

*Carbon fibers: Superior electrical and thermal conductivity, exceptional tensile strength.

*Reinforced polymer nanofibers and cellulose-based fibers: Enhanced flexibility, breathability, and moisture control.

These fibers provide ideal conditions for integrating sensors and electronic components.

*Antibacterial and odor-resistant coatings

*Self-cleaning surfaces for reduced maintenance

*Energy-harvesting layers using organic solar cells or triboelectric nanogenerators (TENGs)

These features ensure comfort, durability, and independent power supply for embedded electronics.

3. Comparative Table: Properties of High-Performance Fibers

Fiber Type	Tensile Strength (MPa)	Thermal Resistance (°C)	Sports Application
Kevlar	3620	500	Protective and impact-resistant gear
Nomex	3400	370	Fire-resistant athletic apparel
Carbon Fiber	4000	600	Lightweight performance wear
UHMWPE	3000	140	Ultra-light clothing for runners

6. Advantages of Smart Sports Textiles

4. Smart Sensors and Embedded Systems in Sportswear

Advanced textile fabrication allows embedding of nanoscale and microscale sensors into yarns and fabrics, enabling continuous monitoring of:

*Skin and core body temperature

*Sweat and moisture levels

*Heart rate and respiratory rhythm

*Muscle tension and applied pressure

*Movement patterns and posture

These readings are wirelessly transmitted via Bluetooth Low Energy (BLE) or Near-Field Communication (NFC) to smartphones and smartwatches, where AI algorithms process the data for analysis and feedback.

*Enhanced precision in physiological and biomechanical monitoring

*Real-time personalized feedback for performance optimization

*Reduced injury risk through early detection of abnormalities

*Lightweight and durable construction

*Elimination of bulky monitoring devices

*Easy maintenance via antibacterial and self-cleaning technologies

5. Manufacturing Technologies and Functional Coatings

Smart textiles require precise weaving, knitting, and microstructural alignment of fibers. Additionally, surface treatments and coatings enhance textile performance:

Hydrophobic coatings for moisture-wicking and quick drying

7. Applications in Sports and Rehabilitation

*Professional sportswear: Intelligent biometrics tracking, posture correction, training optimization

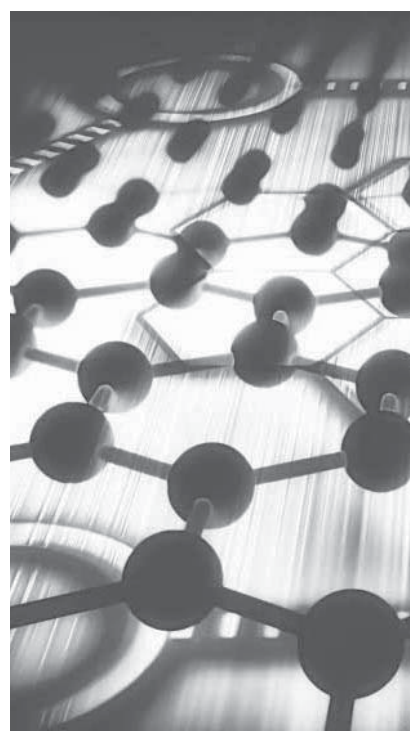
*Rehabilitation tools: Monitoring therapeutic progress, biofeedback for muscle re-education

*Health wearables: Continuous tracking of vital signs for injury prevention

*Protective gear: Enhanced shock absorption and joint stabilization

8. Conclusion

Smart sports textiles based on high-



performance fibers represent the convergence of textile engineering, materials science, and artificial intelligence.

These innovations not only elevate athletic performance and safety but also revolutionize healthcare and physiotherapy through wearable technologies.

Continued development promises more sustainable, responsive, and intelligent sports gear in the near future.

References

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Dr. F Nayeb Morad



High-Performance Fibers and Smart Sports Equipment



Textile Engineering Innovations for Enhancing Athletic Performance and Safety

Abstract

Recent advances in material science and textile engineering have led to the emergence of a new generation of smart fabrics specifically designed for sports applications.

