

Reinventing Paithani Weaving: Integrating Metallic Wire for Enhanced Strength, Durability, and Contemporary Aesthetic Appeal

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Abstract

Famous for its detailed motifs, vivid hues, and pure silk threads, Paithani weaving from Maharashtra is an age-old craft that exudes a sense of luxury. Yet, even with its deep cultural roots, the classic style struggles to meet the modern aesthetic demands of today's high-fashion and couture runways. This research seeks to refresh this craft by replacing the usual silk weft with a 0.8 mm copper wire inserted into the shuttle. It evaluates the impact of the metal wire on the fabric's strength, drape, and color interplay. The goal is to develop a textile that has luster like silk yet stands up to rigorous wear, giving designers a fresh, sculptural option for top-level garments.

In-depth research on traditional Paithani weaving methods was conducted to preserve the fabric's integrity while also exploring the possibility of using copper wire as weft. Copper wire was a suitable choice due to its durability and ability to develop a beautiful patina over time, increasing the fabric's value. Replacing silk with copper wire in the weft called for modifications to the traditional loom setup. Special attention was given to the tension, flexibility, and interaction between both the silk warp and copper wire to maintain the necessary flexibility for clothing while also ensuring a consistent weave. Comprehensive testing revealed that copper wire, owing to its malleable properties, achieves a balance between the rigidity required for sculptural effects and the flexibility required for high fashion, particularly in clothes tailored for a three-dimensional fit. The incorporation of metallic wire markedly improved the fabric's reflecting properties, imparting a delicate sheen akin to traditional silk luster.

The study suggests a promising result in rejuvenating traditional procedures by merging expert workmanship with modern materials, particularly in haute couture and avant-garde fashion. The final product is a fabric that preserves the legacy of Paithani weaving while providing distinctive functional and aesthetic opportunities in garment design.

Keywords: Paithani, craft, design intervention, metal wire, handloom weaving, structured form

Introduction

The Paithani sari, a quintessential and opulent fabric of India, originates from the town of Paithan in Maharashtra. Paithani weaving, praised for its deep history, detailed motifs, and bright hues, is a labor-intensive method that coalesces Indian handicraft with a distinctive weaving technique. The remarkable characteristic of this painstaking craft is distinguished by its intricate weaving method, the use of lustrous silk threads, and the vibrant traditional motifs that embellish the fabric. The main objective of this research is to examine the effect of substituting the conventional silk weft with copper wire on the structural integrity and aesthetic characteristics of the Paithani fabric. Paithani saris are made from silk; the warp is pure silk, and, though the weft too is usually silk, earlier weavers often added strands of gold or silver to create extra opulence. A signature feature of Paithani saris is the use of metal threads, usually gold or silver, woven boldly along the pallu and border, giving the fabric its rich, shiny look (Raheja and Bhagat, 2022).

A Paithani sari begins its journey on an ancient handloom called a pit loom, a manually operated loom with ancient roots. This loom's vertical warp mechanism and horizontal shuttle make it ideal for weaving the intricate Paithani patterns, which require fine craftsmanship to produce the correct textures and designs. Weaving begins with the setup of the warp strands, which are carefully placed on the loom. With multiple loom sections controlling the various colors and types of threads to achieve the necessary motifs, the threads are typically arranged to match the intended design (Mahajan, 2022). To develop the fabric, the weaver interlaces the weft threads over and under the warp threads using a shuttle. To create the finished fabric, the shuttle gradually interlaces the threads as it oscillates between the loom's two sides. The double-sided technique used in the Paithani weave ensures that the design is visible from both sides of the fabric, adding to its complexity. This is achieved by a unique technique known as "Kadiyal," in which the warp and weft threads interlace in different directions to create a fabric with the same designs on both sides. Patterns and themes such as nature, mythology, and regal symbols serve as inspiration for the traditional Paithani sari designs. Common motifs include geometric shapes, peacocks, paisleys, and floral patterns, all of which represent different aspects of Indian culture. The "Asavali" (mango or flower motif), "Kunda" (peacock), and "Shikaras" (temple) patterns are some of the most recognizable patterns. These patterns are often intricately woven, employing a method known as

“Dola,” which entails alternating threads of various colors to produce elaborate motifs inside the fabric (Datta, 2021). The pallu, which is the decorative end of the Paithani sari, is the most detailed part of the sari.

