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Antimicrobial Fabrics for Hospital Applications: Antimicrobial Hospital Linen and Medical Devices for Infection Prevention

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Abstract

Textile fabric structures, woven and knitted ones, are commonly employed to protect human skin and support muscle reinforcement. Fabric contamination is a serious threat to patients and staff and a major source of hospital-associated secondary infections. The fabric surface morphology and weave structure encourage bacteria to adhere and form biofilms. Therefore, they behave as debauched drug carriers. The hospital linen and in-vivo medical devices made of textile fabrics are prone to infection. Our research work is focused on preventing hospital linen infections. An environmentally friendly natural dye with antimicrobial properties was prepared for the hospital linen. The antimicrobial test proved that hospital linen dyed fabrics demonstrated excellent antimicrobial properties against *Staphylococcus aureus (S. aureus)* bacteria. In a bacteria release test method, the natural dye-treated fabrics displayed a 100% reduction of bacteria. Chitosan also plays an important role as an antibacterial agent and a drug carrier. Soluble drug as levofloxacin, was trapped in chitosan gel to develop antimicrobial webs for wound healing. The results confirmed that composite webs of cellulose and silk with chitosan can hold soluble drugs and release them to cure infected wounds. Synthetic drug carrier (β-CD) containing a drug cavity can hold insoluble and soluble drugs within its cavity. In-vivo coated medical devices provide antimicrobial release within the incision, which is more effective than oral suspension and post-operative prophylaxis.

Key words: Antimicrobial; Fabric; Medical devices; Hospital; Infection.

Purified Atmosphere by an Air Filtration System Against Pollution Contaminants

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Abstract

Nowadays, the growth of industries is significantly involved in global issues of environmental pollution, causing negative impacts on the atmosphere and human health. The air filtration is the most suitable technique for purifying the atmosphere against environmental pollutants and is beneficial for human health. This process is extensively involved in removing contaminants from the atmosphere and providing a healthy life. The utilization of sustainable materials can enhance the durability and effectiveness of air filtration. Various external factors influence the filtration ability and the effectiveness of filter materials to eliminate specific pollutants and effectively capture various kinds of contaminants, such as airborne particles, volatile organic compounds (VOCs), and aerosol particulate matter. Clean air has a positive impact on society, reducing breathing issues, improving productivity, and promoting overall health. Characterization is the most important factor of filtering materials, such as mechanical, chemical, and morphological properties, and their end uses. The aim of the study is to minimize the hazardous pollutants in both indoor and outdoor atmospheres. In addition, this technique is applicable in various contexts, such as residential areas and companies, manufacturing plants, and hospitals. The important development is controlling atmospheric pollution, managing public health, and ensuring a sustainable future for the next generations.

Keywords: Atmosphere; Air pollution; Filtration.

Fabrication of Bio-inspired Textile with Durable Directional Moisture Transport

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Abstract

Functional textiles can offer an energy-free alternative to regulate the comfort of the human body. However, their manufacturing often involved complex preparatory processes and lacked durability. Herein, we report the design of a sweat-gland-inspired textile using conventional screen printing. Designed textile exhibits excellent directional moisture transport, indicating the potential of providing energy-free comfort to the wearer. Designed fabric offers one-way transport index of >700%, water vapor transmission rate of > 290 g m^{-2} h^{-1}, and air permeability of > 100 mm s^{-1}. Additionally, the designed textile displayed a stable one-way transport index of 650% after 25 h of washing. This work offers a way to prepare functional fabrics with considerably high stability for personal moisture regulation using existing techniques.

Keywords: Functional textile; Bio-inspired fabric; Moisture transport.

Sustainability Challenges: A Strategic Model of Fashion Education System through Cross-cultural Ideology

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Abstract

The challenge of global aspects is overcoming the mainstream fashion system, which is the major unsustainable factor in the fashion supply chain from design thinking to product end-use. Educators can play an activist role, and the fashion education system can take on a challenging role as a medium for constructive change. Keeping this in mind, we have initiated an ongoing research project under the 'Fashion Sustainability Research Center' to investigate how the education system can develop a target for sustainable fashion development. Therefore, this research proposes a 5-I model (incorporating awareness, influence, idea generation, initiatives, and implementation) for the sustainable fashion education system to analyze the related influencing factors and provide potential solutions to overcome the challenges. To derive the model, this study will apply a mixed-methods approach. First, a quantitative questionnaire survey will be conducted among fashion design students and general consumers from China and other countries to gain cross-cultural perspectives. The survey contents will be driven by the 5-I aspects and related contexts to collect the psychological thinking of participants for the development of a sustainable education system. Secondly, this will be supported by using in-depth interviews among educators and designers to evaluate the cross-cultural ideology of students and general consumers toward education system development. Those proposed methods will develop a strategic model for sustainable fashion education from a global perspective based on the 5-I aspects by addressing the challenges for fashion sustainability that can be overcome through the education system. Additionally, this will convey a creative and practice-based education system that will support large-scale changes in fashion systems toward sustainability. This research will help to broaden research on the education system in a

contemporary, sustainable approach with challenges. This research will provide insights and recommendations for sustainable fashion education to achieve a significant change in the fashion supply chain, as well as opportunities for future research into the development of fashion sustainability.