These textiles are based on high-

performance fibers and integrated intelligent systems that not only provide protection but also monitor, optimize, and enhance the physiological performance of athletes. This paper analyzes the structure, function, and practical implications of smart textiles in professional sports and rehabilitation.

1. Introduction

Innovations in smart materials,

nanotechnology, and wearable electronics have transformed the role of sports textiles from passive clothing to active monitoring systems.

Smart sportswear, built on high-performance fibers, is now capable of real-time tracking of physiological signals, injury prevention, and enhanced comfort and safety.

These textiles are central to the development of next-generation athletic apparel and rehabilitation technologies.

2. High-Performance Fibers: The Foundation of Smart Sports Textiles High-performance fibers are engineered with advanced mechanical and functional properties for demanding environments. Common types include:

*UHMWPE (Ultra-High-Molecular-Weight Polyethylene): Very high strength-to-weight ratio, excellent abrasion and stretch resistance.

*Aramids (e.g., Kevlar, Twaron): High thermal and mechanical resistance, lightweight, impact-resistant.



Creative Tech Textile's Seawool®

Opens New Horizons For Sustainable Fashion

In celebration of World Environment Day, Creative Tech Textile is sharing the success story behind Seawool® — its innovative material transforming discarded oyster shells and recycled plastic into a sustainable textile solution. This pioneering approach shows how reusing natural waste can move fashion toward a more sustainable future.

Fashion's Push to Become More Sustainable

The global fashion industry has recently faced growing pressure to become more sustainable. According to the World Economic Forum, incorporating recycled materials into clothing could reduce CO₂ emissions by up to 80%. Yet, polyester—plastic-based and derived from fossil fuels—remains the most widely used fiber in textiles, while less than 1% of clothing materials are recycled into new garments, per the Geneva Environment Network. In particular, there is a growing need to reduce short-lifecycle plastic-based fabrics and increase uptake of circular, low-impact material innovations.

Seawool®: The 'Emerald from the Ocean'

Creative Tech's proprietary Seawool® material represents a bold leap in sustainable material development. By blending discarded oyster shells from Taiwan with recycled PET plastic bottles, the company has created

a textile that is as functional as it is environmentally conscious.

Already adopted by leading US apparel brands, Seawool® generates around TWD\$200 million (US\$6.1 million) in annual revenue and is quickly gaining global traction. In May, Creative Tech showcased Seawool® at PanTextiles Tokyo, an international trade event by the Taiwan Textile Federation.

"As consumers grow more conscious of their clothing's environmental impact, we want them to know sustainable material innovations like Seawool® exist and are scalable," noted Eddie Wang, Founder and CEO of Creative Tech Textile. "Our goal is to replace traditional fibers with more environmentally-friendly alternatives — facilitating true sustainability from the upstream end of the fashion industry supply chain."

Creative Tech currently produces 2,500 tons of Seawool® annually, repurposing approximately 500 tons of oyster shells.

How Seawool® Compares to Traditional Materials

Seawool® stands out for both its environmental footprint and fabric properties:

Odor-resistant

Moisture-wicking

Offers UV protection

Furthermore, the oyster shell powder inside is a low thermal conductivity material, offering temperature stability.

Seawool® also has cost and environmental advantages:

1/10 the cost of down

1/20 the cost of high-grade wool

Lower water usage compared to down and wool

Performs better for water absorption than polyester

Improved odor resistance compared with cotton

Comparable thermal regulation to pricier low-conductivity fabrics, but at 1/6 to 1/10 the cost

A sustainable world inside an oyster shell

While Taiwan produces an estimated 100,000 tons of oyster shells annually, far greater quantities are generated in the US and China, highlighting the abundance of this natural raw material. Turning oyster shells into functional powder requires a specialized process which Creative Tech has mastered with unique production advantages that support large-scale manufacturing. As demand for eco-conscious materials grows, Creative Tech is well-placed to deliver consistent quality and scale for fashion brands seeking sustainable alternatives.

Source :

www.textileworld.com/textile-world/fiber-world/2025/06/creative-tech-textiles-seawool-opens-new-horizons-for-sustainable-fashion/