



# IE TEX 2018

International Conference on  
Innovation & Entrepreneurship in Textiles

## 3<sup>rd</sup> NTU DICE Textile Innovation Event

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**Dr. Sheraz Ahmad**  
Conference Secretary

## FOREWORD

1st International Conference on Innovation & Entrepreneurship in Textiles (IE-TEX-2018) is organized National Textile University, Faisalabad in collaboration with Dice Foundation, USA, Higher Education Commission, Pakistan and Interloop Pvt. Ltd. Pakistan.

The time is now right to reflect on a number of questions. Today, textile industry of Pakistan is at the crossroads of its future: Did we choose the right instruments in the crisis? Have our recovery programs had the intended effects? How can we secure lasting and sustainable growth? How do we produce long-term value creation?

The objective of this conference is to find answers to these questions. This conference is going to become one of the biggest gathering of representatives as well as experts from academia, industry and government sector to discuss how textile industry can shift to highly value added technical textiles so that exports may be enhanced.

It is an invaluable platform for the researchers and scholars of the field to share their research work about growing diversity in technology and its range of applications with Industry as well with each other. The research papers have been selected for IE-TEX-2018 after shear scrutiny in respect to their importance, validity and reliability. The research papers cover most of the conspicuous researches in technical textile and its related technologies, covering the main areas of technical textiles: Nonwoven, Composites, Protective textiles, functional textiles, Theoretical modelling, Medical and Healthcare, Fibers and polymers, Nanotechnologies, Smart Textiles etc.

We are thankful to all researchers and speakers from Pakistan and all around the world for their interest in presenting their research work and concern in publishing their research contributions through IE-TEX platform. We believe that their contribution would entail a milestone in the textiles.

At the same time, we express our gratitude to all the members of the Event Organizing Committee from National Textile University for their support in arranging and organizing this event. We are grateful to the members of Technical and Publication Committee for their valuable and endeavor in the publication process of the IE-TEX-2018 proceedings.

But most of all, we truly indebted to Higher Education Commission, Pakistan for realizing the importance of the conference and financial support for this case. We hope the conference immense benefit for researchers, professionals, and other involved in the worldwide innovation in Technical Textiles.

A handwritten signature in black ink, appearing to read 'Yasir' with a stylized flourish at the end.

**Dr. Yasir Nawab**  
Conference Chair

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## **A CRITICAL ANALYSIS OF CONDUCTIVE YARN MANUFACTURING, APPLICATION AND MARKET TRENDS**

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Worldwide market size for conductive yarns are growing exponentially with the increasing demand and rampant advancement in textile technology. Conductive yarns are being extensively used in smart textiles, are the yarns that feature electrical conductivity along with comfort presenting physical flexibility and small form factor that cannot be achieved with other existing electronic manufacturing techniques. Interconnection based on conventional textile materials like cotton, polyester, wool etc., and conductive components are intrinsic to the smart fabric and are less visible and not susceptible of becoming tangled or snagged by surrounding objects. The blending of metal fibers, e.g. stainless-steel fibers with natural or synthetic textile fibers to produce conductive yarns is well known. Having one of the world's largest spinning section in Pakistan, such products manufacturing is highly feasible keeping in view the current resources with the aim to compete in international market providing major benefits not only to our yarn exports but also the value-added chain of smart textiles which are in high demand. In this review, we report a critical analysis of worlds conductive yarn market and the feasibility to produce and export the same using the available resources in our country.

**Key words:** Conductive yarns, Smart textiles, Spinning, Synthetic fibers.

## **DETERMINATION OF FATIGUE CRACK GROWTH RATE OF FIBRE METAL LAMINATES**

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Aerospace structural components are subjected to fatigue loading throughout their service life. Fatigue is the phenomenon in which material failure occurs below yield point due to variation of large number of stresses at a specific location. During fatigue loading, if applied load exceeds threshold value, fatigue crack initiates at microscopic level. Once initiated, crack tip behaves as a stress concentration zone, which leads to further crack propagation. When crack reaches critical size, fatigue specimen becomes unable to further withstand the imposed loading and finally sudden fracture occurs.

In this research work, Fiber metal laminates (ARALL, CARALL and GLARE) are used to investigate their fatigue crack propagation behavior because of their prime importance in aerospace industry. Center crack specimens of Aluminum alloy (AA 1050-H2) were also fatigue tested for comparison with FML's.

Different surface preparation techniques were applied to achieve durable adhesive bond. Vacuum Assisted Resin Transfer Molding (VARTM) process was used to fabricate ARALL, CARALL and GLARE containing woven Aramid, Carbon and Glass fibers.

Fatigue tests were conducted on servo hydraulic universal testing machine model MTS 810. Traveling optical microscope was used to monitor the fatigue crack. Graphical correlation like  $\sigma$  Vs  $\epsilon$ ,  $dadN$  Vs  $\Delta K$ ,  $a$  Vs  $N$  and load Vs displacement was developed. Numerical simulation was also performed. Experimental results and results of simulation was also plotted. Fracture toughness of ARALL, CARALL and GLARE, evaluated from experimental data and from simulation data has % age difference less than 2%. Scanning electron microscope was used to observe the fracture surfaces for qualitative analysis.

