

Electrolytic Soft Gold Plating

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Elan International, Inc. was given the challenge by a customer to locate a Printed Circuit Board Manufacturer in China that had the capability of producing rigid PCB's with very specific characteristics for a wire bond application.

Requirements:

Electrolytic Gold Plating Process

Ultra Smooth Gold plated Surface of with an Ra of <20nm as measured by AFM (Atomic Force Microscope)

High Purity SOFT Gold of at least 99.99% and Knoop hardness 90 maximum (Total impurities in the gold plating tank of <200ppm)

Pattern Plating would be preferred, but a combination of Panel and Pattern plating with the required results would be accepted

An onsite chemical laboratory and knowledgeable process engineering staff capable of communicating with a high level of expertise focused on plating would be essential.

ISO TS16949 approved

This customer is a significant supplier of automotive electronics to 1st Tier and 2nd Tier Automotive Manufacturers in high volumes. These assembled devices require the use of an automated wire bonder that records data for every bond joint. (Devices are used in cab, under hood, transmission, braking, exhaust, lighting, etc.)

Wire Bonder - Delvotec 6400 Wedge Bonder
Wire Type - Aluminum wire

In the search to locate a PCB manufacturer to provide the capabilities required by our customer, there were significant numbers of companies that could not achieve one or more of these requirements:

- A) Many companies, who claimed they were ISO TS16949 certified, were really not certified or their certification was not legitimate.
- B) Companies claiming to have the Electrolytic plating process either did not, or had abandoned electrolytic gold plating in favor of the now, more mainstream ENIG plating.
- C) If companies did have electrolytic gold plating, they had purity levels in their gold plating tanks of <99.5%
- D) Most companies, even if they did have electrolytic gold plating, their plating was for Hard Gold.
- E) Of the companies that did have electrolytic Soft gold plating, they had no idea how to achieve the Ultra Smooth Gold Plated Surface

Finding a company to satisfy all the necessary requirements set down by our customer was a long process that took us through contacting, in excess of, 800 PCB manufacturers.

Throughout this search when a short coming of the PCB manufacturer was identified, it typically was not meet with how they could adjust their process or capability to meet the needs of the customer, but rather the customer should adjust their requirements to accept the PCB manufacturer's process or capability.

There were a few PCB manufacturers who appeared to meet all of the criteria and have a technical understanding of the plating requirements and could produce boards in a controlled prototype environment. However, when they attempted to build a production lot, they were not able to achieve the desired results.

The results of this long search was the location of only one company that could achieve all of the necessary requirements set down by the customer and achieve the results in a production environment.

SURFACE SMOOTHNESS REQUIREMENT

(Ra to be 20nm or less as measured by AFM)

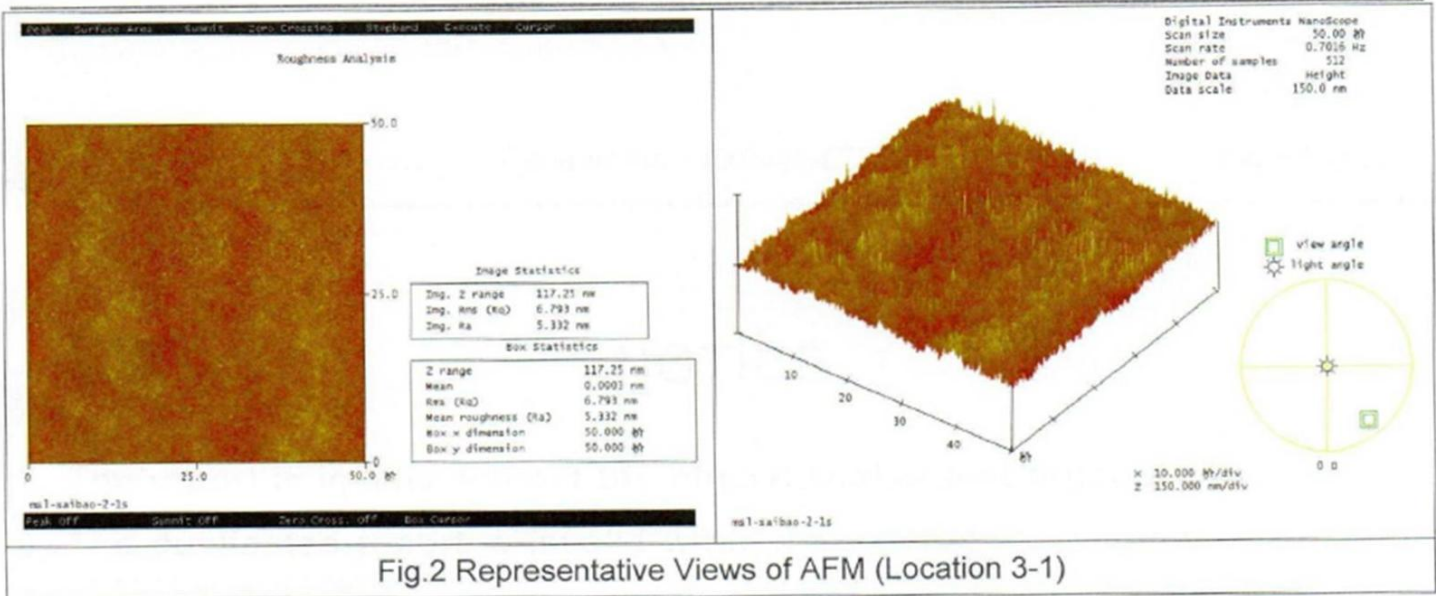
As shown by the samples submitted to a 3rd Party to provide the testing for the PCB manufacturer, the **Surface Smoothness exceeded the requirement by achieving a Ra of <6nm**

