A Viable Copper Based Alternative to Pd Activation Systems for Electroless Copper Processing

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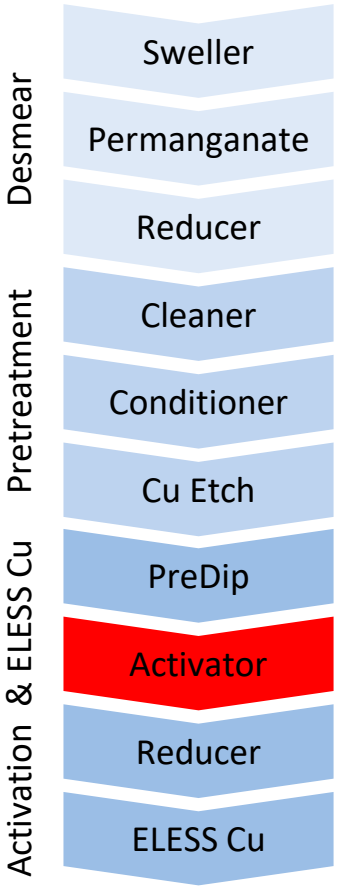
Technology for tomorrow's solutions

Copper Based ELESS Activation

Electroless Copper Process Sequence



Soften the resin

Etch and roughen the resin

Reduction and removal of manganese dioxide residues

Remove organic residues on resin and glass

Prepare glass reinforcement for deposition

Clean and roughen inner layer copper surfaces

Remove any residual Cu oxides & protect the activator solution

Adsorption of the ionic Pd catalyst onto conditioned surfaces

Reduce the ionic Pd to Pd metal

Deposit Copper layer

Copper Based ELESS Activation

Electroless Copper Activators

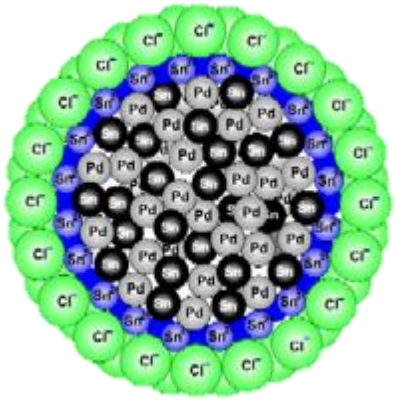
Pd - Sn Colloid

- Cl⁻ 0.181 nm
- Pd 0.128 nm
- Sn^{2+} 0.093 nm

Colloid diameter

Typ.: 2-10 nm

Max 100 nm

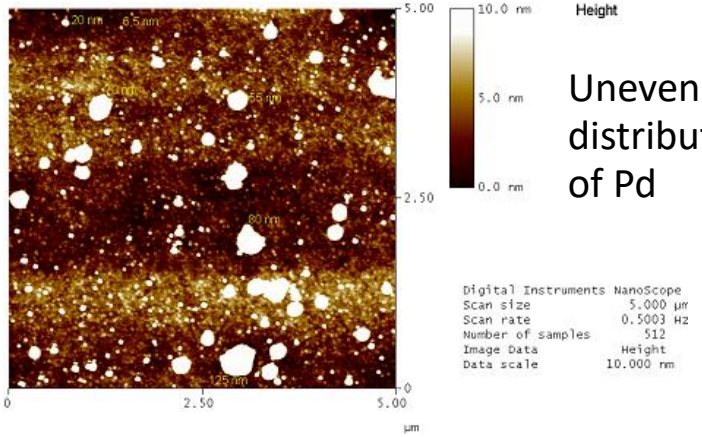


