

Semi-Additive Process for Variant Polyimide Substrates in Ultra-Fine Flexible Circuitry

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Content

- Introduction:

 - Ultra-Fine and Flexible Circuitry

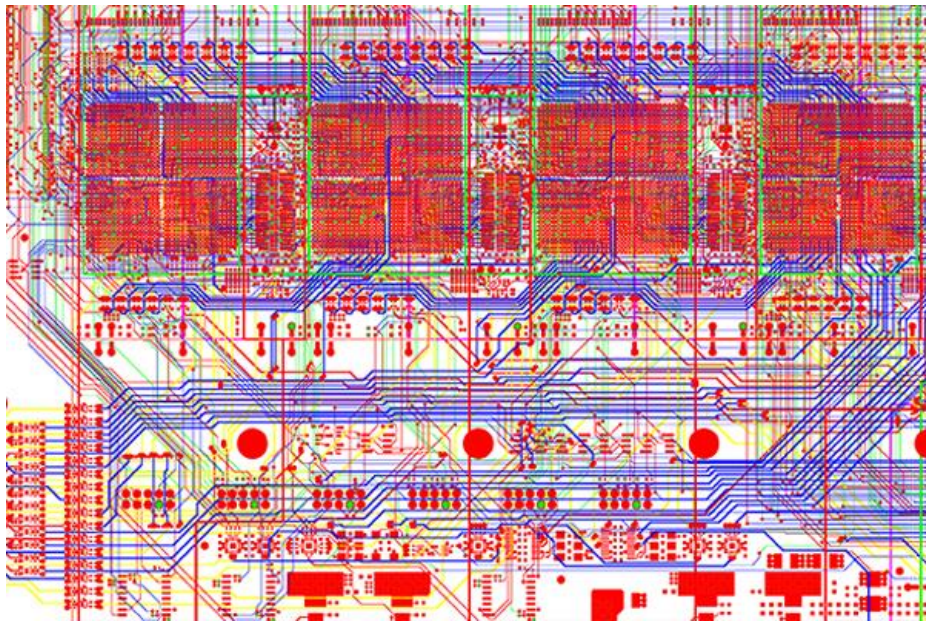
 - Semi-Additive Process (**SAP**)

- **SAP-FLEX** for Ultra-Fine Flexible Circuitry

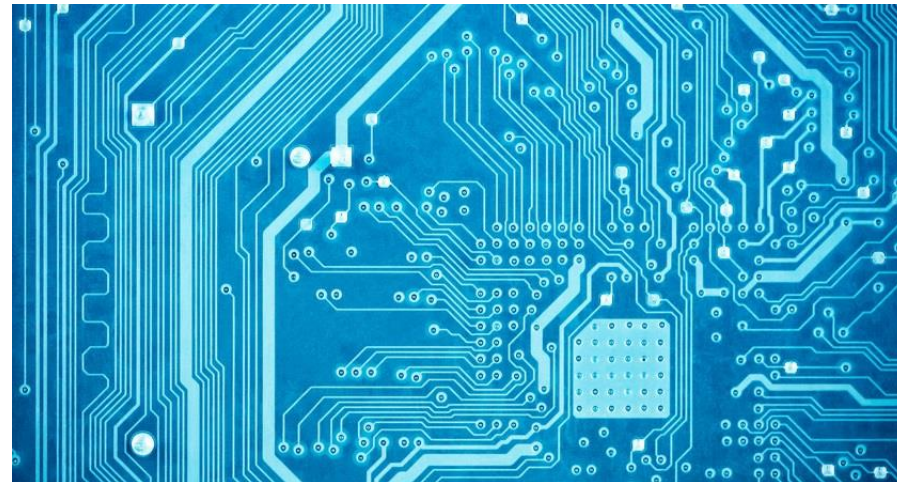
- Summary

Introduction: Ultra-Fine Circuitry

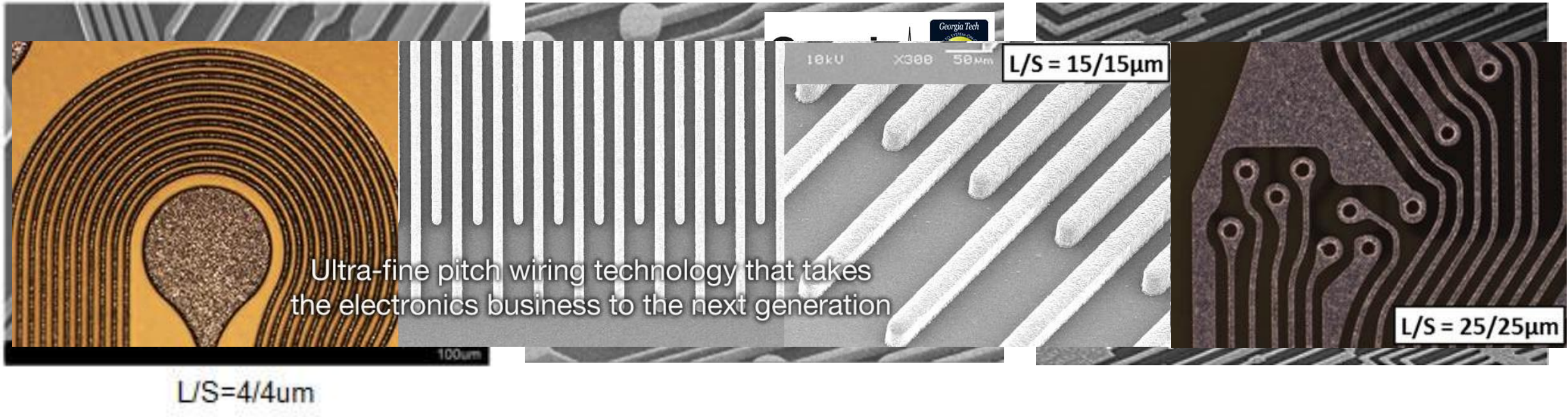
Why Ultra-Fine?



- Miniaturization
- Light weight
- Better high-speed signal



Ultra-Fine Circuitry: How Fine?



