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(54) Manufacturing method for a sliding contact assembly

(57) Manufacturing method for a sliding contact assembly (10) for low current applications, comprising the following steps:
- providing a printed circuit board substrate (16) with at least one stationary contact pad (18),
- providing a movable contact element (12) including a support member (26) having a contact surface (28) to be biased against said contact pad (18),
- plating at least one layer of gold on the contact pad (18),

characterized in that said plating step is implemented according to an Electroless Nickel Electroless Palladium Immersion Gold process step made by sequential deposition of:
- an electroless nickel layer (22),
- an electroless palladium layer (24),
- a gold flash layer (25).

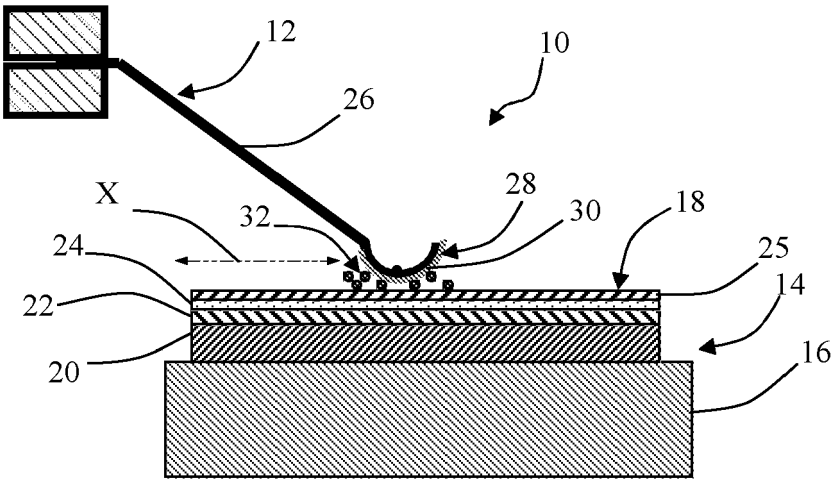

Figure 1

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Description

TECHNICAL FIELD

[0001] The present invention relates generally to a manufacturing method for sliding contact assemblies in low current applications.

BACKGROUND OF THE INVENTION

[0002] The present invention relates more particularly to the manufacturing method of a sliding contact assembly to be implemented in a vehicle, for example in the column integrated module (CIM) arranged on the steering column of the vehicle, for electrical connection of switch devices.

[0003] Automotive suppliers use since decades Printed Circuit Boards with gold plating pads as direct contact interface for low current sliding contacts. Several gold plating processes are available on the market, providing various wear behavior.

[0004] Galvanic hard gold electroplated PCBs provide performance and contact reliability for low current applications, but galvanic hard gold electroplating is also the most expensive technology. This type of plating generates extra costs due to the quantity of gold necessary and due also to the process complexity.

[0005] In a cost driven industry, it is required to use a cheaper solution using standard low cost PCBs while still providing high reliability and good performances. To manufacture standard low cost PCBs with contact pads for this type of application it is generally required to use Electroless Nickel Immersion Gold (ENIG) or electrolytic pattern flash gold, these two processes providing a very thin layer of gold, or gold flash layer, having a thickness generally lower than 0,150μm.These two types of gold plating process will be designated in the following description under the general term of "gold flash process" and PCBs comprising a protective layer of gold deposited according to a gold flash process will be named as gold flash PCBs.

[0006] Due to the very low thickness of gold deposited on the contact surface, the gold flash layer is not sufficient to provide long term reliable contact resistance without additional protection. Said gold flash layer is porous, and exhibits the underneath nickel layer through pores. It can generate an oxide and increase the electric contact resistance. To avoid corrosion or oxidization of the nickel, contact grease with specific protection properties is used.

[0007] The main problem with the use of gold flash PCBs is the wear behavior with an extreme sensitivity of gold even when hardened with cobalt or nickel.

[0008] Generally, the contact sliders used in sliding contact assemblies are made of a bronze based contact spring which is electroplated with a nickel underlayer and a gold cobalt protective layer. When such gold plated contact sliders are used on gold flash PCBs, the lifetime is too short and some reliability problems can occur. To increase sliding contact assembly lifetime it is necessary to use a gold flash PCBs with very high requirements in term of roughness, in view to minimize friction at the contact interface. Such roughness requirements are very difficult to comply with and it increases PCB cost. It also requires use of expensive contact grease.

[0009] At the end, current technology is not entirely satisfactory because the lifetime is not guaranteed. Customers using this type of sliding contact assemblies constantly ask for higher reliability and longer lifetime.

SUMMARY OF THE INVENTION

[0010] The purpose of the present invention is to solve the above mentioned problem by providing a reliable and low cost solution to build sliding contact assemblies.

[0011] For this purpose, the present invention proposes a manufacturing method for a sliding contact assembly for low current applications, comprising the following steps:

- providing a printed circuit board substrate with at least one stationary contact pad,
- providing a movable contact element including a support member having a contact surface to be biased against said contact pad,
- plating at least one layer of gold on the contact pad,

characterized in that said plating step is implemented according to an Electroless Nickel Electroless Palladium Immersion Gold process step made by sequential deposition of

- an electroless nickel layer,
- an electroless palladium layer,
- a gold flash layer.

