The Adultery of Materials: Electroforming Fashion

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Abstract

This paper will outline PhD research into the effect of electro deposition on complex fibre and textile structures. The intervention and consequence of hand skills makes this process a craft of the 21st Century. Traditional skills of knit, weave and embroidery are synthesized with the industrial process of electroforming but the humanising effect remains. Electrolysis of an inert fibre transforms it into a replica structure with a fine deposition of metal. As well as form, the resultant structure also adopts the properties associated with which ever metal has been transposed, adding to potential applications.

Research into conductive textiles has focused on the integration of metals through yarn structure. Stainless steel, copper and silver are some of the most popular metals and alloys spun with a plethora of man made and natural fibres to create conductive yarns. By encasing a completed fabric in metal the "whole" is transformed into a conductive medium rather than an individual strand. The introduction of semi conductive fibre in the electroforming process challenges the overall structure and as a result the fabric handle. Shibori shaped resist methods, more akin to dye techniques can be utilised to simultaneously pattern and introduce breaks in the metal, increasing movement and articulation, particularly where deposition is so heavy it becomes rigid.

By combining industrial tools and materials with a portfolio of inherent making skills, new materials and potential applications can be created.

Introduction

With the ever-widening array of new technologies available, the design community is being forced to reassess the role of traditional crafts. Over the last 10-15 years, in the disciplines of fashion and textile design; print, weave, knit and embroidery are the most common crafts succumbing to digitisation. However craftsmen and designers have more recently been integrating the industrial processes of laser cutting, vacuum forming, and rapid prototyping into the studio and catwalk. Sarah Braddock Clarke (2007 pp19) comments that,

> "Digital technology has had an enormous impact on craft and there is a real shift to ways of linking high-tech with low-tech and technology with tradition. In-depth

knowledge of a material's inherent properties is being combined with a distinct understanding of technology." [1]

In the field of conductive textiles, electro deposition is still in its infancy, despite electroplating having been used commercially since the 1830's.[2] In 1995 Dr Francis Geesin's doctoral thesis[3], focused on the technical and physical aspects involved in metal deposition onto textile. I intend to build on this knowledge, particularly in the areas of colouration and aesthetics. Leslie Curtis, School of Silversmithing and Jewellery, University of Central England, has facilitated the use of electroforming in the applied arts with his book 'Electroforming"[4], although mentioned he does not expand greatly on the fusion of textiles and metal.

My approach to electro deposition as a creative medium does not stem from the associated camp of jewellery and metalsmithing, but that of a textile designer. The curiosity and pleasure I derive as a designer / maker / artist has led me from textile and costume design to adornment of a more hybrid nature. In this paper I will present the re framing and tacit adjustment I have experienced whilst designing with alien materials and industrial tools.

Inspiration

I first became interested in metals at Glasgow School of Art, where I did my BA Honours degree in Embroidered and Woven Textile Design. Even at that early stage I experimented with metals; woven copper, silver pigment printing and hand beaten embroidered silver sequins. However I was frustrated at the lack of true metal / textile integration I was able to achieve. This curiosity was later fired by an exhibition of kimonos I saw in London, shortly after graduation. They were all Shibori dyed with a 3D surface quality I had never witnessed before, however the ones that really stick in my mind are those that looked encrusted with gold. That exhibition inspired me to research the ancient Japanese shaped resist dye technique of Shibori.[5]

Serendipity and the Vital Flaw

The most joyous aspect of this traditional dyeing is the child like delight experienced in the "opening" of dark wet bundles of cloth, straight from the dye vat. To unwrap every thread as carefully as it was bound, still holds a thrill of the unknown. Even though an identical type of binding yarn is used over the same silk it will produce a unique cloth, with marks as individual as fingerprints, sometimes frustratingly so.

From speaking to potter Rupert Spira I know this element of chance can be staged during glazing, with all the same conditions but rarely will the copper red kiss appear when and where invited. [6]

In the precepts associated with Wabi-Sabi, appreciation is given to the irregular, flawed and one of a kind. "Things Wabi-Sabi may exhibit the effects of accident, like a broken bowl glued back together again. Or they may show the result of just letting things happen by chance, like the irregular fabrics that are created by intentionally sabotaging the computer program of a textile loom." [7]

Many fashion companies have created collections including Shibori in the detailing or to achieve an all over 3D or patterned effect in the whole garment. Prada, Issey Miyake, Yohji Yamamoto, Nuno, Joseph, Kenzo amongst many others, have featured the idiosyncratic marks left by shaped resist dyeing. I propose the impact of silver Shibori to be somewhat more rarefied than the dyed variety. Leslie Curtis recalls the labour intensive (and therefore expensive) business of electroforming for a client,

> 'Some time ago I did some work for an Italian fashion house, which was making dresses with metal pockets. The pockets were sewn into the fabric and then these areas were lacquered. The rest of the fabric was protected with wax. The copper deposited onto the pockets was subsequently silver-plated and the wax was removed by boiling.' [8]

During the years I have spent dyeing and unwrapping bundles of folded, stitched or clamped fabric I am constantly engaged with how the colour has migrated. My shift from dye to silver hasn't lessened the element of serendipity involved in my work, something I foster and appreciate. This element comes with the territory of resist dyed textiles, as it also does with electroforming.