Tighter Pitch, Thinner Line/Spacing, Smaller Via

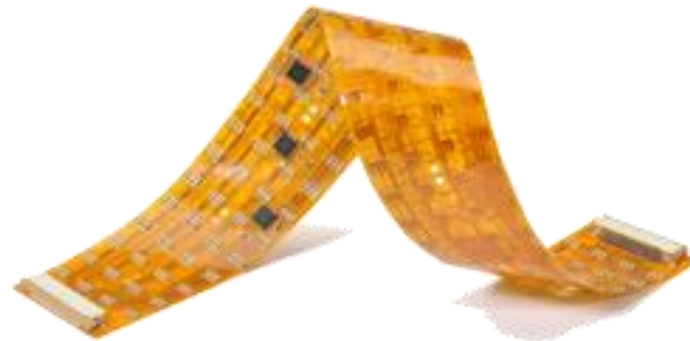
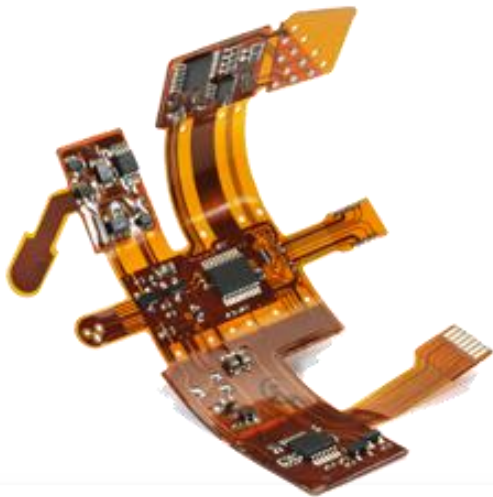
Flexible Circuitry

Adhesion in FPC

- Surface roughness: $R_a \leq 100$ nm
- Initial adhesion: ≥ 550 gf/cm
- Baking test: after 7-day @ 150 °C, ≥ 350 gf/cm

Polyimide (PI)

- Thin
- Flexible
- Light weight
- Good dielectrics properties
- Excellent chemical & thermal stability



Introduction: Semi-Additive Process (**SAP**)