Ionic Pd Complex

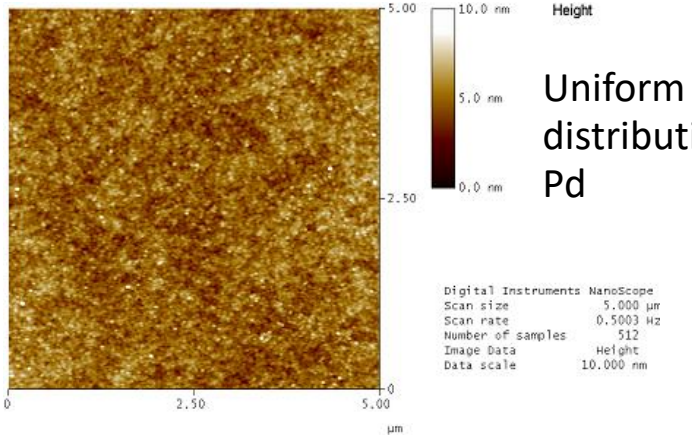
- Organic chelator
- Pd^{2+} 0.128 nm

Cluster diameter

Typ.: 1.0 nm



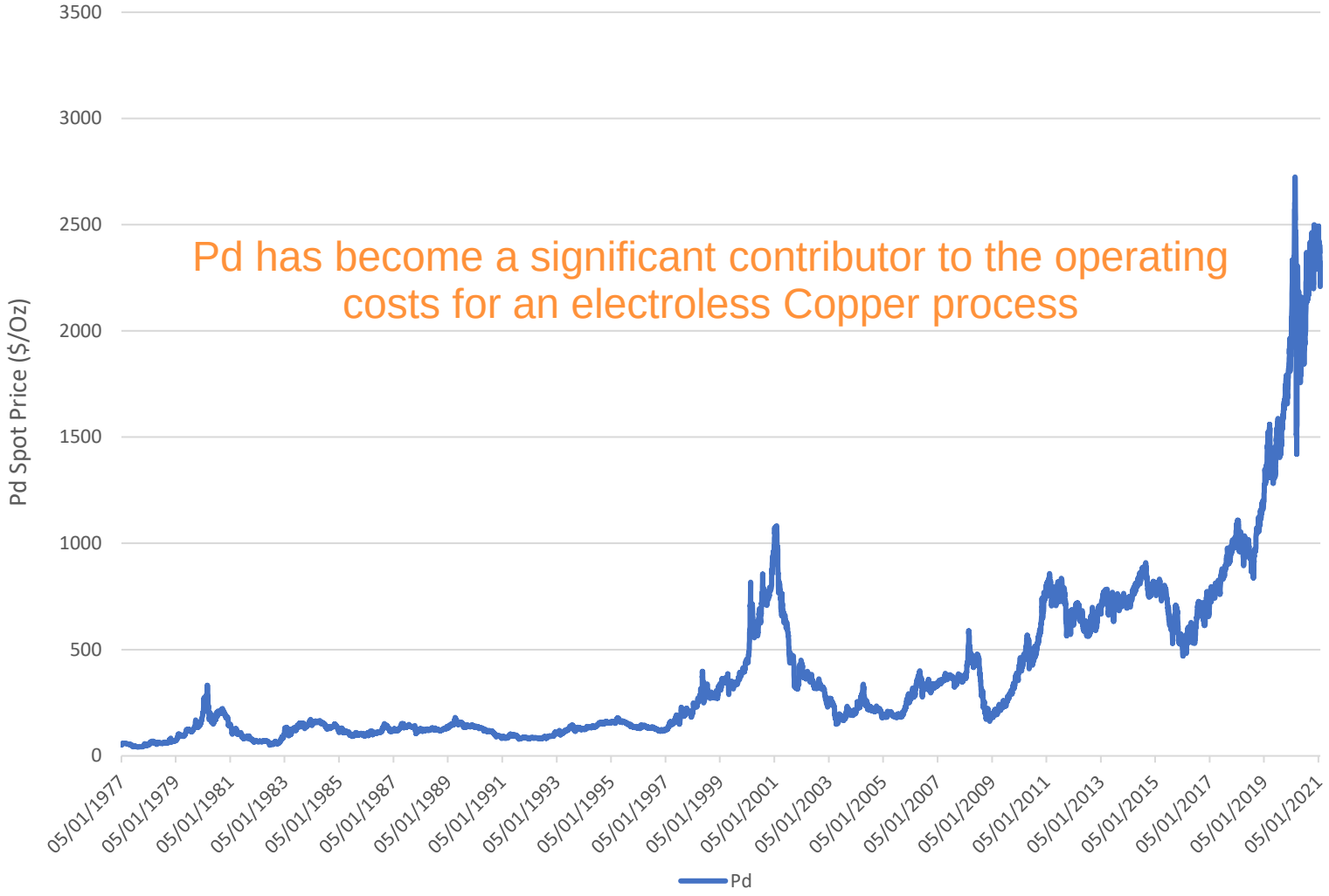
Uneven distribution of Pd



Uniform & fine distribution of Pd

Copper Based ELESS Activation

Why Change a Good Thing?



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Copper Based ELESS Activation

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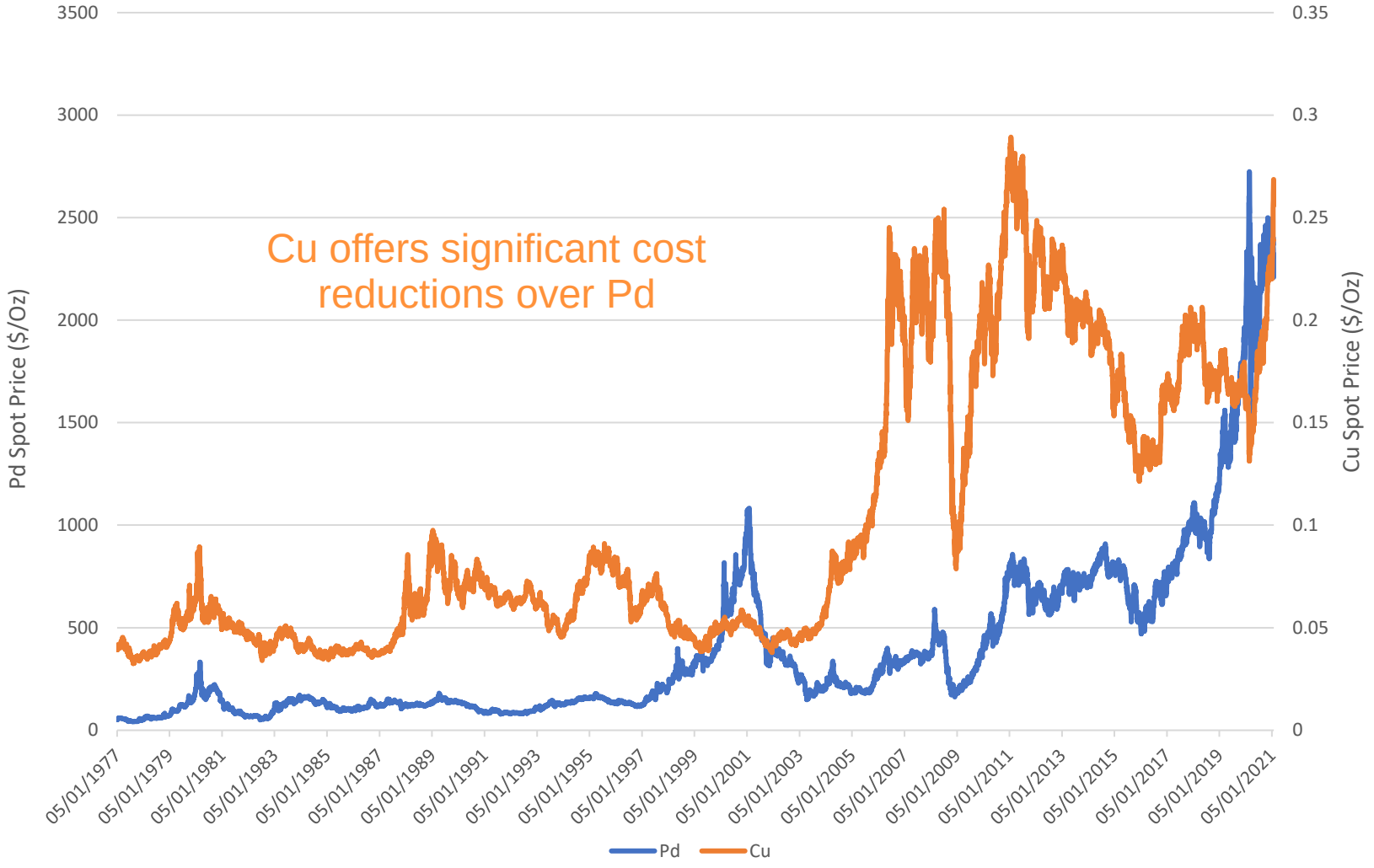

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Copper Based ELESS Activation

Why Change a Good Thing?

- Copper as an activator is not a new idea
- No production viable process available
  - Low bath stability – Activator precipitates rapidly
  - Poor resistance to rinsing – Activator washes off – poor coverage/adhesion

- Our focus has been on developing an activator solution based on colloidal Copper

- With a performance that is at least comparable to that of ionic palladium activation system

