

ELECTROFORMED COMPONENT MANUFACTURE

The present application relates to methods of manufacturing an electroformed component and also to apparatus suitable for producing
5 electroformed components.

The electroforming process is used in a range of industries to form precision components, such as stencils. Currently in the electroformed stencil industry large metal sheets, called mandrels, are used as the substrate material for the subsequent manufacturing steps. The mandrels are typically made out
10 of stainless steel and a photoresist is applied to them. Using lithography techniques the photoresist is patterned to leave portions of the mandrel exposed. The mandrel and the patterned photoresist form a stencil mould onto which the stencil is electroformed. The stencil is removed from the mandrel, cleaned and mounted in a frame for use.

15 There is an ongoing demand for electroformed components, such as stencils, capable of defining smaller diameter apertures at reduced pitches. Components having apertures with a diameter of less than $100\mu\text{m}$, for example $50\mu\text{m}$, at a pitch of sub- $200\mu\text{m}$, and even sub- $100\mu\text{m}$, are desirable in a range of applications. However, forming apertures at this scale requires that the
20 photoresist is patterned at a sufficiently high resolution and this is difficult to achieve reliably with known techniques.

The present application relates to apparatus and methods which, at least in preferred embodiments, overcome or ameliorate at least some of the problems associated with known techniques.

25 Viewed from a first aspect, the present application relates to a method of forming an electroformed component comprising the steps of:

- (a) forming a conductive seed layer on a substrate;
- (b) providing a patterned resist over the conductive seed layer; and
- (c) electroforming the component;

30 wherein the step of forming the conductive seed layer comprises spraying at least a first solution onto the substrate to form a first conductive layer.

- 2 -

A seed layer could be deposited through a vacuum deposition step (using, for example, sputtering, thermal evaporation, or electron beam evaporation) which creates a highly smooth and uniform coating. The problem with vacuum deposition is the high cost and long processing time associated
5 with this process. In addition the cost of purchasing and maintaining the equipment is also high. By spraying at least a first solution onto the substrate to form a first conductive layer, it is possible to use relatively inexpensive equipment.

The first solution is preferably a silvering solution and the resultant first
10 conductive layer is preferably a layer of silver. The silvering solution typically forms a silver film on the substrate.

The silvering solution may contain silver nitrate (AgNO_3). The silvering solution may, for example, comprise Reflectasil RAG1 Silver, 1.5% silver nitrate and 5-10% ammonia solution mixed with a buffer concentrate, such as 10-30%
15 sodium hydroxide. The resulting layer of silver has low resistance and therefore provides a good base for the later step of electroforming the stencil.

A second solution may also be sprayed onto the substrate to form the first conductive layer. The second solution may, for example, be a reducing solution, such as a mixture of Reflectasil R2 reducer and 1-5% Formaldehyde.
20 The first and second solutions may be sprayed onto the substrate one after the other. Preferably, however, the first and second solutions are sprayed onto the substrate simultaneously. For example, the first and second solutions can be sprayed simultaneously by a spray gun having two nozzles.

It will be appreciated that the silvering solution and the reducing solution
25 described herein could be mixed immediately prior to spraying onto the substrate. Thus, only a single solution would have to be sprayed.

The method preferably includes the initial step of cleaning the substrate before the conductive seed layer is formed. A sensitizer solution may be applied to the cleaned substrate after it has been cleaned. The substrate is
30 preferably then rinsed to remove the sensitizer solution prior to forming the conductive seed layer. The sensitizer solution may, for example, comprise 5-

- 3 -

10% formic acid, 5-10% hydrochloric acid and 1-5% Tin (ii) Chloride (stannous chloride). De-ionised water is preferably then used to rinse the substrate.

5 The step of forming the conductive seed layer may comprise applying a second conductive layer over the first conductive layer. This second conductive layer can help protect the first conductive layer provided on the substrate. The second conductive layer may, for example, be copper. This is desirable since it helps prevent an oxide layer forming on the silver. It will be appreciated that the conductive seed layer may consist of two (bi-metallic), three (tri-metallic), or more conductive layers. Preferably, however, the seed layer consists of a
10 single conductive layer.