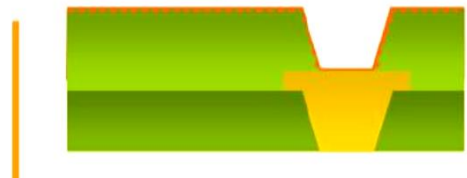
Lamination & Laser Via Formation



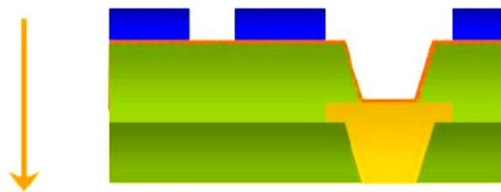
Adhesion Promotion & Via Cleaning



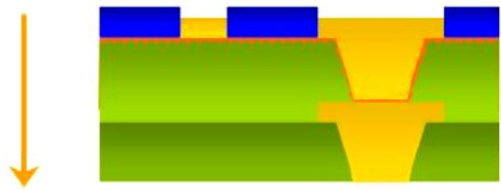
Electroless Copper Plating



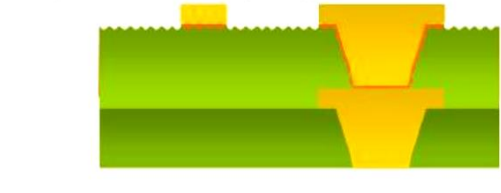
Dry Film Patterning



Electrolytic Copper Plating



Dry Film Stripping & Flash Etching



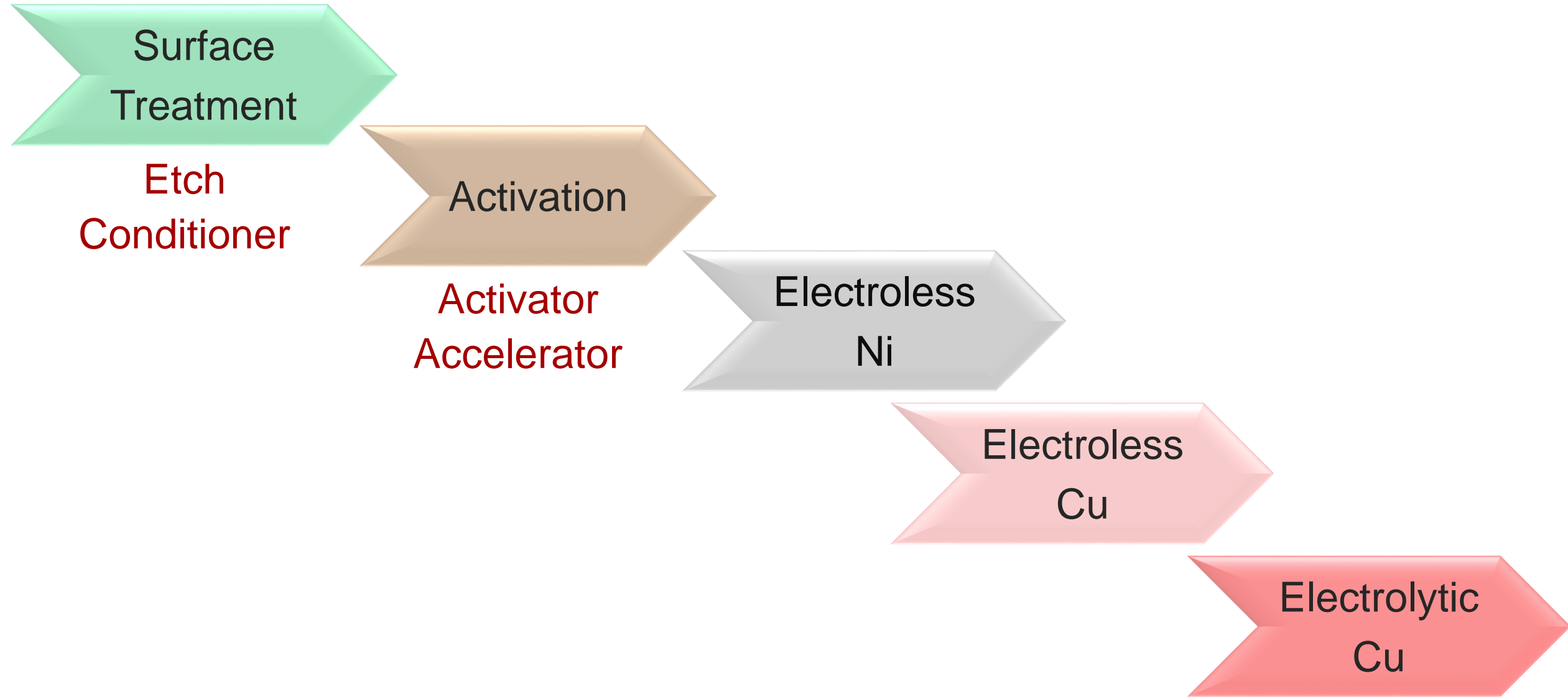
Additive vs. Subtractive

- Pattern plating on dielectric top
- Etching on Cu for Pattern

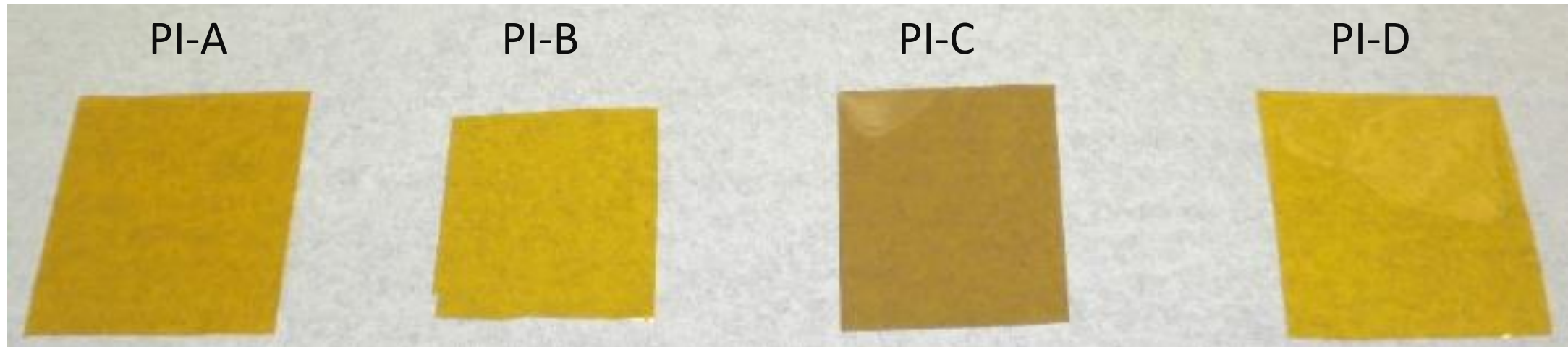
Semi-Additive vs. Full-Additive

- Cu thickness= E-less + E-lytic
- Cu thickness= E-less only

SAP-FLEX for Ultra-Fine FPC



SAP-FLEX: 4 PI Substrates



Element	Wt%	At%
C K	12.69	30.88
O K	25.47	46.54
Si K	0.35	0.37

MacDermid 10.0kV 6.4mm x5.00k SE 4/15/2014 12:03 10.0um

Element	Wt%	At%
C K	13.36	33.27
O K	27.77	51.91
Si K	3.09	3.29

MacDermid 15.0kV 10.6mm x5.00k SE 4/9/2014 10:13 10.0um

Element	Wt%	At %
C K	12.49	33.16
O K	25.63	51.06
Si K	2.39	2.71

MacDermid 15.0kV 10.8mm x5.00k SE 4/9/2014 10:24 10.0um

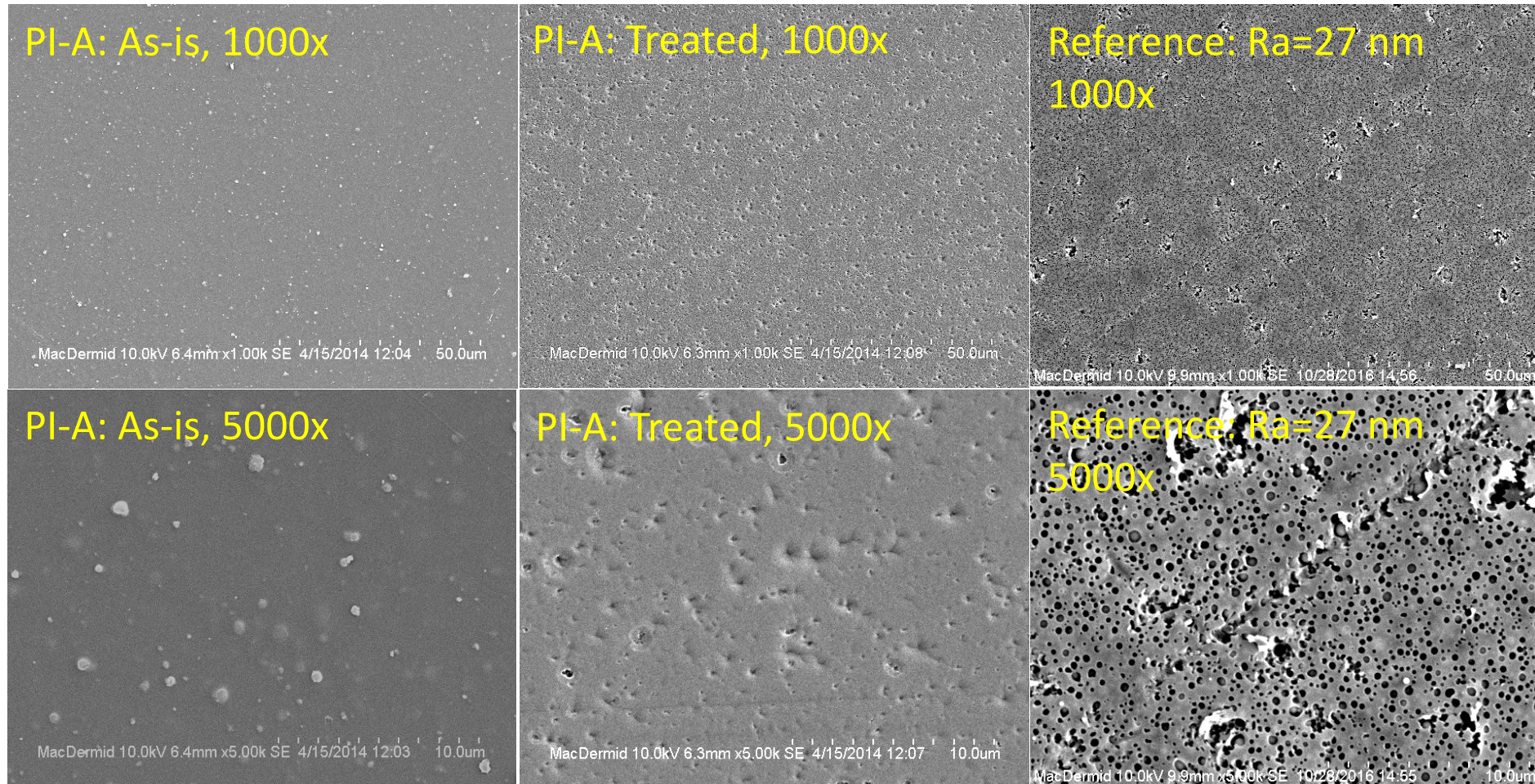
Element	Wt%	At %
C K	53.39	60.31
O K	33.08	28.05
Si K	3.04	1.47