> 'Indeed it is the very tug-of-war that takes place between order and the element of surprise, between what is in and out of control, that can be recognised, harnessed and applied when selecting a specific conductive aid or layer as the first stage of the chemical process.' [9]

Humanising Electroforming

My background in Shibori dyeing heavily influenced the approach I had to experimenting with electro deposition. Initial test pieces were done with an electroplater, which deposits a

very fine layer of metal onto the piece of work, to which it will remain permanently attached with the aid of metal salts and an electric current. [10] The size of tank I had access to severely limited the area of work I was able to produce, although it did encourage a more inventive style of practice. Resist dyeing by its very nature requires fabric to be reserved through compression (in some techniques) and then secured, to prevent selected areas from being coloured. In my case I wanted to apply the same principle of Shibori dyeing to electroplating, essentially dyeing with metal. By concertina stitching and folding, lines of silver on white were created where the metal was allowed to penetrate the silk, as illustrated below.

Figure 1. Fine silver electrodeposited onto silk satin. Photo: the author

Early samples were made from a semi conductive cloth, comprising of a silk warp and metal alloy weft. Fabric was stitched and compressed in a variety of manners, making it possible to plate up to a meter of cloth at a time in a 5 litre tank. Without Shibori manipulation approximately 2% of this would have been possible. In addition to being able to electroplate more fabric, simultaneous resist patterns were also created.

Dye remains a factor in the making of these metallic fabrics. Initial samples with semi conductive fabrics only plate the metal component, increasing fluidity of the cloth and allowing the opportunity for colour to be introduced in the form of dye or Patination. Functional and aesthetic properties can be influenced by the introduction of a metal alloy

with natural fibre and when combined with man made fibres, the possibilities for heat setting are exposed, resulting in a permanent 3D textile. The inclusion of a smart fibre with encapsulation, hydrophobic or hydrophilic capabilities, extends applications beyond that of the purely decorative, for example in sportswear.

Electroforming is a process developed in industry to produce precision moulds. However it has been used within the jewellery industry to replicate items identically with a mould or by irreversibly and permanently depositing metal onto the surface of an article (often inert). The result is a lightweight, complex structure or self-supporting shell, often impossible to create with traditional metalwork techniques.

With all applications a mandrel form (the cathode) is first required, over which an electroform can “grow”. Electroforming deposits metal (gold, silver, copper, nickel etc) onto a piece of work (cathode) suspended in a tank with metal salts and solid metal anodes. An electric current carries particles of the metal from the anodes to the cathode, gradually building a skin of metal over the piece of work. If this is made from an inert substance, such as fibre it first needs to be primed with an electro conductive fluid. Deposits can be sufficiently heavy as to make the cloth solid or relatively light, creating a flexible material.