Keywords: Fashion sustainability; Strategic model; Cross-cultural Ideology.

Electrospun Nanofibers for Energy Conversion & Storage: A Step Towards Sustainable Textiles for a Sustainable Future

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Abstract

Energy conversion and storage are a global challenge due to ever-increasing energy consumption. In energy storage, lithium-ion battery technology is considered one of the most promising technologies so far, but it also has some limitations, such as dendroid formation, cost, and cyclability. Post-lithium technologies are still in a developing phase and will take some time to be scaled up. While in energy conversion, there is no developed technology available and efficient enough through which the maximum of the available natural energy can be converted to usable energy. To investigate the feasibility of heterogeneous systems for energy conversion (through hydrogen evolution reactions, oxygen evolution reaction, CO_2 reduction), we are working on electrospun nanofibers for energy conversion and storage. Electrospinning is an advanced technology serving in multiple fields of science due to its versatility, simplicity, operation and scalability. As energy consumption is increasing day by day, electrospun nanofibers have been extensively researched for optimum utilization in the field of energy conversion and storage. This talk will cover our approach of using electrospinning technology for photocatalytic hydrogen evolution, electro-catalysis, and post lithium batteries, mainly sodium ion batteries and potassium ion batteries.

Keywords: Electrospun nanofibers; Sustainable Textiles; Energy storage.

Silver-Coated Elastomeric Electrodes for EMI Shielding Applications

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Abstract

During recent years, the research has centered on developing conductive polymer elastomers (CPEs) and intrinsically conductive polymer elastomers (ICPEs) reinforced with conductive fillers. To enhance the electrical conductivity of polymers, fillers like carbon black, carbon fiber, and graphite were utilized. This study focused on developing electrically conductive polymeric composites by using recycled materials of carbon particles and silicon elastomers, which inhibits high electrical conductivity, electromagnetic shielding properties, and strong mechanical performance. The primary goal of this study was the fabrication of multifunctional and electrically conductive electrodes personalized for multifunctional applications. Electrodes were developed through two stages. First of all, the dispersion of particles into a flexible elastomer, followed by silver electroplating, was done. The morphological variations were analysed by using techniques like dynamic light scattering, XRD, and SEM. Different concentrations of carbon particles were incorporated to optimize the conductive properties in the developed composites, which were then characterized by using SEM, electrical conductivity, EMI shielding, and mechanical performance, which reveals better electrically conductive results for the sample containing 12% carbon particles. The durability and electrical properties of the developed electrodes were observed through washing. The SEM microstructure technique proves that the electrodes display better particle retention and minimal loss in conductivity after washing.

Keywords: Conductive polymers; Elastomers, EMI shielding.

Ultrathin Nanosheet $MoCo_2O_4$ Integrated with Carbon Nanofibers Binder-Free Approach for Flexible Energy Storage for Supercapacitors

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Abstract

Binding-free current collector carbon nanofiber (CNF) based electrode material has a promising electrochemical performance for supercapacitors, with high specific energy density, rapid charging and discharging, with good cycling rate. The poly (acrylonitrile-*co*-*β*-methylhydrogen itaconate) polymer is used to prepare carbon nanofibers (CNF) by electrospinning, with good mechanical properties and flexibility. Thus, the nanosheet of molybdenum cobalt oxide $MoCo_2O_4$ grew along the surface of CNF uniformly by the hydrothermal method to prepare a freestanding 3D CNF/$MoCo_2O_4$ network. The asymmetric result of composite electrode material CNF/$MOCO_2O_4$ with specific capacitance is 225.3 Fg^{-1} at a current density of 1 Ag^{-1}. The long cycling performance is 78.96 % retention after 1000 cycles, which is are very good stability result; therefore, it can be used for high-performance supercapacitor applications in the future.

Keywords: Hollow carbon nanofibers; Supercapacitors; Nickel cobalt oxide; Free-standing; Flexible.