MacDermid 10.0kV 9.4mm x5.00k SE 7/5/2017 13:17 10.0um

Surface Treatment

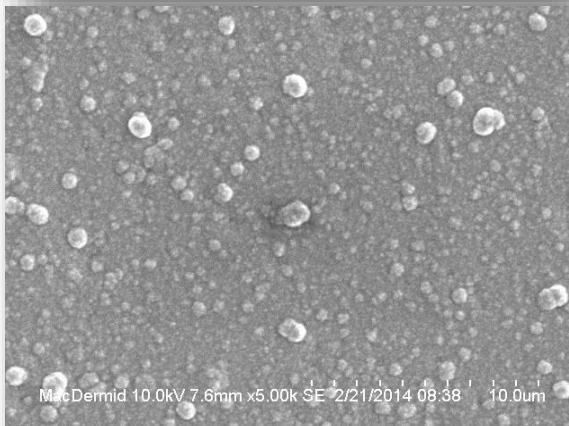
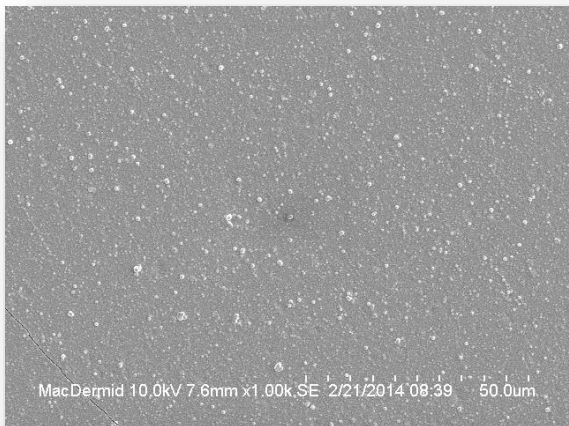
Etch Conditioner

SAP-FLEX Surface Pretreatment

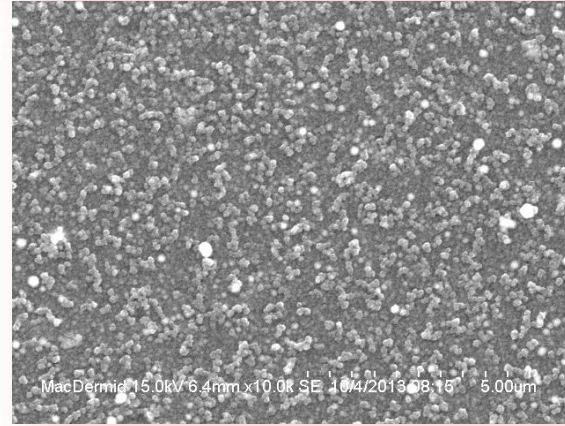
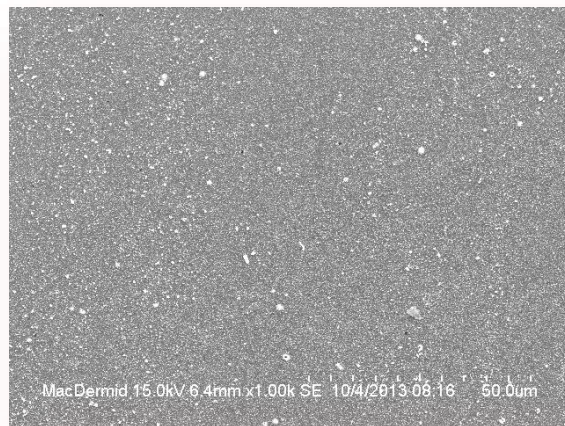


SAP-FLEX: Plating

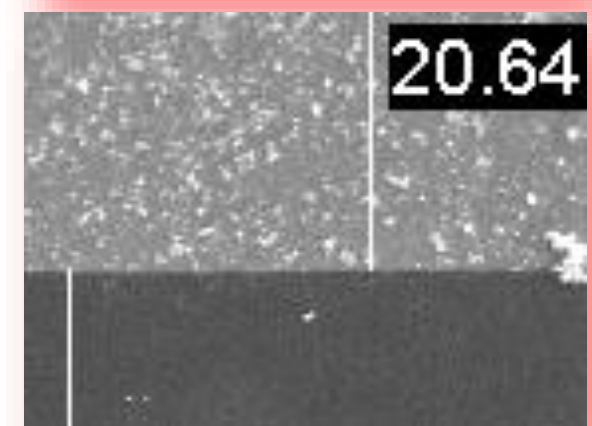
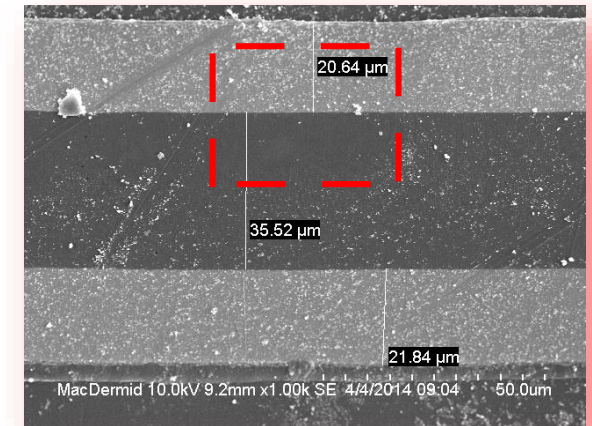
Electroless Ni