## **DEVELOPMENT OF COMFORTABLE FIRE RESISTANT FABRICS FOR BED SHEETS**

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The aim of this research was to develop comfortable bed sheet fabrics with fire resistance (FR) properties. Twelve woven fabric samples were prepared on sample weaving machine by using 24/1 blended yarns. Blended yarns consist of cotton, FR viscose and FR polyester at different blend ratios. Weave designs of 2/1 S twill and 4/1 satin were used to make fabric samples with construction of 24\*24/130\*70. Different properties of fabric samples such as moisture management (AATCC TM 195-2009), tensile strength (ISO-13934-1), tear strength (ISO-13937-1) and fire resistance (BS 7175) were investigated by using standard test methods. The results revealed that moisture management of those samples is better and acceptable which consist of polyester proportion less than 50 %. Tensile and tear strength of all samples is reasonable, however those samples which consist of polyester proportion more than 50 % is higher as compared to others. FR properties of all samples are acceptable except those sample which consist of cotton portion of 20 %. The best option is that sample which consists of 40 % FR polyester and 60 % FR viscose. However, a sample which consists of 50 % FR polyester, 40 % FR viscose and 10 % cotton with twill weave may be considered best keeping in view the cost.

**Key Words:** Fire resistant, Viscose, Polyester, Cotton, blended yarn, Moisture management

## **DEVELOPMENT OF ELECTROSPUN NANOFIBER INCORPORATED FACEMASK AND STUDY OF ITS PERFORMANCE AND COMFORT PROPERTIES**

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Protection for the respiratory system has become a need of the day due to increased air pollution. Different nonwoven filter media have been utilized for this purpose. However, such media does not provide protection against particulate pollution in the nanometer range. Performance of such systems may be improved further by the addition of finer fibrous materials such as electrospun webs in them. Moreover, the comfort properties of such media also need to be studied as they can affect the performance of wearer. In this study, electrospun nanowebs were incorporated between layers of commercially available nonwoven filter media to improve its performance. Effect of addition of nanofibrous web on comfort properties was also studied. It was concluded that inclusion of nanowebs, significantly, improved the filtration capability of filter media. Moreover, it was found to have mixed impact on comfort properties of the resultant composite filter media.

**Keywords:** Respiratory protection, facemask, nanofibers, filter, comfort

## **DEVELOPMENT OF LIGHT WEIGHT AND LOW COST THERMAL BLANKET**

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Thermal resistance property is most desirable for winter fabrics and especially when it is about thermal blanket then thermal resistance becomes the primary objective. The focus of this research was to develop a lightweight cost effective thermal blanket with better thermal resistance properties. For this purpose, two set of yarn were developed consisting of intimate blend and core spun yarn structure. Two types of yarns i.e., Ne 20/2 CVC 60:40 intimate blend spun yarn and Ne 20/2 45D cotton/polyester core spun yarn were used in the warp direction. While three types of yarns i.e. Ne 16/2 CVC 60:40 blended spun yarn, Ne 16/2 45D cotton/polyester core spun and Ne 16/2 75D cotton/polyester core spun yarns were used in the weft direction. At first stage, four woven fabrics were manufactured with weave patterns; 1/1 plain, 2/1 twill, 3/1 twill and honeycomb single ridge using intimate blend spun yarns both in warp and weft. The thermal resistance values of fabrics samples were measured using sweat guard hot plate. Among these sample, the 3/1 twill fabric was found superior with a thermal resistance with a value of 0.0495 m<sup>2</sup>K/W. At second stage, selecting 3/1 twill weave pattern, two more fabric samples were produced using 16/2 45D and 16/2 75D core spun yarns separately in the weft and 20/2 45D in the warp. The thermal resistance valves of these samples were found to be 0.0790 m<sup>2</sup>K/W and 0.0723 m<sup>2</sup>K/W respective. Hence, it is observed that fabrics made of core spun yarns offers better thermal resistance due to concealed polyester filament within the cotton sheath compared to the thoroughly distributed polyester fibres in CVC blend yarns fabrics. The polyester fibre having low specific heat than that of cotton, cannot contribute directly to the thermal conductivity of fabric in case of core spun yarn fabrics, which is happened otherwise in intimate blend yarn fabrics. The finding of study are quite significant to develop light weight and cost effective warmer structures for cold environment.

**Key Words:** Thermal resistance, CVC, core spun, intimate blend, polyester, cotton

## **DEVELOPMENT OF MELT-SPINNING TECHNOLOGY FOR POLYOXYMETHYLENE FIBERS AND THEIR APPLICATION FOR REINFORCEMENT OF GEOPOLYMERS**

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Polyoxymethylene (POM) is a semi-crystalline engineering polymer with prominent characteristics of high strength, outstanding anti-fatigue performance, excellent surface lubrication, and good chemical and weathering resistance as well as a reasonable cost and can easily be processed by injection-molding, blow-molding and extrusion methods due to its thermoplastic nature. In the current work, high-strength POM fibers were first prepared through melt-spinning followed by a hot-drawing procedure, and then a series of metakaolin-based geopolymeric composites with different contents of POM fibers were synthesized. The mechanical and tribological properties of the resulting composites were evaluated, and the morphology and microstructure were investigated. The POM fibers provided significant mechanical reinforcement for the metakaolin-based geopolymer. The composites were optimized for flexural and compressive strength with respect to fiber content and fiber length. Compared to unreinforced geopolymer, the composites obtained an optimum improvement by approximate 150 % in flexural strength and by almost 26 % in compressive strength. The reinforcing mechanisms were discussed on the basis of morphological investigation and considered as a cumulative energy-dissipating effect by fiber pullout and orientation, fiber rupture, fiber debonding from the matrix, and fiber bridging within cracks. The geopolymeric composites also achieved a considerable reduction in friction coefficient and abrasion loss rate in the presence of POM fibers. Such an enhancement of tribological performance is ascribed to the formation of self-lubricating transfer films between the contact surfaces of composites against the steel counterpart.