The step of providing a patterned resist preferably comprises applying a substantially continuous layer of resist over the conductive seed layer and then removing one or more selected areas of the resist. The resist is preferably a photoresist. The resist is preferably patterned using lithography techniques.

15 The inventors in the present case have also recognised that during lithography better results are achievable with a substrate with a high surface smoothness, such as glass or silicon, because the collimated light that passes through the photoresist is reflected back through the photoresist at least substantially perpendicular to the surface of the substrate. Using a substrate
20 with a rough surface, such as a metal mandrel, causes scattering of the reflected light which results in a loss in imaging resolution. Any material capable of providing a high degree of surface flatness may be used as the substrate. The substrate is preferably made of glass or silicon.

The first solution is preferably at room temperature or at a temperature
25 less than 50°C, 75°C or 100°C when it is sprayed onto the substrate.

Viewed from a further aspect, the present application relates to a method of forming an electroformed component, the method comprising the steps of:

- (a) forming a layer of silver on a substrate; and
- (b) providing a resist over the layer of silver.

30 The electroformed component may be an inkjet nozzle, a fuel injection nozzle or any other microelectromechanical systems (MEMS) component.

- 4 -

However, the electroformed component is preferably a stencil. The stencil is preferably a screen-printing stencil.

Stencils produced in accordance with the present invention are typically suitable for use in a wide range of applications in the electronic substrate fabrication, microelectronic packaging and electronic assembly industries. For example, the stencil may be suitable for printing printed circuit boards; depositing solder paste; depositing conductive adhesive; or conductive or dielectric materials.

Viewed from a further aspect, the present application relates to a method of producing an electroformed component, the method comprising the steps of:

- (a) forming a conductive seed layer on a substrate;
- (b) providing a patterned resist over the conductive seed layer; and
- (c) electroforming the component;

wherein, the conductive seed layer comprises a layer of silver.

The formation of a layer of silver is relatively straightforward and, because of its relatively low resistance, provides a good base for the later electroforming step.

The layer of silver is preferably applied using a silvering technique.

The silvering technique may comprise the step of pouring a silvering solution over the substrate. For example, an ammoniacal silver solution, mixed with Rochelle salt or with a nitric acid/cane sugar/alcohol mixture may be poured over the substrate. Alternatively, the substrate may be immersed in a silvering solution

Preferably, however, the silvering technique comprises the step of spraying a silvering solution onto the substrate.

Any material capable of providing a high degree of surface flatness may be used as the substrate. Preferably, however, the substrate is glass or silicon.

The step of providing a patterned resist preferably comprises applying a substantially continuous layer of resist over the conductive seed layer and then removing one or more selected areas of the resist. The resist is preferably a photoresist. The resist is preferably patterned using lithography techniques.

- 5 -

Viewed from a further aspect, the present application relates to a patterned substrate for electroforming a component, the patterned substrate comprising a conductive seed layer and a patterned resist; wherein the conductive seed layer comprises a layer of silver. The patterned resist is preferably provided over the conductive seed layer and preferably contacts said layer of silver.

The conductive seed layer may comprise only the layer of silver. Alternatively, one or more additional layers may be provided in the conductive seed layer. For example, a layer of copper may be provided over the layer of silver. The patterned substrate may be suitable for electroforming a stencil.

Viewed from a still further aspect, the present application relates to a method of forming a layered-structure, the method comprising the steps of:

- (a) forming a conductive seed layer on a substrate; and
 - (b) providing a layer of resist over the conductive seed layer;
- wherein the conductive seed layer comprises a layer of silver.

Advantageously the layer of resist may protect the layered-structure whilst it is handled or during transportation. The layer of resist may subsequently be patterned to form a patterned substrate using lithography techniques. Thus, the layered-structure may initially be a generic item which is subsequently tailored by a manufacturer to suit a particular application. The resist is preferably a photoresist. The patterned substrate may be suitable for electroforming a component, such as a stencil.

