Reflecting on ITMA 2023: A Showcase of Innovation in Electrospinning and Extrusion Machines

ITMA 2023: Pregled inovacija u elektroispredanju i ekstruziji vlakana

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Abstract

The International Textile Machinery Association (ITMA) 2023, held in Milan, Italy, was a pivotal event showcasing the latest innovations in the textile and garment industry, with a particular focus on electrospinning and extrusion machines. This review provides an in-depth analysis of the advancements presented at the fair, drawing on promotional materials, press releases, and firsthand accounts from exhibitors and attendees. The event underscored several industry trends, including a strong focus on sustainability, digitization, and automation. The review delves into these trends, discussing their implications for the textile industry and how they reflect the industry's broader goals and challenges. The advancements in extrusion and electrospinning technologies presented at the fair were particularly noteworthy, promising to revolutionize various aspects of textile production. The fair's success underscores the importance of such events in driving innovation and fostering dialogue within the industry.

Keywords: ITMA 2023; textile industry; electrospinning; 3D printing; innovations

Sažetak

Međunarodna asocijacija za tekstilnu opremu (ITMA) 2023, održana u Milanu, Italija, bio je ključan događaj koji je prikazao najnovije inovacije u tekstilnoj i odjevnoj industriji, s posebnim naglaskom na elektroispredanje i ekstruzijske strojeve. Ovaj pregled pruža detaljnu analizu napretka predstavljenog na sajmu, temeljeći se na promotivnim materijalima, priopćenjima za tisak i izravnim izvještajima izlagača i posjetitelja. Događaj je naglasio nekoliko industrijskih trendova, uključujući snažan fokus na održivost, digitalizaciju i automatizaciju. Pregled se detaljno bavi ovim trendovima, raspravljajući o njihovim implikacijama za tekstilnu industriju i kako odražavaju šire ciljeve i izazove industrije. Napredak u tehnologijama ekstruzije i elektroispredanja predstavljen na sajmu bio je posebno značajan, obećavajući revolucionirati različite aspekte proizvodnje tekstila. Uspjeh sajma naglašava važnost takvih događaja u poticanju inovacija i poticanju dijaloga unutar industrije.

Ključne riječi: ITMA 2023; tekstilna industrija; elektroispredanje; 3D printanje; inovacije

1.Introduction

The International Textile Machinery Association (ITMA) 2023, held in Milan, Italy, was a testament to the relentless pursuit of innovation in the textile and garment industry. The event, which saw over 1,700 exhibitors from 47 countries occupying 200,000 square meters of exhibition space, served as a global platform for industry leaders to showcase their latest developments and breakthroughs.

ITMA 2023 was a celebration of technological advancement, with each exhibitor unveiling technologies that pushed the boundaries of what is possible in textile and garment manufacturing. From advancements in automation and digitization to the development of sustainable and eco-friendly manufacturing processes, the event was a testament to the industry's commitment to addressing the evolving needs of the global textile market.

One of the focuses was the development of advanced manufacturing technologies such as electrospinning and extrusion machines. These technologies, which represent a significant leap forward in the production of textiles, offer unprecedented levels of precision, efficiency, and versatility.

Electrospinning, a process that uses an electric field to draw charged jets of polymer solutions or melts to create fine fibers, has opened up new possibilities in the production of non-woven textiles. At the ITMA fair, a machine showcasing the potential for continuous yarn production using alternating current (AC) electrospinning was exhibited by the team of Technical University of Liberec.

The presence of these technologies at ITMA 2023 underlines the industry's commitment to innovation and development of advanced manufacturing techniques. As we reflect on the event, it is clear that the

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future of textiles is being shaped by these advancements, offering new opportunities for manufacturers and reshaping the landscape of textile production. ITMA 2023 was a showcase of the industry's capacity for innovation, with electrospinning and extrusion machines standing out as key examples of the technological advancements that are driving the future of the textile and garment industry. As we look forward to future ITMA events, we anticipate even more groundbreaking innovations that will continue to push the boundaries of what is possible in textile and garment manufacturing [1].

2. Methodology

The review is based on a thorough analysis of accessible promotional materials, press releases, and firsthand experiences shared by both exhibitors and attendees. The aim is to provide a balanced and comprehensive overview of the advancements in extrusion and electrospinning technologies presented at the fair. The review also incorporates insights from industry experts to provide a broader context and deeper understanding of the trends and technologies presented at the fair.