**Keywords:** POM fibers, Melt-spinning technology, Reinforcement; Geopolymeric composites

## **DISPOSABLE NON-WOVENS AS RISING OPPORTUNITY FOR YOUNG ENTREPRENEURS**

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Medical non-woven disposables provide better hygiene and protection to the patients as well as doctors from the infection. It eliminates the risk of cross contamination and delivers great bacterial filtration. Global Medical non-woven disposable market was USD 6.0 Billion in 2014. The revenue of this market is anticipated to increase at CAGR of 7.9% during the forecast period. North America is the leading market for medical non-woven disposable industry by revenue which accounted for the largest share worldwide. Asia Pacific will grow with the highest growth rate owing to an increase in demand for disposable medical equipment and products. Rising awareness of medical disposables is triggering the demand and hence boosting the market growth.

In Pakistan, the total government health facilities have increased by 14% over the last 15 years, making a total of more than 14,000 health facilities including hospitals, dispensaries, BHUs, sub health centres, maternity and child health centres, rural health centres and TB centres. Owing to better bacterial filtration and eliminated cross contamination, is driving the market of disposable nonwovens in Pakistan. Therefore, the young entrepreneurs can find this market as the potential area for investment and initially they can start the business from trading the readymade goods available in the market.

## **EFFECT OF STRUCTURAL HYBRIDISATION ON BALLISTIC PROPERTIES OF ARAMID FABRICS**

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This paper presents an investigation regarding the ballistic performance of hybrid panels formed by combining para-aramid woven fabrics and unidirectional fabrics. For this purpose, hybrid panels are formed at different structure and fabric ply numbers by combining Twaron CT 710 type woven and K-Flex unidirectional fabrics. The hybrid panels formed this way are subjected to ballistic tests according to NIJ standarts. Ballistic performance of test samples are determined by measuring trauma depth and diameter. The energy absorbed by fabric layers and the energy transmitted to the back of fabric layers are determined from trauma depth and diameter values using a different approach. It is shown that in hybrid panels, around 4.48% improvement is obtained in trauma depth in hybrid panels compared to panels formed by 100% woven fabrics and 3% improvement is obtained in trauma diameter in hybrid panels compared to panels formed by 100% unidirectional fabric panels. As far as the energy transmitted to the back side of the panels is concerned, an improvement of 13.9% is gained with hybrid panels compared to 100% unidirectional fabric panels. It is also found that an improvement of 8.48% in energy absorbed per unit weight is obtained with hybrid panels compared to the panels formed by using 100% woven fabrics.

**Keywords:** Ballistik Performance, Hybrid Structure, Energy Absorbtion



## **ELECTRICAL CONDUCTIVITY PROPERTIES OF CARBON COMPOSITES INCORPORATED WITH GRAPHENE AND METAL WIRES**

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In this study, firstly two dimensional (2D) carbon preform was coated with graphene using robust coating process. Secondly 2D carbon preform was woven with different metallic wires. The metallic wires were interlaced with different densities of metallic wires. Carbon composites were manufactured by resin infusion method. The electrical conductivity of carbon composites incorporated with graphene and metallic wires were assessed. The incorporated wires increased the conductivity in composites significantly. The graphene and different metallic wires were also comparatively analyzed.

## **ENABLING TECHNOLOGIES FOR EMBEDDING ELECTRICAL INTERCONNECTIONS IN TEXTILE SUBSTRATES**

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Formally, work on the development of Electronic textiles started in MIT back in 1980s. The initial attempts resulted in cumbersome devices that were simple ‘mounted’ on the textile article. Since then this area of research has attracted significant interest from the academia as well as the industry. The focus of course has been on making the functional articles more ubiquitous. In order to achieve this, numerous new materials have been developed and consequently electronic textiles possessing a broad range of functionalities are available today.

Despite all the developments that have been made in associated materials science and manufacturing technologies, some challenges remain to be tackled. One of these is the technology of interconnections. Generally speaking, interconnections can be made by either incorporating a conductive thread in the fabric structure or by depositing a conductive material on the substrate by printing, etc. Most of the research done on these is concentrated in the EU and USA and these regions maintain their technological edge by investing huge sums in the research sector. We at the Department of Textile Engineering, NED University are working on both streams, i.e, use of conductive threads and use of conductive inks. This is part of the effort on our end that the local industry is not left behind when it comes to tapping the niche technology areas in the field of electronic textiles. This talk will cover some of the work that is being done towards development of Electronic Textiles in Textile Department, NEDUET.