Sustainability in Fashion

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Abstract

What sustainability is possibly known and agreed, however, to bring sustainability and who is responsible for sustainability can be debatable. The same is the case for fashion. Thinking about more than 8 billion people in the world desiring to go along with fashion, with an undetermined responsibility to contribute in nurturing the environment-friendly fashion is resulting in a small fraction (1 %) of recycled fiber. Customer, fashion brand, and fabric manufacturers, fashion processors, marketers and merchandisers, civil society, public offices, municipal bodies, and industrial sectors are the entities to vitalize sustainable fashion growth. With the significant number of research and development interests and work currently in the sustainability of textiles, there is a strong need to increase environment friendly fashion in the market. However, the real market figures show the fashion driving forces come from business model, marketing, merchandising trends, and uncontrolled demanding customers. This study, therefore, presents the current situation of sustainability in fashion and determines how this can be enhanced through practicable measures.

Keywords: Sustainability; Fashion; Textile; Environment; Fiber; People; Market.

Carbon Aerogels for Thermal Insulation

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Abstract

Aerogel is super light and porous synthetic material manufactured by replacing liquid in the gel with gas to obtain a low-density and thermally conductive solid. Sol-gel method and freeze-drying method are commonly used to manufacture aerogels. Aerogels melt at 1200 ºC and exhibit almost no thermal conductivity because they consist of about 99.8% air, which eventually neutralizes the convection, conduction and radiation, making it a better insulating material. It resists the connective transfer of heat as there is no air flow in its morphology; on the other hand, gas molecules efficiently resist the thermal conduction. The use of carbon-based gel causes a certain level of impedance to the transfer of radiation, and this kind of gel at the nanostructured level is used as an insulation material. It is manufactured by supercritical drying and high temperature carbonization, consisting of nanopores and nanostructured carbons. Carbon aerogels' nanosized pores and particle size show low thermal conductivity, knowing that it is extremely affected by several components and conditions. This study will pay attention to the heat transfer mechanism of carbon-based aerogels. In addition, the applications of pristine carbon aerogels are quite restricted due to their poor mechanical properties, which signifies the need for reinforcement for the enhancement of characteristics. This study is divided into subsections, which include carbon aerogel, monolithic porous carbon structure (pyrolysis), porous carbon (structures synthesized via Sol-gel process), and activated carbon (structure at high temperature). Furthermore, their performance across the different ranges of thermal conductivity was also observed. An analysis of different kinds of aerogel-

based carbonaceous structures were done to monitor the heat and thermal insulation. The effect of different kinds of pore size and pore size distribution were also observed against thermal properties. The last section includes the explanation of testing criteria of aforementioned carbonaceous aerogel structures. The developed thermal insulated aerogels can be utilized as ultra-high temperature thermal insulators in different types of thermal protecting systems including industrial high thermoses and space vehicles. With the increase in advancements of carbon base aerogels, this study focuses on the formation of carbon aerogels that give super insulation systems and known as good sustainable materials. But practical application for the fabrication of carbon base aerogel products requires specific R&D activity.

Keywords: Aerogels; Carbon materials; Thermal insulation.

Highly Flexible Electrically Conductive Porous Electrodes Embedded with Expanded Graphite

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Abstract

Recently, many scientific research has been mainly centered on developing conductive polymer composites (CPCs) and intrinsically conductive polymers (ICPs). Natural materials such as carbon fiber, carbon black, and graphite were used as fillers to enhance the electrical conductivity of polymers. On the other hand, rigid and non-flexible composites face many challenges like limited deformation, brittleness, reduced comfort, limited mobility, and difficulty in processing. In this study, polymer aerogels are embedded with expanded graphite by using techniques such as freeze-drying and thermal annealing, achieving excellent electromagnetic interference shielding. Characterization of porous electrodes embedded with expanded graphite was done by Scanning Electron Microscope (SEM), which is used to analyze the surface, while Energy-Dispersive X-ray (EDX) and X-ray Diffraction (XRD) determined the elemental composition. Then characterization for the electrical conductivity, EMI shielding, and mechanical performance was done which shows that the conductive expanded graphite, including 12% particles, exhibits improved results.

Keywords: Conductive polymers; EMI shielding; Mechanical performance.