This is the result of the PCB manufacturer's ability to understand and control specific additives to the copper and nickel plating to provide the required smooth base for the final gold plating.

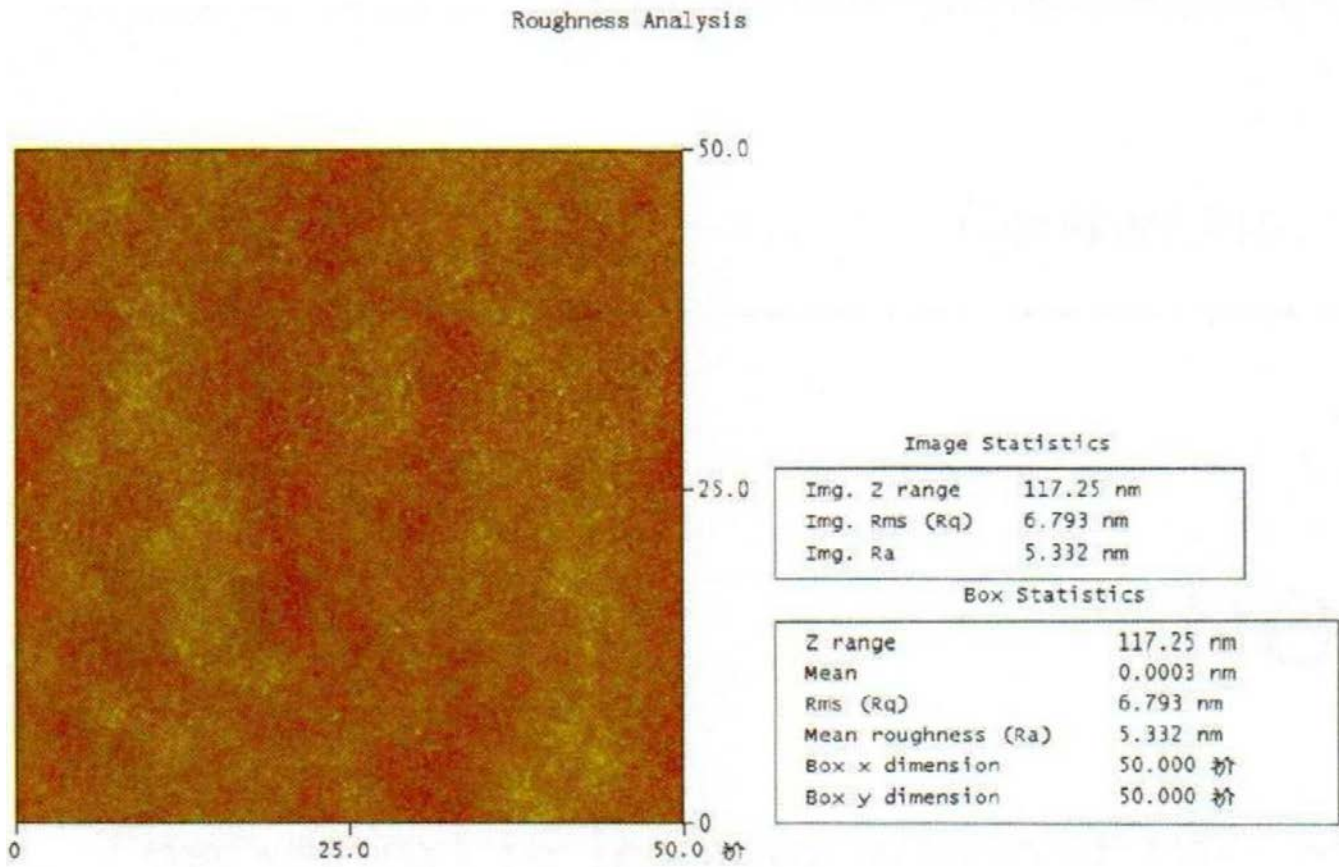
Submission #1 - 3rd Party AFM Test Results