## **ESTABLISHING INSTITUTIONAL MECHANISMS AND INNOVATION PLATFORMS FOR HIGH-VALUE INDUSTRIAL TRANSFORMATIONS – A REVIEW OF TOOLS METHODS AND STRATEGIES.**

Arsalan Ghani

Innovation and technology commercialization is making rapid inroads into universities and research organizations. Technological diffusions through entrepreneurship into industrial ecosystems are transforming supply networks and disrupting the way businesses are conducted. World leading universities are generating enormous resources from external industrial partnerships to fund academic and research programs along with innovative offerings to the industry. In developing countries, there is a significant gap in connecting university innovation and commercialisation activities with industry, government and third sector organisations. Pakistan's manufacturing sector especially its textile and clothing industry is having enormous opportunity brought about the global economic shift. However, capturing value from such an opportunity requires a significant shift in the way manufacturing and service businesses are conducted. This includes adopting new business models, enhancing technological readiness, building new digital platforms, taking advantage of high-performance materials, disrupting supply chains, governing the supply network, developing new M&A strategies and ensuring proactive business transformation. Universities engage businesses across the industrial landscape to address such business requirements through innovative solutions and thereby capture high-value from the ecosystem to further refine its programmes and offerings. University-Industry collaborative platforms are emerging in leading institutions enabling the design and transformation of industrial systems. New business ventures, SMEs and multinationals are taking advantages of such university platforms to enhancing their competitive advantages. I analysed cases of proactive collaborations between universities, companies, governments, international agencies and third sector organisations that are exploiting tools, methods and frameworks emerging from university research and practice. I suggest actors coalition and institutional mechanisms that incorporates proactive and reactive engagements.

## **EXTRACTION OF SUGARCANE FIBERS FROM SUGARCANE BAGASSE AND OPTIMIZATION OF DIFFERENT PARAMETERS OF FIBERS FOR THE TEXTILE APPLICATIONS**

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The natural fibers are cherished for textiles due to their unique properties. Sugarcane bagasse could be a potential source for getting fibers and these fibers could be used for textile applications. The aim of the study is the extraction of sugarcane fibers from sugarcane bagasse and optimization of different parameters of fibers for the textile applications. Firstly, the sugar cane fibers are chemically extracted, then extracted fibers were treated with different chemicals to make them flexible/ soft for their better spin-ability, and to use sugar cane fibers for textiles. Sugarcane fibers were extracted from bagasse by 0.1N NaOH treatment. Extracted fibers were treated with ratios of silicone softeners to make it soft/flexible. The SEM photographs reveal that the fiber is composed of a bundle of cells encrusted by cementing material, outside bundles were composed mainly of short thin-walled parenchyma cells. The fineness of different samples of fibers lies between 39.74 tex and 61.23 tex. The moisture regain of different samples of fibers ranges 4 % to 7.6 %. The fibers show moderate crystallinity. Results after experiments show that the flexibility/softness of fibers is improved but not up to spin-able limits. The properties of sugarcane fibers are closer to the properties of coir fibers. These fibers can be used for making non-woven mats. The nonwoven can be impregnated in resins for making composites for various applications.

**Key Words:** Sugarcane, Bagasse, Flexible, Spin-able, Moisture regain

## **DEVELOPMENT AND OPTIMIZATION OF MODIFIED ELECTROSPUN NANOWEBS FOR USE IN RESPIRATORY FILTERS**

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This study focused on the development and optimization of electrospun nonwovens along their technical usages i.e. respiratory protection. Various type of electrospinning techniques (Needle and needle less) were used for the manufacturing and optimization of nonwoven webs. Based on the significance of these techniques for lab and large-scale production of nonwoven webs electrospinning techniques were utilized. Along it, the measurable influence of electrospinning parameters was also investigated. The results revealed that, the present method was found to be a useful means for study of production and electrospinning process with least faults and defects. The nonwoven web was used for specific application and based on the outcomes and results it was concluded that, they are not only be utilized in respiratory protection but also ideal material for heat generation. These results and observations can further lead to more focused studies in said fields.

## EXTRUSION DIE DESIGN FOR COMPOSITE FILAMENT FABRICATION: PART A

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A new melt extrusion die design was developed composed of two parts, outer shell, and inner structure. The outer shell was designed in a cylindrical shape having a hollow conical shape at the central axial position from top to near bottom. A hollow disc shape ring was developed at the central axial position of the bottom end of inner part joining the hollow conical shape to the end of the outer part. The inner structure was designed as a hollow conical tube with tri-lobes (wings) around it. The conical tube has a hollow conical shape at the central axial position for the passage of core polymer/metallic filament. The schematic illustration of the extrusion die parts and complete extrusion die set are shown in Figure 1 and Figure 2 respectively. Industrial die design rules were considered to design these designs. This melt extrusions die can be used for fabrication of coaxial composite filaments for multiple applications in SMART and intelligent textiles.

**Keywords:** Extrusion die, Melt spinning, composite, Filament, Design

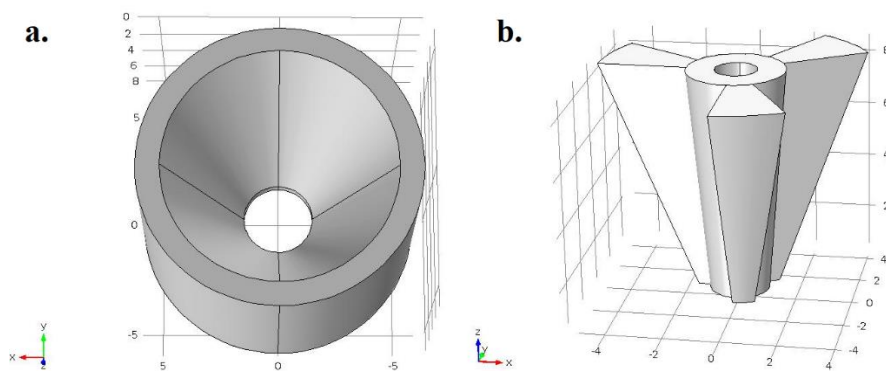


Figure 1. Schematic illustration of extrusion die parts, a. Outer shell; b. Inner structure