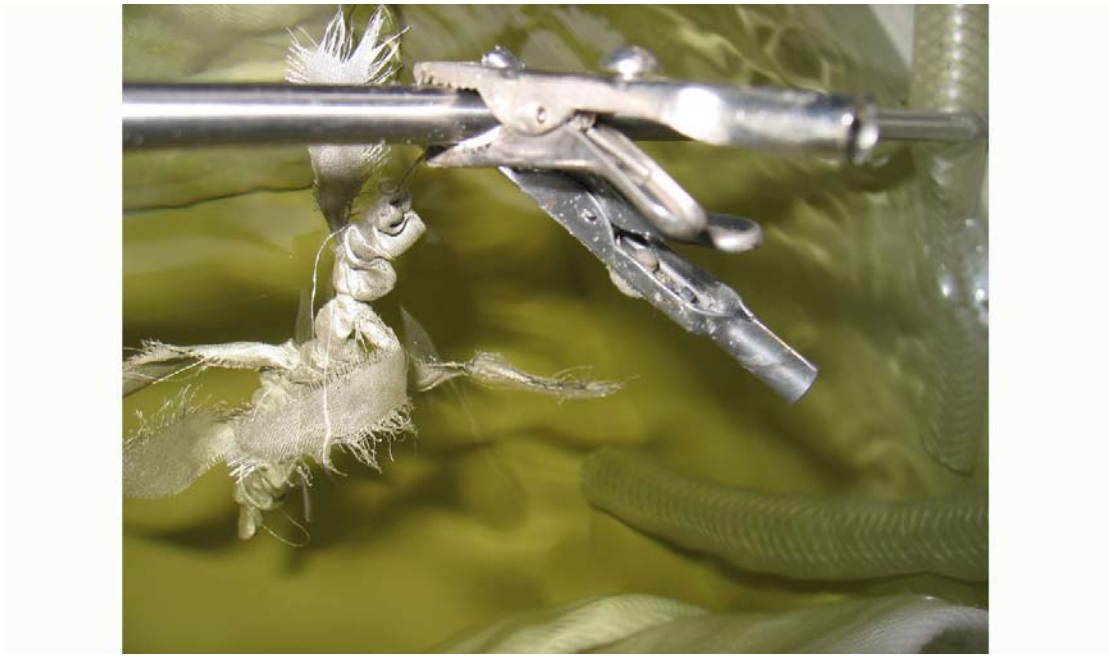

Figure 2. Electroforming in progress. Silk organza compressed during the process aids articulation when the deposition of metal is heavy.

Shibori manipulation of fabric, followed by electroforming achieves selective metallic patterning. If the deposition of silver is particularly heavy the breaks in pattern and metal, created through resist, have the added benefit of allowing the textile to fully articulate, giving full movement to the body. However, practical reasons for electroforming in this manner are far outweighed by the aesthetic qualities achieved. It is within this spectrum that my research lies.

Formed Aesthetics

The visual qualities achieved are similar to those created by a heavy frost, partially revealing the textile below. It's appearance is that of cloth, with all the intricacies of the weave, fibre, stitch apparent but somehow trapped beneath a layer of silver. The eye is cheated by seemingly appearing as light and delicate as a knot of silk chiffon, but with the rigidity and lustre of solid silver. The fine silver (99% pure) used in electroforming can be finished in similar ways to ordinary sterling silver (92.5%) although the increased amount of copper present in 925 silver changes colour with patination and oxidisation more easily. Final polishing of 3D forms are best burnished with a brass brush under water or if flat, an agate stone. After electroforming for even a short period of time (2hrs), every fibre of the yarn is identifiable, challenging the eye to perceive it as a soft wisp, not solid metal. The weight of pieces, betrays their fragile aesthetic, although still remarkably light and fine for pure silver.

Areas previously under resist appear velvety smooth next to the unyielding contour of silver. This contrast is heightened when the white fabric (silk, cashmere, linen etc.) is dyed, adding colour to the winter scene. Dye finds its way into every crack left unformed in silver. This has the effect of "shadowing" the metal, giving it an unexpected glaze of colour. In the preserved areas of textile the dye bites deeply, highlighting the metallic sheen of the formed silver.

Figure 3. Fully and partially electroformed silk organza bundles.

In the previous image (Fig. 3), several test pieces of electroformed silk organza bundles are shown: manipulated, rolled and bound; hydraulically pressed and dyed; a section through the centre of a bundle which was then dyed and finally a heavily deposited pressed sample which was then enamelled. A natural logwood dye was used to dye the silk organza, which surprisingly also adhered to the surface of the silver, despite barrelling the metal to clean it up. The addition of dye to the equation adds another layer of patina and age to this hybrid material. Like the veins of a tributary, they creep across the silver.

These shells of silver have many similarities to those found on the tide line. The passage of time is evident in the structure and texture. Peaks of fabric grow more bulbous than the troughs, the rough surface burnished back to a sheen. Every stitch like a mark left by an invertebrate. Rigid in form and yet fragile in appearance.

Parallels with textiles end with the visual characteristics. This frozen cloth has an increased weight to it, particularly useful when isolated on areas of fabric, to accentuate movement.

Departure from the true nature of materials is not exclusively textile. Electroformed silver does not behave like sheet silver. When shaping and finishing, the silver yields more easily, yet again defying its perceived strength, except this time far more pliable than expected. The touch is cool like metal. However tactile qualities go far beyond the initial sensory perceptions of temperature. Every thread, edge, frayed end, pleat, knot and stitch is recognisable to the caress of a finger. Although reassuringly familiar to textile hands, they confuse the brain with a jaggedness more akin to unfinished metal. The audible difference is startling, no longer a light distinctive tinkle, but more of a tinny ness associated with inferior metals. Where a skin of silver is formed selectively onto cloth the sound is deadened, unable to sing.

Figure 4. Silver Tracery 3, the author. One of three in a series of assembled test pieces. The top sample is pleated and electroformed until solid and burnished, the middle one has been oxidised to highlight the folds in the formed silk. The bottom sample is woven with an extra long cut pile, then dyed.

