silver ink vs. attach on copper surface
- Temperature tolerance
  - Flexible substrates work with lower temperature



Interconnects

- Solder
  - Most common but limited to thermal stability of low cost substrates
  - Reflow temperature 240-265C for Sn-Ag-Cu
  - Low temperature solder such as Sn-Bi reflow under 175C

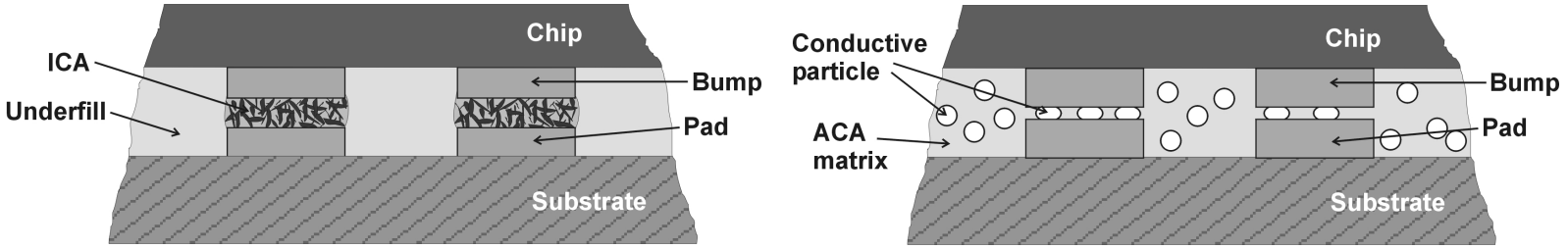




Soldering Surface Mount Components Onto Inkjet Printed Conductors on Paper Substrate Using Industrial Processes, IEEE TRANSACTIONS ON COMPONENTS, PACKAGING AND MANUFACTURING TECHNOLOGY, VOL. 6, NO. 3, MARCH 2016

Interconnects

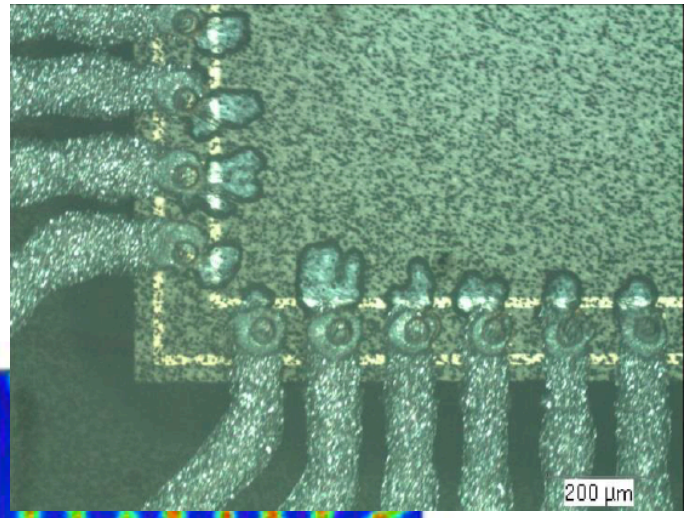
- Adhesive jointing
  - Isotropic conductive adhesives (ICA)
  - Anisotropic conductive adhesives (ACA)
  - Higher resolution
  - Higher mechanical flexibility

