DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring now to FIGS. 1-11 of the drawings, FIGS. 1-4 and 7 shows a conventional process and structure for forming a contact pad 7 on a printed circuit board (FIG. 7) over a plate filled via 7. Typically, contact pads 7b are formed on a printed circuit boards 1 by subtractive etching using a hard gold plated layer over a Ni plated layer acting as an etch resist 5 (with Gold on top of the Nickel layer) defining the pad geometry of the underlying base metal 2, typically copper. Many other metals can be utilized as the wear resistant etch resist 5 including Palladium, and rhodium. As shown in FIG. 1 for the case of via-in-pad technology, traditionally a blind or through via 7 is formed in a printed circuit board 1 which is subsequently plated with an electro-less plating process to form a thin layer of metallization or a conductive polymer or other conductive material such as graphite. In the case of electroless copper, the copper is also deposited on the base copper layers 2 of the board's 1 external surface. This prepares the vias 7 for subsequent electro-plating operations. A conductive metal 3, typically copper, is next electro plated in the vias 7 and subsequently on the surface of the panel that contains the board 1 (as shown in FIG. 2). Boards 1 are typically built into a larger process panel and then removed from this panel in a later routing step. This plating step is called a "panel plate" step due to the fact that the entire surface of the panel is plated. Once a sufficient amount of copper is plated in the vias 7, and subsequently on the surface, a filling step occurs in which a fill material 7a, typically an epoxy, is filled in the vias 7 and removed from the surface and planarized to the surface in a sanding step (see FIG 3).

An electro-less plating step, metal or conductive material is then formed on the surface of the panel to prepare the surface of the panel for the subsequent electro-plating step. This step is primarily used to initiate the surface of the epoxy fill 7a in order to electro plate in subsequent steps. This step may be unnecessary if a conductive fill material is used such as CB100 from DuPont Corporation. Next, a plating mask 15, typically a photosensitive mask, is applied to the surfaces of the board 1 and removed from just the areas that will define the final shape of the contact pads 7b and, typically, all the remaining circuitry. The panel is then electro-plated on the exposed pattern and filled epoxy surface. This mask and plate step is typically referred to as the pattern-plating step.

After plating metal on the exposed pattern, typically copper, a final plating finish, typically nickel and gold, is plated on the exposed surface (FIG 4). The photosensitive mask is removed at this stage. Viewing the contact pads 7b from the sectional view as shown in FIG 4, the base copper 2 can be seen extending across the entire surface of the board 1 with a thin electro-less metallization across the base copper and into the via. Panel plating also extends across the base copper 2 and into the via 7, and epoxy fill 7a is seen the via 7. Further, there is an additional electroless metallization across the panel plate and the epoxy fill 7a. In the case of some electro-less conductive polymers this layer would only be visible on the planerized epoxy surface. A layer of metallization 4 (Pattern Plate) can be seen on top of the planerized epoxy and across the extents of the circuit pattern. This circuit pattern metal would be proud of the base metal layers culminating with layers of nickel-gold as the permanent etch resist. It is

plated in the via 7 and subsequently on the surface of the panel that contains the board 1. Boards 1 are typical built in a larger process panel and then removed from this panel in a later routing step. This plating step is called a "panel plate" step, due to the fact that the entire surface of the panel is plated. Once a sufficient amount of copper is plated in the vias 7 and subsequently on the surface a filling step occurs in which a fill material 7a, typically an epoxy, is filled in the vias 7 and removed from the surface and planerized to the surface in a sanding step.

At this point, an electro-less plating metallization or conductive polymer is formed on the surface of the panel to prepare the planarized epoxy surface for the subsequent electro-plating step. Alternatively, the epoxy fill 7a may contain conductive particles as in but not limited to CB100 from DuPont Corp. that would eliminate or mitigate the need for the previous electro-less step. Next, a plating mask 15, typically a photosensitive mask, is applied to the surfaces of the board 1 and removed just from the areas that will define the final shape of the contact pads 7b and in many cases, all the remaining circuitry. The panel is then electro-plated on the exposed pattern that includes the filled epoxy surface. Additional masks and metal layers of varying shapes and thicknesses may be added at this stage to build-up successive layers of metals. This mask and plate step is typically referred to as the pattern-plating step. After plating metal on the exposed pattern, typically copper, the photoresist is removed prior to adding the final surface finish layers, preferably but not limited to nickel and gold. Then, another photo resist is applied (encapsulation resist) and an area slightly larger than the pattern area, preferably but not limited to 2-3 mils larger, is selectively removed from the pattern area. Next, a temporary etch resistant metal is applied to the exposed areas including