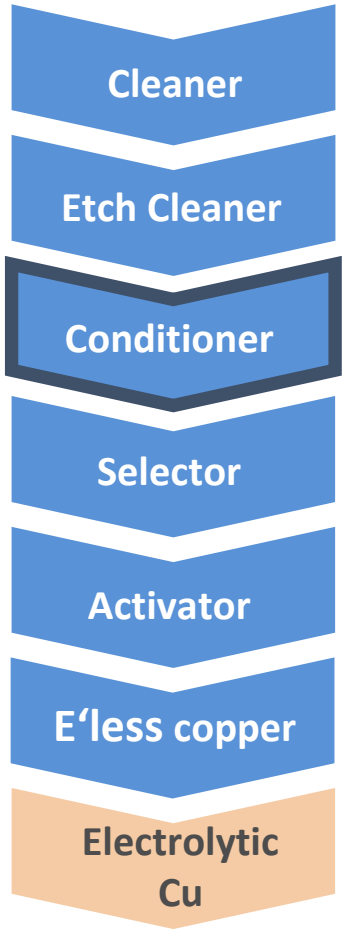
Copper Based ELESS Activation

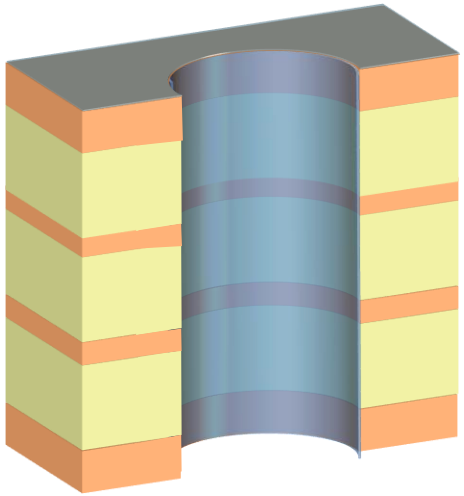
Process Integration – Sequence

Process sequence	Ionic Pd Activation	Colloidal Cu Activation
Sweller	Sweller	
Desmear	Permanganate	
Reduction	Conditioner & Glass Conditioner	
Cleaner - 1	Cleaner	
Cleaner - 2	Cu Etch	
Activation - 1	PreDip	Conditioner
Activation - 2	Pd Activator	Selector
Activation - 3	Reducer	Activator
Electroless Copper	ELESS Cu	

Copper Based ELESS Activation

Process Integration – Conditioner

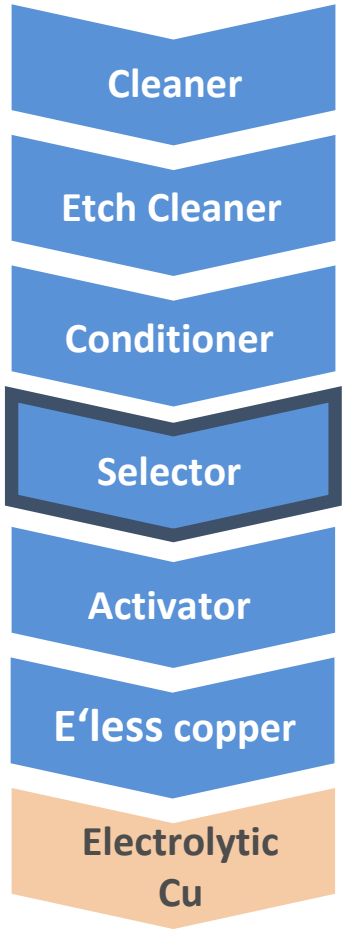


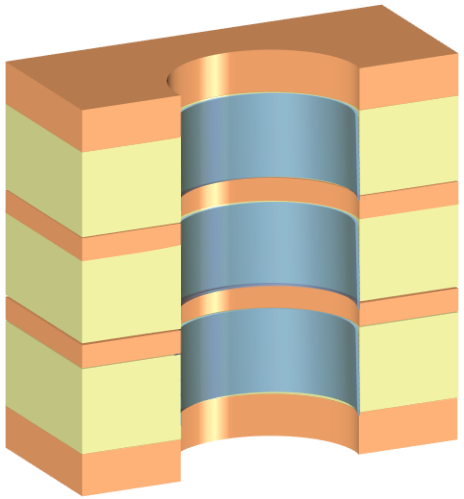


- Wetting and conditioning of the hole wall surface (resin and glass fibers) for best copper coverage by means of the Cu based activator.
- The conditioner is based on a unique highly functionalized polymer.

Copper Based ELESS Activation

Process Integration – Selector

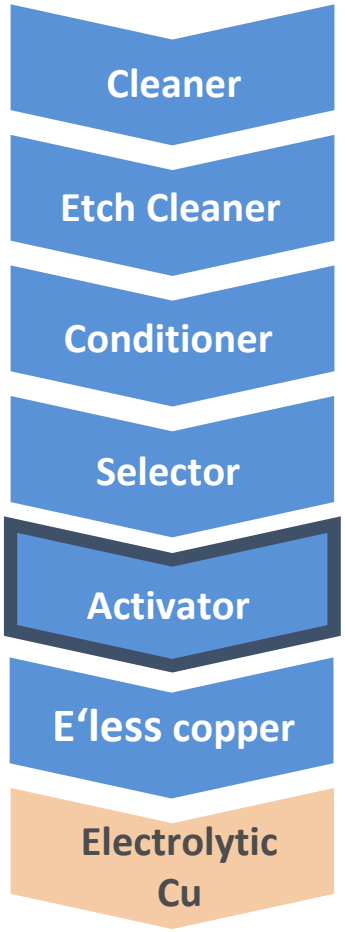


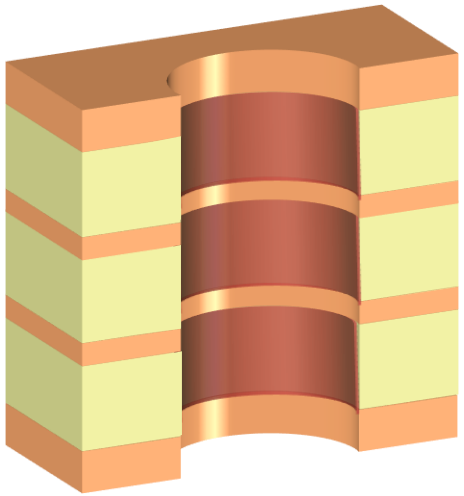


- Cleaning and removal of conditioner residues from copper surfaces to ensure an optimum Cu – Cu adhesion on inner layers