Sustainable Green Composites Reinforced with Recycled Cotton Fibers Treated with Green Synthesized ZnO-NPs

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Abstract

Over the past few years, sustainable materials have gained a lot of attention, especially in the manufacturing of composites having natural antibacterial agents embedded in them. Due to the risk of causing environmental pollution, agricultural fiber wastes were preferred instead of synthetic fiber. Common agricultural waste used for the development of composites includes Jute fiber waste, cotton stalks and lint waste, and flax fiber residues. But these materials are prone to environmental impacts. Overcoming the natural environmental factors, such as attack of pathogens, flammability, and moisture absorption, is another big challenge that needs to be addressed for attaining sustainability. The current study focuses on the development of sustainable green composites reinforced with agricultural cotton waste fiber to resist the aging factors affecting the natural fiber. The developed composites were resistant to the aging environmental factors. In the first step, the pre-treatment of jute fiber was done. Then, three different techniques were used for the enhancement of the developed composites. On the other hand, several concentrations of green-synthesized ZnO nanoparticles were utilized to enhance the antibacterial effect of the green matrix composite. The changes in the structure of jute fiber were analyzed by using a scanning electron microscope. In the concentration of 30 g/L ZnO-NPs nanoparticles, the variation in the antibacterial zone of treated and untreated reinforcement samples was observed. The mechanical performance of green composites was

also analyzed. The developed green sustainable composite embedded with ZnO nanoparticles regained low moisture while showing enhanced tensile and flexural strength. Hence, the developed composites can be replaced with wood in several morphological applications such as doors, panels, and many furniture items.

Keywords: Sustainability; Green composites; Nanoparticles.

An Analysis of the Symbols and Motifs Depicted on the Saddle Blankets of Cholistani Camels

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Abstract

This study explores the symbols and motifs depicted on the saddle blankets-called jhools in the local language, used to adorn the camels in Cholistan. The study finds that the blankets are woven in geometrical lines and shapes resembling the prehistoric cave paintings alongside discovered in India. The jhools reveal a remarkable knowledge of cosmic structures and nature. The desert of Cholistan was once a busy part of the Indus Valley Civilization with trade routes the river Hakra which once flowed there. The lineation found on the symbols and motifs of the jhools can be observed in the Indus Valley Civilization pottery paintings excavated from various sites. The jhools of the camels found in Marut, Cholistan desert exhibit horizontal, vertical, and diagonal line patterns without the floral and animal motifs. This indicates that the desert's designers of camel blankets near the Pakistan-Indian border are still following their prehistoric ancestral links. The engraved parallel and vertical lines in the prehistoric cave paintings of Khoupum, District Tamenglong, Manipur, India also depict great similarity with the interwoven patterns of a camel's saddle cloth observed in the deep desert areas of Marut, Cholsitan.

Keywords: Traditional motifs; Camel blanket; Cholistan culture.

Reviving Regional Crafts of Pakistan as Ethical Fashion Practice

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Abstract

The concept of "Ethical fashion" intersects with sustainable practices in the textile industry. This abstract explores the use of regional crafts in textile design as a source of promoting both environmental and cultural well-being. By incorporating traditional crafting techniques, such as hand-weaving, embroidery, and natural dyeing, designers can create garments that reduce the reliance on mass production and synthetic materials, thereby contributing to a more eco-conscious industry. Regional crafts also preserve cultural heritage, offering a platform for artisans to showcase their skills and maintain their craft traditions. This fusion of sustainability and cultural preservation not only supports the local economy but also encourages consumers to embrace fashion that respects both the planet and its diverse cultures. Through this approach, fashion becomes a holistic solution that addresses the need for environmentally friendly practices, ethical labor standards, and the preservation of regional craftsmanship.

Keywords: Ethical fashion; Regional crafts.

A Study of Chūgha/Robes in the Collection of the Lahore Museum

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Abstract

A comprehensive analysis of couture focusing on male Chūgha/robes present in the collection of the Lahore Museum. It also yields an understanding of the exclusive skills that craftsmen nurture over generations. In regions with a rich historical past and cultural continuity, the crafts assume a character in which one finds layers of cultural identity, aesthetic taste, and expertise. This paper explores the male robes of textile apparel present in the collection of Lahore Museum in a cultural, symbolic, and construction in historical context. The study focuses on recalling stylistic features, identifying its cultural importance, and promoting to recall inheritance of Chūgha/robes in Lahore Museum, Lahore. To connect the past with the present, the study compares the apparel market in Pakistan amounts to US$1.83bn according to digital data present in Statista 2025. The traditional men's attire is gaining popularity and is on the rise among men's fashion in Pakistan, reflecting a cultural shift towards embracing local fashion. This research will be focusing on formal and contextual aspects, therefore providing the researchers with an opportunity to ascertain the cultural impact and ideological basis that define their roots in the economy of Pakistan. The samples are handpicked and explained with descriptive analysis.

Key words: Chūgha/robes; Attire; Culture; Lahore Museum; Robes stylistic connections.