Viewed from a yet further aspect, the present application relates to a method of forming a layered-structure, the method comprising the steps of:

- (a) forming a conductive seed layer on a substrate; and
 - (b) providing a layer of photoresist over the conductive seed layer;
- wherein the step of forming the conductive seed layer comprises spraying at least a first solution onto the substrate to form a first conductive layer. The first conductive layer preferably comprises silver.

Viewed from a still further aspect, the present application relates to a layered-structure comprising a substrate, a conductive seed layer and a layer of photoresist; wherein the conductive seed layer comprises a layer of silver. The

- 6 -

layer of silver is preferably applied using a silvering technique. The layer of photoresist is preferably applied directly onto the layer of silver. The layered-structure is preferably suitable for forming a patterned substrate. The patterned substrate may be suitable for electroforming a component, such as a stencil.

5 Viewed from a further aspect, the present invention relates to a method of producing an electroformed component comprising the steps of:

- (a) forming a conductive seed layer on a substrate;
- (b) providing a patterned resist over the conductive seed layer; and
- (c) electroforming the component;

10 wherein the step of forming the conductive seed layer comprises spraying at least a first conductive layer onto the substrate.

The first conductive layer may be sprayed on as a solution, such as a silvering solution. Alternatively, a thermal spraying technique may be used. If a thermal spraying technique is employed, the first conductive layer may be
15 formed by spraying molten and/or finely divided metals on to the substrate. The conductive layer may, for example, comprise copper, aluminium or nickel which are sprayed onto the substrate using thermal spray coating techniques. Alloys, such as nickel alloy, may also be applied using thermal coating techniques.

20 Viewed from a yet further aspect, the present application relates to a method of producing an electroformed component, the method comprising the steps of:

- (a) forming a conductive seed layer on a substrate;
- (b) providing a patterned resist over the conductive seed layer; and
- (c) electroforming the component;

25 wherein the component is electroformed to a thickness less than or equal to the thickness of the patterned resist.

By ensuring that the component is not electroformed to a thickness greater than that of the resist, apertures defined in the component do not suffer from closure. If the electroforming continues after the component is thicker than
30 the resist, material may be deposited on a top surface of the photoresist resulting in over plating (or mushroom plating). Accordingly, it is more difficult to control the size and profile of the apertures. By controlling the process to

- 7 -

ensure that the thickness of the component does not exceed that of the resist, these problems can be avoided. The component preferably has a thickness in the range $15\mu\text{m}$ to $50\mu\text{m}$; $50\mu\text{m}$ to $100\mu\text{m}$; $100\mu\text{m}$ to $150\mu\text{m}$; or $150\mu\text{m}$ to $200\mu\text{m}$. The photoresist is preferably $5\mu\text{m}$ to $15\mu\text{m}$; $15\mu\text{m}$ to $25\mu\text{m}$; or $25\mu\text{m}$ to $50\mu\text{m}$ thicker than the desired component thickness. The component is preferably a stencil.

Viewed from a yet still further aspect, the present application relates to a method of electroforming a component on a patterned substrate, the patterned substrate comprising a conductive seed layer and a patterned resist; wherein the method comprises electroforming the component to a thickness less than or equal to the thickness of the patterned resist.

The electroformed component is preferably a stencil. The electroforming steps of the methods described herein preferably utilise a bi-polar waveform comprising a cathodic and an anodic pulse. The cathodic pulse preferably has a lower peak value than the anodic pulse. The period of time over which the cathodic pulse is applied is preferably greater than the period of time over which the anodic pulse is applied. The waveform is preferably square. The application of a bi-polar current waveform is described in the Applicant's international patent application number PCT/GB2004/000318, which is incorporated herein in its entirety by reference.

The present application also relates to an electroformed component formed in accordance with the methods described herein.

The term cathodic pulse herein refers to that portion of the waveform that causes deposition of metal. Conversely, the term anodic pulse refers to that part of the waveform that causes removal of metal.

The term patterned substrate used herein refers generally to a frame, mold or template on which a stencil is formed.

Viewed from a still further aspect, the present invention relates to a method of forming an electroformed component comprising the steps of: (a) forming a conductive seed layer on a substrate; (b) providing a resist over the conductive seed layer; and (c) electroforming the component; wherein the conductive seed layer is formed using a Physical Vapour Deposition technique.