3. Overview of Extrusion and Electrospinning Technologies

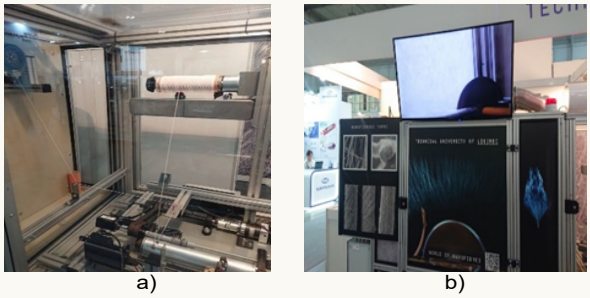
Extrusion and electrospinning are two key technologies in the textile industry. Extrusion, which involves forcing material through a die to create objects of a fixed cross-sectional profile, has revolutionized the production of synthetic fibers. Electrospinning, on the other hand, uses an electric field to draw charged jets of polymer solutions or melts to create fine fibers, opening up new possibilities in the production of non-woven textiles. These technologies offer unprecedented levels of precision, efficiency, and versatility, making them crucial to the future of the textile industry.

3.1.Exhibitors and Technologies

The Technical University of Liberec, a renowned institution known for its innovative research and development in the field of textile engineering, was among the exhibitors at the ITMA 2023 fair. The University's participation in the event underscored its commitment to advancing the textile industry through the development of cutting-edge technologies.

At ITMA 2023, the Technical University of Liberec showcased its groundbreaking work in the production of pure AC electrospun nanofibrous yarn. This technology represents a significant leap forward in the production of nanofibers, which are increasingly used in high-value applications such as composites, filtration media, gas separation, sensors, and biomedical engineering [2].

The University's electrospinning technology allows for the production of nanofiber yarns with a diameter of several microns. These yarns, which contain thousands of fibers with radii of approximately 600 nm, have a large specific surface area, making them ideal for applications that require slow diffusion of gases and liquids, high filtration efficiency, intensive drug release, or high-efficient adsorption of specific molecules on their surface [3].



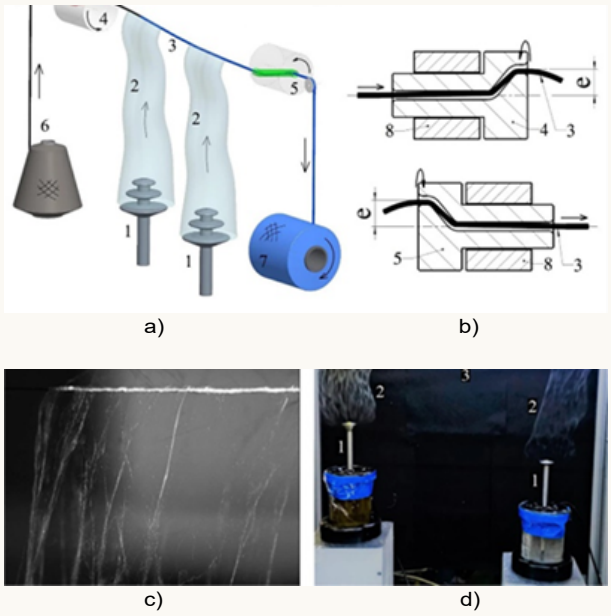
a) b)

Figure 1. ITMA University of Liberec stand: a) AC electrospinning yarn, b) Screen swocasing AC electrospinning from inside

Figure 1 shows the collection of the electrospun yarns on a roller (a) and the electrospinning device with a screen showcasing AC electrospinning from the inside (b).

The potential of this technology is vast, with the University predicting that it could lead to the production of a new generation of yarns and textiles with applications in almost all current textile product groups. The core technologies are protected by several international applications and patents, underscoring the novelty and potential impact of this innovation [4].

Figure 2 shows, (a) A basic diagram of the apparatus that includes: AC spinning electrodes (1), nanofiber plumes (2), the core yarn moving from left to right (3), the initial twirling mechanism (4), the secondary twirling mechanism (5), a coil storing the core yarn (6), and the output coil containing the composite yarn (7). The core yarn is horizontally fed into the spinning area above the two vertically-aligned rod spinning-electrodes and is enveloped with nanofibers; (b) A basic diagram of both twirling mechanisms. The top image illustrates the initial twirling mechanism, which consists of a rotor (4) with a yarn chamber having an off-center hole displaced by distance e from the rotation axis, the stationary frame of the mechanism (8), and the yarn (3) threading through the mechanism. The bottom image presents a basic diagram of the secondary twirling mechanism (5); (c) The axis of the yarn core and the axis of the nanofibrous plume discharged from the spinning electrode are nearly at right angles to each other; (d) Two integrated screw pumps with the spinning electrode featuring disc-like heads (1) and the polymer reservoir discharging nanofibrous plumes (2) that encircle the ballooning yarn core (3).