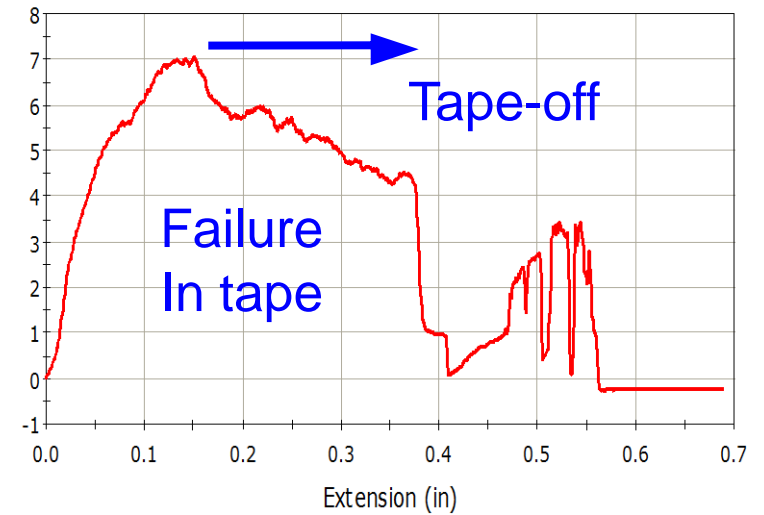
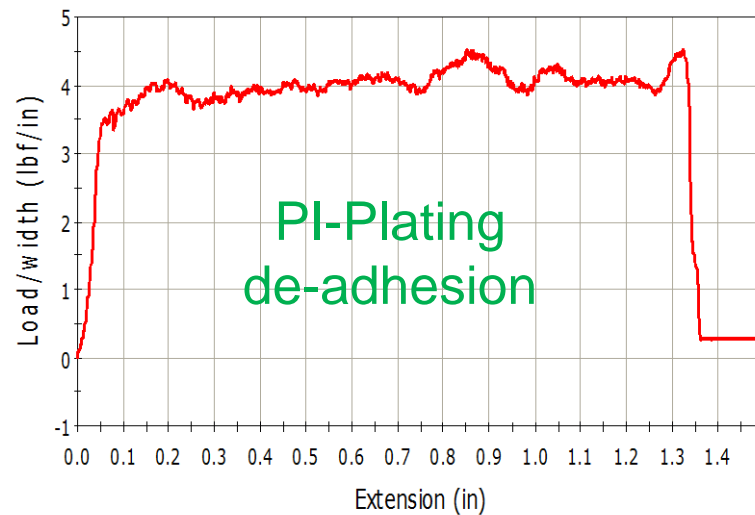
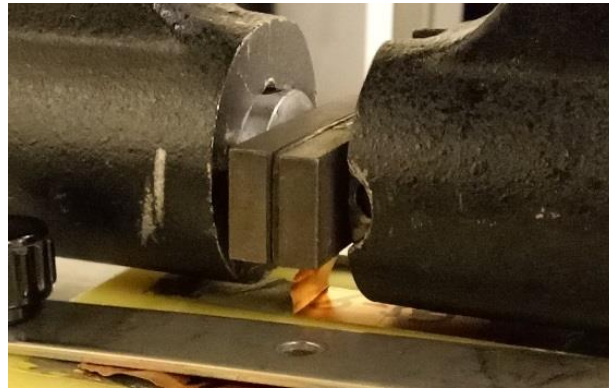
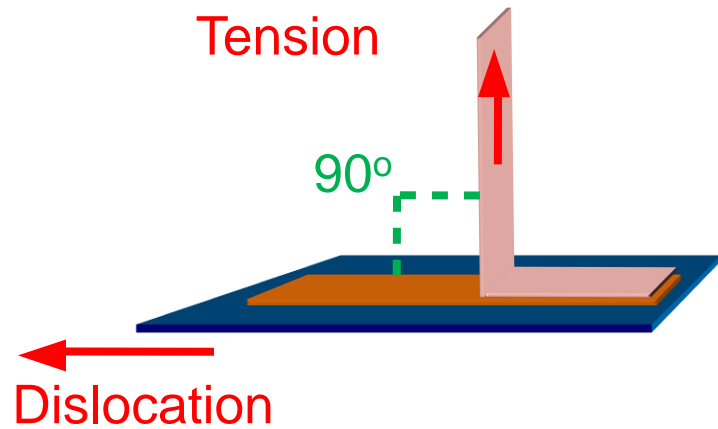
Electroless Cu



Electrolytic Cu



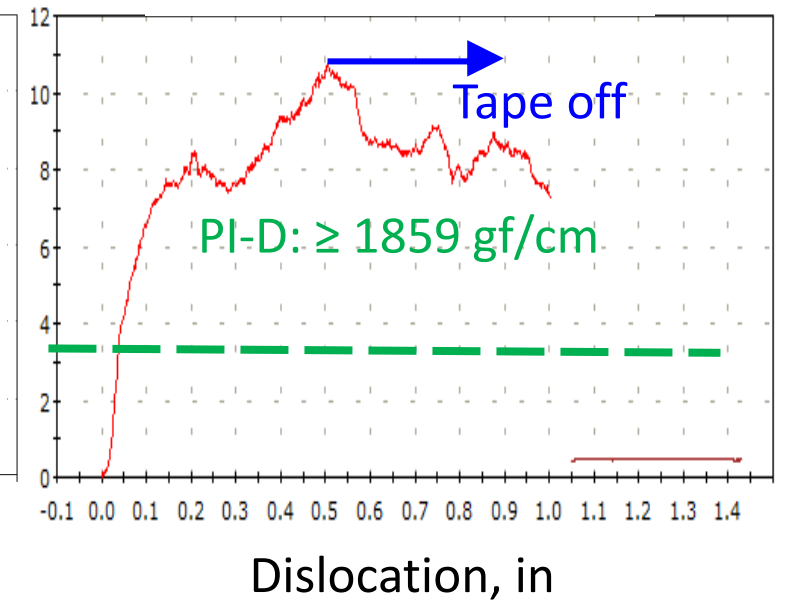
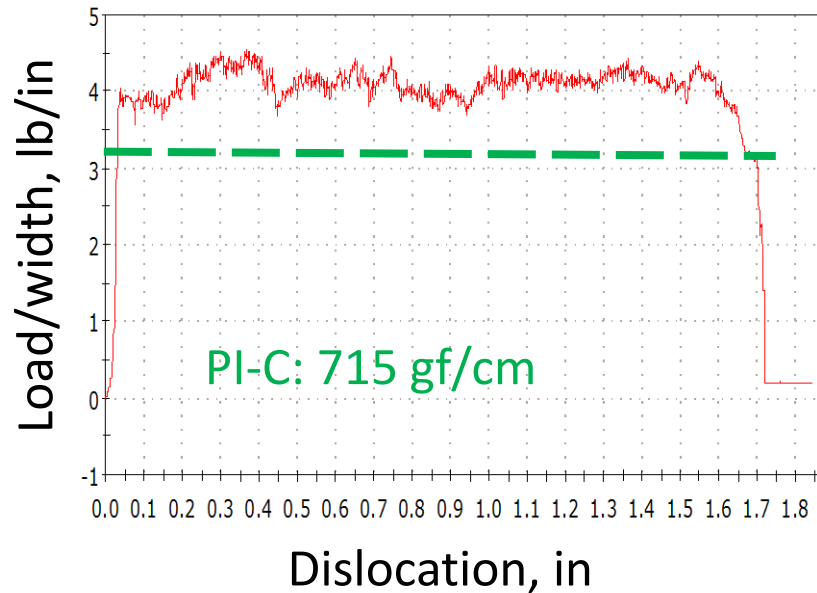
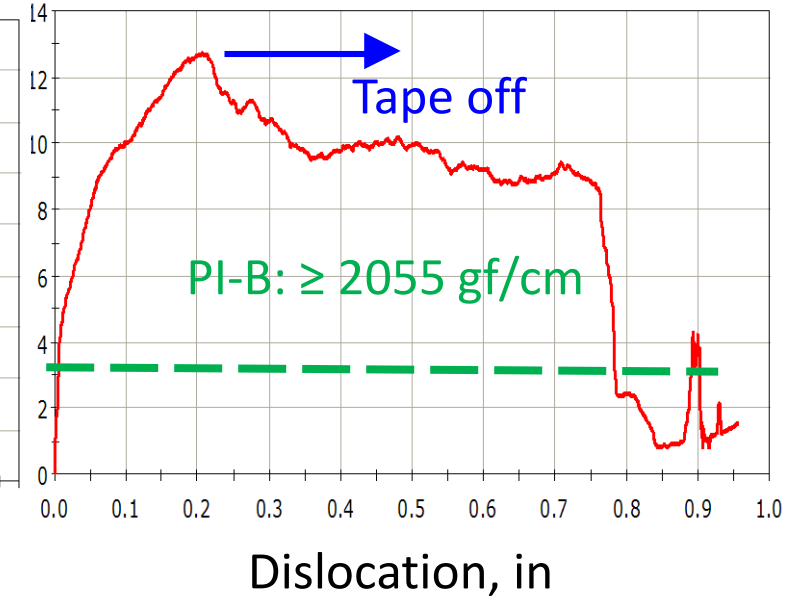
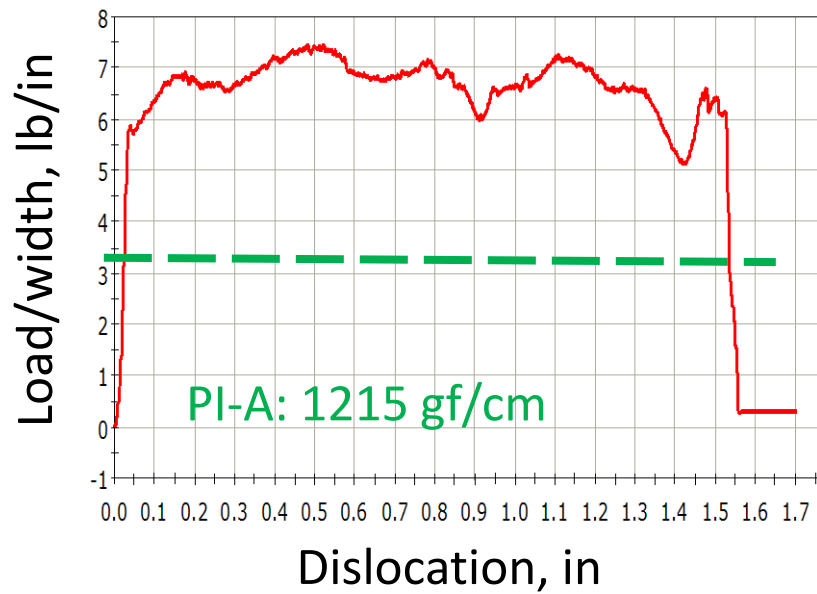
SAP-FLEX: PI-Plating Adhesion