- 8 -

The electroformed component is preferably a stencil.

The conductive seed layer may have a thickness less than or equal to three microns. Preferably, the conductive seed layer has a thickness less than or equal to one micron.

5 The conductive seed layer may comprise or consist of Titanium or Chrome. The skilled person will appreciate that the conductive seed layer may be formed from other metals.

The substrate is preferably cleaned prior to formation of the conductive seed layer.

10 The substrate is preferably made of glass. However, it will be appreciated that the substrate may be made of other materials.

The substrate is preferably placed in a vacuum chamber and an at least partial vacuum formed prior to formation of the conductive seed layer.

15 The Physical Vapour Deposition technique may be thermal evaporation; electron beam evaporation; sputtering or pulsed laser deposition.

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

20 Figure 1 shows schematically a substrate in accordance with the present invention having a conductive seed layer formed thereon;

Figure 2 shows the substrate of Figure 1 with a layer of photoresist applied on top of the conductive seed layer;

Figure 3 shows schematically the step of patterning the photoresist by exposing selected regions to UV light;

25 Figure 4 shows schematically the patterned photoresist after it has been developed;

Figure 5 shows the stencil being formed on the regions of the conductive seed layer not covered by the photoresist;

Figure 6 shows the stencil separated from the substrate; and

30 Figure 7 shows the stencil once the remaining photoresist has been removed.

- 9 -

The different stages in the manufacture of an electroformed component in accordance with the present invention are shown in Figures 1 to 7. In the present case, the electroformed component is a stencil 1 but it will be appreciated that the process may be used to form other components.

5 A glass substrate 3 having a conductive seed layer 5 is shown in Figure 1. The conductive seed layer 5 comprises a silver layer 7. The application of the silver layer 7 to the glass substrate 3 will now be described.

10 The glass substrate 3 is cleaned thoroughly so that it is free of any dust or grease. The cleaning may be performed using a wet-chemical pre-clean; and/or using ultrasonic cleaning techniques to enhance the removal of particulate material. The wet-chemical pre-clean may, for example, use a detergent, methanol or acetone. The substrate may also be polished, for example using cerium oxide.

15 The glass substrate 3 is then wetted over its entire surface with a sensitizer solution comprising 5-10% formic acid, 5-10% hydrochloric acid and 1-5% Tin (ii) Chloride (stannous chloride). The sensitizer solution is preferably made by mixing 40 millilitres of Reflectasil S3 Sensitizer with 970 millilitres of de-ionised water. The glass substrate 3 is then rinsed with de-ionised water.

20 The silver layer 7 is then formed by applying a silvering solution and a reducing solution to the prepared surface of the glass substrate 3.

25 The silvering solution is a mixture of a silvering concentrate, a buffer concentrate and deionised water. The silvering concentrate is preferably Reflectasil RAG1 Silver; and the buffer concentrate is preferably Reflectasil B1 Buffer. A preferred silvering solution comprises Reflectasil B1 Buffer (10-30% sodium hydroxide), Reflectasil RAg1 Silver (1.5% silver nitrate and 5-10% Ammonia Solution), Reflectasil R2 Reducer (1-5% Formaldehyde), Reflectasil S3 Sensitiser (5-10% Formic Acid, 5-10% Hydrochloric Acid and 1-5% Stannous (Tin II) Chloride).

30 The reducing solution is a mixture of a reducing concentrate, such as Reflectasil R2 reducer, and deionised water. The reducing solution is made by diluting 30 millilitres of the reducing concentrate to 1 litre with deionised water.

- 10 -

The silvering solution and the reducing solution are sprayed onto the upper surface of the glass substrate 3 simultaneously using a twin nozzle spray gun (not shown). The silvering solution is supplied from one nozzle and the reducing solution from the other nozzle at equal flow rates. The silver layer 7
5 then gradually forms as a film and the spraying is continued until the silver film uniformly covers the entire upper surface of the glass substrate 3.