Copper Based ELESS Activation

Process Integration – Activation

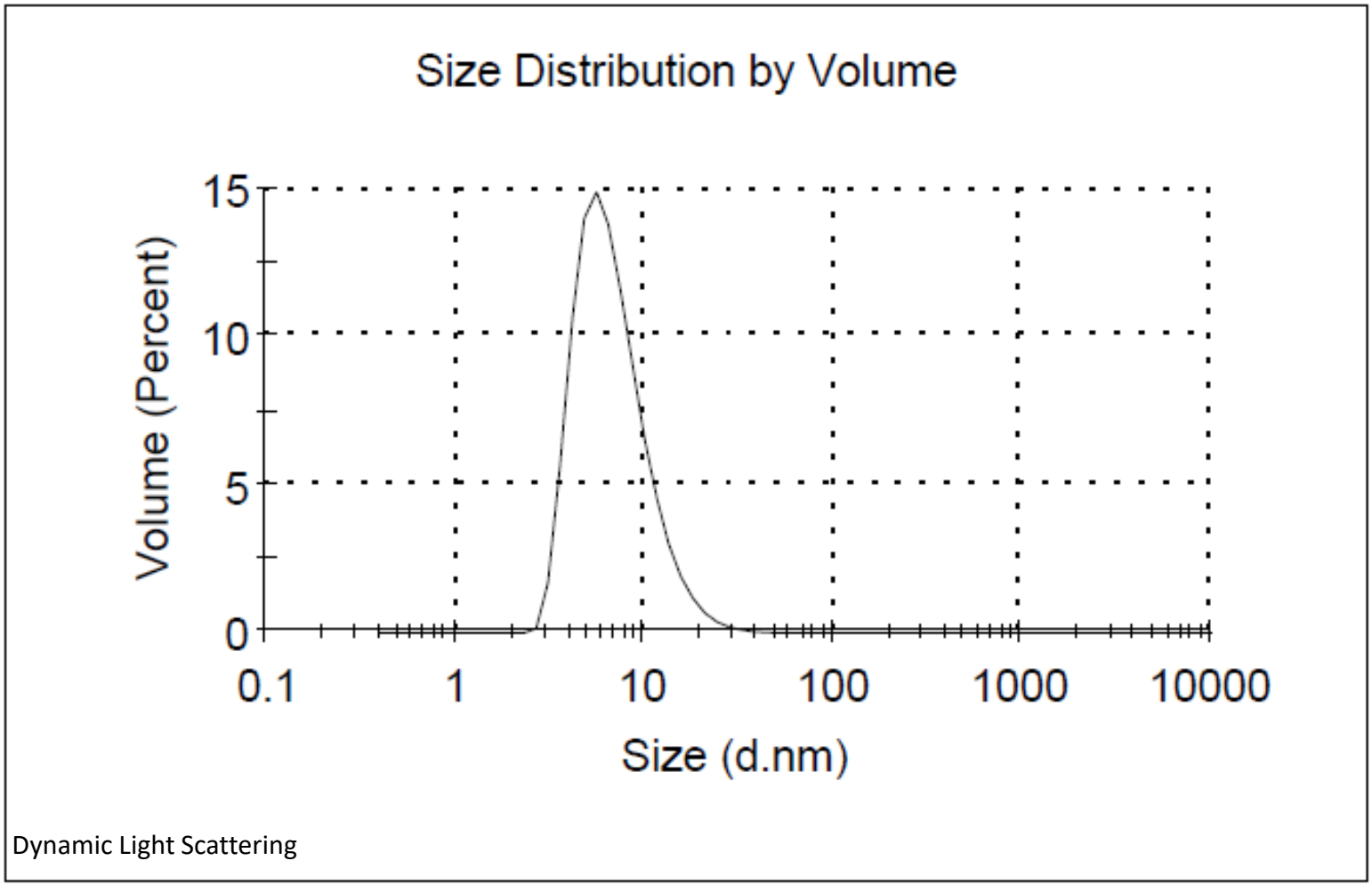




- Activator is entirely free of palladium.
- The copper activator is based on colloidal metallic copper particles of nanoscopic size.
- This formulation ensures a homogenous and dense coverage with copper seeds.

Copper Based ELESS Activation

Process Integration – Activator Colloid Particle Size



Dynamic Light Scattering

Copper Based ELESS Activation

Cu Colloid Activator – Make Up

- Novel make-up of the activator bath
- In-situ formation of Cu colloids
  - Mix
  - Analyze
  - Ready to go

Copper Based ELESS Activation

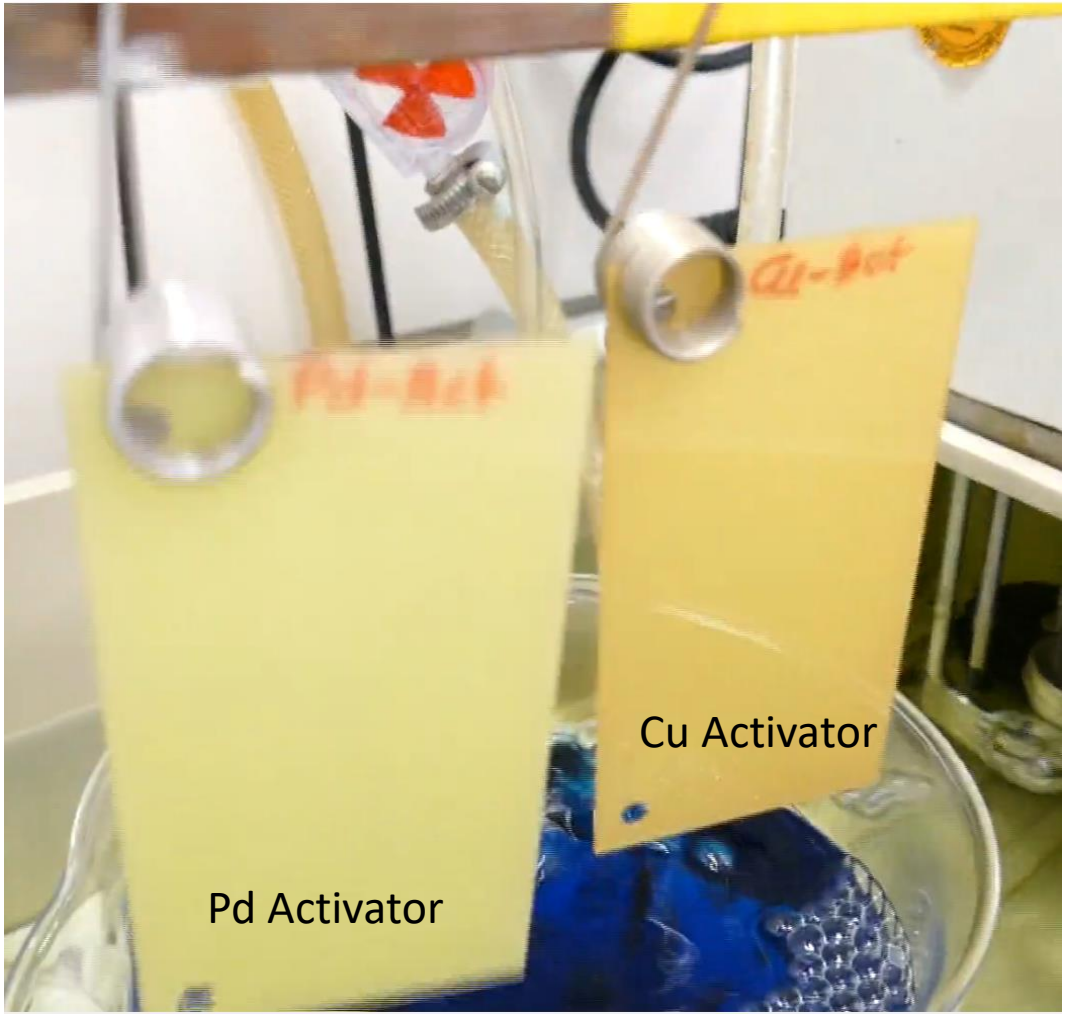
Cu Colloid Activator - Rinsing

- The deposited Cu seed layer is robust enough to withstand vigorous rinsing.