Table 2 Test Results of Roughness Analysis

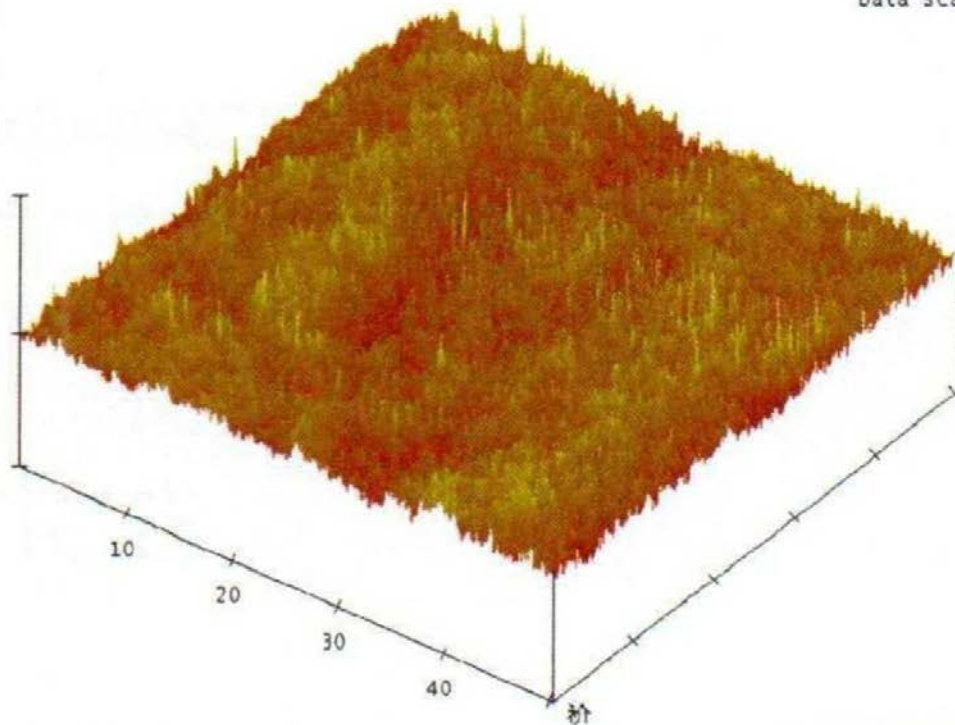
Location	Ra (nm)	RMS(Rq) (nm)
1	5.683	/
2	5.860	/
3	5.432	/
3-1	5.332	6.793



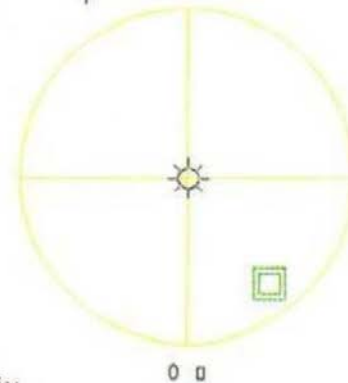
Enlarged views below



Digital Instruments NanoScope
 Scan size 50.00 μm
 Scan rate 0.7016 Hz
 Number of samples 512
 Image Data Height
 Data scale 150.0 nm



