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ALTIUMLIVE 2018:
FLEX: SOMETHING NEW FOR EVERYONE

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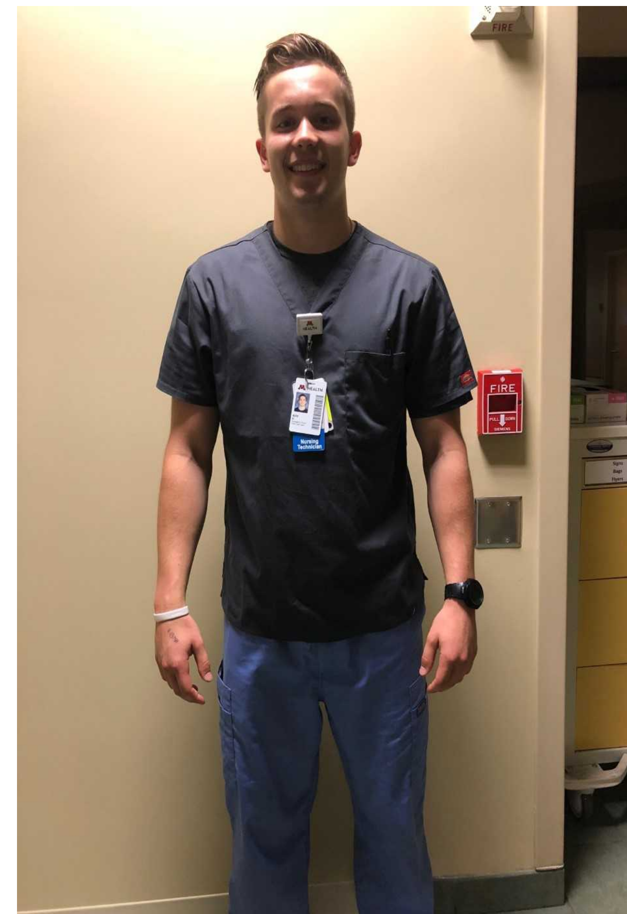
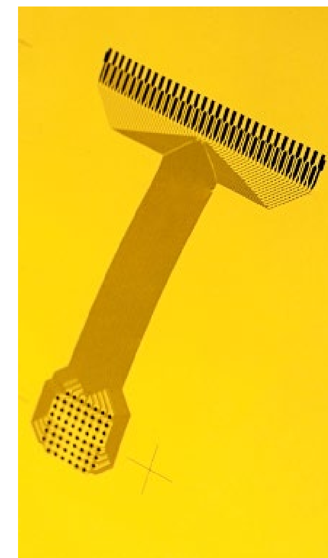
President

San Diego
October 5, 2018


FIRE

Applications That Span Technology



Today's Discussion:

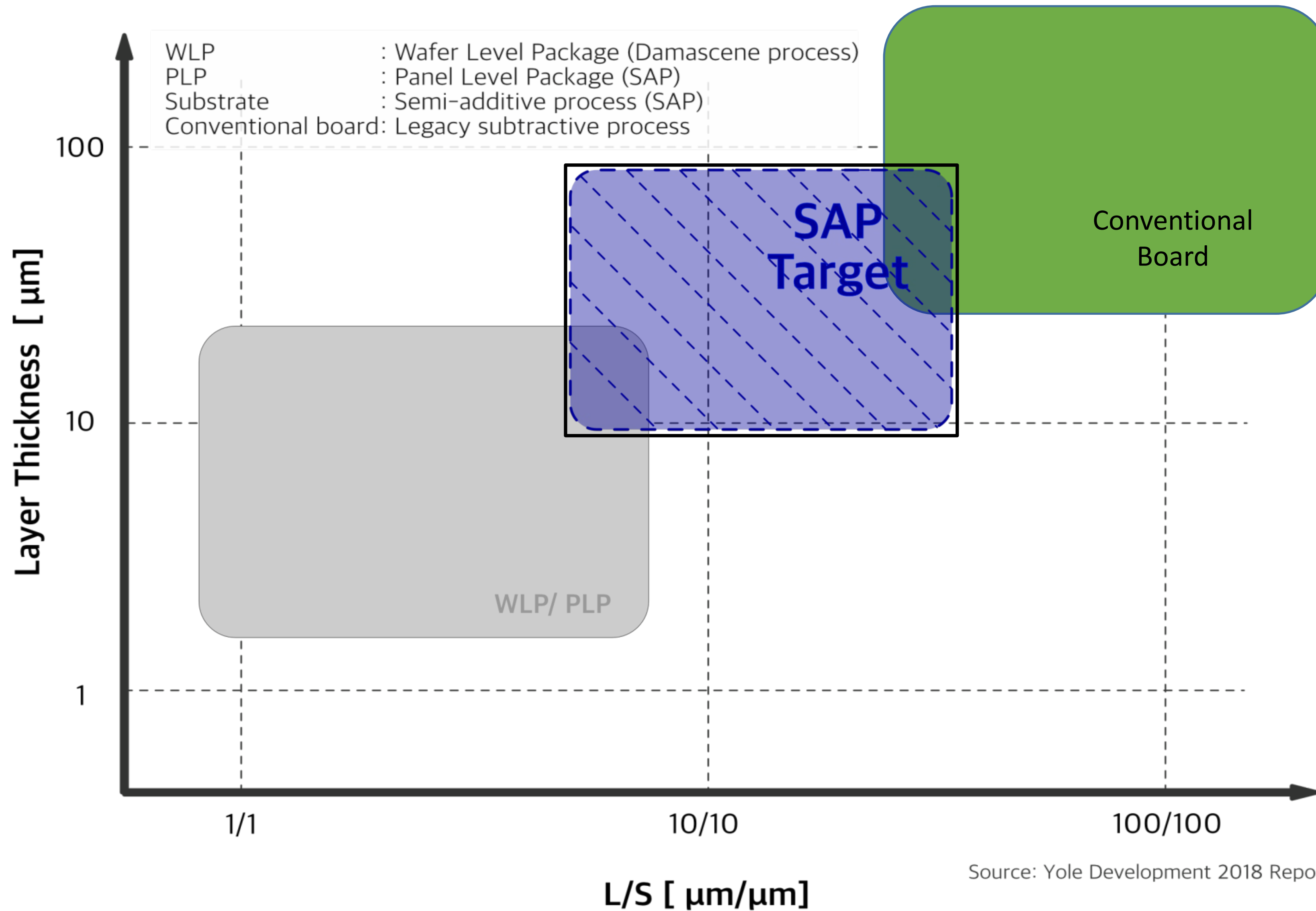
1. Basic processing steps for both subtractive etch and semi-additive flexible circuit manufacturing