Upcycling and Slow Fashion: A Sustainable Solution for Climate Change

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Abstract

Fashion is today a global industry and has a huge effect on our environment, becoming a cause of climate change. Climate change is a serious global problem. As textile is a strong industry in Pakistan, it is important to understand that industrial emissions and pollution at large are key contributing factors. To battle this issue implementation of sustainable fashion production systems is implemented. For this purpose, not only sustainable production systems need to be adopted, but also spread general awareness among people. Our objective was to study the awareness among people about sustainability in the fashion industry, i.e., slow and upcycled fashion that could be a solution for conserving the environment and climate change. Understanding the shopping values of consumers can also be helpful in this regard. In this research, we used a quantitative survey method to collect data. A standardized questionnaire consisting of 23 items was used to measure the constructs, i.e., shopping behavior, environmental values, and knowledge of slow and upcycled fashion. A convenience sampling technique was used to select 120 male and female respondents for data collection. We found out that people were generally less aware of the concepts of sustainable, slow, and upcycled fashion. As there is a dire need for adopting sustainable solutions in the fashion industry, timely awareness is necessary in this regard. Slow fashion production and upcycling could be the answer for a sustainable fashion industry. Key issues for sustainable fashion involve production, consumption, design, waste, use, and reuse. It is about slowing down the processes from making to using and reusing, making a garment last longer, both in style and in material, as well as consuming differently. Although we found out that people were positive about sustainable

shopping practices, little awareness can hamper the change in mindset required for the solution of these problems.

Keywords: Climate Change; Sustainability; Slow Fashion; Upcycling.

Innovations in Zn-Ferrite and Polymer Nanocomposites for Protective Textiles: Dielectric and Absorption Properties at Microwave Frequencies

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Abstract:

This study focuses on advancing both electric and structural characteristics of Poly-Pyrrole through the fabrication of iron-substituted spinel ferrites with $Zn_{0.5-x}Mg_{0.25+x}Co_{0.25}Fe_{1-x}Cr_{1+x}O_4$ structure (where x = 0.25) using an established sol-gel process. The synthesis process used ethanol and polyethylene glycol (PGA6000) as mediums to produce nanoparticles. We subjected all synthesized NPs to a three-hour thermal treatment at 500°C in an electric furnace to purify and enhance their grain alignment. Our analysis of the annealed samples included testing with XRD, SEM, LRC, TGA, and DTA equipment. The tests measured temperature-induced changes in material properties through TGA and DTA, while XRD explained its atomic arrangements. Our research used three ferrite concentrations at 0.2, 0.4, and 0.6 in Zn-nano-ferrites/Poly-Pyrrole composite materials to measure their microwave absorption properties. The enhanced absorption capacity for microwaves indicates these composites have value as protective textile materials. These nanocomposites demonstrate excellent electromagnetic wave absorption capabilities, which enable them to protect from EMI and microwave radiation. The lightweight and adjustable characteristics enable these composites to serve as shielding textiles in conditions where people need protection from electromagnetic waves.

Keywords: Protective textiles, Nanocomposites; Microwave shielding.

Fashion's Green Future: Innovating Textile Waste

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Abstract

This research investigates how circular design principles and sustainable materials reduce textile waste and promote eco-friendly fashion production. The study explores the transition from a linear fashion system to a circular economy, integrating recycling, upcycling, and modular design to minimize waste and encourage material reuse. Utilizing a qualitative thematic analysis, data was collected through interviews, case studies, and field observations in textile production units and fashion companies. Findings reveal that designing for circularity significantly reduces resource consumption, fabric waste, and production inefficiencies. Companies implementing alternative materials and sustainable production processes reported measurable reductions in water usage, energy consumption, and textile disposal rates. Additionally, the research identifies key challenges, including limited industry adoption, lack of regulatory frameworks, and high costs associated with sustainable material sourcing. However, findings suggest that integrating circular design practices within fashion industry can accelerate the adoption of sustainability driven innovations. The study highlights the potential of design strategies that extend product lifecycles, encouraging waste-conscious material usage at both the conceptual and production stages. This inquiry contributes to the advancement of circular fashion methodologies, equipping designers, manufacturers, and educators with practical strategies to embed sustainability within creative and industrial processes. By addressing textile waste reduction and eco-conscious material utilization, the study provides a roadmap for transitioning toward a more resource-efficient, circular fashion industry.

Keywords**:** Circular fashion; Textile waste reduction; Sustainable design; Eco-friendly materials; Modular design.