Although the traditional Paithani weaving process has largely persisted throughout the ages, current weavers are progressively exploring new materials, such as synthetic fibers and metallic wires, to produce more modern iterations of the fabric. The meticulous process, involving elaborate pattern-making, double-sided weaving, and the use of luxurious materials such as silk and zari, yields a fabric that is both visually captivating and structurally complex. The Paithani sari symbolizes India’s cultural heritage and artistry, and its evolution via the integration of innovative materials and techniques offers significant opportunities for the future of this revered craft.

Metallic threads have long enriched the craft of weaving. People have been using metals as strands to construct defensive mesh that can block swords and other weapons for a long time. But the metallic mesh fabric was formed of merely metal strands and was not knitted or woven into the fabric. Elena Phipps’s landmark book “Woven Silver and Gold: Metallic Yarns in Colonial Andean Textiles” provides a comprehensive analysis of the influence of Spanish-introduced metallic threads, primarily silver and gilt-silver, in Andean textile traditions. Phipps (2010) demonstrated through technical study and art-historical context that indigenous master weavers adeptly integrated these metallic threads into warp and weft systems.

In the recent past different contemporary designers have focused on incorporating metal wire in weaving for varied structural and sculpted effects. Indian designer Gaurav Jain Gupta in the year 2024 used metallic yarns like copper, stainless steel, and metallic zari directly in the weaving process for his Akaaro collections instead of just putting them on the surface (Acharya, 2024). He combined these with fibers such as silk, merino wool, and khadi to create garments that were both durable and visually appealing. Metallic threads were interlaced on handlooms employing techniques such as Ikat, satin weave, and twill. This required meticulous regulation of warp tension, maintaining a steady beat, and blending metal fibers with softer yarns to ensure the cloth remained wearable. This union made fabrics that had a subtle, built-in shine, depth of touch, and architectural shape while still keeping the quality of handloom work (Aggarwal, n.d.). Another Indian designer, Rimzim Dadu, in her collection Stucco presented at India Couture Week 2024, experimented with metallic wires in her baroque-inspired collection (Chopra, 2020). The essential elements were the use of metallic hand-cut and engineered cords, with an emphasis on structure and detail. This collection demonstrates that metallic yarns are

capable of producing structural shapes and remarkable couture drapes. She employed 0.45 mm fine wires, which were hand-sewn to create fabrics featuring exquisite textures and architectural silhouettes. She designed garments such as sculpted jackets, draped tops, dresses, and also stunning sarees. This was a labor-intensive process where each cord was sewn with precision in layers and tensioned to create sculptural textiles.

Selection of copper wires for weaving

In the context of utilizing copper wire as a weft thread in the Paithani weaving technique for this study, a critical decision pertained to selecting the ideal thickness. The selected thickness affects the technical viability of weaving, along with the fabric's structural integrity, aesthetic attributes, and functionality (Mofarah, Najar and Etrati, 2018). This section delineates the parameters influencing the use of copper wire for weaving, with particular emphasis on the thickness range and its effects on the weaving process and the resultant fabric characteristics.

Factors influencing the selection of copper wire gauge

Tien Chiu, teacher and artist, has experimented with incorporating unconventional materials into the warp and weft to produce novel textures and effects (reflection, transparency, light-activated luminescence) that could be striking in wearable art clothes. Her report on “Weaving with Non-Traditional Materials” provides profound insights into material experimentation in weaving as shown in Figure 1 (Chiu, 2017). Although it does not explore profound theory, its efficacy resides in practical exploration and realistic analysis of material behavior, which is precisely the type of creative inspiration sought by several textile designers.



Figure 1: Coated copper wire, copper wire, steel-core thermoplastic woven cloth

Source: Chiu, 2017

Based on the review of the report, the following conclusions were drawn:

- The diameter of the copper wire must adhere to the suitability and specifications of the selected weaving. Traditional handlooms, which are employed for Paithani weaving, demand precise control of tension and spacing to incorporate the wire without compromising the fabric's integrity. A wire that is excessively dense may cause the fabric to become stiff, thereby hindering the natural flow of the weaving process. If the wire is excessively slender, it may lack the requisite structural integrity to create a fabric that preserves its shape, particularly in high-fashion and couture applications. The integration of copper wire into the Paithani weave substantially enhances the fabric's structural integrity and durability. Copper, being a metal, possesses greater strength than silk, rendering it an optimal selection for reinforcing the weft thread. A copper wire with a diameter of 0.6 mm to 0.8 mm achieves equilibrium between tensile strength and flexibility.
- Copper, as a metal, exhibits greater strength than silk, making it an ideal choice for reinforcing the weave thread. A copper wire with a diameter ranging from 0.6 mm to 0.8 mm attains a balance between tensile strength and ductility. These wires have adequate thickness to ensure durability while preserving the flexibility of the fabric. They provide a textile with increased rigidity, enabling the fabric to maintain its shape—a crucial attribute for couture garments that incorporate sculptural elements or form-fitting designs. The durability of copper enhances the fabric's resistance to degradation relative to traditional silk-based Paithani textiles, thereby improving its suitability for contemporary fashion applications where garments must withstand frequent use and handling.
- The aesthetic qualities and visual impact of the fabric are notably enhanced by copper wire, primarily due to its reflective surface and the patina it acquires over time. The selection of wire gauge influences the luminosity and visual quality of the fabric. Copper wires of 0.8 mm impart a striking metallic luster that enhances the fabric's elegance while emphasizing the traditional motifs of Paithani weaving—namely the *asavali* (flower) and *kunda* (peacock)—making them more prominent and three-dimensional.

Moldability and couture applications

In couture and high-fashion design, a crucial attribute of a fabric is its capacity to be molded and converted into sculptural forms. Copper wire measuring 0.8 mm in diameter facilitates the fabrication of textiles capable of maintaining three-dimensional forms, rendering it suitable for garments featuring sculptural components, such as

structured gowns or avant-garde creations. This moldability is a distinguishing feature that differentiates this modified Paithani fabric from original silk Paithani, which does not possess the same structural capability for intricate, three-dimensional clothing patterns. A thicker copper wire, such as 10 mm, would yield a fabric that is significantly more stiff and able to maintain extreme shapes. Nonetheless, this may compromise the fabric's drapability and fluidity, making it less suitable for particular couture applications that necessitate a combination of rigidity and elasticity (Chase, n.d.). 0.6 mm to 0.8 mm copper wire is deemed the optimal choice for this study, offering an excellent combination of strength, flexibility, and aesthetic appeal. This thickness enhances the fabric's durability, enabling it to withstand wear and maintain its structural integrity, while also providing a lustrous metallic sheen that elevates the fabric's aesthetic appeal. This research adeptly integrates contemporary materials with traditional weaving techniques by rigorously assessing the thickness of copper wire, thus offering novel prospects for the future of Paithani weaving.

Methodology

The methodology comprised three essential components: selection of suitable materials, the weaving process incorporating copper wire, and a comparative investigation of the new fabric against conventional Paithani textiles. The project was undertaken by semester seven students in the course Craft-Based Product Development and was supported by the Development Commissioner (Handlooms) as part of the Craft Cluster Initiative of the National Institute of Fashion Technology. The authors supervised this Paithani weaving project, and the design development of this project was conducted in the Yeola Cluster of Paithani weaving. The authors, as fashion educators and scholars, have engaged with the Indian fashion industry, cultivating an understanding of the craft sector and the transformative potential of design in the same. Engagement with the institute's programs in the crafts sector offered further possibilities to comprehend traditional crafts, including the materials and processes involved, through joint projects with students and artisans. These collaborations and interactions fostered an awareness of how design may tackle the challenges of product diversity and innovation in traditional weaving techniques for advanced surface development.

The research utilizes a practice-based methodology, incorporating co-design and co-creation with craftspeople. NIFT collaborates with several textile craft clusters under the guidelines of the Ministry of Textiles for this craft-based project. Students, guided by educators, collaborate with craftspeople to co-create, generating innovative concepts and creations in modern design language. For this experiment, the students worked together with Paithani weavers in Yeola to produce new patterns and conduct

surface exploration. The cluster visit lasted 5-7 days, during which the concepts were discussed with the craftspeople and modified based on collaborative conversations and their feedback. In the Yeola project, students developed surfaces and materials within the cluster and designed and constructed fabrics on campus. Following experimentation in the lab, the final samples were developed at the cluster. The objective of these initiatives was to create versatile designs for urban customers in India and beyond, with consideration for the slow fashion movement. The following sections delineate the methodologies, materials, and equipment employed in the creation of a modified Paithani fabric integrating 0.5 mm copper metallic wire as the weft and its evaluation.