2. Flex materials and considerations

3. Design for manufacturability best practices

4. Real world lessons learned

Learning Curve for Everyone



Basic Process Steps – PCB Fabrication

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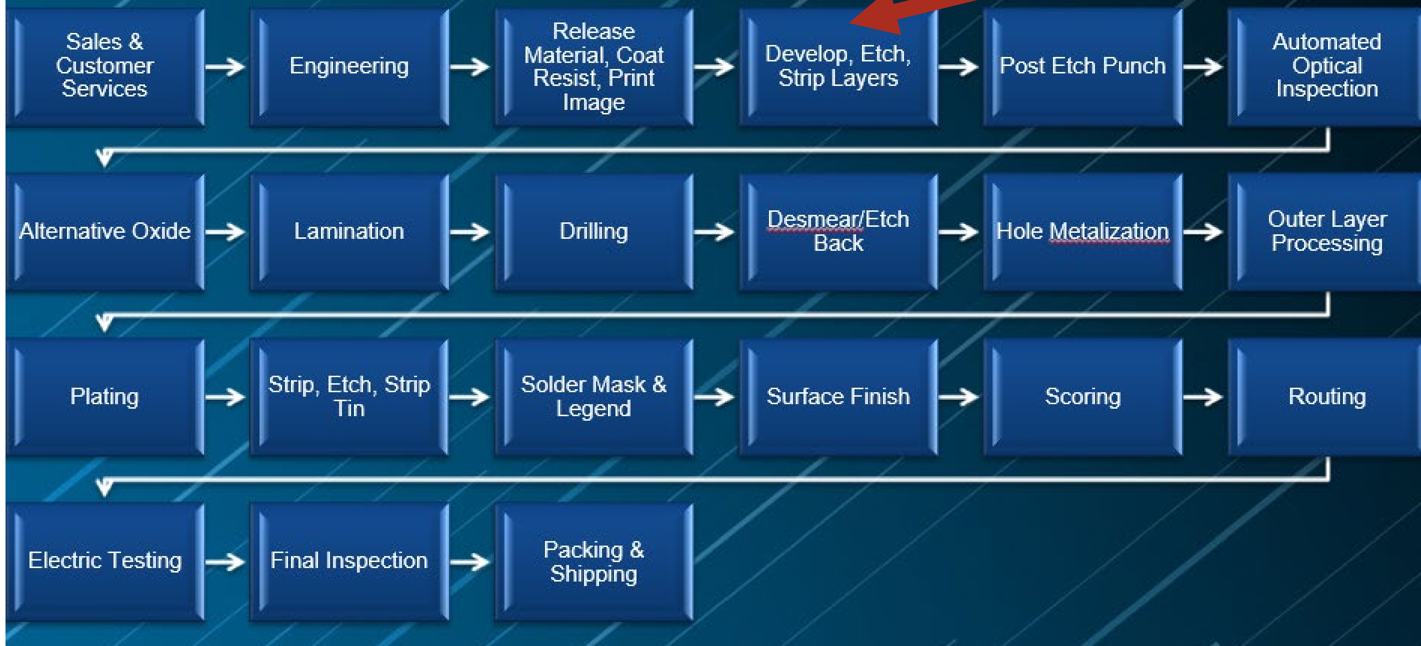
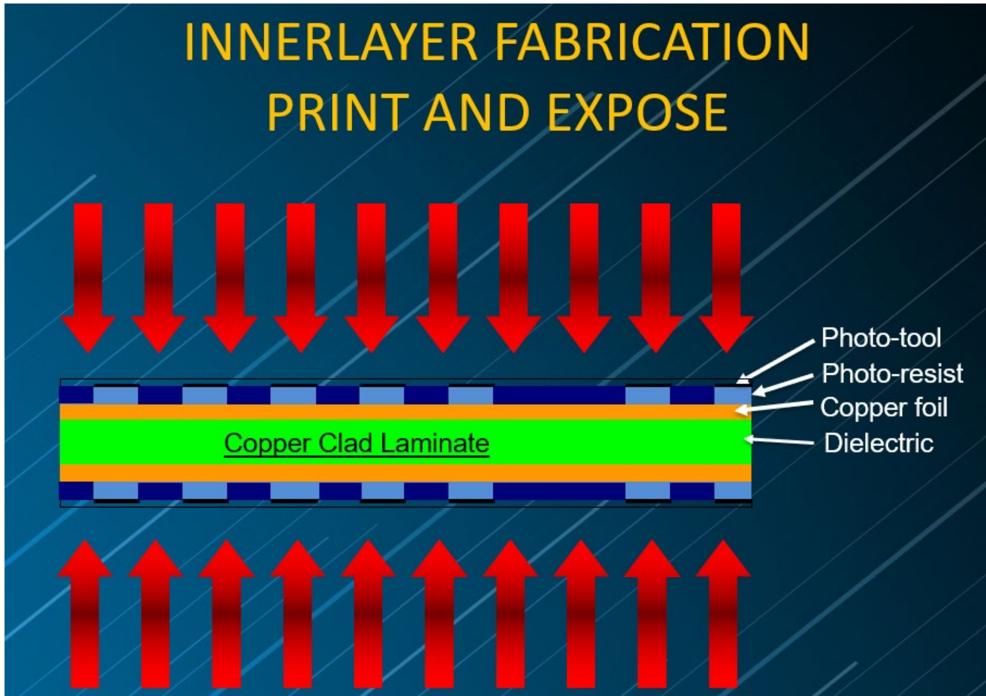
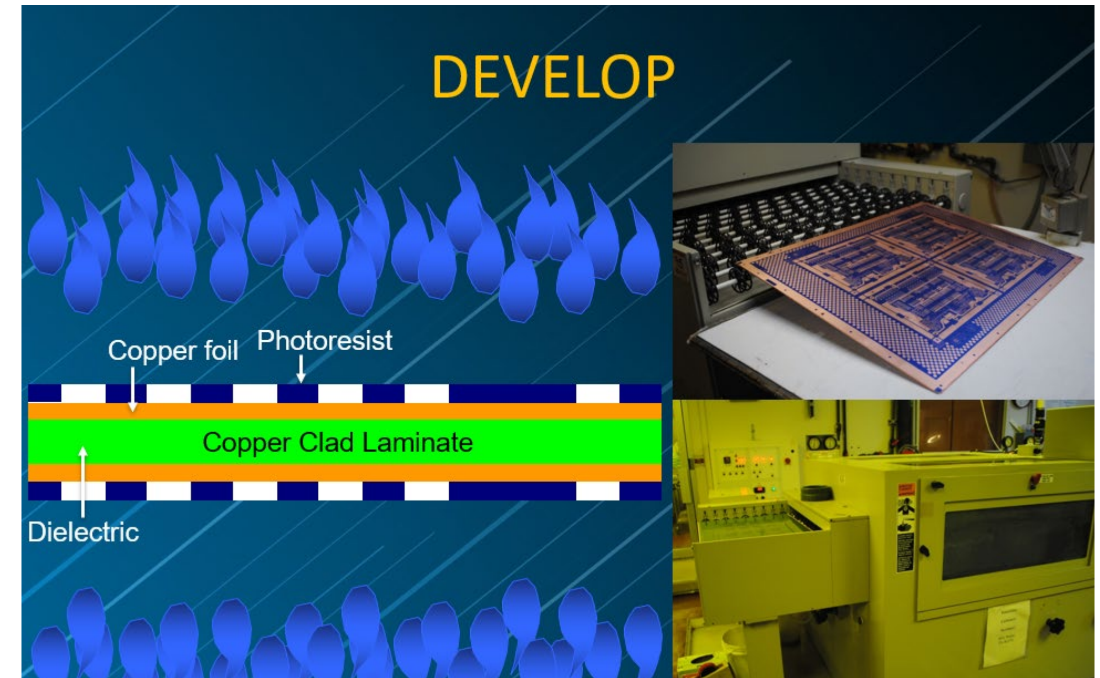


Key differences between subtractive etch and SAP:

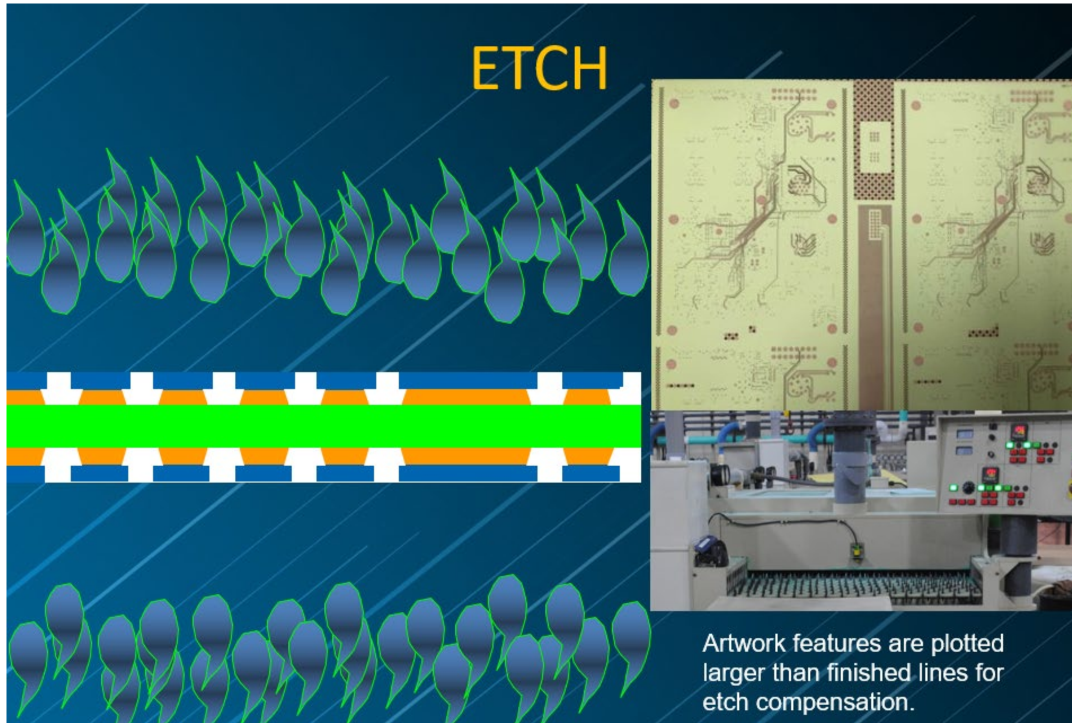
- Base materials
- Develop -Etch -Strip process
- Hole Metalization