CLAIMS

1. A method for forming contact pads or circuits on a printed circuit board (PCB) over a filed or unfilled plated via, the steps comprising:

applying one of either an additional metallic or non-metallic coating to a final surface of a finished plated circuit or pad encapsulating side walls of a final surface plate, and also covering side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal to provide a slight undercut of panel plated metal and virtually no undercut of the base metal and of the pattern plated metal, preventing subsequent undermining through the etching process and removing or limiting any excess of the coating around the pad to prevent shorting of the pad's or circuitry to adjacent pads or circuitry after etching exposed wrapped plate and base metal layers.

2. A method according to Claim 1, in which the coating is a metal suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

3. A method according to Claim 1, in which the coating is a metallic temporary etch resist to be removed after etch revealing the final surface finish suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

4. A method according to Claim 1, in which the coating is gold.

5. A method according to Claim 1, in which the coating is palladium.

6. A method according to Claim 1, in which the coating is rhodium.

7. A method according to Claim 3, in which the temporary etch resist is tin.

8. A method according to Claim 1, in which the coating is a temporary polymer etch resist to be removed after etch revealing the final surface finish suitable for the circuit or pads end application.

9. A method according to Claim 8, in which the polymer is applied with spin coating, spray coating, electrostatic spray coating, dip coating, or techniques otherwise known in the art.

10. A method according to Claim 8, in which the polymer is a photosensitive polymer selectively removed through photolithography.

11. A method according to Claim 9, in which the polymer is selectively removed through laser ablation or mechanical milling techniques.

12. A method for forming contact pads or circuits on a printed circuit board (PCB) over a filed or unfilled plated via, the steps comprising:

applying one of either an additional metallic or non-metallic coating to a surface and side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal,
removing or limiting any excess of the coating around the pads or circuits to prevent shorting of the pad's or circuitry to adjacent pads or circuits after etching exposed wrapped plate and base metal layers.

13. A method according to Claim 12, in which the coating is a metal suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

14. A method according to Claim 12, in which the coating is a metallic temporary etch resist such as but not limited to tin to be removed after etch revealing pads and or circuits ready to accept a suitable final surface finish.

15. A method according to Claim 12, in which the coating is a temporary polymer etch resist to be removed after etch revealing pads and or circuits ready to accept a suitable final surface finish.

16. A method according to Claim 15, in which the polymer is applied with spin coating, spray coating, electrostatic spray coating, dip coating, or techniques otherwise known in the art.

17. A method according to Claim 8, in which the polymer is a photosensitive polymer selectively removed through photolithography.

18. A method according to Claim 12, in which the polymer is selectively removed through laser ablation or mechanical milling techniques.

19. A structure including contact pads or circuits formed on a printed circuit board (PCB) over a filed or unfilled plated via, comprising:

either an additional metallic or non-metallic coating that covering to a final surface of a finished plated circuit or pad that encapsulates side walls of a final surface plate, and also covers side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal plated in the via and onto the surface of a base metal in which any excess of the coating around the pad has been removed or limited to prevent shorting of the pads or circuitry to adjacent pads or circuitry after exposed wrapped plate and base metal layers have been etched.

20. A structure including contact pads or circuits formed on a printed circuit board (PCB) over a filed or unfilled plated via, comprising:

an additional metallic or non-metallic coating covering a surface and side wails of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal in which any excess of the coating around the pads or circuits has been removed or limited to prevent shorting of the pads or circuitry to adjacent pads or circuits after exposed wrapped plate and base metal layers has been etched.

