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Electroforming articles

This invention relates to a method of producing articles in a finish material and is particularly but not exclusively, concerned with the producing in high-purity, precious metal, such as gold, reproductions of articles to be modelled in such precious material.

It is desirable in producing precious metal articles that the fabrication process be economical in usage of precious material, and that the article has sufficient overall hardness and strength and thus durability when finished and yet be workable into a desired form and capable of reproducing fine detail and delicate features.

In mass production terms, it is also desirable that the article can be reproduced with consistency or uniformity and without undue cost. To this end, it is desirable that no undue amount of skilled labour is required in the fabrication process for multiple article reproduction.

Such requirements are especially relevant in the fabrication of jewellery, ornamental or decorative items, dental castings and specialised industrial components.

According to the invention there is provided a method of producing articles in a finish metal, comprising the steps of making a working replica in a disposable non-electroconductive material of an article to be produced, metallising said working replica, electrodepositing a finish metal layer upon the working replica to a required depth, removing the working replica to leave a hollow electroform of finish material, and further electroplating with finish material after the working replica has been removed in order to increase the overall electroform wall thickness and thereby strengthen the electroformed article as a whole.

The finish material may be gold.

Such a process of electrolytic deposition of gold is able to reproduce more intricate details even on complex shapes, without difficulty to a degree impossible or too costly to be achieved by conventional fabrication techniques such as casting, machining and hand-forming or cutting.

The electroforming gold process is applicable to high-purity gold electroforms or to control purity compositions to gold carat specification.

It is found that electrodeposited pure gold coatings are much harder and stronger than, say, wrought gold formed by conventional (jewellery) processes.

A working replica for subsequent electroforming or fabrication can be obtained by making a master model or replica of the article to be reproduced or modelled. Working replicas of

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these master models or replicas are then reproduced from the master in wax by casting. By choice of suitable casting materials, working replicas can be made of fragile or delicate natural objects such as flowers, leaves, fruits, eggs etc., reproducing the fine natural detail so that the final electroform will be very real or lifelike in appearance.

The working replica is of a non-conductive material such as wax or, plastic.

The choice of working replica material takes account of the nature of the article to be produced and the ease of making and removing the working replica after electroforming. Removal in some cases may require destruction of the working replica, for example by chemical etching or decomposition. Holes may be left in the outer electroform to facilitate such removal by solvent etching or dissolving or even by heating and melting out at a lower temperature than the gold electroform itself would melt. Alternatively, the working replica or model or mandrel may be re-used.

The metalising of the nonconductive working replica can be effected by coating with chemicals containing conductive pigments, by chemical vapour deposition, by sputtering molten metal or chemical metallisation processes such as mirroring.

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Metallising the working replica is important as otherwise gold is consumed in evening-out the surface imperfections in order to achieve the desired surface finish. It is preferable to achieve such a preliminary surface evening-out or finishing by electrodepositing a thin even coat of a relatively inexpensive base material such as nickel or copper prior to gold deposition. This intermediate plating step may be particularly advantageous for metallised non-conductive working replicas where the metallising process itself yields small imperfections, for example surface roughness on plated areas and holes with contaminants.

Prior to electrodeposition of gold, any areas not to be coated with gold may be masked with a suitable coating, such as a lacquer, and for such selective electrodeposition of gold the application of a base metal prior to application of masking material coating may be advantageous.

The gold electrodepositional plating itself is desirably performed in an electroplating bath capable of yielding a strong deposit of consistent thickness at both high and low current density regions of the working replica. The electrolyte itself must be stable, easy to control and capable of plating out substantial quantities of gold in strong coherent deposits.

After electrodepositing gold, minor surface finishing may be carried out before non-gold constituents are removed.

The surface finishing may include the mounting or incorporation of gemstones, i.e. precious or semi-precious stones, on the preliminary electrodeposited gold surface and the assembly returned to the gold plating bath for further electrodeposition in order to finish and secure the gemstone mounting.

There now follows a description of some particular embodiments of the invention, by way of example only:

A master model or replica is made of the article which is to be reproduced as a gold electroform. For example, an ornament such as a miniature animal e.g. a horse, might be selected as a model whose intricate and delicate detail must be reproduced or modelled.

The master model or replica may itself be reproduced by moulding or casting and the material used for the master model or replica must allow subsequent production of working models or replicas, which may themselves be destroyed in the fabrication process or may be re-used.

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Working replicas of a master model or replica may be produced by casting in wax, so that the encapsulated working replica may be melted out after the gold electroform has been produced.

The working replica is metallised and then finished to a desired standard, for example by polishing, possibly after further plating with copper or nickel.

A conductive wire may be embedded in such material to provide a return path for the plating current.

The plating path for the preliminary metal coating must give a good throwing power and even non-porous deposits, so that the working model or replica or mandrel can be finished to the desired standard.

At this stage any parts of the replica not to be plated with gold are masked with a (non-conductive) coating, for example a suitable lacquer. Such non-coated areas result in apertures in the electroform which may advantageously allow removal of the working replica after the electroform has been produced.

After any preliminary metallising and masking, the working replica is cleaned and placed in an electroplating gold bath to produce a gold electroform to a desired surface thickness. In

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particular, it is necessary that the gold electroform shell produced has sufficient inherent strength and coherence to support itself when the working replica is removed. Typically a gold bath capable of depositing bright strong ductile gold coatings of thickness up to 0.5 mm is chosen. An even gold deposit is desirable for appearance, strength and economy of gold usage.

Minor surface finishing of the gold electroform may be performed if there is any plating roughness during electro forming.

Selective drilling of the electroform with small holes, which can be plugged unobtrusively at a later date, may be performed in order to remove the non-gold working replica or mandrel by etching or melting. A final check for complete removal of the working replica may be performed by application of an acid which will not adversely affect the gold itself.

The electroform is cleaned and flushed out suitably with water, of any residual chemicals, and if necessary for further strength returned to the gold plating bath to increase the electroform wall thickness.

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Further finishing and decoration may be performed on the gold electroform, for example other precious metal finishing, enamelling or gemstone setting.

In order to remove the discardable working replica completely, a combination of chemical etching and heat melting may be employed.

Further strengthening of the electroform is readily achieved and because the electroformed gold is hard and strong the overall article strength can be improved by further electroforming.

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Claims

1. A method of producing articles in a finish metal, comprising the steps of making a working replica in a disposable non-electroconductive material of an article to be produced, metallising said working replica, electrodepositing a finish metal layer upon the working replica to a required depth, removing the working replica to leave a hollow electroform of finish material, and further electroplating with finish material after the working replica has been removed in order to increase the overall electroform wall thickness and thereby strengthen the electroformed article as a whole.
2. A method of electroforming as claimed in claim 1, including the step of electroplating the working replica with a intermediate material prior to finish electrodeposition.
3. A method of electroplating as claimed in claim 1 or claim, including the step of masking off any areas of the working replica not to be plated with finish material.
4. A method of electroforming as claimed in any of the preceeding claims, wherein precious or semi-precious stones are set into the electroform by mounting in the working replica prior to further electrodeposition.
5. An electroformed article produced by the method according to any of the ~~proceeding~~ claims.

