Faculty of Manufacturing Engineering

ELIMINATION OF GOLD TARNISH BY POST DIP AFTER GOLD PLATING PROCESS IN FLEXIBLE PRINTED CIRCUIT BOARD MANUFACTURING.

Umadewi A/P Ganasan

Master of Manufacturing Engineering
(Manufacturing System Engineering)

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UMADEWI A/P GANASAN

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To my beloved family, lecturers and friends.

APPROVAL

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ABSTRACT

Flexible printed circuits (FPC) industry has high growth rate and high competition. FPC manufacturer should always ensure tighter tolerance to produce the highest quality of output products to their important and fulfill customer's high quality demand. Gold plating is often used in the electronics industry to provide an electrically conductive layer on copper base layers, typically in electrical connectors and printed circuit boards. ENIG provides excellent surface planarity with very good soldering and gold wire bonding. ENIG is now arguably the most used surface finish in the FPC industry due the growth and implementation of the RoHs regulation. There is a weak point in ENIG surface finishing, where RR10 chemical from subsequence process tend to attack the gold layer thereby causing tarnishing of its surface and formation of an oxide and or sulfide layer. Thus, the study help find root cause from subsequence processes that causing gold tarnish. A post dip after gold plating used ABC solution as barrier layer on top of Nickel-Gold layer. The new layer formation from the post dip, was evaluated to ensure that they do not impair the essential surface properties such as contact resistance and solder or bonding functions needed for most connector applications. This study shown RR10 chemical that utilized as a part of stripping process which is end process after ENIG plating tend to oxidise ENIGsurface. The ideal arrangement of handling parameters was observed to dipping time (2 minutes), temperature (27.3°C) and concentration (5.85pH), to accomplish the achieve desired quality failure mode (2 or 3 or 4) and resistance (3-10kΩ). No effect on continuity as gold grains remain bonded and no corroded. The ABC solution coating does not impact properties and functionality of FPCs.

ABSTRAK

Litar bercetak fleksibel industri (FPC) mempunyai kadar pertumbuhan yang tinggi dan persaingan yang tinggi. Pembuatan FPC perlu sentiasa memastikan toleransi yang lebih ketat untuk menghasilkan produk lebih berkualiti untuk memenuhi permintaan pelanggan. Penyaduran emas sering digunakan dalam industri elektronik, sebagai contoh ENIG kini boleh dikatakan penyaduran yang paling banyak digunakan dalam industri FPC kerana pertumbuhan dan pelaksanaannya peraturan Rosh. Terdapat satu titik lemah dalam ENIG kemasan permukaan, di mana bahan kimia daripada proses yang berikutnya cenderung untuk menghakis lapisan emas sekali gus menyebabkan kerosakan permukaan dan pembentukan lapisan oksida dan atau sulfida. Oleh demikian, kajian ini bertujuan mencari punca daripada proses yang berikutnya yang menyebabkan permukaan emas kekuningan atau noda. Satu proses penyaduran selepas penyaduran emas akan membentuk satu lapisan halangan di atas lapisan nikel-emas. Pembentukan lapisan baru, akan diuji untuk memastikan bahawa lapisan baru tidak menjejaskan sifat-sifat permukaan penting seperti rintangan elektrik dan pematrian atau fungsi diperlukan untuk kebanyakan aplikasi penyambungan. Kajian ini menunjukkan bahan kimia RR10 yang digunakan sebagai sebahagian daripada proses pelucutan yang merupakan proses akhir selepas plating ENIG cenderung mengoksida ENIGsurface. Susunan parameter pengendalian yang ideal diperhatikan untuk mencelupkan masa (2 minit), suhu (27.3 ° C) dan kepekatan (5.85pH), untuk mencapai mod kegagalan kualiti yang diingini (2 atau 3 atau 4) dan rintangan (3-10kΩ). Tiada kesan ke atas kesinambungan kerana biji emas kekal terikat dan tidak berkecai. Lapisan penyelesaian ABC tidak memberi kesan terhadap sifat dan fungsi FPCs.