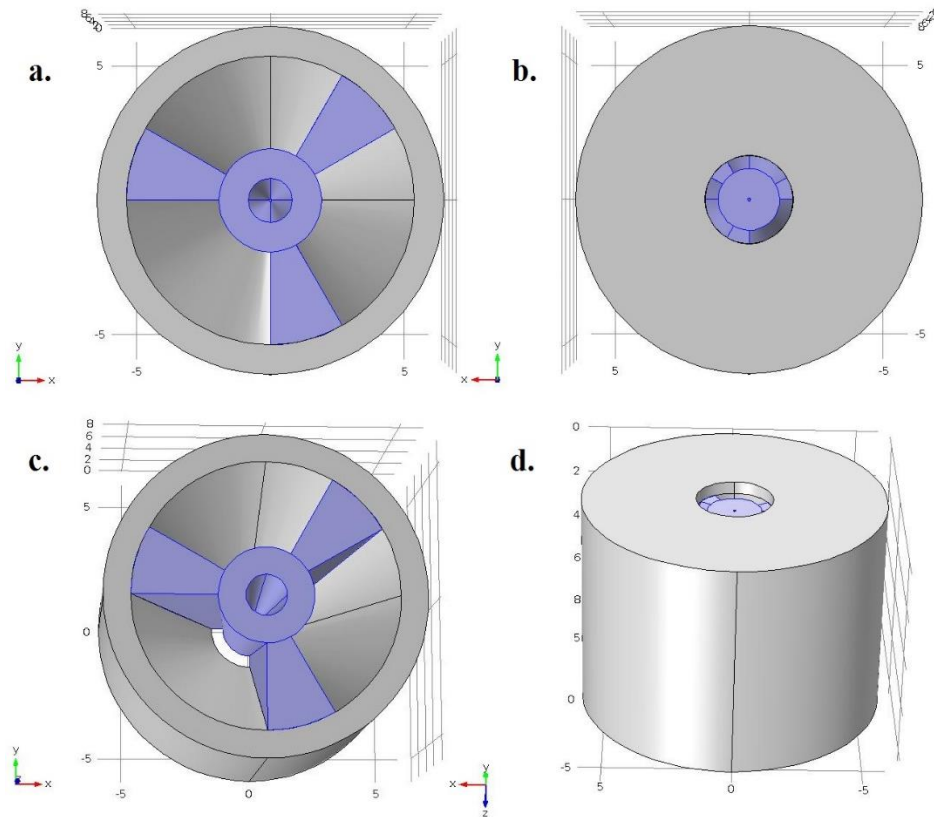


Figure 2. Schematic illustration of extrusion die designs, a. Top view; b. Bottom view; c. Inclined top view; d. Inclined bottom view

## **FABRICATION OF HIGHLY FLEXIBLE, LIGHT WEIGHT INTRINSICALLY CONDUCTIVE NANOFIBERS USING SILVER NANOCLUSTER**

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Porous electrodes with high flexibility and low density have become source of attraction due to substantial increase in demand of conductive and smart textiles. In order to meet the exponentially growing demand of robust, light weight flexible electrode, electrospun nanofibers provides a suitable and economical solution with ultra-high flexibility, low rigidity and facile synthesis routes. Here in this work, the fabrication route of a novel electrode material with high flexibility and conductivity is reported using electrospun nanofibers uniformly coated with silver nanoclusters. The silver nanoclusters were fabricated on the surface of polyvinylidene fluoride (PVDF) by the chemical reduction of silver precursors directly incorporated in PVDF nanofibers. The 1D-0D hybrid electrospun nanofibers based system provides two steps synthesis route for intrinsically conductive and mechanically durable nanofibers with high porosity. The presence of silver nanocluster makes the highly flexible nanofibers matrix electrically conductive owing to its significantly small size and uniform distribution while the mechanical robustness of polymeric matrix provide high resistance against high strains. The fabricated electrodes were demonstrated as strain sensors having the ability to distinguish strains of varying amplitudes proportional to change in their electrical resistance. The reported methods provide novel and facile synthesis route for intrinsically conductive high performance electrospun nanofibers for electrodes and strain sensing applications.



## HIGH STRAIN RATE COMPRESSIVE BEHAVIOR OF ARAMID AND UHMWPE COMPOSITES

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In this paper, high-strain-rate compression properties of aramid and ultra high molecular weight polyethylene (UHMWPE) composites with different fiber architectures in the out of-plane direction are tested at room temperature on a SHPB apparatus. The objective was to investigate the effect of fabric structure and material on the out of plane properties of the developed composite materials. The stress-strain and energy absorption behaviour of these composite samples was determined at different compression rates and compared with each other. Three different fabrics were used as reinforcement and nolax A21.2007 low density polyethylene (LDPE) adhesive film was used as a matrix system.