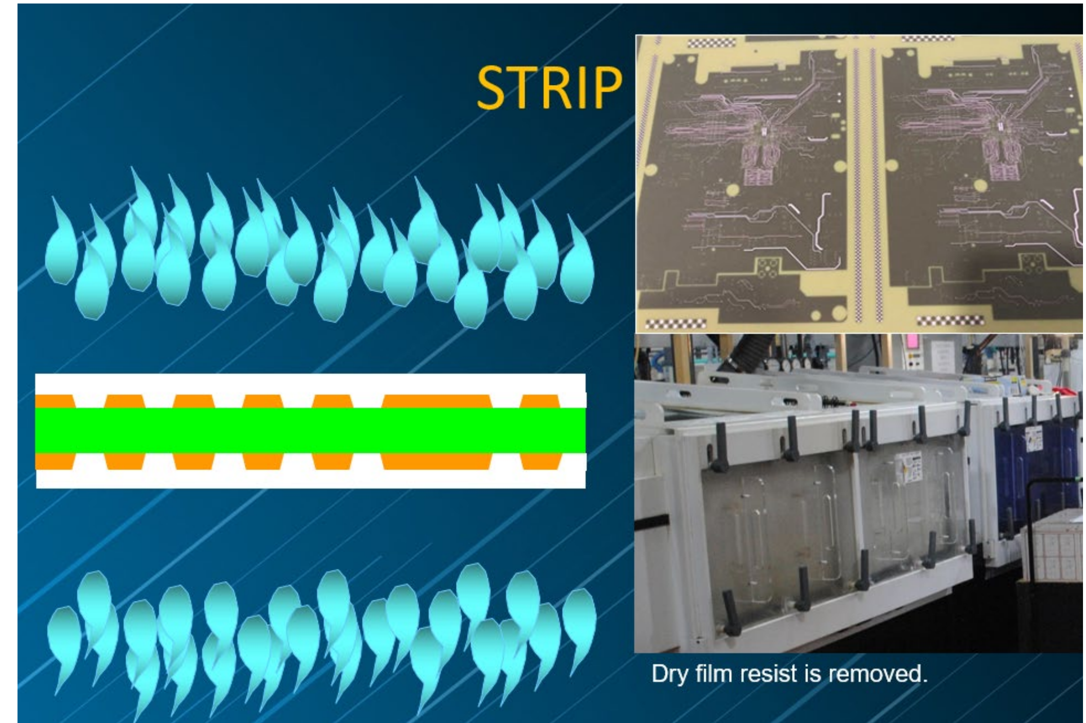
Basic Inner Layer Process Steps – Subractive Etch





Basic Inner Layer Process Steps – Subractive Etch





Basic Inner Layer Process Steps – Semi – Additive Processing

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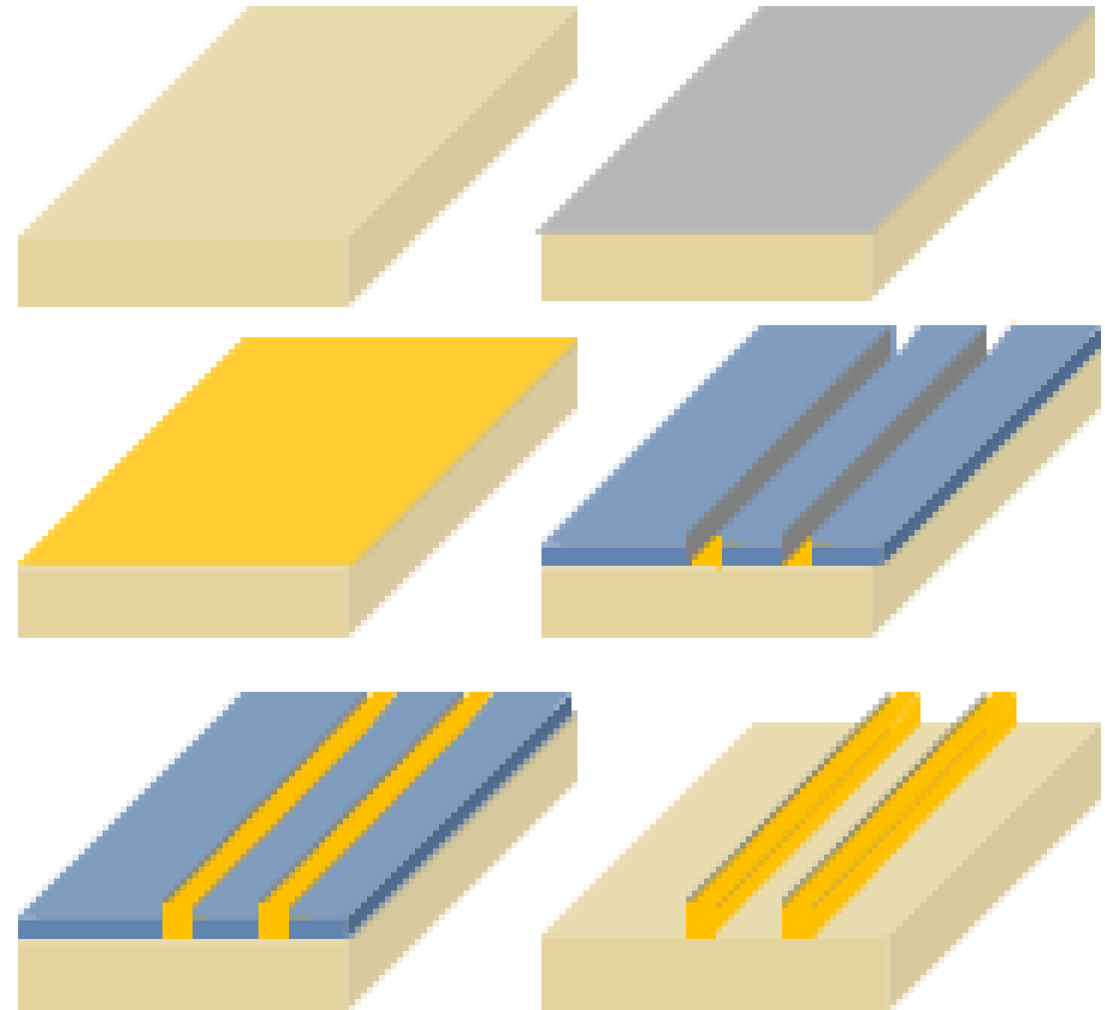
1. Start with polyimide film
2. Coat polyimide with ALD Ink
3. Plate with thin electroless copper
4. Apply and pattern resist
5. Electroplate traces
6. Strip resist and remove thin electroless copper