Expert review

To assess the feasibility of incorporating copper wire in Paithani weaving, in-depth interviews were conducted with Ms. Bhamini Subramaniam, designer and member of Paramparik Karigar, an organization promoting and preserving Indian traditional crafts, and Ms. Savitha Suri, textile revivalist, curator, and author. The points of discussion revolved around the fabric's aesthetic and functional characteristics and the possibilities and challenges of incorporating metal wires into handloom weaving.

Material and equipment for textile weaving

This research employs pure silk threads, 0.5 mm copper wire, and zari threads (gold or silver). Each material was selected for its distinctive properties that enhance the fabric's texture, durability, and aesthetic appeal. The primary innovation in this study is substituting the conventional silk weft with 0.5 mm copper wire. Copper wire was chosen for its malleability, durability, and distinctive reflecting properties, which provide an aesthetically appealing fabric and augment its structural integrity. Copper wire, unlike silk, provides rigidity to the fabric, rendering it appropriate for the development of more structured or sculptural designs in haute couture garments (Desai, 2007). One of the steps involved coiling copper wire and winding it on small bobbins called tillis, used in the ancient Paithani weaving technique (Figure 2-3). These tillis facilitate the uniform distribution of copper wire within the fabric during the weaving process, ensuring consistency. Using these tiny tillis also prevents wire tangling and allows for smooth and easy handling of the wire during the weaving process. Zari threads, made from gold or silver metallic fibers, were added to the pallu and borders of the saree. The zari threads maintained the shiny, luxurious quality of Paithani fabrics, while the copper wire provided an additional layer to the fabric's texture and durability.



Figure 2: Paithani artisan coiling copper wire



Figure 3: Copper wire on small bobbins called tillis

The weaving process commenced with the preparation of the warp threads, which were arranged on the loom in the conventional manner with pure silk. The warp threads were carefully wound onto the loom, keeping even tension to ensure a smooth fabric while adding the weft. The 0.5 mm copper wire that was wound onto small bobbins was then placed on the shuttle of the loom for the weft to initiate the weaving. The tension of the warp threads was meticulously regulated to prevent the fabric from becoming excessively tight or loose. The copper wire was interlaced with the silk warp under regulated tension to preserve a balance between rigidity and pliability. The weaver deliberately reduced the weaving pace in contrast to conventional Paithani techniques. This facilitated improved manipulation of the metallic wire. Copper wire behaves differently than silk and requires more time to manipulate well to guarantee correct interlacing with the warp threads.

Working with copper wire in the weft required careful handling because the wire had to blend seamlessly with the silk warp while keeping the design intact. The weaving included mixing copper wire with traditional zari threads to create intricate patterns. This was done while maintaining the classic Paithani motifs, like the Asavali (mango) and Kunda (peacock), while adding new structural and visual details through the metallic wire. Special care was taken with the pallu and borders, which are the most complex parts of the Paithani saree. The pallu was crafted from a combination of copper wire and zari threads, necessitating meticulous attention to attain a uniform metallic luster from both components.

Fabric testing

The comparison between the pure silk Paithani and the experimental Paithani sample with metallic weft yarns was conducted to better understand the alterations in structure, functionality, and aesthetics resulting from the integration of metallic wire into the conventional weave.

Expert evaluation

Prototype samples of copper-infused Paithani fabric were produced on handlooms in Yeola, Maharashtra, and subsequently presented to experts for qualitative assessment. Feedback was obtained concerning the economic viability and market expansion of handloom fabrics through the integration of materials such as copper wire. The expert panel consisted of Mr. Rajesh Kumar, an exporter, handloom, and handicraft brand; Ms. Rugmani Venkatadri, an academician; Mr. Sagar Kherud, Sagar Silks; Yeola Paithani, a Paithani weaver from Yeola; Ms. Ila Ranjan, Head Designer, Suta Pvt. Ltd.; and Ms. Suchitra Dhiloria, a fashion designer.

Comparison between Modified Fabric and Traditional Paithani

Table 1 denotes the comparative chart that provides a comprehensive analysis of the performance characteristics between the traditional pure silk Paithani and the modified Paithani that includes metallic wire in the weft. Each parameter, namely drape, fabric count, weight, stiffness, resilience, and tensile strength, was assessed manually utilizing fundamental textile testing methods to preserve the authenticity and artisanal character of the research. The findings unequivocally indicate that although the incorporation of metallic yarn marginally augmented stiffness and weight, it significantly improved tensile strength, durability, and structural stability. This comparative assessment is essential to the research, as it empirically substantiates the intervention, connecting traditional handloom artistry with contemporary technological advancements, thus bolstering the study’s aim of structural improvement without sacrificing aesthetic integrity.