A layer of photoresist 9, approximately 50 μ m thick, is then deposited on the conductive seed layer 5 by spin coating, as shown in Figure 2. In the present case, the negative photoresist SU-8, available from Microchem. Corp.,
10 USA, is used. The substrate 3 and the photoresist 9 are then baked on a hotplate or in an oven at a temperature of 90°C until the photoresist 9 has cured. The baking time can be up to 2 hours, depending on the thickness of the photoresist 9.

A glass photomask 11 is provided over the photoresist 9. The use of a
15 glass photomask has been found to be particularly advantageous in this application since the improved transmission of light through the photomask provides good sidewall definition in the photoresist 9. A coating 13 is provided on the photomask 11 and a series of apertures 15 in the coating 13 expose predetermined regions of the photoresist 9 to a collimated light source. The
20 light source typically emits light at a wavelength in the range 350nm to 400nm and having energy in the range 100-5000 mJ/cm². The apertures 15 in the coating on the photomask 11 pattern the photoresist 9. It will be appreciated that the apertures 15 are configured to provide the desired pattern for a particular application.

25 The glass substrate 3 and the patterned photoresist 11 are then optionally baked for a second time, again at a temperature of 90°C for up to 2 hours. The photoresist 11 is then developed by immersing it in a solvent, such as Microposit EC solvent, for 2-10 minutes.

As shown in Figure 4, developing the photoresist 9 leaves a patterned
30 substrate for electroforming the stencil 1. The patterned substrate has a series of projections 17 corresponding to the apertures 15 in the photomask 11. The

- 11 -

surface of the conductive seed layer 5 surrounding the projections 17 is exposed.

The patterned substrate 3 is then moved to a bath of electroforming solution. The electroforming process is then initiated to form the stencil 1 on the exposed regions of the conductive seed layer 5 in the patterned substrate. Thus, the stencil 1 forms around the projections 17 and apertures 19 corresponding to the projections 17 are created in the stencil 1. The patterned substrate functions as a mould for defining the stencil 1. The electroforming solution preferably comprises nickel sulphamate (500g/l), boric acid (50g/l) and nickel chloride (15g per litre). A 99.99% pure nickel anode is used and the solution is maintained at a temperature of 50°C.

A bi-polar AC current waveform is applied during the electroforming process. The bi-polar waveform comprises a cathodic pulse and an anodic pulse. The magnitude of the peak value of the anodic pulse is preferably greater than the magnitude of the peak value of the cathodic pulse. The cathodic pulse typically has a duration of 45ms and a current density of 10A/dm² (Amps per decimetre squared); and the anodic pulse typically has a duration of 5ms and a current density of 20A/dm².

As shown in Figure 5, the electroforming is controlled such that the thickness of the stencil 1 is less than the thickness of the photoresist 9. This ensures that closure of the apertures 19 does not occur above the photoresist 9. In the present case, the stencil 1 has a thickness of less than 50µm.

The stencil 1 is then removed from the glass substrate 3. The projections 17 are typically detached from the conductive seed layer 5 along with the stencil 1 and remain in the apertures 19, as shown in Figure 6. The remaining photoresist 9 is then dissolved using a solvent such as NMP, available from White Chemicals, USA, leaving the finished stencil 1, as shown in Figure 7.

The stencil 1 is then cleaned by drying in nitrogen. A release agent, such as parylene, may optionally be applied to the stencil 1. The stencil 1 is then installed in a frame to enable it to be handled more readily.

- 12 -

Since the surface of the substrate 3 is smoother than conventional metal mandrels, scattering of reflected light into the photoresist 9 surrounding the apertures 15 is reduced. The use of a glass photomask 11 further reduces the exposure of the photoresist 9 around the apertures 15 to light. Accordingly, the projections 17 have well defined sidewalls and this advantageously helps to ensure that the sidewalls of the apertures 19 in the stencil 1 are well defined.

Although a preferred embodiment of the present invention has been described herein, it will be appreciated that various changes and modifications can be made with departing from the scope of the present invention. For example, it will be appreciated that a positive photoresist may be applied over the conductive seed layer. Furthermore, alternative silvering techniques may be employed to form the silver film on the substrate.

Moreover, it will be appreciated that the process described herein is not limited to forming stencils. The process may be employed to electroform precision components, such as inkjet nozzles, fuel injection nozzles and other MEMS devices.