Development of Foam Dyeing Technique for Silk Fabric using Acid Dye

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Abstract

In the textile dyeing industry, foam dyeing has been recognized as a significantly sustainable alternative method. It has been investigated in many studies for the dyeing of cotton fabrics using direct, reactive and vat dyes. However, it has highlighted that this efficient technology undergoes many issues related to the foam generation, foam optimization, and the required performance of the resultant fabrics. The key purpose of this research is to investigate foam application for development and optimization of the acid dyes recipes for the silk fabrics. Silk is a well-known textile fiber aptly known as the “Queen of Textiles” for its luster, luxury appeal, comfort, elegance, sensuousness, and glamour. Silk’s natural beauty, excellent drapability, properties of comfort, and retention of warmth during winters have made it a sought-after fiber for high-fashion clothing. The foam dyeing recipes were generated and optimized using the different stabilizers, foaming agents, and three primary colors of acid dyes. The different recipes were applied onto the silk fabric using laboratory scale foam coating machine. The performance of the foam coated and padded fabrics were evaluated using main criteria including the shade depth, rubbing fastness and washing fastness. The newly optimized foam dyeing recipes were found very competitive with the conventional pad dyeing process with respect to the shade-

depth and the other performance properties. The optimization of the foaming parameters and addition of the stabilizers have advanced the foam dyeing process, which would accelerate the implementation of the foam dyeing methods in the textile industry. Furthermore, significant water and energy savings would be achieved as compared to the conventional foam dyeing. In this research, the novel foam dyeing recipes have been developed for the silk fabrics through the optimization of the different stabilizers, foaming agents, and the three primary colors of acid dye. Until now, the exiting literature has not reported the combination of these stabilizers with the different foaming agents and three primary colors of acid dyes for the improvement of the sustainable foam silk dyeing process.

Keywords: Acid dyes; Silk dyeing; Foam dyeing.

Reducing Fashion Waste Through Ai-Driven Pattern Making

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Abstract

This research examines how AI-based digital pattern-making technologies, such as CLO3D and Tukatech, minimize waste, optimize material usage, and promote sustainability in fashion design. It explores the integration of these technologies into academic curricula and industrial workflows, particularly in the Pakistani fashion industry, to transform conventional design and production methods. This qualitative study employs industrial case studies, interviews and experimental prototyping to assess the effectiveness of CLO3D and Tukatech in material optimization and waste management. Findings indicate that CLO3D enables virtual prototyping and fit testing, significantly reducing paper, fabric, printing, dyeing, sampling, and production errors. Meanwhile, Tukatech enhances efficiency through AI-driven cutting layouts, minimizing fabric waste and offcuts. However, a key limitation of Tukatech is its reliance on synthetic materials, as laser-cutting technology restricts its application to natural and breathable textiles. The study also identifies emerging alternatives, such as air-weaved knits, as potential solutions for integrating sustainable materials with AI-driven production. This research is particularly relevant to Pakistan's fashion education and industry, where sustainable practices are still evolving. By incorporating AI-driven digital tools, the study bridges the gap between experimental academic work and industrial production, equipping students with data-based design approaches and decision-making skills. Additionally, the findings highlight how technology-driven sustainability supports local Pakistani brands already investing in AI-based material optimization. The study concludes that AI-enhanced pattern-making aligns with green technology initiatives, promoting waste-consciousness, resource-efficiency, and made-to-order

production. Furthermore, these models that can benefit Pakistan’s growing fashion industry and contribute to a sustainable future for apparel manufacturing.

Keywords: AI-driven fashion; Digital pattern-making; CLO3D; Tukatech; Sustainable fashion; Conscious design; Green technology; Pakistan fashion industry.

Fig Leaves Extract for Eco-Friendly Fabric Dyeing and Property Enhancement of Natural Fibers

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Abstract:

Dyes are used to add color to materials, such as textiles, paper, and leather, typically soluble in water. Dyes extracted from things that are close to nature are eco-friendly, have no adverse effect on the environment. Synthetic dyes have become the most used type of dye due to their versatility and wide range of colors but their disposal causes adverse effects on environment such as health risks and environmental pollution. The paper highlights the use of fig leaves extract and eucalyptus leaves extract to make a sustainable and environmentally friendly method of dyeing fabric, property enhancement and also check the impact of fig leaves and eucalyptus leaves on fabric. In this paper, Alovera is a natural mordant instead of manmade mordants. They are easily penetrating the fabric, and prevent the loss of colour when they are exposed to sunlight for longer period. The process of naturally extracting Ficus carica dye is optimized with the use of an alkaline medium. The dye extract of Ficus carica and the blend are optimized for cotton by the bath dyeing method, and the further dyeing process of the textile is optimized with the aid of RSM modeling. Dyeing's without any mordant are contrasted with those achieved by pre mordanting with milk and post mordanting with Alovera (a natural mordant) instead of synthetic mordant. It is found that dyes produced with the aqueous extraction method of Fig leaves and the combination of both Fig and eucalyptus leaves have excellent color strength and better fastness qualities than dye extracts obtained in water. Natural mordant also results in property enhancement. Ultimately, it is inferred that natural

dyeing leaf extract has no adverse environmental impacts as its disposal doesn't contain contamination.

