EVERY CONNECTION COUNTS

WHITE PAPER

OVERVIEW ABOUT PdNi PLATING AS ALTERNATIVE OF GOLD PLATING

BACKGROUND:

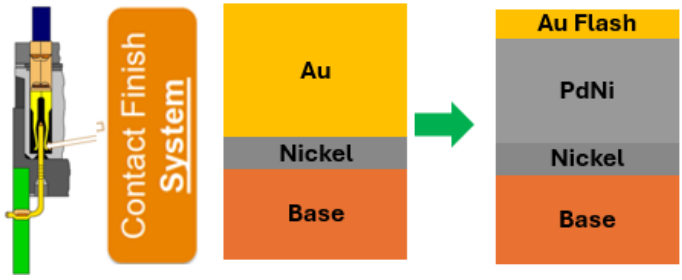
TE Connectivity (TE)'s Connected Living Solutions (CLS) business unit is developing technological improvements which provide sustainable and cost-competitive solutions to meet our customer requirements. This involves reducing Scope 3, Product Carbon Footprint (PCF) and Green House Gasses (GHG), of the material in use for a connector, extending the product life cycle and finding alternatives for the hazardous substances. This paper describes an example towards reaching these business unit goals by replacing the current gold plating with gold flashes palladium nickel (PdNi) plating technology.

Gold plating is a process of depositing a thin layer of gold onto the surface of another metal, typically using electroplating techniques. This process is widely used in various industries due to the unique properties of gold and the benefits it provides in electrical engineering and electronics, particularly for connectors and printed circuit boards (PCBs) where it provides excellent conductivity, corrosion resistance, and reliability for electrical contacts. Gold plating also prevents tarnish films and improves the performance of contacts and terminals. Gold-plated connectors are recommended in applications requiring high reliability and low contact resistance

This white paper will explore the various aspects of gold plating and PdNi plating, including their applications, processes, and performance.

WHAT IS PdNi PLATING TECHNOLOGY:

The cost pressures and environmental concerns are driving research into alternatives and more efficient plating processes, nickel-palladium (PdNi) plating has emerged as a sustainable alternative to gold plating in the electronics industry, particularly for connector applications. Nickel-palladium (PdNi) plating is an electrodeposition process that combines the properties of nickel and palladium to create a coating with unique characteristics.



This plating technique is widely used in various industries due to its excellent balance of cost-effectiveness and performance. The primary reasons for its adoption include:

1. **Palladium nickel offers reductions of ≈ 80% in CO_2E**
2. **Material usage reduction can be reached, while maintaining the plating thickness integrity**
3. **Cost:** PdNi plating offers a competitive cost solution compared to traditional gold coatings.
4. **Material Properties:** PdNi alloys exhibit properties similar to gold, making them suitable for electrical contact applications: noble metal characteristics (resistant to oxidation and tarnishing), good electrical conductivity and wear resistance
5. **Performance Characteristics:** PdNi platings offer performance similar to gold: superb mechanical and electrical contact performance, low electrical contact resistance, good environmental coating stability over time and high mechanical hardness

Different studies have been conducted internally to TE and the general conclusion is that the different gold and PdNi combinations exhibited functionally similar performance.

In a particular case studied on Micro MATE-N-LOK connectors, comparing 0,38µm/0,76µm gold plating with gold flash over 0.31/0.69 µm palladium-nickel, the new plating type is according to the relative product specification and same or better performance has been observed.

	Specified	15µin (0.38µm) of Gold	Gold flash over 0.31µm PdNi	30µin (0.76µm) of Gold	Gold flash over 0.69µm PdNi	Additional Information
Mating Force	82.40 N maximum	73.94 N	76.78 N	77.14 N	65.52 N	
Unmating Force	8.24 N minimum	17.72 N	20.28 N	17.88 N	18.03 N	
Contact Resistance	20 mΩ maximum	3.48 mΩ	3.34 mΩ	3.39 mΩ	3.47 mΩ	Before Durability, Random Vibration, Mechanical Shock
		4.53 mΩ	3.47 mΩ	3.63 mΩ	3.80 mΩ	After Durability, Random Vibration, Mechanical Shock
Contact Resistance	20 mΩ maximum	3.71 mΩ	3.41 mΩ	3.40 mΩ	3.56 mΩ	Before Mixed Flowing Gas, Temperature Life
		4.80 mΩ	4.38 mΩ	4.43 mΩ	4.52 mΩ	After Mixed Flowing Gas, Temperature Life
Temperature Rise (5A & 4A)	30°C max above environment temperature	According to TE product specification (108-1836)		According to TE product specification (108-1836)		Before Mixed Flowing Gas, Temperature Life
Resistance to Soldering Heat	No damage	No physical damage was found		No physical damage was found		After Mixed Flowing Gas, Temperature Life

- Product specification used was 108-1836
- Connector tested was a 12x2 position connector: 5 samples for each tipes tested-average values included.
- Data included into 502-161654

In conclusion, gold flashes PdNi plating represents a sophisticated surface engineering solution that combines the beneficial properties of both nickel and palladium. Its applications span a wide range of industries, from traditional electrical connectors to cutting-edge technologies, making it a versatile and valuable plating option in modern engineering.

PdNi plating offers a compelling alternative to gold in many connector applications, with performance creating a more sustainable product reducing the use of precious metals (balancing cost-effectiveness). Its adoption continues to grow as the industry seeks to optimize material usage and meet evolving technical and environmental requirements.

The unique combination of electrical conductivity, corrosion resistance, and catalytic properties of PdNi alloys is particularly advantageous.

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