view angle
 light angle



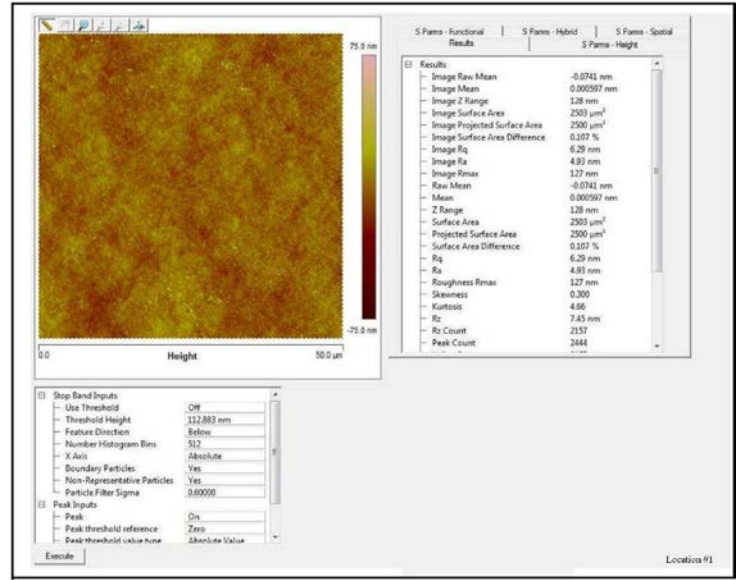
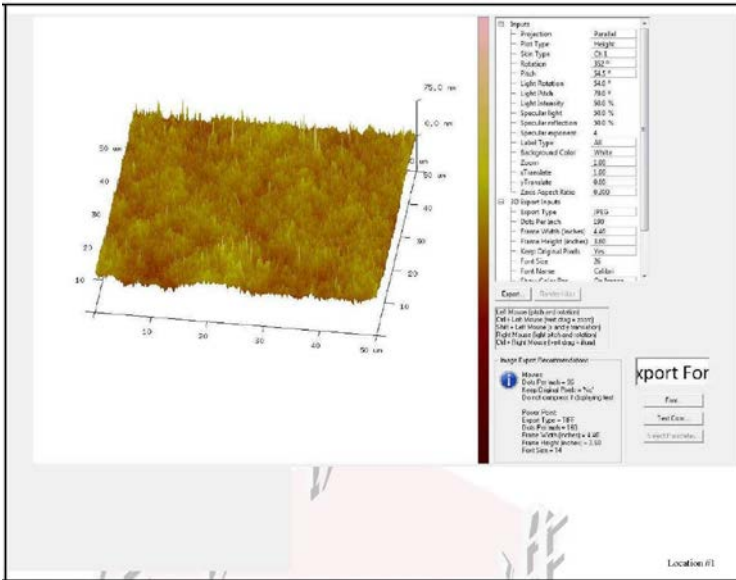
X 10.000 $\mu\text{m}/\text{div}$
 Z 150.000 nm/div

Submission #2 - 3rd Party AFM Test Results
 (Submitted 4 months after Submission #1 from a separate production lot)

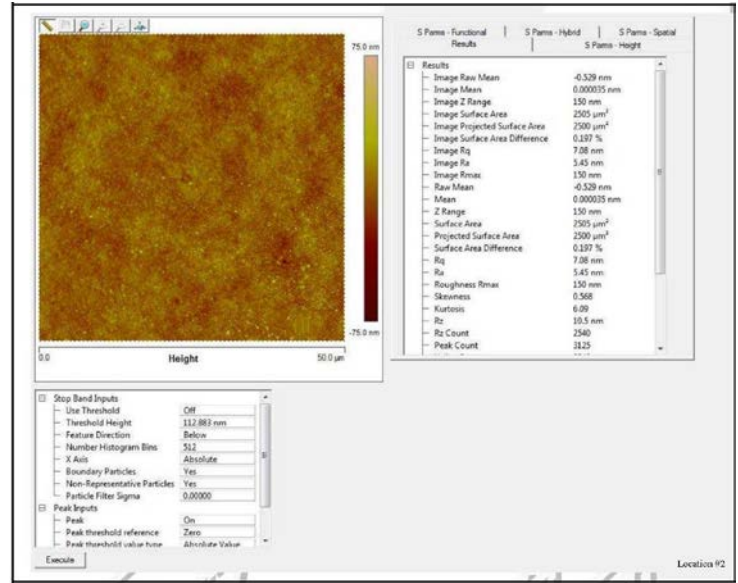
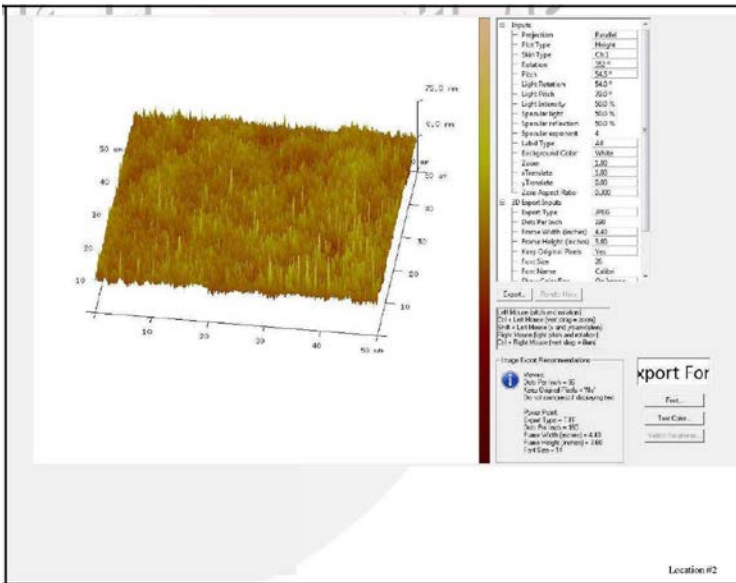
Table 2 Test Results of Roughness Analysis