Basic Process Steps – Semi – Additive Processing

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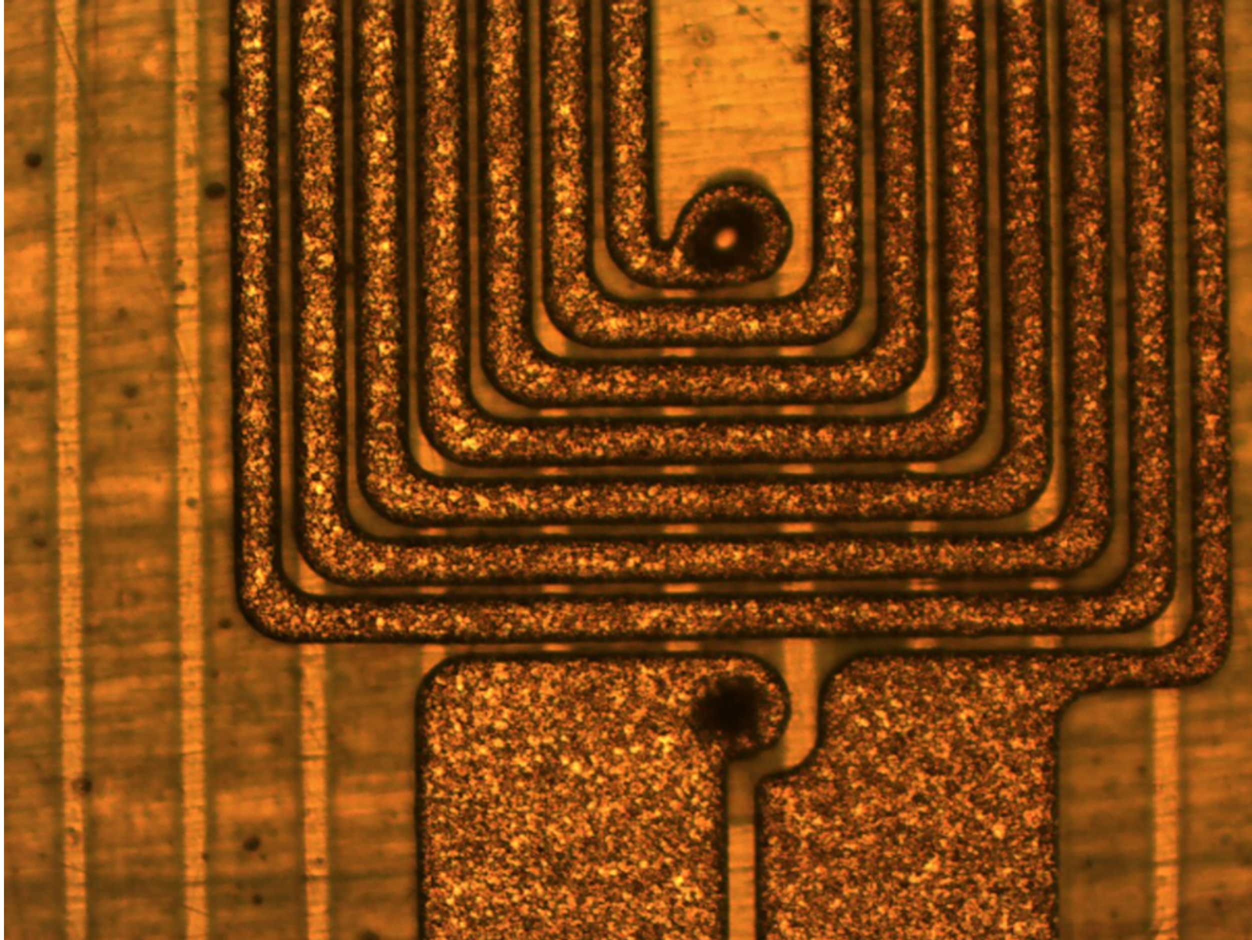
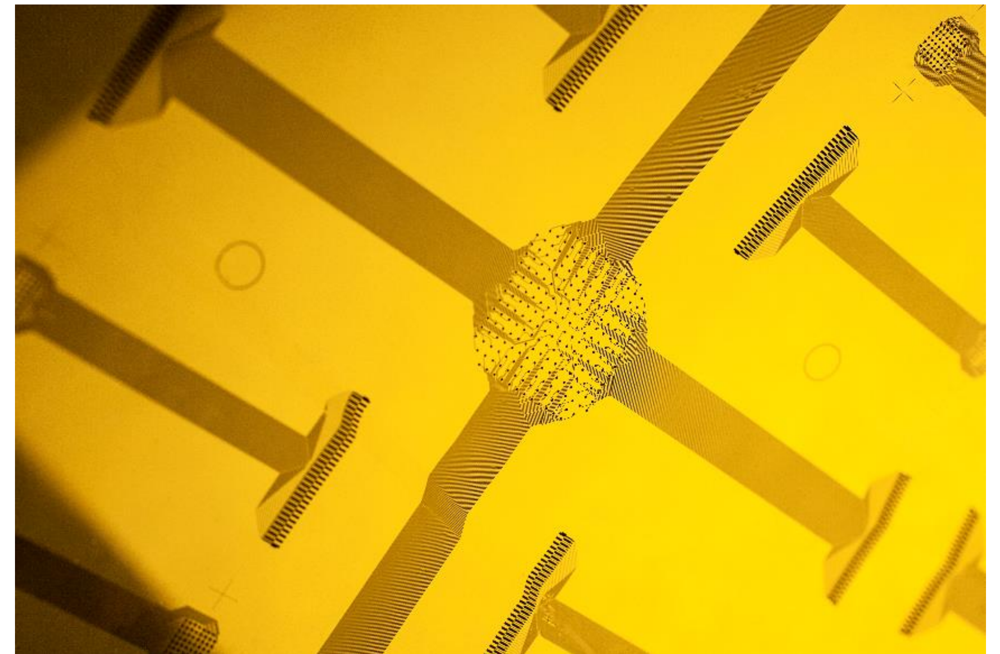
- 35 µm pitch, 24 µm lines, semi additive



25 µm traces, polymide with gold conductors, semi additive



Base Material Types and Considerations

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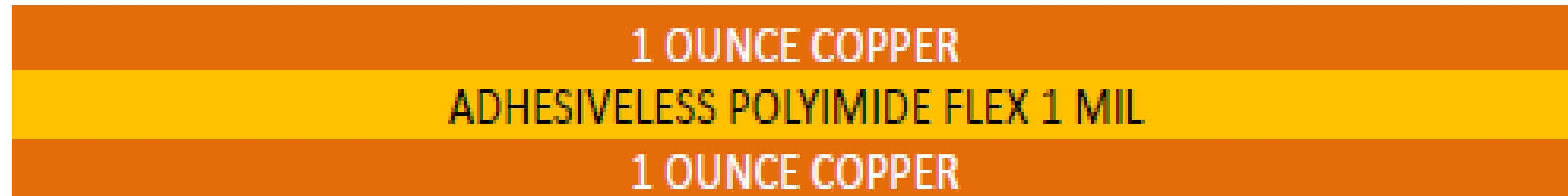
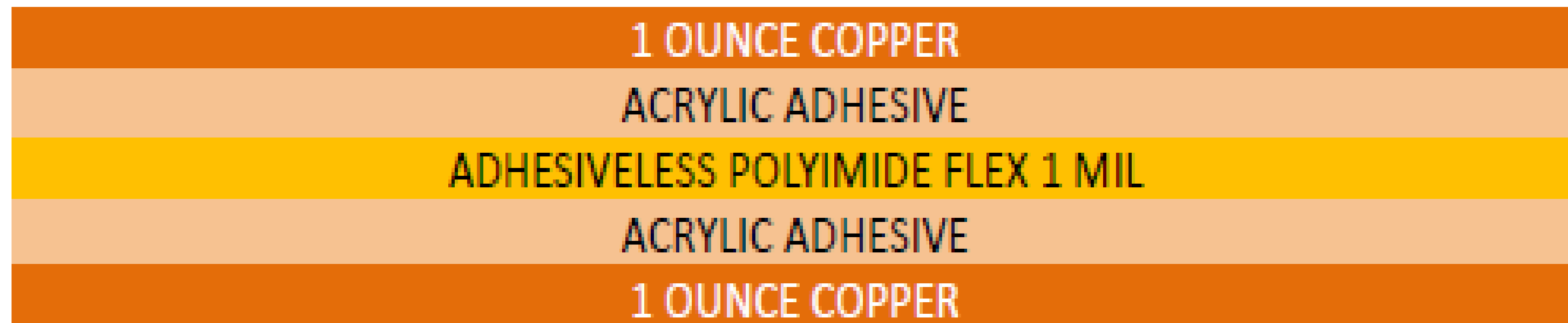
Base Materials: Two Primary Construction Types