SAP-FLEX:

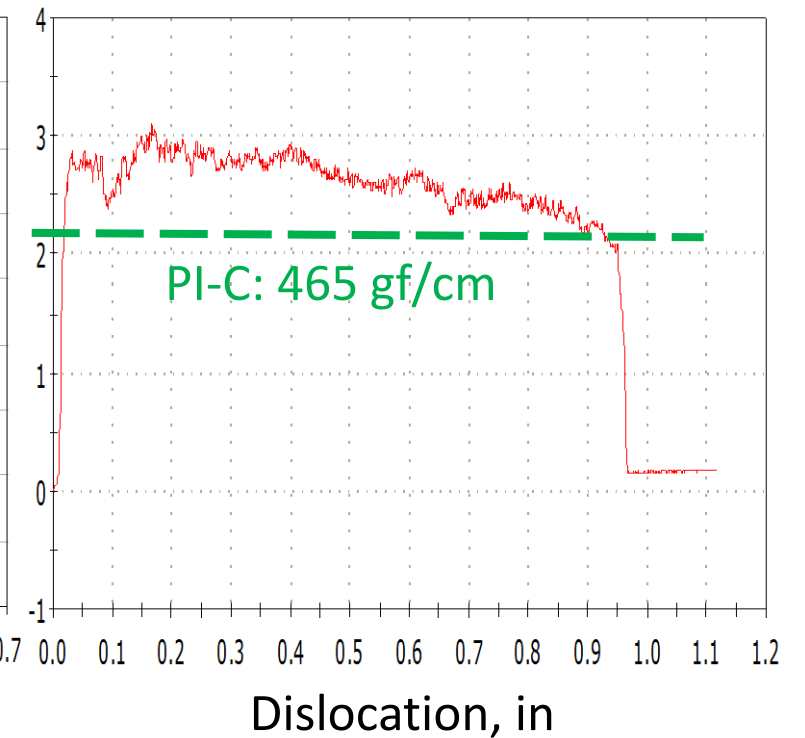
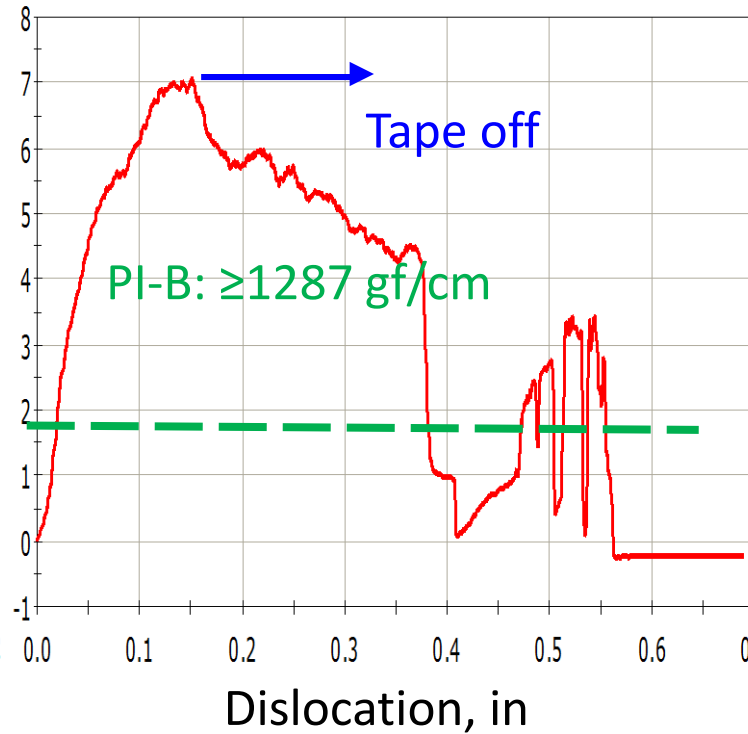
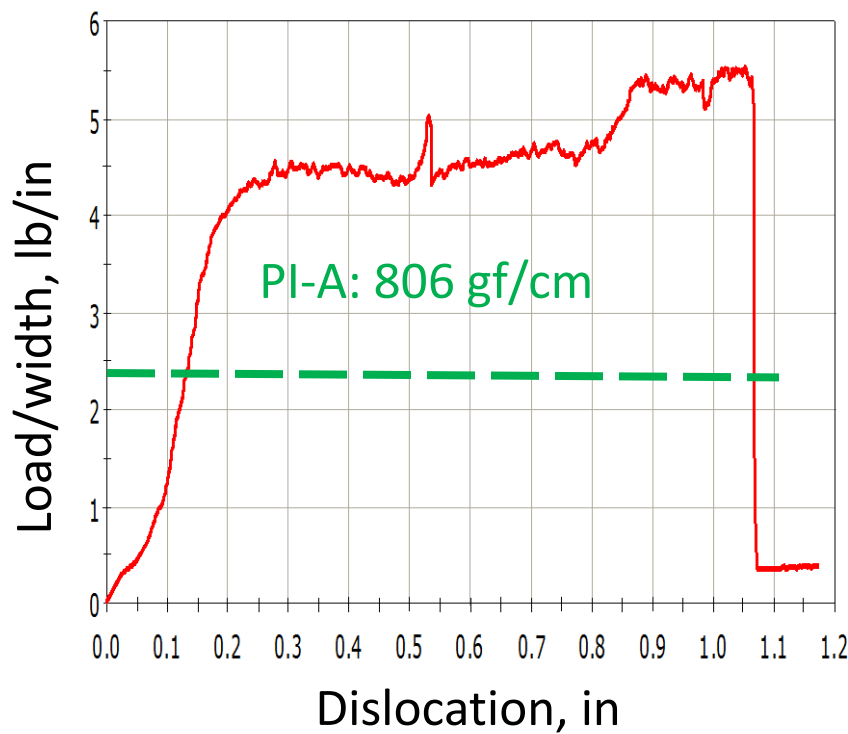
Initial Adhesion,