[0012] Acccording to other features of the invention:

- the electroless nickel layer has a thickness of 3 to 6 gm;
- the electroless palladium layer has a thickness of 0.05 μm to 0.2 μm;
- the gold flash layer has a thickness of 0.02 to 0.05 um

[0013] The present invention also proposes a sliding contact assembly for low current applications comprising:

- a printed circuit board including a substrate on which is arranged at least one contact pad made of at least one gold layer,
- a movable contact element including a support member having a contact surface, said contact surface being biased against said contact pad when the movable contact element is moved with regards to said contact pad, characterized in that said contact pad, from the bottom to the top, is made of :

- an electroless nickel layer,
- an electroless palladium layer,
- a gold flash layer.

[0014] According to other features of the present inventions:

- the electroless nickel layer has a thickness of 3 to 6 μm;
- the electroless palladium layer has a thickness of 0.05 μm to 0.2 μm;
- the gold flash layer has a thickness of 0.02 to 0.05 μm;
- the contact pad includes a base layer of copper, between the substrate and the electroless nickel layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention is now described by way of example with reference to the accompanying drawings in which:

- figure 1 is a schematic view showing a sliding contact assembly according to the present invention including a movable contact element;
- figure 2 is an enlarged cross-section view showing a portion of the contact surface of the movable contact element of figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Figure 1 shows a sliding contact assembly 10 for low current applications built according to a preferred embodiment of the present invention. Said sliding contact assembly 10 includes a movable contact element 12 which is movable along a longitudinal direction X relatively to a printed circuit board 14. The stroke of the contact element 12 can be between 1mm to 50mm.

[0017] Said printed circuit board 14 includes a substrate 16 on which is arranged at least one stationary contact pad 18 made of several layers. According to the embodiment shown on figure 1, said contact pad 18 is constituted, from the upper surface of the substrate upwards of:

- a base layer 20 of copper, for example 35μm thick,
- a electroless nickel layer 22, preferably 3 to 6μm thick,
- an electroless palladium layer 24, preferably 0.05 to 0.2μm thick,
- a gold flash layer 25, preferably 0.02 to 0.05μm thick.

[0018] According to the manufacturing method of the invention, the plating above the base layer 20 is deposited through an Electroless Nickel Electroless Palladium Immersion Gold (ENEPIG) process made by sequential deposition of the electroless nickel layer 22, the electroless palladium layer 24, and the gold flash layer 25.

[0019] Said movable contact element 12, or slider, comprises a support member 26 in the shape of a spring blade having a contact surface 28 provided with a protective coating 30 shown on figure 2. Thanks to the spring blade shape of the support member 26, said contact surface 28 is biased against the contact pad 18 of the PCB 14 when the movable contact element 12 is moved with regards to said contact pad 18.

[0020] Said support member 26 is preferably made of bronze (copper-tin alloy CuSn). Alternatively it could be made of another copper alloy such as copperberyllium alloy or copper-nickel alloy.

[0021] Advantageously, a film 32 of grease material is deposited above said contact pad 18, at the contact interface between the contact pad 18 and the contact surface 28, in order to ease the sliding of said contact surface 28 on said contact pad 18. The grease is chosen in order to allow the contact functionality at temperatures down to -40°C. The grease material is preferably a perfluorpolyester (PFPE) based grease.

[0022] Advantageously, said protective coating 30 on the contact surface 28 includes a layer 34 of palladium alloy comprising at least 60% of palladium. Advantageously, said palladium alloy is constituted substantially of 80% palladium and 20% nickel. Preferably, said layer 34 of palladium alloy has a thickness between 2 and 3 μm and it is deposited through an electrolytic process.

[0023] Said protective coating 30 may include an underlayer 36 of nickel on which said layer 34 of palladium alloy is deposited.

[0024] Optionally, said protective coating 28 includes an additional layer 38 of gold which is deposited on said layer 34 of palladium alloy through a gold flash type process. Said additional layer 38 is preferably 0.05μm to 0.1μm thick and has a cosmetic purpose as well as an oxidization protection purpose.

[0025] Alternatively, the palladium alloy layer 34 could be replaced by a gold layer deposited through a gold flash type process.

[0026] Thanks to the manufacturing method of the invention, different types of slider 12 can be used, with lower requirements as to the wear behavior. The use of ENEPIG plating on the contact pad 18 improves the wear behavior by reducing surface roughness.

Claims

1. Manufacturing method for a sliding contact assembly (10) for low current applications, comprising the following steps:

- providing a printed circuit board substrate (16) with at least one stationary contact pad (18),
- providing a movable contact element (12) including a support member (26) having a contact surface (28) to be biased against said contact pad (18),

- plating at least one layer of gold on the contact pad (18),

characterized in that said plating step is implemented according to an Electroless Nickel Electroless Palladium Immersion Gold process step made by sequential deposition of:

- an electroless nickel layer (22),
- an electroless palladium layer (24),
- a gold flash layer (25).