a) b)

c) d)

Figure 2. A simplified scheme of the device at ITMA: a) The diagram shows an apparatus with AC electrodes, nanofiber plumes, and a core yarn with twirling mechanisms, b) It includes two separate twirling mechanisms with distinctive features, c) The core yarn and nanofibrous plume axes are almost perpendicular, d) The depiction features two screw pumps with spinning electrodes and a polymer reservoir [3]

Tree to Textile, a Swedish-based company, is revolutionizing the textile industry with its innovative approach to sustainable fabric production. The company's unique technology transforms wood pulp from sustainably managed forests into high-quality textile fibers. This process not only offers an eco-friendly alternative to traditional textile manufacturing, but also addresses the industry's pressing need for scalable, low-cost, and low-environmental-footprint materials [5]. Figure 3 shows a dress completely made of tree pulp.

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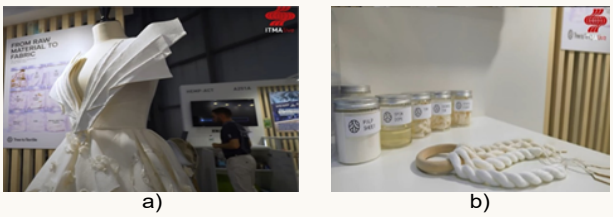


a) b)

Figure 3. Tree to Textile ITMA: a) Tree to textile dress, b) tree to textile braids [6]

The company's groundbreaking technology involves a series of steps that convert wood pulp into a versatile fiber, suitable for creating a wide range of textile products. The process begins with the extraction of cellulose from the wood, which is then dissolved and spun into fibers. These fibers are subsequently woven or knitted into textiles. The end result is a product that marries sustainability with performance, offering the textile industry a viable path towards a greener future. With its commitment to sustainability and innovation, Tree to Textile is not just producing textiles, it's weaving the fabric with a more sustainable future.

3.2. Innovation and Trends

The fair underscored several industry trends, including a strong focus on sustainability, digitization, and automation. Numerous exhibitors presented innovative solutions aimed at reducing the environmental impact of textile production, improving efficiency, and embracing the digital age. These solutions ranged from energy-efficient machinery and eco-friendly materials to advanced software for design and production management. This review delves into these trends, discussing their implications for the textile industry and how they reflect the industry's broader goals and challenges.

The ITMA 2023 show in Milano served as a testament to the future of wearables, with digital knitting taking center stage. The fair, owned by CEMATEX, is the world's most influential textile and garment technology exhibition, and it showcased the latest advancements in textile and garment processing technologies, machinery, and materials. This year, three specialized additive manufacturing (AM) companies, HP, Stratasys, and CeramTec, participated as exhibitors, each focusing on different aspects of the textile supply chain.

HP 3D Printing, in collaboration with Lonati Group and Decathlon, presented an innovative and sustainable approach to shoe manufacturing. The shoe combines Lonati's digitally crafted sock with an innovative midsole and outsole produced using HP's Jet Fusion 5200 3D printer for series production, this can be seen in Figure 4. The components are manufactured using BASF Ultrasint TPU01 material, a thermoplastic polyurethane powder known for its shock absorption and flexibility. By integrating these materials and technologies, Decathlon and HP are focusing on the advantages of 3D printing and digital knitting for manufacturing at an industrial level, emphasizing customization, circularity and repeatability, localized production, and flexibility.

