	Title of the reference	Name of the fiber	Select application	Materials	Products developed	Technologies	Equipment	Developing methods	Risks	Dissipate properties	Conductive propertie	Chemical safety
1	A novel breathable flexible metallized fabric for wearable heating device with flame-retardant and antibacterial properties	Copper Nanoparticles Networks/Nylon 6	Nanoparticles nonferrous for flexible semiconductors	Copper Nanoparticles Networks/Nylon 6 Woven Fabric (CNNs/NWF) based on PA/APTES hybrid coating	Wearable heater; anti-bacterial, breathable, flame resistant	Sol-gel; Catalytic surface activation; Electroless deposition	Standard wet chemistry equipment	Standard wet chemistry methods	Copper nanoparticles are a moderately toxic material	High heat dissipation, thermal conductor	Electron conductor	Oxidation resistant
2	Conductive cotton fabric using laser pre-treatment and electroless plating	Cotton (laser treated; copper plated)	Flexible sensors/actuators	Laser-treated conductive cotton fabrics by means of copper metallization techniques	Health monitoring; smart sensory; wearable electronics; actuator systems	Laser treatment of cotton fabric; electroless copper deposition	Adjustable CO2 Laser source; Standard wet chemistry equipment	Modification of cotton fabric, laser treatment, wet chemistry	Copper remains exposed to sweat and produces water soluble oxidations products	-	Electron Conductor	Copper ions: NFPA 704 Health Level 2: Intense or continued but not chronic
3	Plasma-based treatments of textiles for water repellency	plasma-treated clothing	Smart flexible sensors/actuators non-invasive wearable	Plasma treatment of textiles is now used in an emerging faction of the textile industry. This refers to the production of smart textiles. Smart textiles are fabrics that have technological components such as microcontrollers, sensors, actuators, and even computers embedded into them. Plasma treatment of textiles is used in this industry as part of the production of integrated circuits and it is also used to make these components hydrophobic.	Hydrophobic coatings are a very important use for plasma treatment of textiles as it has benefits for medical purposes. The fabric that lab coats, gloves, and surgical smocks are made of could undergo plasma treatment for textiles to make them hydrophobic. Hydrophobic fabrics have the benefit of not being able to absorb water. This makes them resistant to dirt and bacteria. When trying to create a sterile setting such as in an operating room, this is a much desired characteristic	Plasma treatment of textiles is a growing function of plasma technology. Using Thierry's low-pressure systems, plasma treatment of textiles is used to pre-treat fibers to increase wettability which allows for solvent free dyes to absorb and bond very strongly	Plasma treatment of textiles is used to pre-treat fibers to increase wettability which allows for solvent free dyes to absorb and bond very strongly.	plasma treatment of textiles is used to coat fabric with a specialized layer with varying characteristics.	N/A	It has proven to be successful in shrink-resist treatment of wool with a simultaneously positive effect on the dyeing and printing	temperature safety	..
4	New Design of a Soft Robotics Wearable Elbow Exoskeleton Based on Shape Memory Alloy Wire Actuators	Shape memory alloy.	Flexible sensors/actuators	Shape memory alloy	Mmedical rehabilitation exoskeleton for the elbow with one degree of freedom for flexion-extension.	Development of SMA-based actuator,	-	Modelling in MATLAB/Simulink.	-	Nonlinear behaviour in heating/cooling processes.	Electroconductive	Safe
5	Presentation of textile pneumatic muscle prototypes applied in an upper limb active suit experimental model	Kevlar and Twaron aramid yarns	Flexible sensors/actuators	Twist braided cords	prototype of textile pneumatic muscles	Braiding	-	-	-	Impermeable to air, externally collocated, cylindrical shape.	Electroconductive.	Safe.