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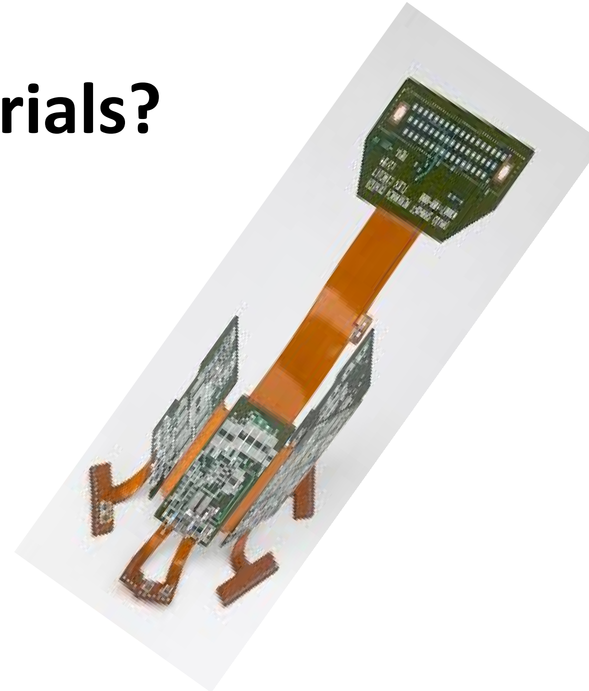
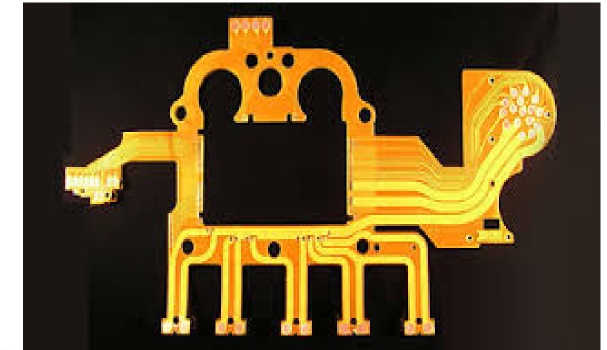
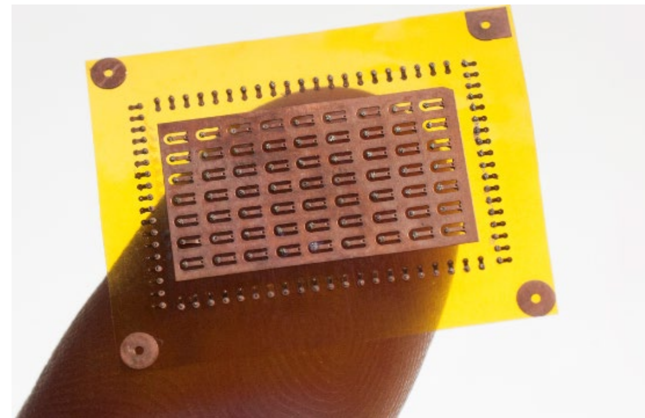
How Do You Select Base Materials?





1. Layer Count
2. Flex or Rigid Flex
3. Cost
4. SAP



Coverlay Options and Considerations

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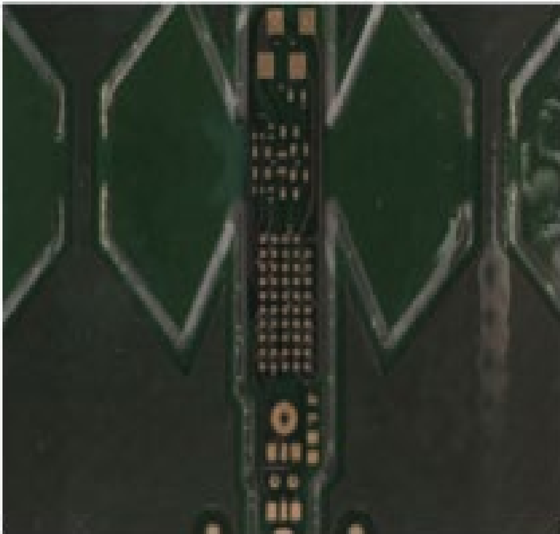
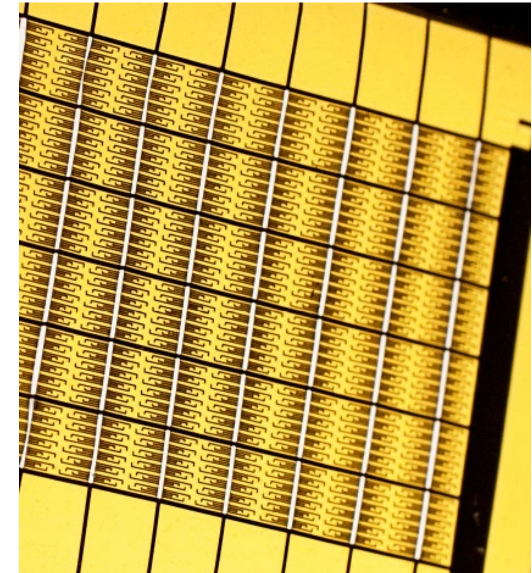


Solder mask on flex circuit

Coverlayer on flex circuit



Liquid polyimide

Cost vs. Function

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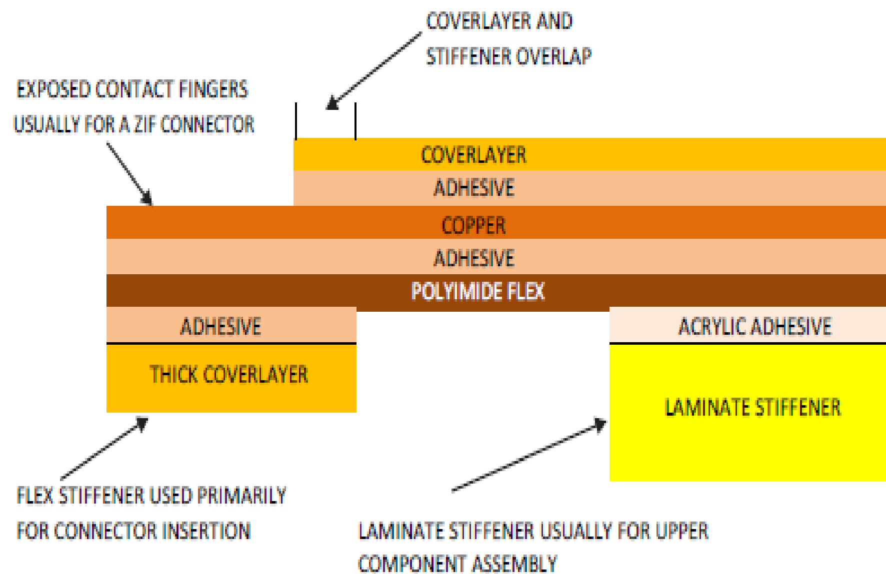
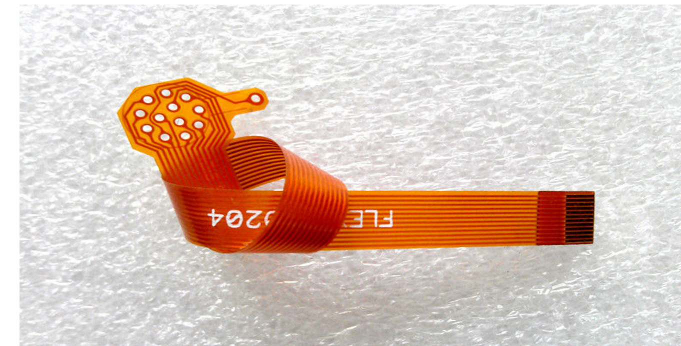
Stiffener Types