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Referring now to FIGS. 1-11 of the drawings, FIGS. 1-4 and 7 shows a conventional process and structure for forming a contact pad 7 on a printed circuit board (FIG. 7) over a plate filled via 7. Typically, contact pads 7b are formed on a printed circuit boards 1 by subtractive etching using a hard gold plated layer over a Ni plated layer acting as an etch resist 5 (with Gold on top of the Nickel layer) defining the pad geometry of the underlying base metal 2, typically copper. Many other metals can be utilized as the wear resistant etch resist 5 including Palladium, and rhodium. As shown in FIG. 1 for the case of via-in-pad technology, traditionally a blind or through via 7 is formed in a printed circuit board 1 which is subsequently plated with an electro-less plating process to form a thin layer of metallization or a conductive polymer or other conductive material such as graphite. In the case of electroless copper, the copper is also deposited on the base copper layers 2 of the board's 1 external surface. This prepares the vias 7 for subsequent electro-plating operations. A conductive metal 3, typically copper, is next electro plated in the vias 7 and subsequently on the surface of the panel that contains the board 1 (as shown in FIG. 2). Boards 1 are typically built into a larger process panel and then removed from this panel in a later routing step. This plating step is called a "panel plate" step due to the fact that the entire surface of the panel is plated. Once a sufficient amount of copper is plated in the vias 7, and subsequently on the surface, a filling step occurs in which a fill material 21, typically an epoxy, is filled in the vias 7 and removed from the surface and planarized to the surface in a sanding step (see FIG 3).

An electro-less plating step, metal or conductive material is then formed on the surface of the panel to prepare the surface of the panel for the subsequent electro-plating step. This step is primarily used to initiate the surface of the epoxy fill 21 in order to electro plate in subsequent steps. This step may be unnecessary if a conductive fill material is used such as CB100 from DuPont Corporation. Next, a plating mask 15, typically a photosensitive mask, is applied to the surfaces of the board 1 and removed from just the areas that will define the final shape of the contact pads 7b and, typically, all the remaining circuitry. The panel is then electro-plated on the exposed pattern and filled epoxy surface. This mask and plate step is typically referred to as the pattern-plating step.

After plating metal on the exposed pattern, typically copper, a final plating finish, typically nickel and gold, is plated on the exposed surface (FIG 4). The photosensitive mask is removed at this stage. Viewing the contact pads 7b from the sectional view as shown in FIG 4, the base copper 2 can be seen extending across the entire surface of the board 1 with a thin electro-less metallization across the base copper and into the via. Panel plating also extends across the base copper 2 and into the via 7, and epoxy fill 21 is seen the via 7. Further, there is an additional electroless metallization across the panel plate and the epoxy fill 21. In the case of some electro-less conductive polymers this layer would only be visible on the planerized epoxy surface. A layer of metallization 4 (Pattern Plate) can be seen on top of the planerized epoxy and across the extents of the circuit pattern. This circuit pattern metal would be proud of the base metal layers culminating with layers of nickel-gold as the permanent etch resist. It is

plated in the via 7 and subsequently on the surface of the panel that contains the board 1. Boards 1 are typical built in a larger process panel and then removed from this panel in a later routing step. This plating step is called a "panel plate" step, due to the fact that the entire surface of the panel is plated. Once a sufficient amount of copper is plated in the vias 7 and subsequently on the surface a filling step occurs in which a fill material 21, typically an epoxy, is filled in the vias 7 and removed from the surface and planerized to the surface in a sanding step.

At this point, an electro-less plating metallization or conductive polymer is formed on the surface of the panel to prepare the planarized epoxy surface for the subsequent electro-plating step. Alternatively, the epoxy fill 21 may contain conductive particles as in but not limited to CB100 from DuPont Corp. that would eliminate or mitigate the need for the previous electro-less step. Next, a plating mask 15, typically a photosensitive mask, is applied to the surfaces of the board 1 and removed just from the areas that will define the final shape of the contact pads 7b and in many cases, all the remaining circuitry. The panel is then electro-plated on the exposed pattern that includes the filled epoxy surface. Additional masks and metal layers of varying shapes and thicknesses may be added at this stage to build-up successive layers of metals. This mask and plate step is typically referred to as the pattern-plating step. After plating metal on the exposed pattern, typically copper, the photoresist is removed prior to adding the final surface finish layers, preferably but not limited to nickel and gold. Then, another photo resist is applied (encapsulation resist) and an area slightly larger than the pattern area, preferably but not limited to 2-3 mils larger, is selectively removed from the pattern area. Next, a temporary etch resistant metal is applied to the exposed areas including