New Tacit Learning

The adjustments I have made in my practice with the inclusion of industrial tools and unfamiliar materials, has forced a reframing of my design and practical knowledge. Conscious of the new skill base required, I was not able to play spontaneously at first, needing time for the nature of my new medium to become as second nature as textiles. Polanyi termed this as tacit knowledge.[11] Only after that intense period of learning could I reflect on my new knowledge and commence with the experiments required to expose functional and aesthetic possibilities.

During the sampling of various textiles for suitability, I underwent a constant cycle of questioning and learning. Occasionally unwittingly but latterly more aware of the methodology employed to record these findings. Donald Schon calls this process “reflection in action”.[12] He suggests that continual analysis of a problem can lead to new strategies for action, a fact that we commonly take for granted whilst working out a design.

Problem > reflection>action > problem > reflection > action etc.

> "The process spirals through stages of appreciation, action and appreciation. The unique and uncertain situation comes to be understood through the attempt to change it, and changed through the attempt to understand it … practice in the construction, maintenance and use of virtual worlds develops the capacity for reflection-in-action which we call artistry" (Schon, 1995:132)

The sequence I employ extends beyond that of Schon. As well as during the making, my reflective period continues after the completion of a design or artefact. The outcome is as important as the act of practice itself.[13] The continual analysis present in this cycle highlights the necessity of hand interjection, pausing the digital or machine led process mid way in order to distort and question, not accepting the perfect path dictated by programmers and the conventions of a discipline or material.

Future Directions

My approach to using silver with cloth is a transferable skill, something, as a designer of this millennium, that we are expected to have in abundance. I believe that some of the best innovations are discovered at the parameters of a discipline, where, for example metal and textile converge. Materials and technique at seemingly opposite ends of the spectrum can work unexpectedly well together. Reiko Sudo has created many unusual pairings in her designs, such as stainless steel spattered cloth inspired by the automotive industry[14]; Hussein Chalayan illustrates this in his wooden dresses of the 2000 A/W Afterword collection [15] and Hil Driessen with her delicate crochet and porcelain Into Focus collection.[16] Abandon preconceptions about process and venture beyond the conventional.

The use of digital in the traditional domains of textile and fashion streamline process but can also sterilise the result. By nurturing our inherent tacit skills, evidence of the hand, once thought of as "home spun" is now a valued commodity. Laser cutting, rapid prototyping and other emerging production tools are challenging designers to rigorous investigation and play but are only as original as the approach of the designer yielding them. This paradigm shift in attitude is no stranger to the fashion industry but more material bravery will reap inspiring results.

Endnotes

[1] Braddock Clarke, S, 2007, 'Humanising the Digital, Part 1: Aesthetics', *Textile Forum*, no 3, pp.19

[2] Curtis, L 2004, *'Electroforming'*, A & C Black, London

[3] Geesin, F, 1995, *'The chemical and structural manipulation of fabrics and fibres through stiffening techniques with specific emphasis on electro deposition'*, PhD thesis, The Royal College of Art

[4] Curtis, L 2004, *'Electroforming'*, A & C Black, London

[5] Wada, Y., Barton, J. & Rice, M. K. 1983, *Shibori: the inventive art of Japanese shaped resist dyeing: tradition, techniques, innovation,* Kodansha International / USA Ltd. distributed through Harper & Row, USA

[6] Spira, R 2004, *Bowl*, Sainsbury Centre for Visual Arts, UK pp.108

[7] Koren, L 1994, *Wabi-Sabi for Artists, Designers, Poets & Philosophers*, Stone Bridge Press, USA p67

[8] Curtis, L 2004, *Electroforming*, A & C Black, London pp.87

[9] Geesin, F, 1995, *'The chemical and structural manipulation of fabrics and fibres through stiffening techniques with specific emphasis on electro deposition'*, PhD thesis, The Royal College of Art

[10] Curtis, L 2004, *Electroforming*, A & C Black, London

[11] Polanyi, M. 1973, *Personal Knowledge: towards a post-critical philosophy*, Routledge & Kegan Paul, London

[12] Schon, D. A. 1995, *The Reflective Practitioner: how professional think in action,* Ashgate, UK p132

[13] Keith, S 2007*, Reflections of a Practitioner*, in The Art of Research: connections between research and art / design practices : proceedings of the Practice–led doctoral seminar, University of Art and Design Helsinki, Finland 1-3 October 2007, pp 112-116

[14] Millar, L 2005, *21 21 the textile vision of Reiko Sudo and Nuno*, University College for the Creative Arts, Surrey, UK pp.51

[15] Hussein Chalayan, 2008, Autumn/ Winter collection, Afterwords, viewed 11 January, 2008 http://www.husseinchalayan.com/past-collection

[16] Braddock Clark, S O'Mahony, M 2005, '*Techno Testiles 2 Revolutionary fabrics for fashion and design',* Thames and Hudson, London pp.184