A process for forming a stencil in accordance with a second embodiment of the present invention will now be described. Like references will be used for like components in the description of this embodiment.

The stencil 1 is again formed on a glass substrate 3. However, rather than form a layer of silver, a layer of titanium or chrome is formed using a thermal evaporation process. Titanium and chrome have been found to adhere well to the glass substrate 3, but it will be appreciated that other materials may be used.

The glass substrate 3 is cleaned in accordance with the techniques described herein and then placed in a holder in a vacuum chamber. Once a suitable vacuum has been achieved in the vacuum chamber, the titanium or chrome is heated in the vacuum chamber using an electric resistance heater to melt the material and raise its vapour pressure. The titanium or chrome evaporates onto the substrate above forming a thin film. The longer the exposure, the thicker the film formed on the substrate. The film preferably has a thickness of less than or equal to one (1) micron.

- 13 -

The thermal evaporation is done in a high vacuum to allow the vapour to reach the substrate without reacting with or scattering against other gas-phase atoms in the chamber and also to reduce the incorporation of impurities from the residual gas in the vacuum chamber. Obviously, only materials with a much
5 higher vapour pressure than the heating element can be deposited without contamination of the film.

A layer of photoresist 9 is applied to the titanium or chrome film and a pattern formed in the photoresist 9. Suitable techniques for applying the photoresist 9 to the conductive seed layer and forming the desired pattern are
10 described above.

The electroforming process is then initiated to form the stencil 1. The electroforming technique described above is also suitable for forming the stencil 1 in accordance with the present embodiment.

Although the second embodiment has been described with reference to
15 thermal evaporation techniques, it will be appreciated that other physical vapour deposition techniques such as electron beam evaporation; sputtering; or pulsed laser deposition may be employed. For completeness, these techniques will now be described in broad terms.

Electron beam evaporation utilises a high-energy beam from an electron
20 gun to boil a small spot of material; since the heating is not uniform, lower vapour pressure materials can be deposited. The beam is usually bent through an angle of 270° in order to ensure that the gun filament is not directly exposed to the evaporant flux.

Sputtering relies on a plasma (usually a noble gas, such as Argon) to
25 knock material from a "target" a few atoms at a time. The target can be kept at a relatively low temperature, since the process is not one of evaporation, making this one of the most flexible deposition techniques. It is especially useful for compounds or mixtures, where different components would otherwise tend to evaporate at different rates. Sputtering's step coverage is substantially
30 conformal.

- 14 -

Pulsed laser deposition systems work by an ablation process. Pulses of focused laser light vaporize the surface of the target material and convert it to plasma; this plasma usually reverts to a gas before it reaches the substrate.

5 Various changes and modifications may be made to the processes and apparatus described herein without departing from the spirit and scope of the present invention.

- 15 -

CLAIMS:

1. A method of forming an electroformed component, the method comprising the steps of:

- 5 (a) forming a conductive seed layer on a substrate;
(b) providing a patterned resist over the conductive seed layer; and
(c) electroforming the component;

wherein the step of forming the conductive seed layer comprises spraying at least a first solution onto the substrate to form a first conductive layer.

10

2. A method as claimed in claim 1, wherein the first solution is a silvering solution and the first conductive layer is a layer of silver.

15

3. A method as claimed in claim 2, wherein the silvering solution contains silver nitrate (AgNO_3).

4. A method as claimed in claim 1, 2 or 3 further comprising spraying a second solution onto the substrate to form the first conductive layer.

20

5. A method as claimed in claim 4, wherein the second solution is a reducing solution.

25

6. A method as claimed in claim 4 or claim 5, wherein the first and second solutions are sprayed onto the substrate simultaneously.

7. A method as claimed in any one of the preceding claims, wherein the step of forming the conductive seed layer further comprises applying a second conductive layer over the first conductive layer.

30

8. A method as claimed in any one of the preceding claims, wherein the substrate is made of glass.

- 16 -

9. A method as claimed in any one of the preceding claims, wherein the step of providing a patterned resist comprises applying a substantially continuous layer of resist over the conductive seed layer and then removing one or more selected areas of the resist.