CLAIMS

1. A method for forming contact pads or circuits on a printed circuit board (PCB) over a filed or unfilled plated via, the steps comprising:

applying one of either an additional metallic or non-metallic coating to a final surface of a finished plated circuit or pad encapsulating side walls of a final surface plate, and also covering side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal to provide a slight undercut of panel plated metal and virtually no undercut of the base metal and of the plated metal, preventing subsequent undermining through an etching process and removing or limiting any excess of the coating around the pad to prevent shorting of the pad's or circuitry to adjacent pads or circuitry after etching exposed wrapped plate and base metal layers.

2. A method according to Claim 1, in which the coating is a metal suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

3. A method according to Claim 1, in which the coating is a metallic temporary etch resist to be removed after etch revealing the final surface finish suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

4. A method according to Claim 1, in which the coating is gold.

5. A method according to Claim 1, in which the coating is palladium.

6. A method according to Claim 1, in which the coating is rhodium.

7. A method according to Claim 3, in which the temporary etch resist is tin.

8. A method according to Claim 1, in which the coating is a temporary polymer etch resist to be removed after etch revealing the final surface finish suitable for the circuit or pads end application.

9. A method according to Claim 8, in which the polymer is applied with spin coating, spray coating, electrostatic spray coating, dip coating, or techniques otherwise known in the art.

10. A method according to Claim 8, in which the polymer is a photosensitive polymer selectively removed through photolithography.

11. A method according to Claim 9, in which the polymer is selectively removed through laser ablation or mechanical milling techniques.

12. A method for forming contact pads or circuits on a printed circuit board (PCB) over a filed or unfilled plated via, the steps comprising:

applying one of either an additional metallic or non-metallic coating to a surface and side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal to provide a slight undercut of panel plated metal and virtually no undercut of the base metal and of the plated metal, preventing subsequent undermining through an etching process, removing or limiting any excess of the coating around the pads or circuits to prevent shorting of the pad's or circuitry to adjacent pads or circuits after etching exposed wrapped plate and base metal layers.

13. A method according to Claim 12, in which the coating is a metal suitable for the circuit or pads end application such as but not limited to gold, palladium or rhodium.

14. A method according to Claim 12, in which the coating is a metallic temporary etch resist such as but not limited to tin to be removed after etch revealing pads and or circuits ready to accept a suitable final surface finish.

15. A method according to Claim 12, in which the coating is a temporary polymer etch resist to be removed after etch revealing pads and or circuits ready to accept a suitable final surface finish.

16. A method according to Claim 15, in which the polymer is applied with spin coating, spray coating, electrostatic spray coating, dip coating, or techniques otherwise known in the art.

17. A method according to Claim 8, in which the polymer is a photosensitive polymer selectively removed through photolithography.

18. A method according to Claim 12, in which the polymer is selectively removed through laser ablation or mechanical milling techniques.

19. A structure including contact pads or circuits formed on a printed circuit board (PCB) over a filed or unfilled plated via, comprising:

either an additional metallic or non-metallic coating that covering to a final surface of a finished plated circuit or pad that encapsulates side walls of a final surface plate, and also covers side walls of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal plated in the via and onto the surface of a base metal to provide a slight undercut of panel plated metal and virtually no undercut of the base metal and of the plated metal, preventing subsequent undermining through an etching process in which any excess of the coating around the pad has been removed or limited to prevent shorting of the pads or circuitry to adjacent pads or circuitry after exposed wrapped plate and base metal layers have been etched.

20. A structure including contact pads or circuits formed on a printed circuit board (PCB) over a filed or unfilled plated via, comprising:

an additional metallic or non-metallic coating covering a surface and side wails of a metal layer plated onto a filled or unfilled via and on top of a wrap around plated metal that is plated in the via and onto the surface of a base metal to provide a slight undercut of panel plated metal and virtually no undercut of the base metal and of the plated metal, preventing subsequent undermining through an etching process in which any excess of the coating around the pads or circuits has been removed or limited to prevent shorting of the pads or circuitry to adjacent pads or circuits after exposed wrapped plate and base metal layers has been etched.