Maintain .030" overlap between stiffener and coverlay to avoid adding stress points

FR4 adds component support



Polyimide stiffeners

Rigid Flex

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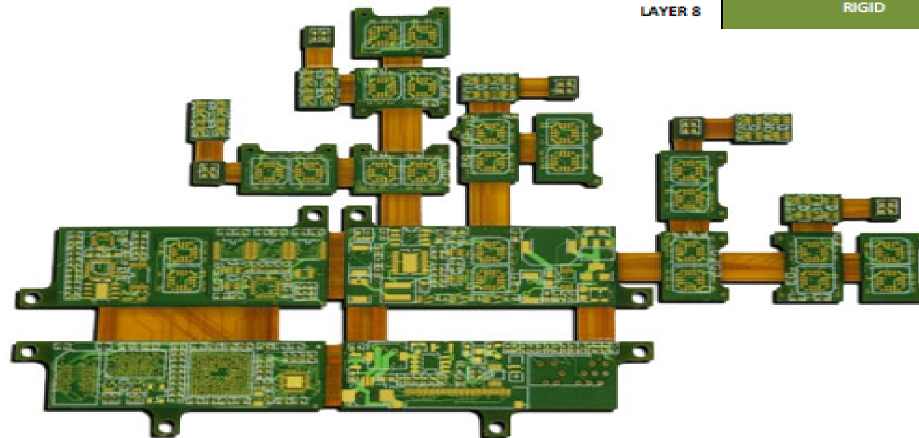
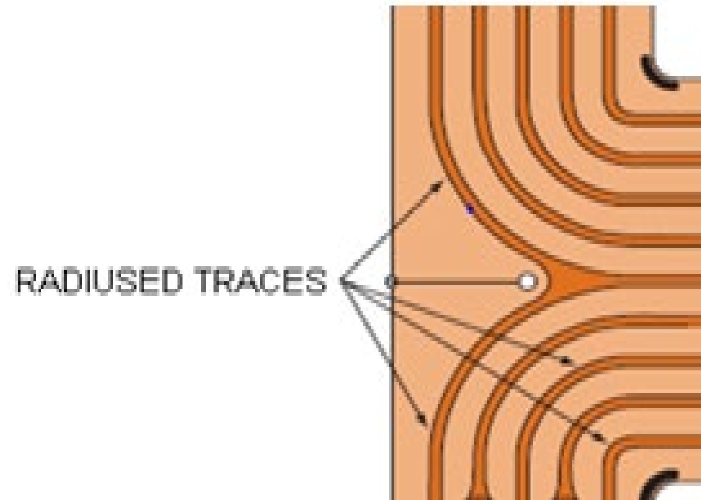
Key Points:

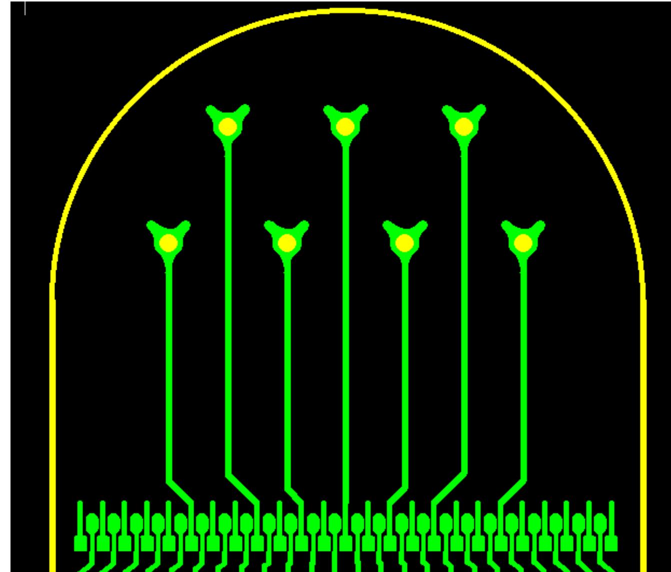
- **Adhesiveless Materials**
- **Bikini Cut the coverlay (.050" into the rigid areas)**
- **PTH should be .050" from edge of flex / rigid interface**
- **Cost Considerations**

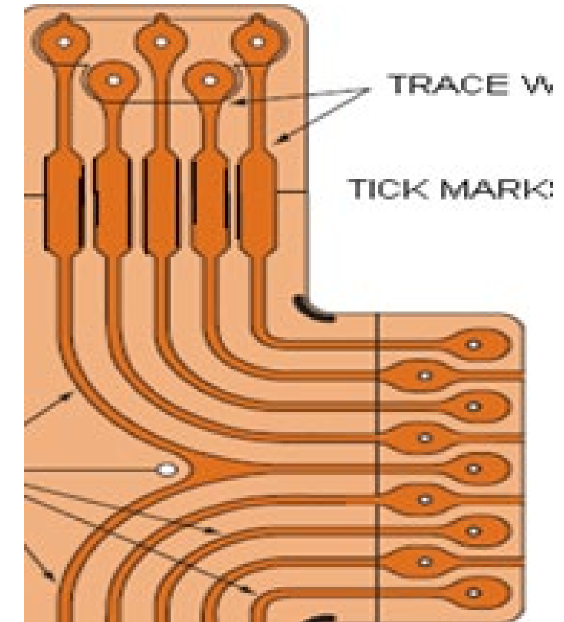


Design Tips

Design for Manufacturability Tips: Universal across manufacturing types







Key: Communicate operational requirements to your fabricator, especially with dynamically flexing applications

Design Tips

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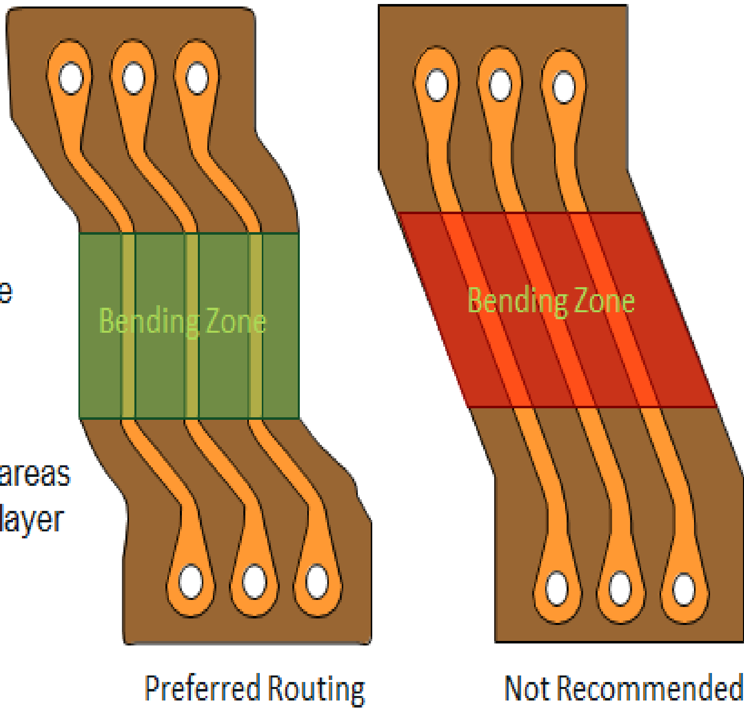
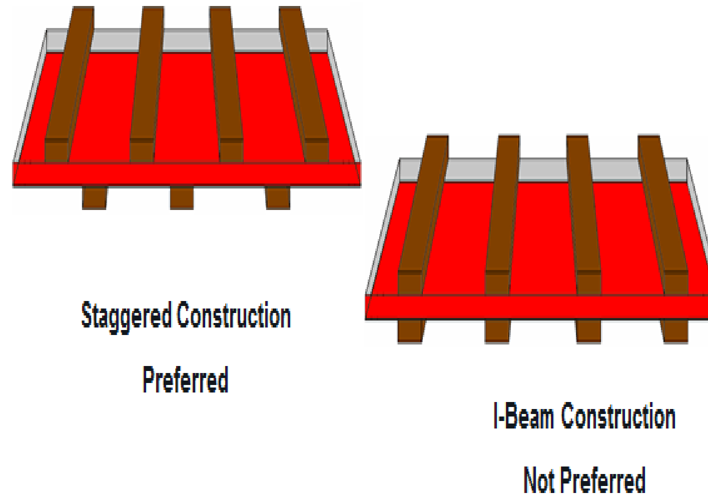
Design for Manufacturability Tips

Preferred practice is to route conductors perpendicular to bend and fold areas in a single metal layer if possible.