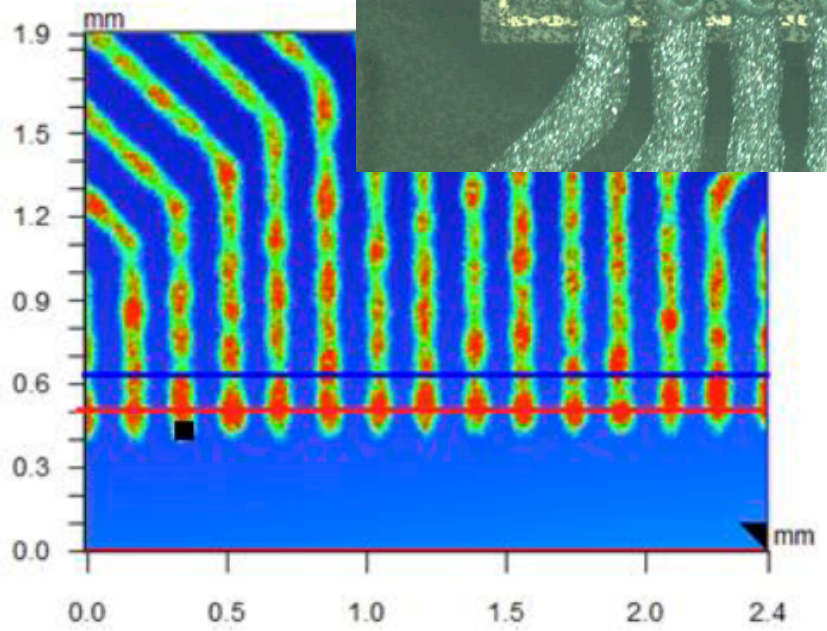


Study of Structure and Failure Mechanisms in ACA Interconnections Using SEM, "Scanning Electron Microscopy"

Common Binding Problems

- Incompatible between bumps and printed silver ink
- Insufficient contacts between adhesives and printed silver ink due to rough printed surface

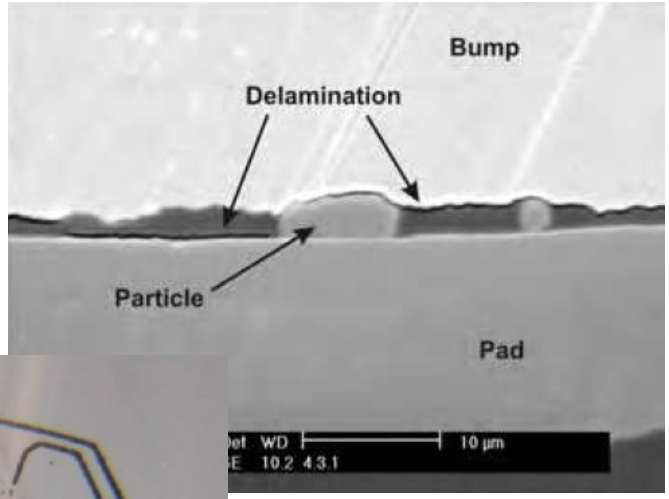




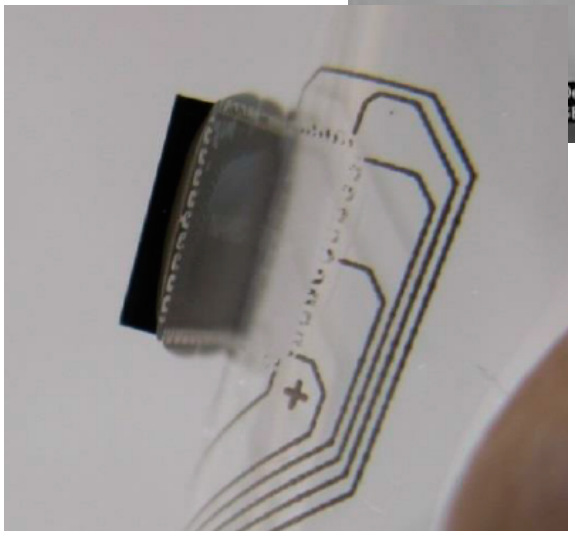
Thesis, Bendability of flip-chip attachment on screen printed interconnections, LYDIA LEPPÄNEN

Reliability – Conductive Traces

- Bending and stretching
- Thermal and humidity reliability
  - Deformation Thermal and humidity cycles can cause delamination
  - Could happen at different contacting points