The compressive behaviour of Aramid and UHMWPE composite panels reinforced with different fiber architectures was determined with a SHPB apparatus at four different pressures to change the strain rate. The results show that composite panel L1 reinforced with UD aramid-GS3000 has excellent out of plane compression properties at all compression pressures. The stress initially showed a nearly linear increase with strain and became non-linear at the later stage of deformation. The areal density, tensile modulus and architecture of the reinforcing material are the main factors affecting the dynamic properties of composites. The materials possessing high modulus, low density and non crimp UD fabrics disperse the strain wave rapidly away from the impact point. It is also justified by the high peak stress value of the hybrid composite panel L2, reinforced with UD aramid-GS3000 and UD-UHMWPE-H62. The energy absorption of the composite panel L2 is best at all pressures. When compared L1 and L3, yarn crimp in the fabric is the important properties affecting as negative the energy absorption properties and peak stress of the composite material.

**Keywords:** Split Hopkinson Pressure Bar, Strain Rate, Energy Absorption

## **HOW ENTREPRENEURIAL EDUCATION CAN BOOST TEXTILE INDUSTRY IN PAKISTAN?**

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Right now, Pakistan is the young nation in which 65 percent of the population is less than the age of 30 years. This may be called as dividend, if productive, otherwise it can be end up as death trap. With this statement, the education system must respond and integrate with market and industry. In Pakistan, the industrialization is synonym to textile industry evident from our exports that is 60 percent of total. Recently, this trend is downward that alarming for the nation growth and development. In this regard, an effective an effective entrepreneurial environment is a strong education system. The graduates would have entrepreneurial skills, including technical skills, financial acumen, and the ability to recognize market opportunities, synthesize information from a variety of sources, and organize and manage operations. There is a need of strong university culture that bring the entrepreneurial mind set among the teachers and students. This should incorporate knowledge, skill and confidence to produce quality graduates. A humble effort is made by Sukkur IBA university to provide entrepreneurial mind set and professionally work in textile industry. This is an area in which considerable room for improvement exists in both the nation as a whole and in Faisalabad City. Along with practical experiences, a good general education and life-long learning opportunities are imperative for entrepreneurial success.

## **INNOVATION IN WEAVING TECHNOLOGIES AND THEIR IMPACT ON TEXTILE INDUSTRY**

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The weaving process is the bottleneck in the pipeline of woven fabric manufacturing and as such, the weaving machines must run at high efficiency and speed to increase their productivity while producing high quality fabrics. Realizing this fact, machine producers developed high speed weaving machines with numerous automated features, such as automatic pattern/weave change, variable pick density, weft break detection and repair, variable weaving speed, online fabric inspection, and adaptive control system in air jet weaving. The weaving automation and speed have reached the limit. In recent years, the focus is directed toward developing machines for the formation of innovative textiles. The purpose of this presentation is to shed light on the most sound recent weaving and weaving preparation technologies, including sample equipment for rapid prototyping, and to emphasize their capabilities for the production of industrial fabrics, intricate designs, carpet, and 3D fabrics. The presentation will also address the opportunities these innovative technologies brought to the woven fabric developers, researchers, and textile industry.

## **INVESTIGATION OF EFFECT OF CRIMP IN CARBON COMPOSITES FOR AEROSPACE APPLICATIONS**

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Crimp in fabric is defined as wavy path introduced in fabric when warp and weft yarns interlace. Crimp affects abrasion resistance, shrinkage and mechanical properties.

T300 carbon plain weave and Uni-directional fabrics were used as reinforcements with epoxy resin to prepare composite samples according to ASTM D-3039. Coupons were subjected to mechanical testing. UD fabric samples showed higher values of UTS (1454.8MPa), E (7.42%), Elasticity modulus (48.2GPa) and Average break load (75.02KN). In comparison plain weave coupons had UTS (625.83MPa), E (4.675%), Elasticity modulus (27.71GPa) and Average break load (32.44KN). These composite laminates were converted to sandwich samples using 3.2mm cell size Nomex honey comb. The 3-point bending plus Compressive load results obtained were (UD/PW) 3.07/2.36 and 4.56/3.83 respectively. This behavior of decreased mechanical performance of plain weave fabric as compared to UD is due to presence of overlaps in the weaved fabric composites.

The future work is envisaged with composites having non-woven and stretched tows fabrics. This is expected to produce improved mechanical performance of these types of composites with applications for airframes.

**MARKET BACK INNOVATION: PAKISTAN'S TEXTILE INDUSTRY**

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This talk will focus on transformation of innovation from technology forward to Market Back Innovation to bring new experiences with textiles. Textiles are an integral part of our everyday lives (clothing, bedding, bath, upholstery, carpet, curtain, etc.). This talk will explore the opportunities of embedding Technology into everyday Textiles to deliver new experiences in health, safety, entertainment, military, etc. Smart Textiles provides the opportunity to evolve the textile industry for a globally competitive low margin business to an innovative high margin industry. This will drive higher wage employment, economic growth and prosperity in the region. At a grass root level, Smart Textile is a great platform to train students to become innovators and entrepreneurs while at the University using a multi-disciplinary approach. This will lead to creation a portfolio of start-ups that evolve into successful businesses. The presentation will discuss the market back innovation methodology using multi-disciplinary approach as well as specific case studies to demonstrate the effectiveness of this approach.

## **CLUSTERING AND EFFECT ON INNOVATION: APPLICATIONS IN BURSA**

Mehmet Karahan and Mustafa Hatipoğlu

Bursa Chamber of Commerce, Bursa Turkey

Bursa is located in the Marmara region and is Turkey's fourth largest city. It is coastal to Marmara Sea and has a logistic location with land, rail, sea and air transportation.