≥550 gf/cm (3.08 lb/in)

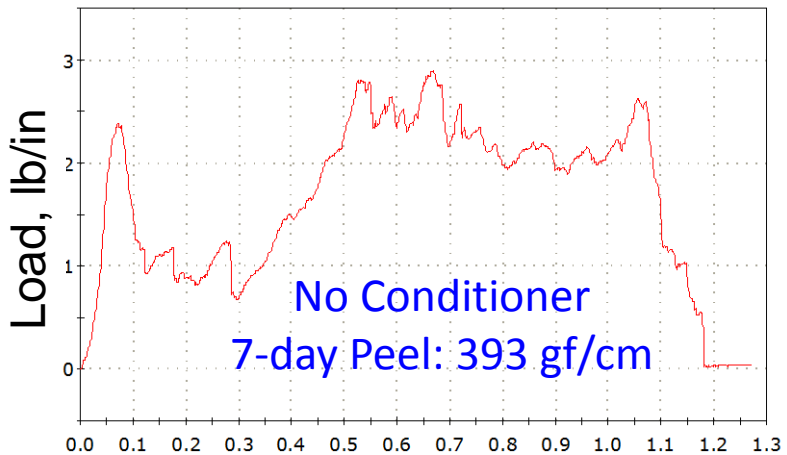
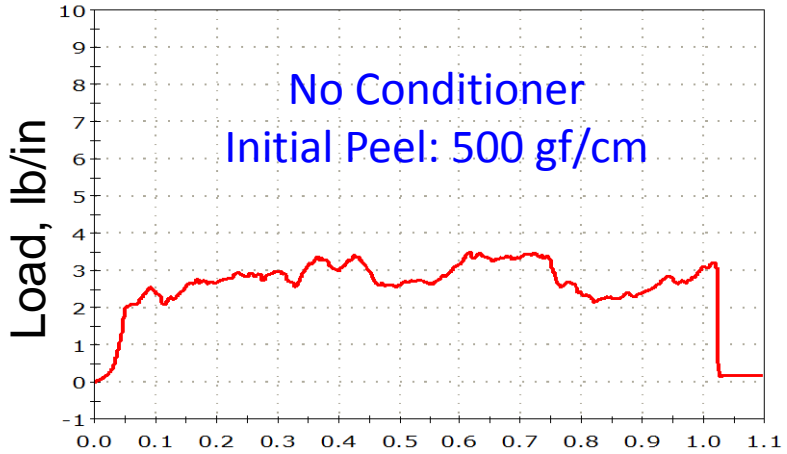


SAP-FLEX:

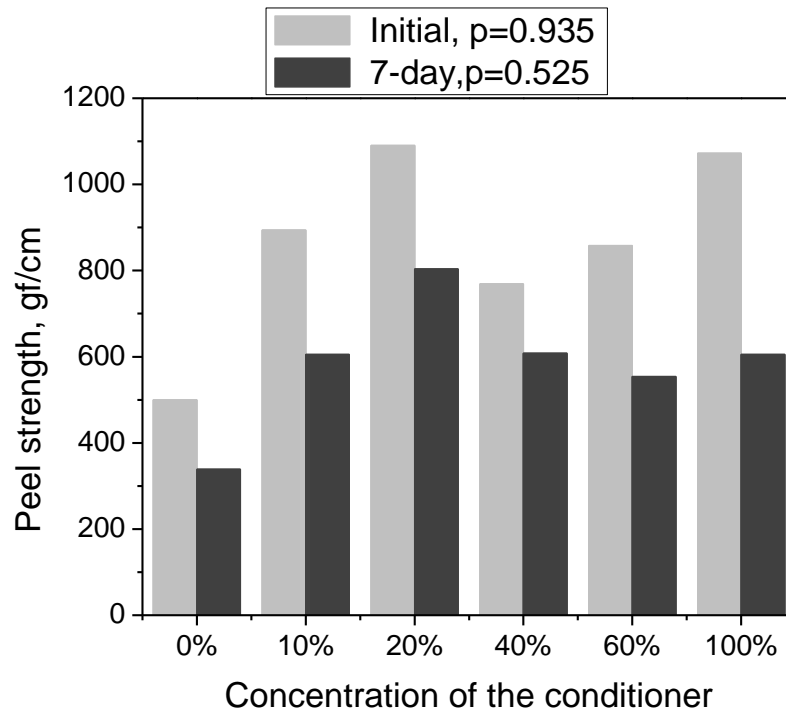
7-Day Baked Adhesion, ≥ 350 gf/cm (1.96 lb/in)