Copper Based ELESS Activation

Cu Colloid Activator - Deposition

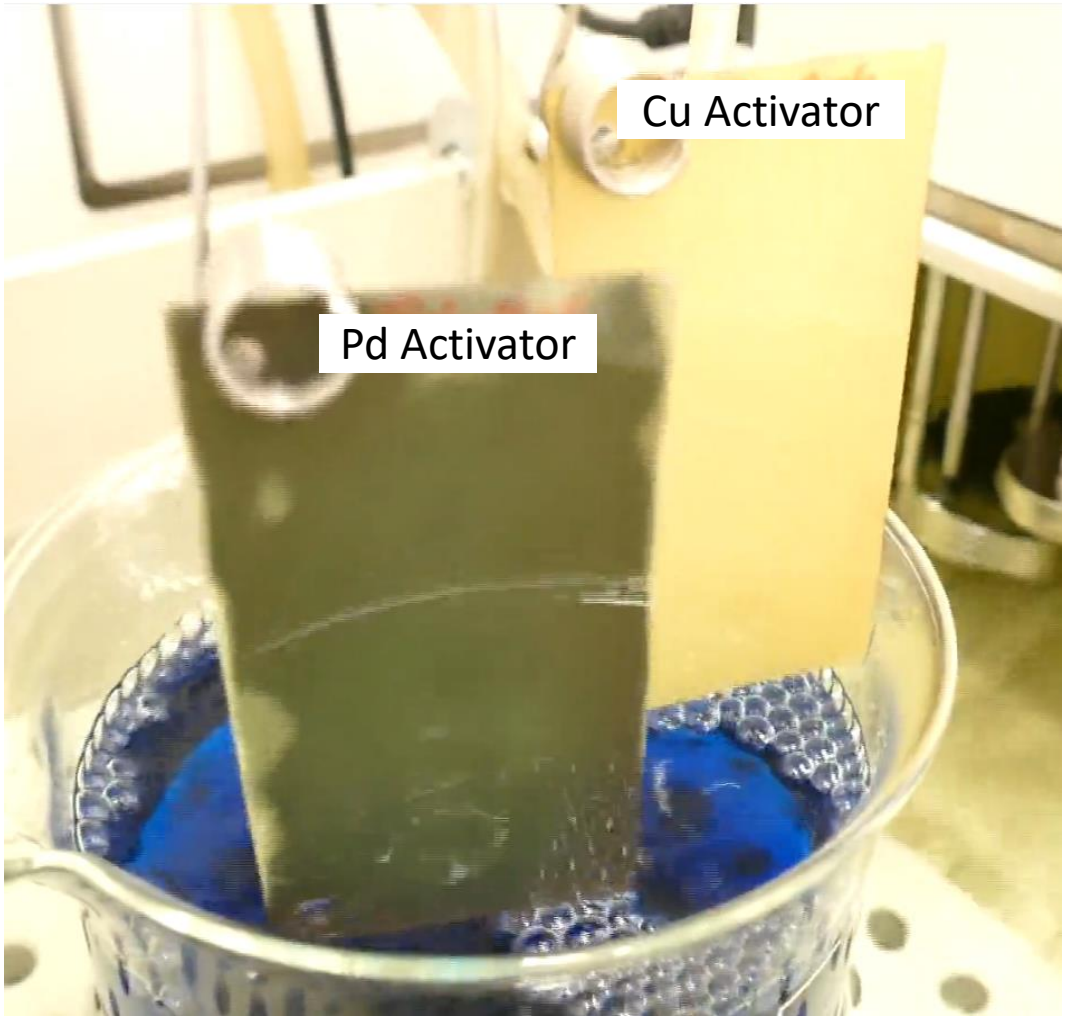
- Deposition of the Cu activator can be easily seen



Copper Based ELESS Activation

Cu Colloid Activator – Deposition of ELESS

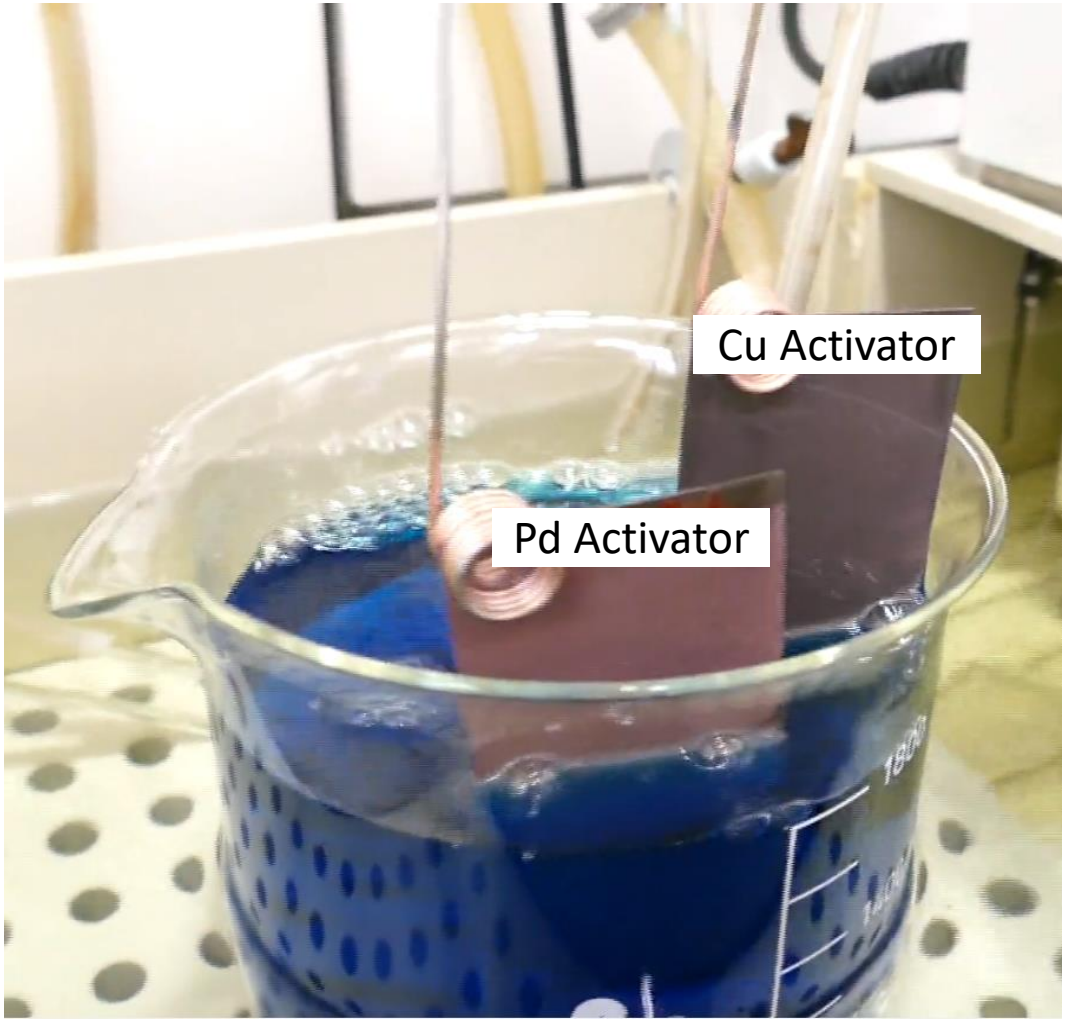
- Deposition appearance after 15 sec
  - Slower initiation with the Cu colloid