Bursa is the 4th biggest city and also one of the biggest industrial cities of Turkey, with 22 organized industrial zones and annual exports of over 15 billion dollars. It is also a very attractive city in terms of employment. There are over thousand large companies in Bursa. There are 65 R&D center of them. There are also two universities one technology development zone in the city. It has a very advantageous position as logistic. It is the logistic most advantageous city in terms of being on the İzmir-Istanbul highway, being very close to harbour, and having an airport and railway connections.

The most important competitive elements of Bursa are the advanced industrial infrastructure. The main sectors in Bursa are automotive, textile, machinery-metal and plastic industry. These sectors have international competitiveness and are committed to raising the value added in production.

Increasing value added in production and more production of high technology products are among the top priorities of Bursa. For this reason, in Bursa, there is a correct conversion of the higher value-added production in the main sectors. With their strong infrastructure, the companies are shifting from standard production to extremely high value-added products. For this purpose, clustering and establishment of common R & D centers in the main sectors are encouraged the conversion in Bursa. We will be talking about the work done especially in the name of clustering.

There are 18 professional councils in total within the Bursa chamber of commerce. In this way, public sector support, known as the International Competitiveness Development Project (other name is shortly URGE, let's talk about it as URGE), was first applied for different sectors. The goal here is to create a semi-cluster with Urge support and then to make it a permanent cluster..

The Bursa Chamber of Commerce has created a unit to manage these activities. This unit is responsible for the execution of all Urge, clustering and other sectoral projects. As you can see,

two of these sectors are composite and textile. In these areas not only clustering, but also the establishment of excellence center has been realized.

## **NANOTECHNOLOGY INNOVATIONS AND APPLICATIONS IN TEXTILE INDUSTRY**

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During the last few decades, a dramatic development has been witnessed in the field of materials especially to control their chemical and physical properties by controlling their nanoscale features. Nanomaterials possess unique chemical and physical properties depending on their nature, size, shape and surface chemistry and are entirely different from those of their building blocks i.e., atoms or molecules and their bulk macroscopic counterparts. The resulting technology, generally known as Nanoscience & Nanotechnology, has impacted various fields due to the tremendous applications of nanoscale materials properties in biomedical sciences, energy, environment, and industries including textile industry. It is always difficult for a new technology to penetrate and diffuse into the traditional sectors but the innovation in Nanotechnology has already led its way to many industries including Textile industry. This talk would, therefore, be an overview of our research in the field of Nanoscience & Nanotechnology and its role to impact various technological sectors including Textile industry.



## NEEDLELESS ELECTROSPINNING: BULLET-SPINNERET

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In this study, a bullet spinneret was used as a fiber generator to spin the Nano fibers for the mass production of nanofibers. To evaluate the each step Poly Vinyl Alcohol was used as a model polymer. Electric field profile and intensity of electric field norm was measured by using the modeling software COMSOL Multiphysics 5.0 and it was found that the electric field is most concentrated on the tips of bullets which facilitate the formation of nanofibers at very low voltage around 24 KV. Influence of electrospinning parameters such as applied potential difference, polymer concentration and spinning distance on the fiber morphology and productivity were also investigated and it was found that the operating parameters play key role on the fiber morphology and productivity. The tensile properties of attained nanofibrous membranes were also investigated and it was found the resulted nanofibrous possess a very good mechanical properties. This spinneret has the ability to be scaled to be used for mass production of nanofibers.

**Keywords:** Needleless Electrospinning, Bullet-spinneret, Nanofibers

## **TEXTILE HELMETS FOR CIVIL APPLICATIONS**

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Civil workers used to wear helmets made of thermoplastic material developed from injection moulding process. In current study, state-of-the-art technique for manufacturing of industrial-helmets from continuously textile reinforced fabric has been discussed. Intentionally, conventional textile materials were used to develop continuously textile reinforced industrial-helmets. Industrial-helmets produced have been tested for impact protection. The industrial-helmets produced, seem to have better impact protection as compared to industrial-helmets developed from injection moulding process.

## **THE CHALLENGE OF COMPOSITES FOR AEROSPACE INDUSTRY**

Professor Dr. Brian Henderson

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Carbon fibre reinforced composites (CFRC) are already established in automotive manufacturing today. The performance of CFRCs very much depends upon the material properties of the carbon fibres, the matrix resin and the interaction between them. The aerospace industry cannot progress without the lightweight advantages of this class of materials. However, the industry is waiting for the next development step in the breakthrough in scaling up to high-volume production in order to reduce manufacturing costs. The composite industry must consider the most significant challenges that come with mass production. This keynote lecture will highlight the various aspects of CFRP production for aerospace applications including composite design, material properties, manufacturing processes and advances in textile preforming.

## **THE NEED OF INNOVATION AND ENTREPRENEURSHIP FOR ECONOMIC DEVELOPMENT OF PAKISTAN**

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The Institute for Policy Reforms (IPR) factsheet claims that unemployment rate in Pakistan is around 8.5%. IPR further reveals that the number of educated jobless persons is double the illiterate unemployed, thus hitting the educated class most. The aforesaid statistic suggests innovation and entrepreneurship is ever important for the economic development of the country. But what makes an entrepreneur a success? These are real passion, professional skills, sound character and external support. Like male, female students sometimes have many brilliant plans but lack practical tools such as financing, marketing, etc. to make businesses out of ideas. Among more than 126 million worldwide women entrepreneurs, Pakistani women constituting 1% of women population are struggling and succeeding in business enterprise. There are many institutions working in the country to help women in enhancing their entrepreneurial skills, for example, SMEDA and Trade Development Authority of Pakistan.