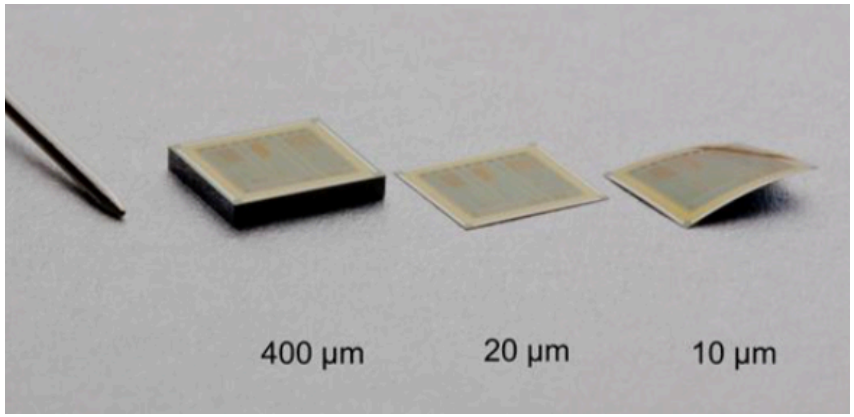
Scanning Electron Microscopy, Chapter 25, Study of Structure and Failure Mechanisms in ACA Interconnections Using SEM

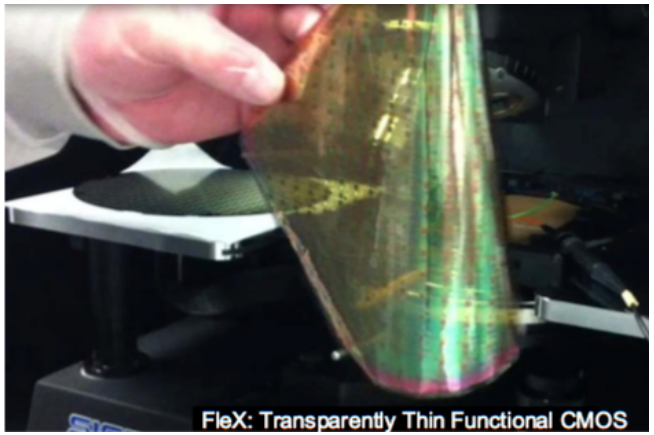


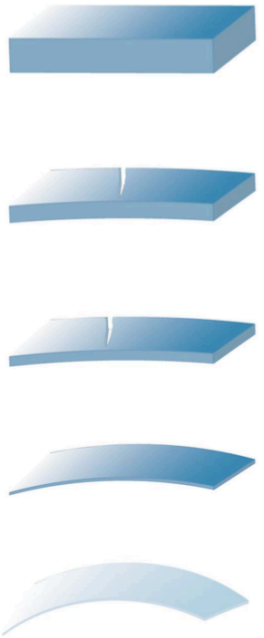
Thesis, Bendability of flip-chip attachment on screen printed interconnections, LYDIA LEPPÄNEN

Thin Chips

- For flexible hybrid electronics, chip thickness is one of the determine factors
- From 300-1000μm thin to 10-30μm
- By wafer thinning process or build on polymer surface