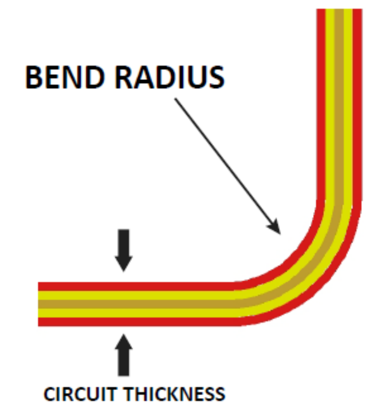
Single Metal Layer: 3-6 times material thickness

Two Metal Layers: 7-10 times material thickness

Multilayer Flex: 15-20 times material thickness

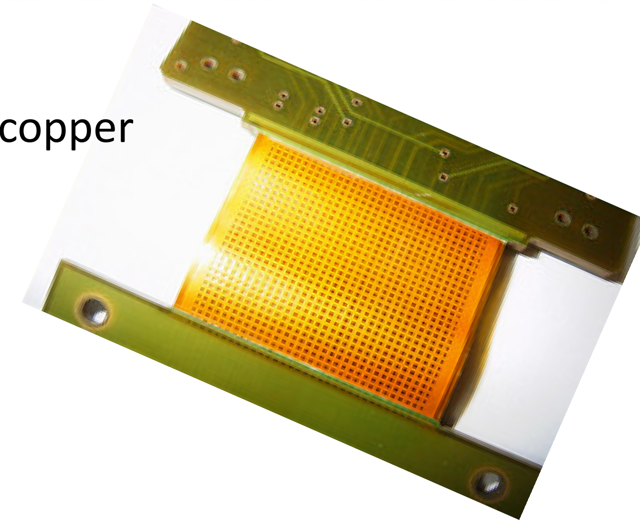
Dynamic Flexing: 20-40 times material thickness.

Thru holes should be placed at least .050" away from any bend areas

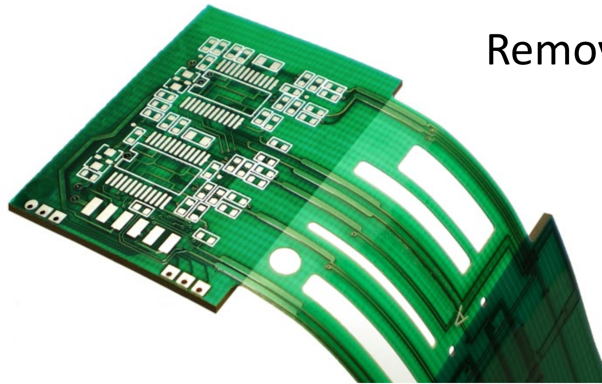


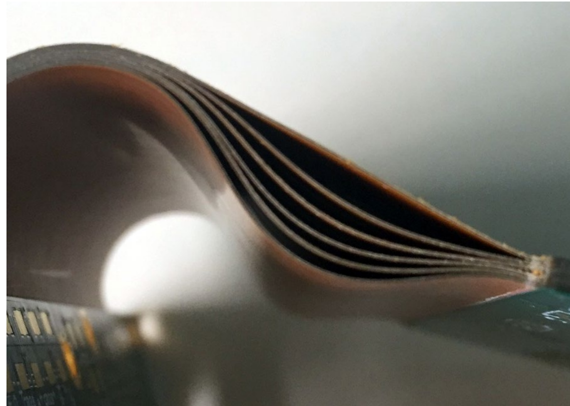
Tips and Tricks for increased flexibility

Cross hatch copper



Remove Material





Un-bonded layers

Route traces to second side and remove copper in flexing area

Consider Button-Plating to eliminate ED copper on panel when creating the PTH

Real World Lesson Learned

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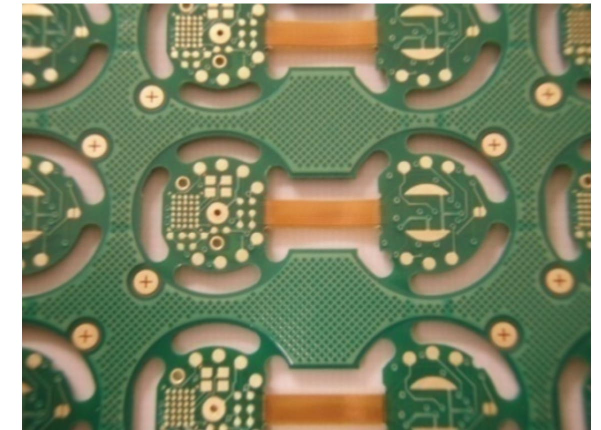
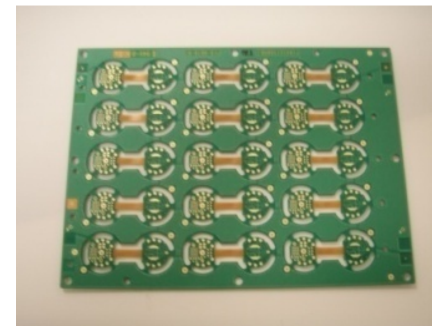
Case Study Medical Pill Camera: Rigid-Flex 4 Layer PCB

Very small part .5” by 1” in size on 15-up array. The part is ingested in pill form.



- **PROBLEM:**
  - Customer had soldering issues on Micro BGA
  - High volume offshore solution needed 100K+ pieces annually

- **SOLUTION:**
  - Offered via fill solution
  - Implemented copper filled vias in 4 mil holes for Micro BGA pads
  - After solution was implemented the customer had zero rejects
  - Qualified off shore partner for high volume production
  - Shipped over 100K parts



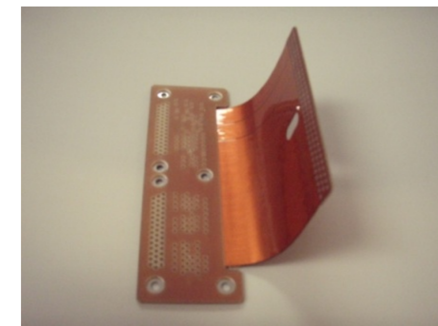
Case Study Avionics Application: Rigid-Flex 4 Layer PCB with 2 stiffeners

PROBLEM:

- Customer had 70% failure rate from existing supplier
- Copper in Flex area was cracking due to flex area of PCB being bent several times

SOLUTION:

- Redesigned stack-up
- Converted customer to adhesiveless kapton material
- Decreased Flex Circuit thickness from 19.6 mils to 13.4 mils a 32% decrease
- Extra thickness was adding rigidity to flex area and causing copper to crack once circuit was bent to form application
- Part is populated, bent to shape and shipped to customer.
- Now qualified on a 12 year program with customer