How textile products are sold is changing quickly. On account of diminishing sales, hundreds of traditional “brick” retail stores are diminishing as a result of “click” stores across the globe. There is a tremendous opportunity while producing locally and selling globally via internet using distribution channels of existing courier services. Currently, we see that entrepreneurs joining textile and clothing sectors are from outside with no past experience or education in textile or clothing industry. This sector requires far less cost of doing business than other industries for a startup company on a smaller scale. Only a few thousand rupees are sufficient to go viral on internet while using the available resources. Unfortunately, in Pakistan most of the so called entrepreneurs are running inherited static businesses following ‘imitation’. However, the innovation attribute of entrepreneurship is vital for all industries including textile. Entrepreneurs use textile innovation as their tool to bring novelty and competitive advantage to the processes and products. They may get innovative ideas from knowledge spillovers especially from

geographically localized research institutes. Moreover, entrepreneurs of newly created textile and fashion companies require certain support services such as space, funding access, business networks and training. Numerous universities including National Textile University, Faisalabad is progressing fast to make available such services in the form of Business Incubation Centre with the help of Higher Education Commission of Pakistan.

As last remarks, there are also growing global opportunities in the next generation technical textiles for the young entrepreneurs who have experience and education in textile. The market for technical textile is expanding in the country and across globe from diverse segments such as healthcare, construction, agriculture, armed forces, automotive, sports, etc. There is a need to highlight further this tremendous opportunity among academicians and young professionals. National Textile University, Faisalabad is doing this job by organizing international events and conferences like this on the subject.

## **THE ROLE OF ACADEMIA TO ENCOURAGE ENTREPRENEURSHIP WITHIN THEIR LOCAL ECOSYSTEM**

Andrew

Universities play a crucial and multifaceted role in encouraging entrepreneurship for the communities within which they reside. They provide human capital development for both entrepreneurs and startup employees. University researchers are also responsible for the creation new technologies, some of which have commercial potential. In addition, many faculty at universities are experts in their field and can serve as advisors or mentors to new ventures. This presentation will discuss the diverse ways in which universities and their personnel can encourage venture creation. It will also present case studies for university-inspired entrepreneurship, including examples from university-developed research, as well as entrepreneurship not based on intellectual property. The presentation will conclude with pragmatic recommendations for universities that wish to play a more prominent role in encouraging entrepreneurship within their local ecosystem. Recommendations to be introduced include strategic partnerships, commercialization of university research, and methods for encouraging student entrepreneurship.

## **THERMAL CHARACTERIZATION OF PHYSICAL PROPERTIES OF CELLULOSE SOLUTIONS IN N,N-DIMETHYL ACETAMIDE AND LITHIUM CHLORIDE**

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Cellulose is a promising biodegradable natural polymer with potential applications in the fields of textile, paper, and membrane. Owing to its higher crystallinity along with inter-, intramolecular hydrogen bonding, however, it is dissolved in limited number of solvents. N, N-dimethylacetamide (DMAc)/ lithium chloride (LiCl) is one of these limited solvents with advantage of lower toxicity and smaller extent of cellulose degradation in comparison with other solvents. Molecular chain structure of a polymer in a specific solvent is a function of the solvent characteristics, molecular weight and polymer concentration. Even though these aspects are essential, the temperature has fundamental influence on molecular parameters and hence the physical properties of the polymer solution. The physical properties of cellulose solutions in LiCl/DMAc were investigated in terms of temperature, molecular weight and polymer concentration. The cellulose solutions in DMAc/LiCl exhibited a lower critical solution temperature (LCST) behavior as the intrinsic viscosity of cellulose solutions was decreased with increasing temperature over the observed range of temperature 30 to 60°C. In addition, LCST system of both cellulose solutions proved thermoreversible. In the dilute and semi dilute concentration regime of 0.1 to 2.5 g/dl, the cellulose solutions turned over a drastic increase of the  $\eta_{red}$  in the proximity of 0.9 g/dl irrespective of temperature and molecular weight.

**Key words:** Cellulose, N,N-dimethylacetamide, lithium chloride, intrinsic viscosity, thermos-reversibility

## VECTOR PROTECTIVE TEXTILES

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In biology and medicine, the term “vector” stands for carriers of infectious diseases, which transmit pathogens to another organism either through contact or by biting without becoming infected itself. Protection from vectors inside the premises is successfully done by insecticide spraying, smoking, fumigation and/or air shield. However, protection of individuals in outside environment is challenging, which needs to be addressed seriously. Vector borne diseases are a major threat not only in tropical areas but also in cold-temperate zones where the presence of insects like mosquitoes can be annoying and harmful. Even today, mosquito borne diseases like malaria and dengue fever cause a lot of deaths worldwide.

Engineered fabrics are considered effective to some extent for personal protection against mosquito bites. Currently, there are three main treatment techniques of fabric with an insecticide; absorption, polymer coating and microencapsulation. The efficacy and longevity of protection provided by these techniques need to be studied carefully. The washing method and heat exposure also have an effect on the efficacy of such engineered fabrics. Thus a comprehensive study on these treatment techniques is required so that the duration of protection can be enhanced.

**Keywords:** Diseases, environment, Mosquito, Personal protection Vectors,