Location	Ra (nm)	RMS(Rq) (nm)
1	4.93	6.29
2	5.45	7.08

Location #1

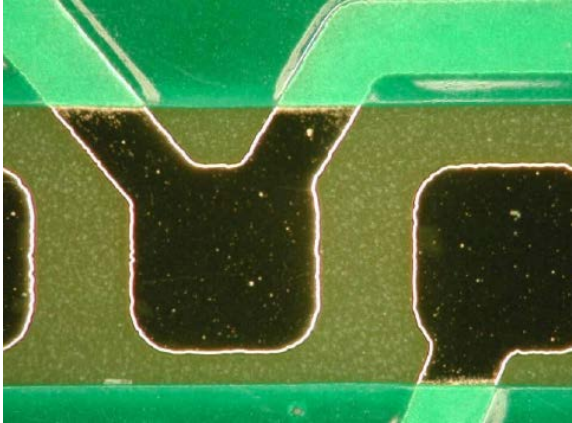


Location #2

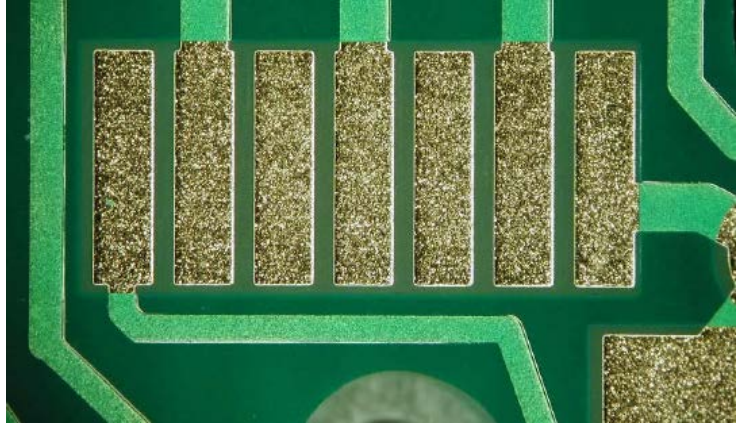


Reference photographs

Board with required finish
Excellent bondability
Note that when photographed the appearance of the gold is black due to the ultra smooth finish.



Poor bondability
Note that there is more of a gold color when photographed due to the non-smooth / coarse plating.



GOLD PLATING TANK

Purity of gold chemicals controlled to maintain >99.99%

Requirement of all contaminants combined – to be <200ppm

Contamination control level targeted internally by the manufacturer at <120ppm
Contamination control after continuous sampling – **Actual Maximum <82ppm**

Gold Plating Tank Contamination Level Control

	Internal Target	Actual Max. after continuous sampling
CU	<5ppm	3.2189
Ni	<100ppm	69.8683
zn	<5ppm	0.0262
Fe	<10ppm	8.3646
Au	0.3-0.7g/l	0.458

INSPECTION REQUIREMENTS

IPC-6012 and IPC-A-600

Additional customer specific requirements that supersede IPC standards are very stringent.

In addition to 100% E-Test, 100% outgoing visual inspection at 10X magnification

Surface defects – scratches and dents

Contamination

Water marks

Under / Over etching

Foreign material

Soldermask

Haloing

Major Inspection emphasis – No scratches allowed on wire bond pads

Current defect rate at customer incoming inspection is <1%

Goal is to refine out-going visual inspection to achieve a “Zero”% incoming inspection defect rate at the customer’s site.

Improvements in processing and handling have and will continue to increase production yields.

Elan International, Inc. is the Representative for this China based PCB Manufacturer that has the capability to offer this Ultra-Smooth / Ultra-Pure Electrolytic SOFT Gold Plating for rigid PCBs.