Key words: Ficus Carica leaves; Eucalyptus Leaves; Ficin; Eco-friendly dyeing; Sustainability.

Sustainability of Hand Embroidery Craft in the Age of Artificial Intelligence

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Abstract

We reside in a land rich in heritage, where strong and stable threads weave together a tapestry of cultural diversity. From folklore to British influences, our traditions celebrate the unity of diverse ethnic groups through intricate clothing embellishments. The poetic imagery within embroidery stitches narrates stories unique to our past and present, capturing their essence. These delicate yet intricate patterns enhance aesthetic appeal and serve as a testament to embroidery's deep-rooted history and artistic significance. However, a pressing question emerges in the contemporary scenario: Who will bear responsibility for preserving and sustaining the extraordinary art of hand embroidery in the age of AI? To find the answer, we must reflect on the era before industrialization, when communities thrived on traditional, machine-free craftsmanship. Life was unambitious, and nature remained undisturbed by industrial advancements. Today, the survival and proliferation of hand embroidery are at risk due to the rapid growth of artificial intelligence in the textile sector. Hand embroidery respects culturally connected fashion, reduces environmental impact, and supports rural artisans. With biodegradable threads and minimal energy usage, it remains an eco-friendly and ethically sustainable craft. To sustain hand embroidery in the digital era, a hybrid approach is the key—blending traditional techniques with modern innovations. With proper and sufficient support, artisans can use AI-powered tools for making innovations in their designs while preserving craftsmanship. Raising awareness of its cultural value will boost demand, while e-commerce and AI-driven marketing can expand its reach and ensure a competitive, sustainable future.

Keywords: Design; Hand embroidery; Craft; Threads; Sustainable; Artificial Intelligence; Tradition; Culture; Marketing.

A Study on the Effect of Middle East Abaya Patterns on the Modern Day Abaya of Pakistan

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Abstract

Hijab is an Arabic word used for the religious Islamic dress code for the public appearance of women. Modesty should be present in the dresses of both men and women. The dress of the modern woman has evolved, and drastic changes have taken place in the outlook of the attire. The same is true for the Hijab. Media has led to the influence of various cultures on the look of the Hijab also. Today, women want to wear the Hijab while maintaining their fashion looks. Middle East Hijab styles influence the Pakistani Hijab nowadays. Traditional Pakistani Hijab are rare to find commercially these days. The aim of the Present study was to find the influence of the Middle East on the Pakistani abayas available commercially. Colour, patterns and embellishments were focused. The content analysis of both abayas' styles was conducted to find similarities and the influence of Middle East abaya brands against locally manufactured abayas. The results showed a high influence of Middle East abayas, particularly in the case of colour, sleeve length and embellishment. The results will help to find the fashion influence of other cultures on our attire which will assist the fashion designers to understand the level of influence made by foreign cultures on our dresses and their level of admiration and acceptability within our country.

Keywords: Islamic dress, Middle East abaya, Modern day abaya.

Nano-coating of Cotton Fabrics for Enhanced Hydrophobic Oleophilic Performance

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Abstract

This research focuses on the development of hydrophobic and Oleophilic cotton fabrics by applying coatings of nanoparticles to enhance their hydrophobicity, oleophilicity, and mechanical performance. The woven fabrics were coated with different combinations of nanoparticles through the dip-dry-cure procedure to ensure long-lasting functionality. The treated fabrics were tested for FTIR, SEM, and then performance indexes such as water repellency, oil absorption ratio, and oil retention rate were tested and evaluated. Mechanical qualities like tensile strength and crease recovery tests were also performed. The treated fabrics exhibit super-hydrophobic behavior, indicating a notable improvement in hydrophobicity and oleophilicity. The findings suggest that these treated fabrics offer promising solutions for oil spill absorbents and can be used in environmental remediation, where they play a role in removing or capturing oil-based pollutants.

Keywords: Hydrophobic; Oleophilic; Mechanical performance; Cotton and oil spill applications.

Integrating the Circular Economy through Traditional Crafts

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Abstract

South Asia has a rich history of textiles, dating back to the Indus Valley Civilization. Ralli craft is one of the ancient textile crafts originating along the banks of the Indus River in Sindh. This intricately hand-appliquéd craft is a testament to the resilience, timeless artistry, and unmatched skills of the craftswomen who intricately stitch each piece, transforming it into a work of art. Stitching Ralli is considered a traditional ritual where female members of the family gather together to create beautiful quilts by reusing old clothes. This age-old practice of recycling old fabrics and stitching them together serves as a form of sustainable textile craft that is not only unique in its appearance, but also offers circular economy solutions to textile waste. Through relevant case studies, this paper aims to promote sustainable practices using Ralli crafts, preserve traditional crafting techniques, and explore potential design interventions to implement a circular economy approach in the field of fashion and textiles. In conclusion, the research will highlight the economic importance of preserving and promoting this traditional craft.