Real World Lesson Learned

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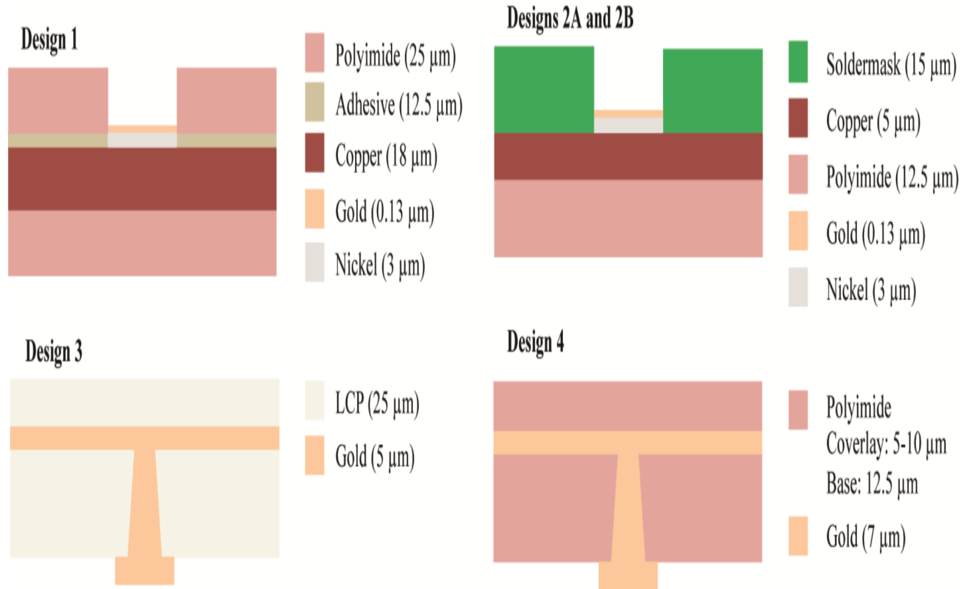
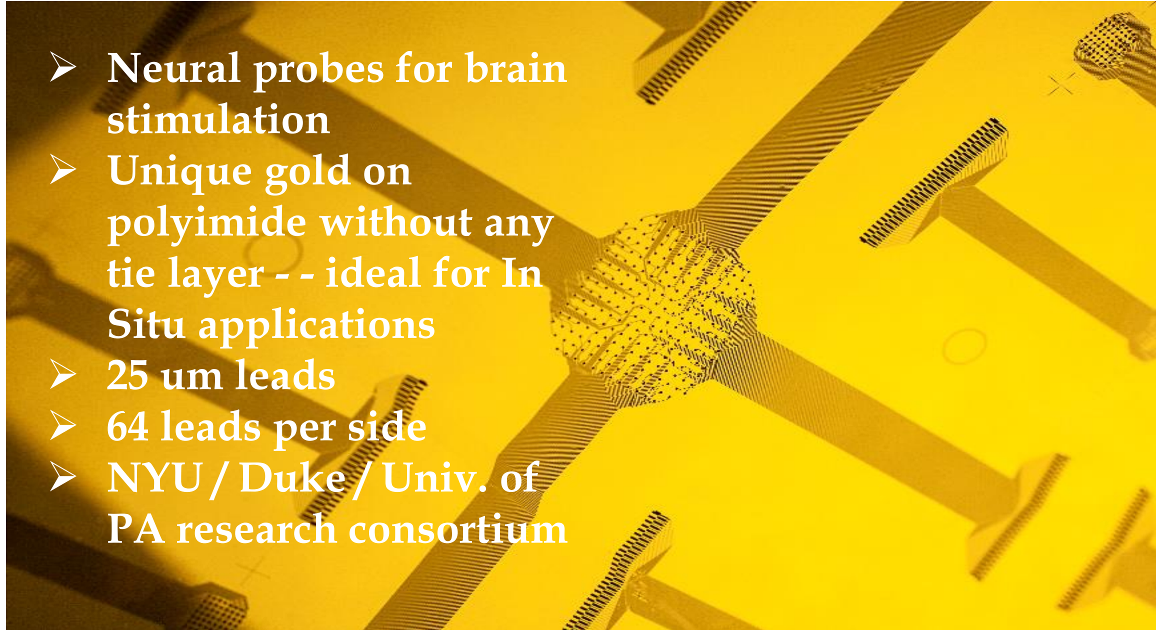
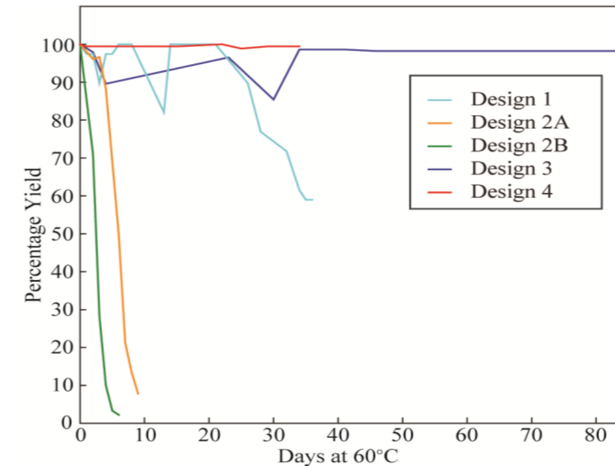
Materials and Metal System for Neural Probes





- A single metal system and reliable materials proved to be the best for this and other implanted probe applications
- The overall simplicity leads to fewer manufacturing steps and greater yield and reliability



Real World Lesson Learned

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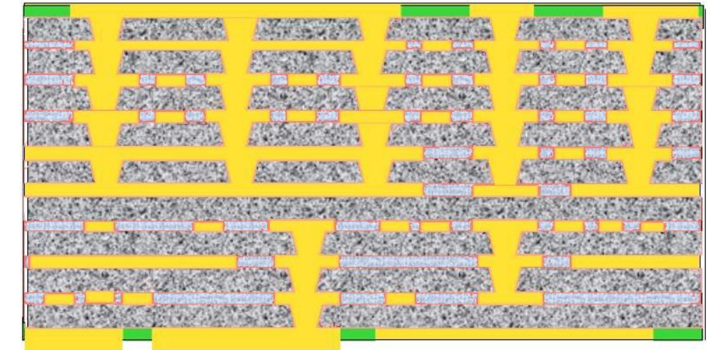
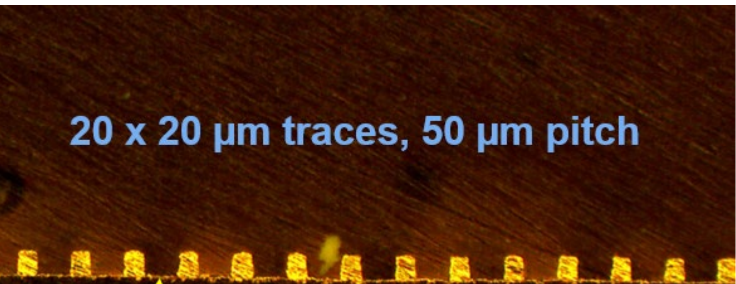
Case Study: Integrating Subtractive Etch Layers with SAP Layers



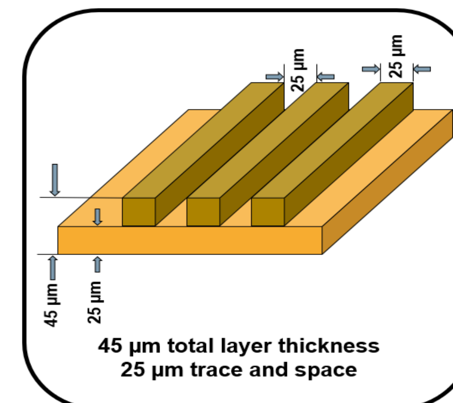
PROBLEM:

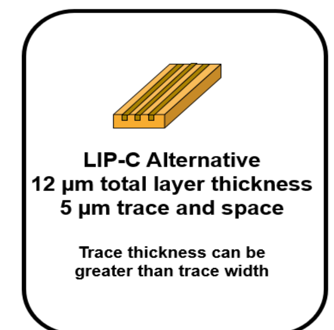
- High density routing requires every layer via design
- Ten layer design requires 4 lamination cycles, which is both expensive and has an extended lead time



SOLUTION:

- Convert 4 of the 10 layers to SAP with 1 mil line and space
- Reduce the total number of layers needed to 8
- Integrate the SAP layers with 4 layers of subtractive etch processing
- Reduce the lamination cycles required from 1 to 4
- In development now with future development planned with LIP-C processing





Thank you!

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