Table 1: Comparative chart of pure silk Paithani fabric and metal wire infused fabric

| Parameter | Manual technique used | Pure silk Paithani (control sample) | Modified weft metallic Paithani (experimental sample) | Observation/ Inference |
|---|---|--|--|---|
| Drape Coefficient (Cylinder Drop Test) | A circular cylinder was placed vertically. Fabric sample (1 m × 1 m) was centered on top. Light projected vertically downward; diameter of shadow measured to calculate drape coefficient manually. | Shadow covered ~68% of circle area – soft, fluid fall; multiple fine folds observed. | Shadow covered ~82% of circle area – broader, stiffer folds; more structured fall. | Metallic yarn addition increased stiffness and dimensional shape; ideal for sculptural forms. |

| Parameter | Manual technique used | Pure silk Paithani (control sample) | Modified weft metallic Paithani (experimental sample) | Observation/ Inference |
|--|---|--|---|--|
| Fabric Count (Manual Pick Glass Test) | A pick glass (thread counter) used to count number of warp and weft yarns per inch manually at three different areas and averaged. | 96 × 72 (fine silk warp and weft) | 96 × 64 (same warp, fewer wefts due to thicker metallic wire) | Metallic wire reduced weft density, slightly loosening the fabric structure. |
| Fabric Weight (Manual GSM Test) | Fabric sample (10 cm × 10 cm) cut and weighed on digital balance. Weight converted to g/m ² . | 95 g/m ² | 124 g/m ² | Metallic yarn increased GSM, adding body and enhancing dimensional stability. |
| Stiffness (Handle and Cantilever Bend Test) | Fabric edge extended from a table; the overhang length measured at point of bending. Also assessed by manual touch and fold resistance. | Low stiffness; bends and folds easily. | Medium stiffness; higher resistance to bending. | Metallic inclusion enhanced rigidity, supporting form retention. |
| Resilience (Manual Crease Recovery Test) | Fabric folded and pressed between two glass plates for 5 minutes under 500 g weight. Time taken for crease recovery visually noted. | High resilience; recovered ~85% of crease quickly. | Moderate resilience; recovered ~70%. | Metallic weft restricted elasticity, but improved shape holding post-manipulation. |
| Tensile Strength (Manual Tug Test) | Equal-sized strips gripped manually and pulled along warp and weft directions until first sign of yarn breakage observed. | Warp: strong; Weft: moderate. | Warp: same; Weft: significantly stronger due to metallic reinforcement. | Overall tensile strength improved, increasing durability and wear resistance. |

Conclusions derived from the comparative analysis

The comparative analysis of pure silk Paithani and metallic-weft modified Paithani indicates substantial alterations in the fabric's physical, mechanical, and aesthetic properties.

- Drapery conduct: The pure silk control sample exhibits a reduced drape coefficient, signifying enhanced fluidity, softness, and the capacity to create delicate, elegant folds.
- Fabric density and composition: The warp count remains constant as both fabrics utilize the identical silk warp. The decrease in weft density in the changed fabric indicates that metallic wefts occupy more space, resulting in fewer picks per inch.
- Fabric weight: The metallic-reinforced Paithani exhibits a notable increase in fabric weight. The elevated GSM enhances body and dimensional stability and imparts a thicker drape. The additional weight enhances designs necessitating volume or structure, whilst the pure silk sample has a lightweight quality, making it suitable for flowing, conventional draping approaches.
- Stiffness: The rigidity and grasp stiffness significantly escalate with the incorporation of metallic elements. The altered fabric exhibits greater resistance to bending than pure silk, signifying increased rigidity.
- Resilience and crease recovery: The metallic-weft fabric demonstrates diminished robustness owing to decreased flexibility. Nonetheless, this diminished recovery proves beneficial when a design necessitates the fabric to preserve pleats, folds, or molded shapes.
- Tensile strength: The warp strength is consistent across both fabrics because of the unchanged warp mechanism. The experimental sample exhibits enhanced weft-wise tensile strength attributed to metallic reinforcement, hence augmenting durability, longevity, and resistance to abrasion or stress during usage.