Copper Based ELESS Activation

Cu Colloid Activator – Deposition of ELESS

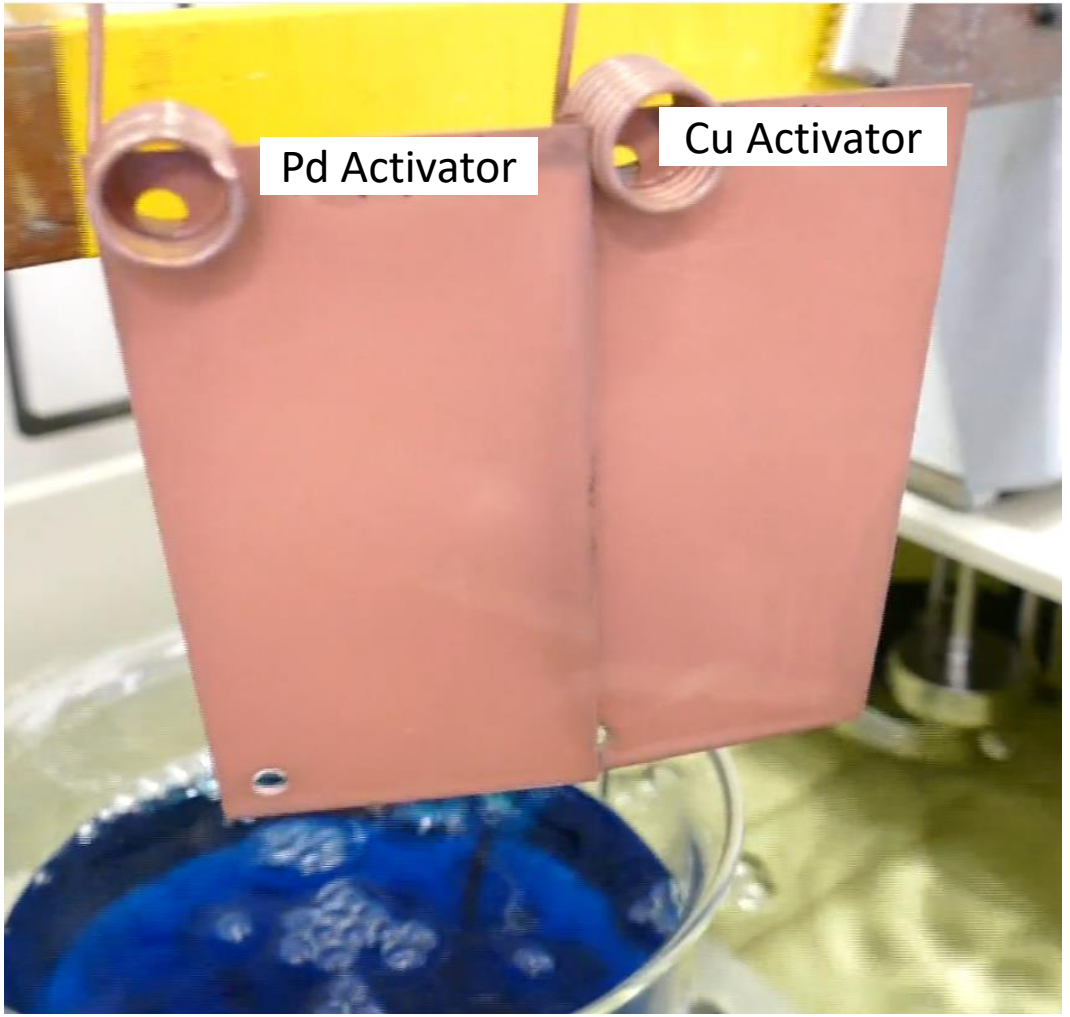
- Deposition appearance after 60 sec
- Now also the deposition of the Cu activator is catching up.



Copper Based ELESS Activation

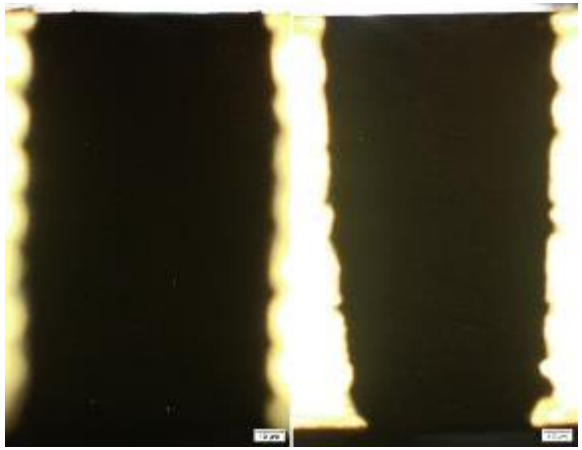
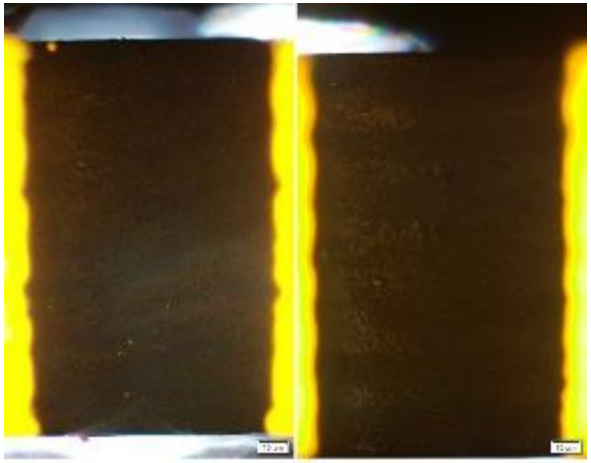
Cu Colloid Activator – Deposition of ELESS

- Deposition appearance after 20 min
- Both coupons are fully plated and indistinguishable
- Deposition thickness for both samples measured at 1.0 µm