2. Manufacturing method according to the preceding claim wherein the electroless nickel layer (22) has a thickness of 3 to 6 μm

3. Manufacturing method according to anyone of claims 1 or 2 wherein the electroless palladium layer (24) has a thickness of 0.05 μm to 0.2 μm

4. Manufacturing method according to anyone of claims 1 to 3 wherein the gold flash layer (25) has a thickness of 0.02 to 0.05 μm.

5. Sliding contact assembly (10) for low current applications comprising:

- a printed circuit board (14) including a substrate (16) on which is arranged at least one stationary contact pad (18) made of at least one gold layer,
- a movable contact element (12) including a support member (26) having a contact surface (28), said contact surface (28) being biased against said contact pad (18) when the movable contact element (12) is moved with regards to said contact pad (18),

characterized in that said contact pad (18), from the bottom to the top, is made of :

- an electroless nickel layer (22),
- an electroless palladium layer (24),
- a gold flash layer (25).

6. Sliding contact assembly (10) according to the preceding claim wherein the electroless nickel layer (22) has a thickness of 3 to 6 μm

7. Sliding contact assembly (10) according to anyone of claims 5 to 6 wherein the electroless palladium layer (24) has a thickness of 0.05 μm to 0.2 μm

8. Sliding contact assembly (10) according to anyone of claims 5 to 7 wherein the gold flash layer (25) has a thickness of 0.02 to 0.05 μm

9. Sliding contact assembly (10) according to anyone of claims 5 to 8 wherein the contact pad (18) includes a base layer of copper (20), between the substrate (16) and the electroless nickel layer (22).

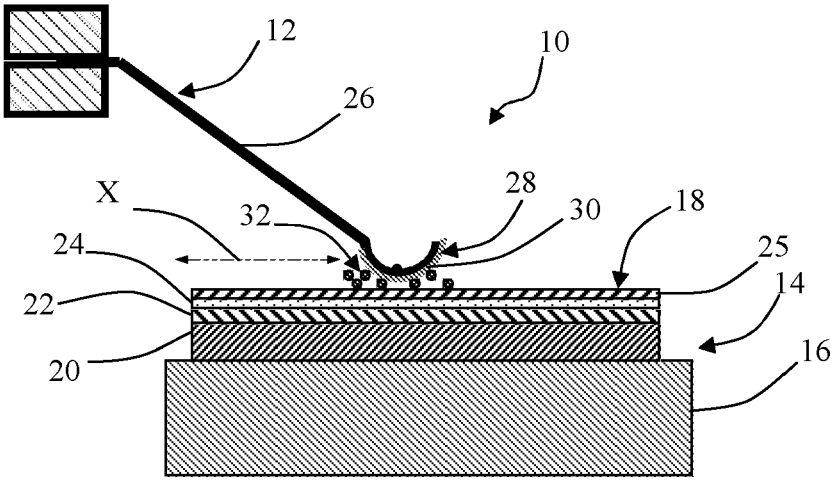

Figure 1

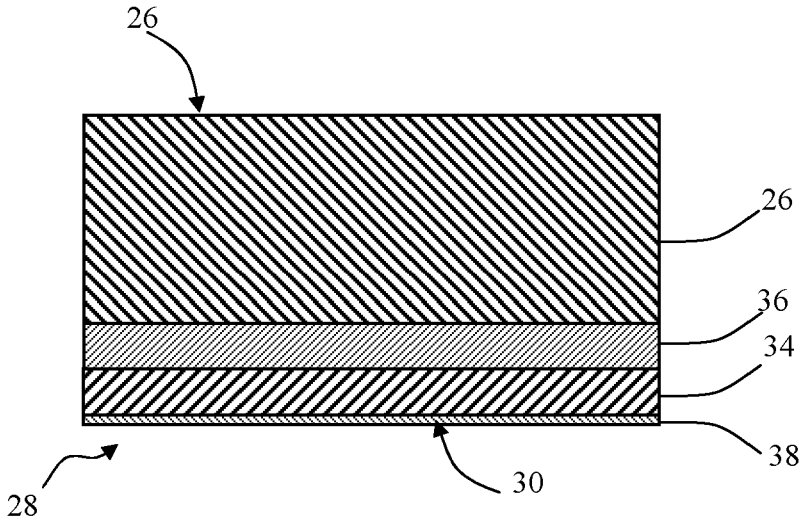

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 9533

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2011/127233 A1 (CHEN SAMUEL [US] ET AL) 2 June 2011 (2011-06-02) * paragraphs [0002], [0030] *	1	
A	US 6 274 254 B1 (ABYS JOSEPH ANTHONY [US] ET AL) 14 August 2001 (2001-08-14) * figure 1 *	1,5	
A	WO 00/60622 A1 (BOURNS INC [US]) 12 October 2000 (2000-10-12) * page 6, line 1 - line 7; figure 2A *	1,5	
			TECHNICAL FIELDS SEARCHED (IPC) H01R H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 October 2011	Garcia Congosto, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 16 9533

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82