Findings

The prototype samples of copper-infused Paithani fabric were developed on tabletop handlooms with a weaving width of 24 inches (Figure 4). The warp comprised silk yarn sourced from Yeola, traditionally used in Paithani sarees, while the weft consisted of 0.5 mm copper wire. The final prototypes that were developed at the Yeola cluster measured one meter in length (Figure 5) and were distributed to a selected expert panel for evaluation. The objective was to assess the viability and market readiness of this innovation.



Figure 4: Sample prototype on tabletop loom



Figure 5: Metal infused Paithani samples

Professionals expressed significant interest in the durability and opulent appearance of the copper-infused fabric. Designers conveyed enthusiasm over the fabric's capacity to maintain its form and facilitate sculptural creations. This established it as a prospective transformative force in the couture and high-fashion sectors. The metallic luster and texture were commended for enhancing the aesthetic appeal of classic Paithani designs, rendering them appropriate for diverse contemporary fashion uses. Although the fabric gathered favorable reviews for its aesthetic attributes, it was crucial to evaluate how its weight could affect its practicality for routine or informal applications. Nevertheless, for couture garments and special events, the additional weight was frequently regarded as advantageous, enhancing the fabric's opulent texture and resilience.

The following summarizes the main observations from the testing of the pilot samples and feedback from experts.

- **Structural integrity:** The incorporation of 0.5 mm copper metallic wire in the weave significantly enhanced the fabric's structural stability. The incorporation of copper wire enhanced the fabric's durability and abrasion resistance, surpassing the capabilities of traditional Paithani sarees, primarily crafted from silk. The copper wire increased the rigidity of the fabric.
- **Shape retention:** A prominent feature of the copper-infused Paithani is its capacity to maintain form. This enhanced moldability was particularly beneficial for creating things that require precise outlines or distinct curves, such as couture gowns,

jackets, or avant-garde designs. The fabric's weight was considerably increased due to the use of copper wire; however, this did not adversely affect its drape or comfort. The additional weight imparted sophistication and richness to the fabric while maintaining its wearability.

- Visual result: The copper wire raised the surface slightly, emphasizing the delicate motifs typical of Paithani designs and adding visual interest. The reflective properties of the copper wire gave the fabric a shiny finish. This sheen enhanced the usual luster of silk, resulting in a fabric that sparkled and changed under different lighting. The use of traditional zari threads (gold or silver) with copper wire enhanced the opulence, imparting a rich, multi-dimensional luster to the fabric. The contemporary metallic finish, combined with the elaborate Paithani patterns, rendered the fabric appropriate for haute couture garments, where texture and visual appeal are paramount. The fabric exhibited a luxurious, modern aesthetic while maintaining the traditional intricacy of Paithani weaving, culminating in an ideal fusion of classic craftsmanship and contemporary innovation.

Analysis

Textural innovation in high fashion

The integration of 3D texture and reflective shine into the fabric offers innovative opportunities for tactile and visual design. The copper wire creates a three-dimensional impression, enhancing the fabric's sculptural quality and facilitating dynamic light interaction. This is particularly significant in evening attire or haute couture, where aesthetic appeal and opulence are essential. Paithani fabrics with metallic wire can be utilized to produce statement items, such as ball dresses, fitted suits, or avant-garde collections, where texture, luster, and structure are essential elements of the design. The integration of traditional Indian weaving methods with modern metallic embellishments promotes cross-cultural creative collaboration. Designers in major fashion capitals such as New York, Paris, and Milan may be drawn to these textiles because of their rich legacy, luxurious aesthetics, and versatility. The metallic sheen may make these materials adaptable across diverse fashion categories, including ethnic attire, modern streetwear, and haute couture collections.

Impediments and limitations

The integration of copper wire into Paithani fabric has significant promise; nonetheless, specific challenges and constraints must be resolved, especially with practical production.

The incorporation of copper wire into the weave poses a considerable issue due to the augmented weight of the fabric. Copper wire possesses significantly greater density than silk, thus augmenting structural stability, although potentially undermining the comfort of the fabric, particularly for garments designed for extended use. The fabric is suitable for couture items and formal wear; yet, its weight may make it less appropriate for casual or everyday clothing.

Complexity of production

Weaving using metallic wire requires greater precision and meticulousness. The copper wire must be handled carefully to ensure smooth interlacing with the silk warp, preventing breakage or distortion. Furthermore, the weaving speed is reduced compared to traditional Paithani weaving due to the rigid properties of the metallic wire. This may result in prolonged manufacturing times and potentially higher labor costs, hence increasing the overall expenses of fabric production. These limitations may hinder the scalability of this technology, especially for mass-market production.