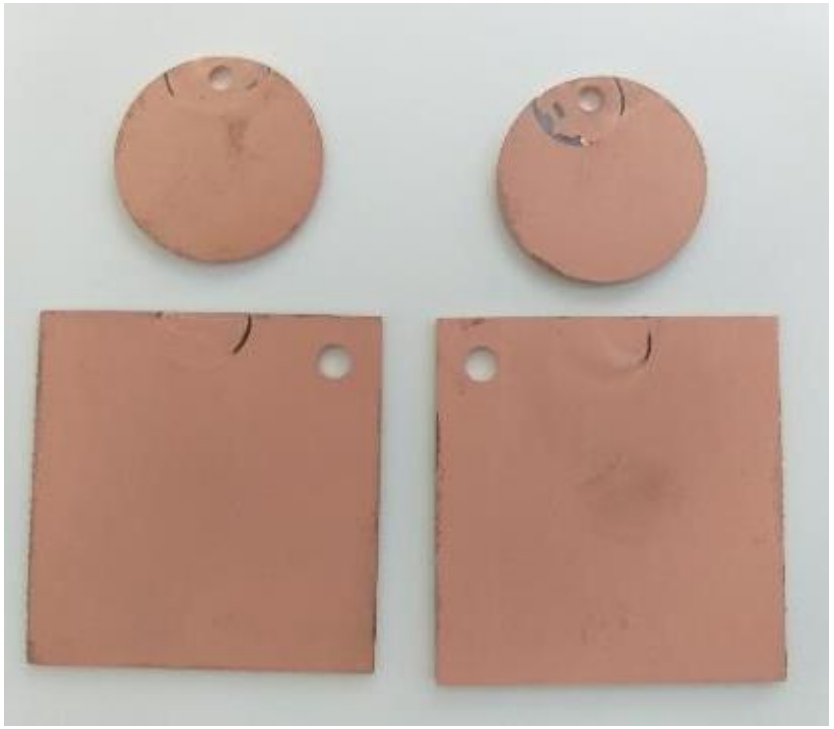


Copper Based ELESS Activation

Cu Colloid Activator – Performance – Coverage

	Ionic Pd Activation	Colloidal Cu Activation
Low/Mid T_g FR4 (140°C)		
High T_g FR4 (180°C)		

Comparable Coverage

	Ionic Pd Activation	Colloidal Cu Activation
ABS		
FR4		

No Blistering on Bare Resin

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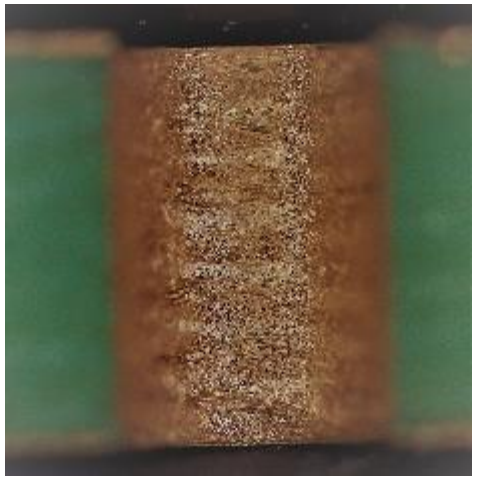
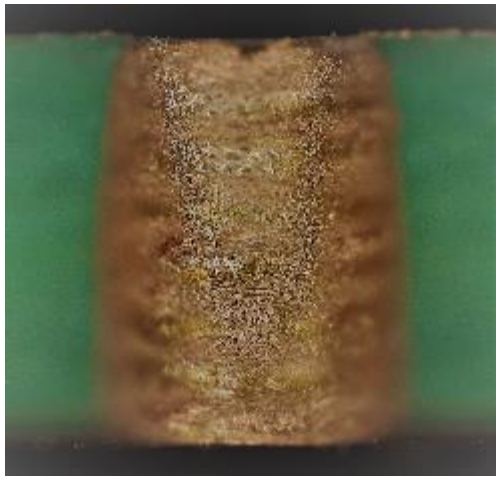
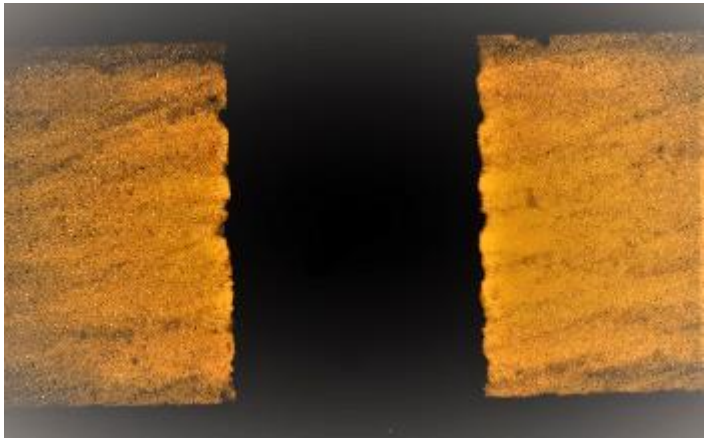
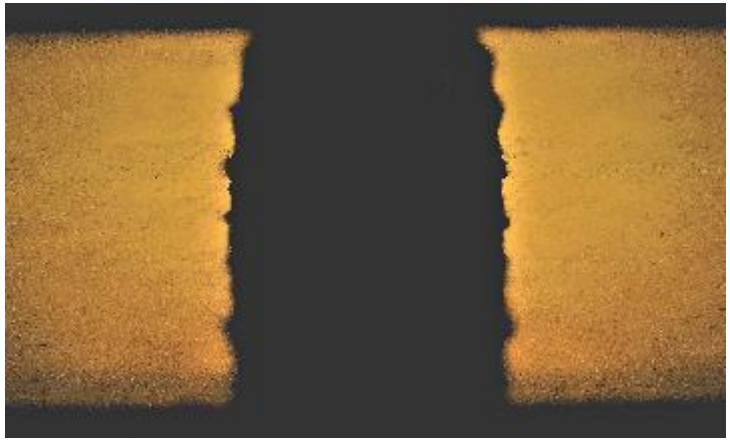
Copper Based ELESS Activation

Cu Colloid Activator – Performance – Coverage

	Ionic Pd Activation & SAP ELESS Cu (20 min)	Colloidal Cu Activation & SAP ELESS Cu (20 min)
High T_g FR4 (180°C)		