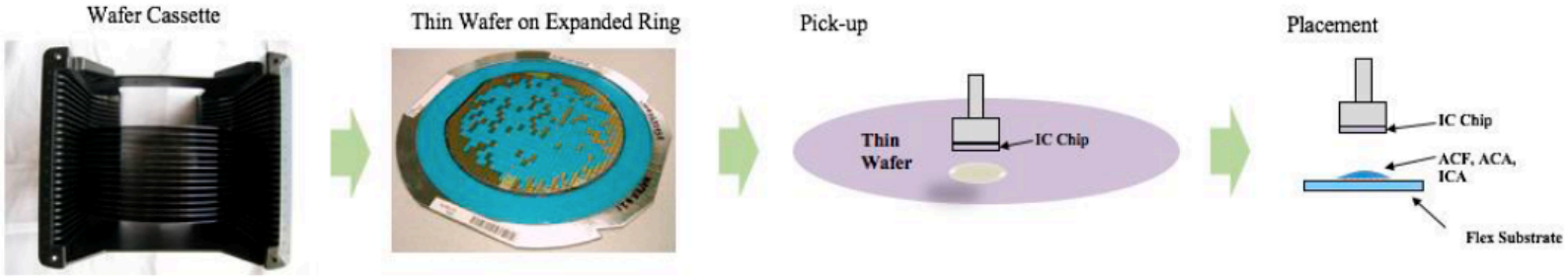


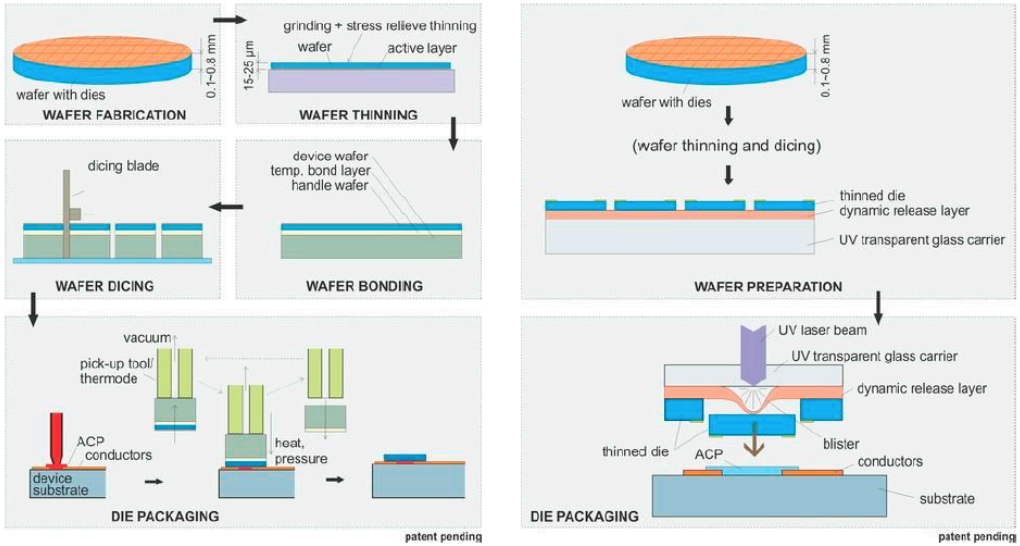




Assembly by Industrial Equipment

- Evaluating MRL level of assembly methods

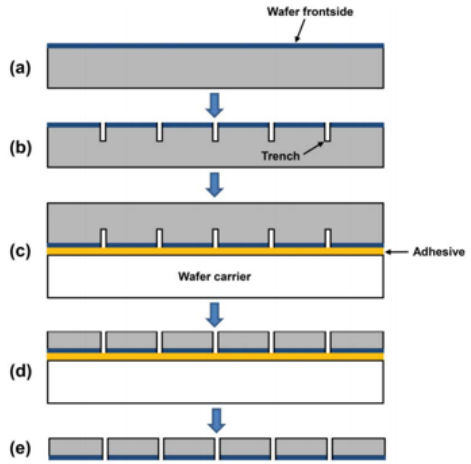




Ultra-thin IC pick and Place Methods (uniqarta webpage, http://www.uniqarta.com/technology.html)

Current Research

- Reliable and cost effective wafer thinning processes
- Industrial scale assembly processes
- Choice of chips with processable pitch configuration for both reliable printing and assembly
- Reliability of assembly for stretching and bending
- Collaboration among material development, printing, wafer processing and assembly – Cal Poly, Jabil, DuPont on a NextFlex grant



Marks, et al. 2015