5

10. A method as claimed in any one of the preceding claims, wherein the resist is a photoresist.

10 11. A method as claimed in any one of the preceding claims, wherein the resist is patterned using lithography techniques.

12. A method of forming an electroformed component, the method comprising the steps of:

- 15 (a) forming a conductive seed layer on a substrate;
(b) providing a patterned resist over the conductive seed layer; and
(c) electroforming the component;

wherein the conductive seed layer comprises a layer of silver.

20 13. A method as claimed in claim 13, wherein the layer of silver is applied using a silvering technique.

14. A method as claimed in claim 13, wherein the silvering technique comprises the step of spraying a silvering solution onto the substrate.

25 15. A method as claimed in claim 13, wherein the silvering technique comprises the step of pouring a silvering solution over the substrate; or immersing the substrate in a silvering solution.

30 16. A method as claimed in any one of claims 12 to 15, wherein the substrate is glass.

- 17 -

17. A method of forming an electroformed component, the method comprising the steps of:

- (a) forming a layer of silver on a substrate; and
- (b) providing a resist over the layer of silver.

5

18. A method as claimed in any one of the preceding claims, wherein the component is a stencil suitable for printing printed circuit boards; depositing solder paste; depositing conductive adhesive; or printing conductive or dielectric materials.

10

19. A method as claimed in any one of claims 1 to 17, wherein the component is a MEMS component, such as an inkjet nozzle or a fuel injection nozzle.

15

20. A component formed in accordance with the method claimed in any one of the preceding claims.

20

21. A patterned substrate for electroforming a component, the patterned substrate comprising a conductive seed layer and a patterned resist; wherein the conductive seed layer comprises a layer of silver.

22. A method of forming a layered-structure, the method comprising the steps of:

25

- (a) forming a conductive seed layer on a substrate; and
 - (b) providing a layer of resist over the conductive seed layer;
- wherein the conductive seed layer comprises a layer of silver.

23. A method of forming a layered-structure, the method comprising the steps of:

30

- (a) forming a conductive seed layer on a substrate; and
- (b) providing a layer of photoresist over the conductive seed layer;

- 18 -

wherein the step of forming the conductive seed layer comprises spraying at least a first solution onto the substrate to form a first conductive layer.

24. A layered-structure comprising a substrate, a conductive seed layer and a layer of photoresist; wherein the conductive seed layer comprises a layer of silver.

25. A method of forming an electroformed component, the method comprising the steps of:

10 (a) forming a conductive seed layer on a substrate;

(b) providing a patterned resist over the conductive seed layer; and

(c) electroforming the component;

wherein the step of forming the conductive seed layer comprises spraying at least a first conductive layer onto the substrate.

15 26. A method of forming an electroformed component, the method comprising the steps of:

(a) forming a conductive seed layer on a substrate;

(b) providing a patterned resist over the conductive seed layer; and

20 (c) electroforming the component;

wherein the component is electroformed to a thickness less than or equal to the thickness of the patterned resist.

27. A method of electroforming a component on a patterned substrate, the patterned substrate comprising a conductive seed layer and a patterned resist; wherein the component is electroformed to a thickness less than or equal to the thickness of the patterned resist.

28. A component formed in accordance with the method recited in any one of claims 25, 26 or 27.

- 19 -

29. A method of forming an electroformed component comprising the steps of:

- (a) forming a conductive seed layer on a substrate;
- (b) providing a resist over the conductive seed layer; and
- 5 (c) electroforming the component;

wherein the conductive seed layer is formed using a Physical Vapour Deposition technique.

10 30. A method as claimed claim 29, wherein the electroformed component is a stencil.

31. A method as claimed in claim 29 or claim 30, wherein the conductive seed layer has a thickness less than or equal to one micron.

15 32. A method as claimed in any one of claims 29, 30 or 31, wherein the conductive seed layer comprises Titanium or Chrome.

33. A method as claimed in any one of claims 29 to 32, wherein the substrate is made of glass.

20 34. A method as claimed in any one of claims 29 to 33, wherein the Physical Vapour Deposition technique is thermal evaporation.