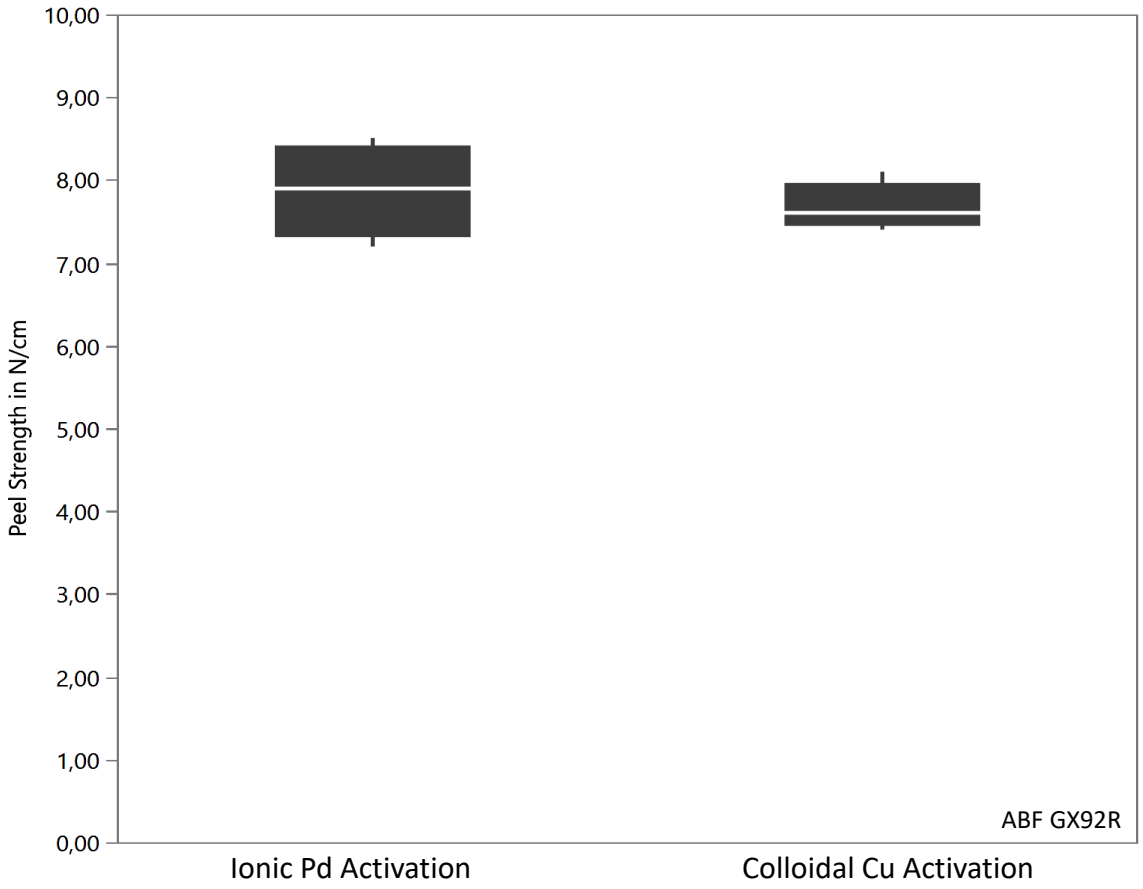




Comparable Coverage to Pd Based Process

Copper Based ELESS Activation

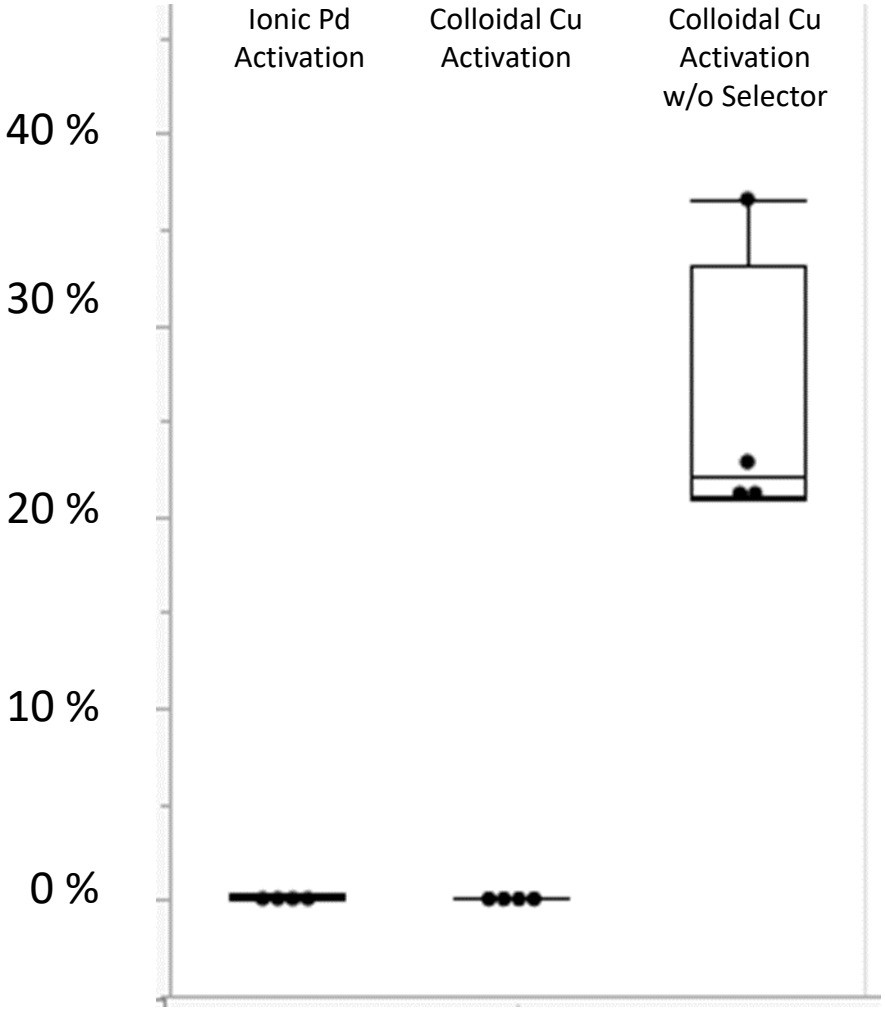
Cu Colloid Activator – Performance – Coverage



Comparable Adhesion to Pd Based Process

Copper Based ELESS Activation

Cu Colloid Activator – Performance – Thermal Reliability



- Comparable ICD performance to Ionic Pd Activation
- Unique Selector step is a must to achieve reliability performance

6 x 10sec @ 288°C

Copper Based ELESS Activation

Cu Colloid Activator – Benefits for SAP production

- The benefits of using Copper-activation for SAP applications
- Reduced CoO
- Simplified process flow
  - No need for additional Pd seed etch
  - Increased yields
  - Enhanced fine line capability

Copper Based ELESS Activation

Cu Colloid Activator – Summary

- Pd pricing continues to remain at an all time high
- A viable Cu based activation system is now achievable for SAP processing
  - Based on sub micron Cu colloids
- Overcomes previous encountered issues with bath stability and rinsing
  - Compatible with typical vertical process sequences
- Process performance is comparable to existing Pd based technologies
  - Coverage
  - ICD
- Benefits for SAP production
  - Reduced CoO, improved yields and enhanced fine line capability
- Further testing ongoing

Thanks for your attention

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