Keywords: Sustainability; Circular economy; Traditional crafts.

Comparative Analysis of Weave Patterns and Performance Properties of Sussi Fabric

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Abstract

Sussi fabric has a history that dates back to the 18th century and comes from the culturally diverse province of Sindh, Pakistan, most especially from the ancient town of Hala, Nasarpur, Amb Sharif. It represented riches, prestige, and cultural resonance and was an essential manifestation of creative mastery and social identity. Brightly colored warp threads were intricately interlaced with darker or black weft threads to create the characteristic striped and checkered patterns that became characteristics of Sussi cloth, showcasing workmanship and its longstanding artistic traditions. The fabric is renowned for its vivid colors, often achieved by juxtaposing brightly dyed warp threads with a contrasting black weft. This interplay creates a striking visual appeal, making Sussi distinct. The research emphasized the ancient methods of warp fixing, yarn dyeing, and handloom weaving, tensile strength, colorfastness, tearing strength, and water vapor permeability, as well as the elaborate artistry that goes into making Sussi fabrics. It revealed that Sussi fabric has functional attributes like lightness, breathability, and a smooth texture in addition to its aesthetic appeal. The findings revealed Sussi's versatility as a textile suitable for both traditional wear and modern adaptations.

Keywords: Weave patterns; Performance properties; Sussi fabric.

Impact of Multani Ijarak Design on Textile and Fashion Industry

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Abstract

Multani Ajrak, a traditional block-printed textile originating from Sindh and South Punjab, has significantly influenced the textile and fashion industry. Characterized by intricate geometric and floral patterns in deep red, indigo, and white hues, Ajrak has transitioned from a cultural emblem to a globally recognized fashion statement. The revival of traditional textile techniques has contributed to sustainable and ethical fashion movements, with designers integrating Ajrak prints into contemporary apparel, accessories, and home textiles. The resurgence of Ajrak in modern fashion has boosted the local artisan economy, preserved centuries-old craftsmanship while created new employment opportunities. Many international and Pakistani designers have incorporated Ajrak motifs in haute couture and ready-to-wear collections, blending tradition with contemporary aesthetics. Additionally, the use of organic dyes and eco-friendly printing methods aligns with the growing demand for sustainable fashion, making Ajrak a preferred choice for ethical consumers. Ajrak's influence extends beyond fashion, inspiring digital prints, textile patterns, and fusion wear, making it accessible to a global audience. Media, celebrities, and fashion influencers have further popularized this design, increasing its commercial appeal in both local and international markets. The expansion of Ajrak into mainstream fashion has led to a fusion of traditional and modern styles, enhancing its versatility and relevance. As the global fashion industry shifts towards handmade and sustainable textiles, Multani Ajrak continues to be a key player in preserving cultural heritage while fostering innovation. Its impact on textile design, artisan empowerment, and sustainable fashion highlights its enduring significance, ensuring its presence in the industry for years to come.

Keywords: Multani Ajrak; Block-printed textile; Textile design; Sustainable fashion; Cultural heritage preservation; Handmade textiles.

Natural Chemical Free Dyeing of Cotton and Wool Fabric by Using Conocarpus Plant Leaves Powder

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Abstract

Natural dyes, derived from animals, plants, and minerals, have been used for centuries in textiles, food, and cosmetics due to their eco-friendly, non-toxic, and sustainable properties. Unlike synthetic dyes, natural dyes are biodegradable, non-carcinogenic, and often possess therapeutic benefits, aligning with modern demands for environmentally conscious products. Traditional dyeing techniques involve mordants to bond dye molecules to fibers, with recent trends favoring natural mordants like lemon and aloe vera over chemical alternatives. This study explores the use of dry Conocarpus leaves powder, a tannin-rich plant traditionally used for dyeing, alongside natural mordants to dye cotton fabric without synthetic chemicals. The resulting dyed fabric is evaluated for wash-fastness, rub resistance, UV protection, and antibacterial properties, offering a hypoallergenic, skin-friendly, and sustainable alternative that benefits both consumers and the environment. The research highlights the cultural and ecological significance of reviving ancient dyeing practices while meeting contemporary textile industry standards.

Keywords: Sustainability; Conocarpus leaves; Natural dyes.