Cost considerations

The utilization of metallic copper wire and requisite intricate weaving techniques increases the fabric's production cost. Copper wire is costlier than conventional silk or zari, and the protracted weaving process contributes to the overall cost. This may render the fabric less attainable for prominent fashion designers or mass-market consumers. In the luxury fashion and couture industries, where exclusivity and craftsmanship are esteemed, the elevated price may be warranted by the distinctiveness and superior allure of the fabric.

Technical proficiency

Creating copper-infused Paithani requires weavers to have both traditional weaving skills and the ability to handle unusual materials. Training to use metallic wires and incorporate them into the loom is essential. Insufficient skill development can lead to fabric damage, uneven patterns, or wire breakage. This matter underscores the necessity for specific training programs to maintain the craft and guarantee sustainable innovation throughout time. It safeguards and advances traditional crafts while fostering innovation within established techniques. Manipulating metallic wire necessitates meticulous handling and proficiency, hence augmenting the intricacy of the weaving procedure and elevating both production duration and expenses. Nonetheless, these obstacles are eclipsed by the fabric's distinctive attributes and its capacity to captivate designers and consumers who prioritize sustainability, artisanal craftsmanship, and

luxury. The successful incorporation of copper wire into Paithani weaving demonstrates the capacity of traditional textiles to flourish and adapt within the contemporary fashion industry. This research establishes the foundation for a new epoch in textile production that integrates traditional craftsmanship with modern innovation, whilst respecting cultural legacy and current design. Designers must assess the comfort of materials, especially in warmer climates or for garments requiring significant mobility. This identifies an area for further research.

Conclusion

This study's findings indicate that the integration of 0.5 mm copper wire into Paithani weaving improves the fabric's durability and aesthetic quality. The copper-infused fabric exhibited enhanced durability and improved shape retention, making it appropriate for structured couture garments. The fabrics' three-dimensional texture and metallic sheen offered a modern, luxurious embellishment to traditional Paithani designs, expanding their relevance in high-fashion settings. Industry professionals and experts have largely provided positive feedback, appreciating the amalgamation of traditional craftsmanship with contemporary innovation. This research demonstrates that incorporating new materials, such as copper wire, into traditional textiles can rejuvenate the handloom industry and maintain its competitiveness in the contemporary market. The incorporation of copper wire in Paithani weaving signifies a departure from conventional techniques while yet respecting the fundamental tenets of handloom weaving. This provides weavers the opportunity to investigate and invent within specified parameters. They can advance their craft while staying true to its roots. The economic viability and market growth of handloom fabrics can improve by incorporating materials like copper wire. Handloom artists may find that creating textiles with added durability and modern appeal could attract a new group of buyers who value sustainability, craftsmanship, and exclusivity.

Incorporating copper wire into the weaving process requires skill in both traditional techniques and handling metallic materials. This could lead to the development of new skills within the handloom industry. Weavers, artisans, and textile designers can be educated in the utilization of novel materials, safeguarding traditional craftsmanship while expanding their product range. The expanding market for these textiles may stimulate the establishment of training programs, workshops, and collaborations, thus enhancing sustainability and diversity within the handloom industry. The incorporation of metallic wire in Paithani fabric presents numerous unique design possibilities in modern fashion and haute couture. Designers can investigate fabric manipulation techniques like pleating, folding, and draping, which can now be executed more effectively on materials that exhibit both visual allure and structural integrity.

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Neena Lokare is a skilled fashion academician, designer, and textile enthusiast, with more than 20 years of teaching experience. She is currently Assistant Professor at NIFT, Mumbai. With a postgraduate degree in fashion management and a fashion design degree from NIFT Mumbai, she is presently pursuing a PhD in Indian textiles with an emphasis on the connections between tradition, sustainability, and modern expression. Apart from her scholarly contributions, Neena is well-known for her book 'Styling my Handloom,' in collaboration with DC Handlooms, launched on Handloom Day 2025 by Hon'ble Minister of Textiles, Shri Giriraj Singh. Neena is passionate about teaching the upcoming generation of designers to appreciate India's living textile traditions in ways that are relevant to the rest of the world. One drape at a time, she hopes to weave stories, identities, and opportunities into India's handloom legacy, making it not only relevant but also inspiring for the next generation.

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