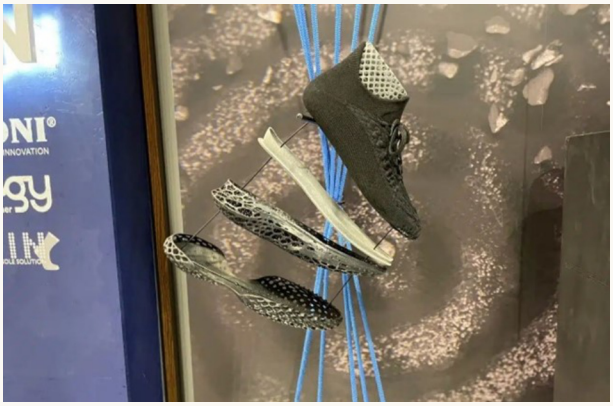
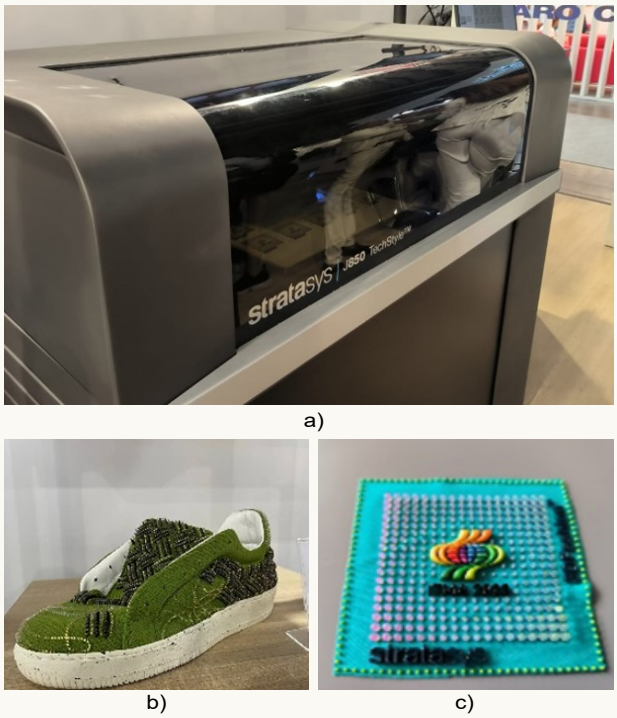


Figure 4. HP 3D printing of shoes [9]

Stratasys, via the Italian Stratasys branch, leveraged ITMA 2023 to show off its unique TechStyle technology for 3D printing on textiles as presented in Figure 5. This technology is looking specifically at the fashion market and was first presented during Milan Design Week in 2022. Using a J850 system, the process enables actual 3D printing of full-color, polyurethane-like decorations and decorative items of different elasticity [7].



a)

b) c)

Figure 5. 3D Print to textile: a) digital anatomy 3D printer, b) 3D printed decoration on footwear, c) 3D printed decoration on fabric [9]

The ability to 3D print specific parts for automated textile and digital knitting machines is truly opening a new era in the industry as companies rapidly develop new and more efficient systems. This is happening at many levels and with many different technologies. For example, Colosio, another company that develops high-tech machines for 3D shoe-uppers production, displayed a few prototypes that combined the digitally knitted uppers with clearly 3D printed soles. 3D printing shoe upper sample can be seen in Figure 6 [8,9].

Figure 6. Colosio 3D printed shoe upper [8]

CeramTec, a German company that is emerging as a leader in the development of new technical ceramic 3D printing applications, implemented a binder jetting process for the production of construction elements made from a new SiSiC technical ceramic [9]. More recently, the company acquired a Carmel system from XJet to 3D print alumina parts, specifically for machines such as those in the textile industry,

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where CeramTec is already present as a key part supplier [9,10]. The company is getting a head start on the future of part manufacturing to meet the constantly evolving part requirements from companies in the textile industry.

These developments underscore the significant opportunities for AM in the textile industry, which is estimated to be worth $26.2 billion and projected to grow to over $40 billion by 2030 [9,11]. The innovations presented at ITMA 2023 highlight the potential of 3D printing in reshaping the textile industry, from footwear to garment manufacturing, and even machine part production.

3.3. Industry Response and Potential Impact

The response to the advancements in extrusion and electrospinning technologies presented at the ITMA 2023 fair was overwhelmingly positive, with attendees and exhibitors alike praising the breadth and quality of the technologies on display. Many expressed optimism about the potential of these technologies to drive growth and innovation in the textile industry. The fair also sparked discussions about the challenges facing the industry, from environmental sustainability to market competition. The review discusses these responses in detail, analyzing how they reflect the industry's current state and future directions. The fair is expected to have a significant impact on the textile industry, influencing trends and shaping practices in the years to come.

4.Conclusion

The ITMA 2023 fair was a landmark event in the textile industry, showcasing a host of innovative technologies and highlighting key industry trends. The advancements in extrusion and electrospinning technologies presented at the fair were particularly noteworthy, promising to revolutionize various aspects of textile production. The fair's success underscores the importance of such events in driving innovation and fostering dialogue within the industry. As we reflect on the fair, several key themes emerge: the central role of technology in the industry's future, the growing emphasis on sustainability, and the importance of collaboration and knowledge sharing. These themes are likely to shape the industry's trajectory in the coming years, influencing everything from production processes to business strategies. As we look forward to future ITMA fairs, it is clear that they will continue to play a pivotal role in shaping the future of the textile industry. With the rapid pace of technological advancement and the industry's commitment to innovation and sustainability, we can expect the textile industry to continue evolving and transforming in ways that were once unimaginable, further underscoring the importance of platforms like ITMA in fostering this progress.

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