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PCB	-	Printed Circuit Board
FPC	-	Flexible Printed Circuit
HDI	-	High-Density Interconnect
Cd	-	Cadmium
Hg	-	Mercury
Pb	-	Lead
LCD	-	Liquid crystal display
DFM	-	Design for Manufacturing
UV	-	Ultraviolet
HASL	-	Hot Air Soldering Leveling
OSP	-	Organic Solderability Preservative
ENEPIG	-	Electroless Nickel Electroless Palladium Immersion Gold
ENIG	-	Electroless Nickel Immersion Gold
Ni	-	Nickel

RSM	-	Response Surface Methods
SEM	-	Scanning Electron Microscope
FFC	-	Flexible Flat Cables
PET	-	Polyethylene Terephthalate
LCD	-	Liquid crystal display
OLED	-	Organic light-emitting diodes
IPC	-	Institute for Printed Circuits
EN	-	electroless nickel
XRF	-	x-ray fluorescence
PTH	-	Plated Through Hole
OM	-	Optical Microscope
EDS	-	Energy Dispersive Spectrometer
XPS	-	X-ray photoelectric spectroscopy
PG	-	Purple gold
EDX	-	Energy Dispersive X-Ray
OEM	-	Original Equipment Manufacturer
DI	-	Deionized
UTS	-	Ultimate Tensile Strength
BBD	-	Box Behnken design

CHAPTER 1

INTRODUCTION

This chapter contains the background of the study and background of company, MFS Technology Sdn. Bhd, problem statement, aim and objectives, and scope of the study. The significance and the expected outcomes of this study are likewise presented at the end of this chapter.

1.0 Company Background

MFS Technology was incorporated in Singapore in the year 1989. The company has first changed the name to MFS Technology Limited which is a holding company for cooperative company in 3 countries such as China, Singapore, and Malaysia. Currently, MFS Technology (S) Pte Ltd is a headquarter office which is in Wearnes Building, Central North of Singapore. In China, there are 2 MFS manufacturing plant for FPC and PCB at Hunan. While there is also another one factory which is in Malacca, Malaysia, namely as MFS Technology (M) Sdn Bhd which can be seen in Figure 1.1.

The basis business is in the manufacture, design, and distribution of printed circuit board (PCB), flexible printed circuit (FPC), rigid flex, turnkey component assembly services and module level integration as strengthen their vertical supply chain to provide a one-stop solution. The company's strategically located manufacturing sites and a customer-centric culture ensures MFS connects with worldwide system of enhanced customer base rapidly. Besides that, it is the vital to meet customers' expectations.

In Malacca, MFS Technology (M) Sdn Bhd specialized in high volume single, ultra-high-density interconnect (HDI) flex, double, rigid flex and multilayer flex. This company has been complied with the ISO 9001, TS16949, ISO 14001, OHSAS 18001 and ISO 13485 requirements.

Furthermore, MFS continues improvement and compliances with legal as well as other requirement related to the environmental aspects. From the company, MFS have been implemented and confined the utilization of hazardous substance (ROHS) such as Cadmium (Cd), Mercury (Hg), Lead (Pb), and others hazardous materials (MFS,2016). Currently, flexible printed circuit (FPC) products of MFS Technology can be applied to various variety fields such as communication smartphones, automotive, medical, and data storage (MFS,2016).

Figure 1.1 MFS Technology Sdn Bhd (Melaka)

1.1 Company Products

MFS has the product design and manufacturing capabilities to provide a comprehensive range of PCB, FPCs, Rigid flex and assembly with personalized features to meet customers' needs for flexible services, and responsive within a short lead time. Below sub-sections are the brief explanations on company products.

1.1.1 Single Sided Flex

A single layer flex circuit as in Figure 1.2, is the most fundamental and comprises of a flexible polyimide film laminated to a thin sheet of copper based on Roy (2017). The copper layer is then chemically etched to create a circuit