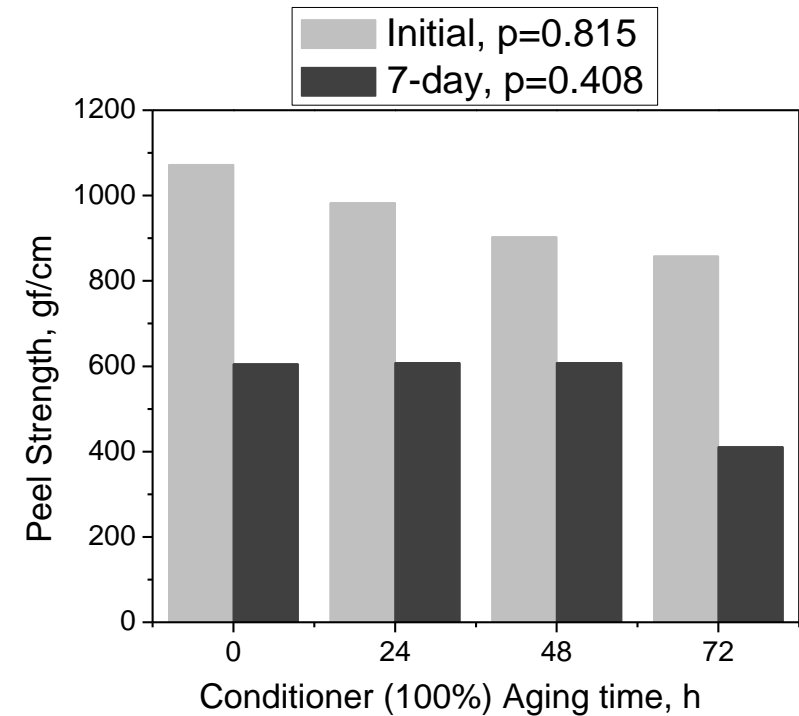
SAP-FLEX: Adhesion Promoter, SAP-FLEX Conditioner



Processing Window

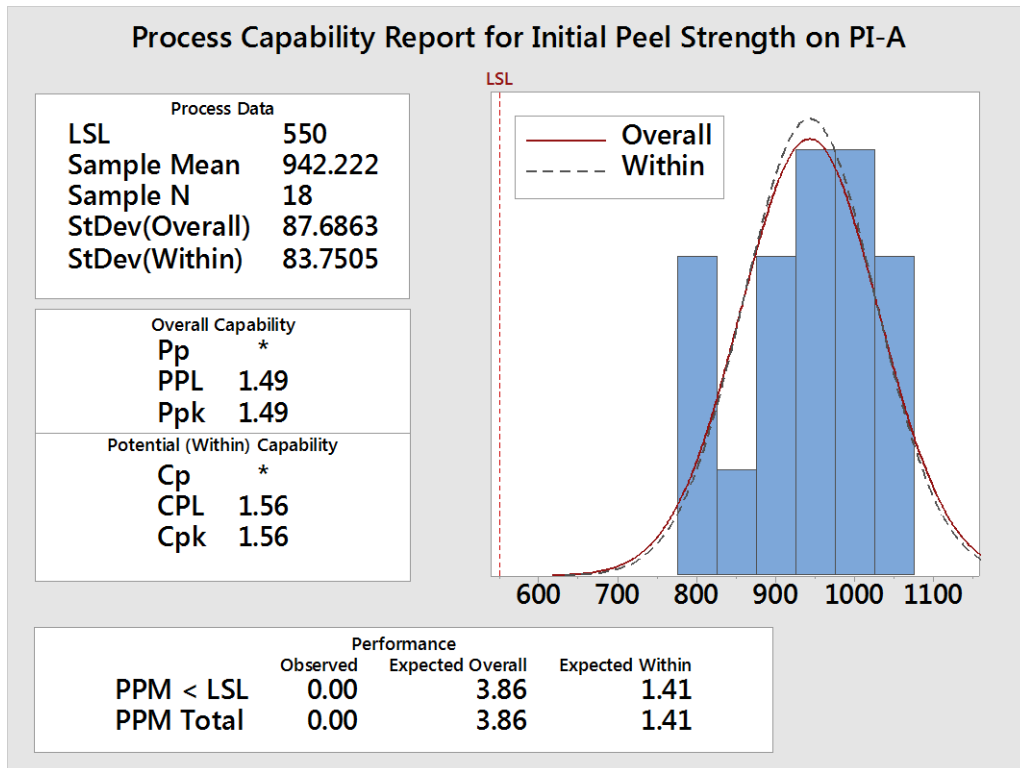


Bath Life

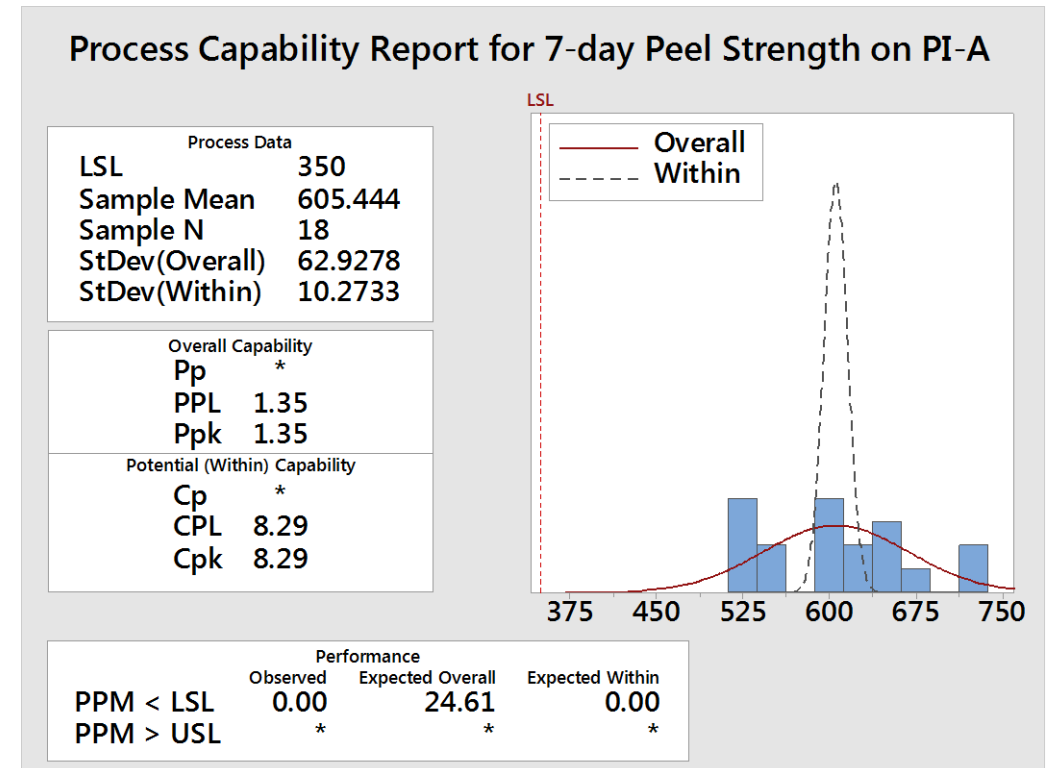


SAP-FLEX: Process Capability

Initial Peel



7-Day Peel



SAP-FLEX for Ultra-Fine Flexible Circuitry

- Ultra smooth PI-Plating Interface
- Excellent Chemical Bonding
- Excellent on Different PI Substrates
- Applies to Rigid and Flexible circuitry

Thank you!



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