6	Electrical Characterization of Conductive Threads for Textile Electronics	Silver coated polyamide	Smart flexible sensors/actuators non-invasive wearable	Silver coated polyamide	wearable electronics	Silver-Tech by Shieldex®	Spinning	3D using Autocad by Autodesk,	-	Conductivity	conductive threads	Possible toxicity
7	The electromagnetic shielding properties of some conductive knitted fabrics produced on single or double needle bed of a flat knitting machine	copper (Cu) and stainless steel (SS) yarns	Textiles for electromagnetic shielding	Knitted fabric	Fabric for electromagnetic shielding	Knitting	electronic flat bed knitting machine	Knitting from electroconductive yarns	-	Low resistance, electromagnetic shielding, flexibility	Electroconductive	Safe
8	A calculating method for the electromagnetic shielding effectiveness of metal fiber blended fabric	Metal fibres	Textiles for electromagnetic shielding	woven fabric containing metal fiber yarns	woven fabric for electromagnetic shielding	Weaving	Weaving loom	grid model, theoretical calculation	-	shielding effectiveness	Electroconductive	Safe
9	Textiles feel the pressure	-	Smart flexible sensors/actuators invasive wearable	heat-sensitive thermoplastic polyurethane	printed pressure sensors	3D printing	3D printer	pressure sensors incorporation into the fabric	-	Stretchability and flexibility	-	-
10	Poly(vinylidene fluoride) nanofiber-based piezoelectric nanogenerators using reduced graphene oxide/polyaniline	electrospun poly(vinylidene fluoride) (PVDF) nanofiber	Nanoparticles nonferrous for flexible semiconductors	rGO- and rGOPANI-doped PVDF nanofiber mats and rGO, PANI and rGOPANI-spray-coated PVDF nanofiber mats	electrospun poly(vinylidene fluoride) (PVDF) nanofiber-based piezoelectric nanogenerators	Electrospinning	Electrospinning	Doping of nanofibres.	-	Converting of waste mechanical and radiative energy to electricity that can be used in self-energy generating systems and sensor technologies	Conductive	reduced graphene oxide (rGO)
11	Flexible nanogenerators for wearable electronic applications based on piezoelectric materials	-	Smart flexible sensors/actuators non-invasive wearable	Bio-based piezoelectric materials	flexible piezoelectric nanogenerators	Flexible composites	-	-	-	Flexibility	Conductive	-
12	Highly skin-conformal wearable tactile sensor based on piezoelectric-enhanced triboelectric nanogenerator	Nanofibres	Smart flexible sensors/actuators non-invasive wearable	piezoelectric-enhanced triboelectric nanogenerator	skin-conformal wearable tactile sensor	Spin-coating	-	-	N/A	high flexibility, excellent sensitivity and wide measurement range	Conductive	-
13	Modified graphene-based nanocomposite material for smart textile biosensor to detect lactate from human sweat	Hydrophobic cotton and embroidered conductive silver yarn	Smart flexible sensors/actuators non-invasive wearable	graphene-based nanocomposite	Smart-textile biosensor for lactate analysis from sweat	embroidering and coating	-	-	-	low-cost, simple, fast, and reproducible properties	Conductive	-
14	Aluminium powder used for textile coating	raluca.maria.aileni@gmail.com	Textiles for electromagnetic shielding	Aluminium	Conductive textile coated with aluminium	Direct printing, Spraying, Lamination, Sputter Coating	Print frame, Cold spray, Fabric lamination machine, Magnetron sputter coating system	Textile coating using paste based Al microparticles (printing, kamination, spraying methods). Textile coating with thin layer of aluminium by sputtering method.	1. neurotoxic effect; 2. carcinogenic effect; References:	Yes	Yes	Safety data sheet aluminium: https://www.carlroth.com/medias/SDB-5285-GB-EN.pdf?context=bWFzdGVyfHNlY3VyaXR5RGF0YXNoZ
15	A carbon nanotube-based textile pressure sensor with high-temperature resistance; Review of toxicity studies of carbon nanotubes	CNTs fibers	Flexible sensors/actuators	Textile coated with CNTs.	Antennas, electromagnetic shields.	Foulard, Screen printing. Textile lamination machine.	Foulard, Textile lamination machine, 3D printer.	Direct printing, lamination, transfer coating, and immersion.	Health risks: inflammation, injury, fibrosis, and pulmonary tumors.	-	semiconductor	CNT toxicity includes oxidative stress, inflammatory responses, malignant transformation
16	Knitted resi: A highly flexible, force-sensitive knitted textile based on resistive yarns	RESi	Smart flexible sensors/actuators non-invasive wearable	RESi yarns	RESI yarn is used to develop wearable sensors.	Weaving or knitting technologies	Weaving loom, Knitting Machine Shima Seiki,	Weaving, knitting or sewing.	No information associated.	no	Conductive	No information associated.
17	1. Piezoelectric force response of novel 2D textile based PVDF sensors; 2. Are fluoropolymers really of low concern for human and environmental health and separate from other PFAS; 3. Effect of electrode pattern on the outputs of piezosensors for wire bonding process control.	-	Smart flexible sensors/actuators non-invasive wearable	Polyvinylidene difluoride (PVDF)	Piezo-resistive pressure sensors.	Lamination, Direct printing	Lamination machine, Printing screen	Lamination, Direct printing	1. Health risks: Irritation by eye contact, skin contact or inhalation; 2. Physical/chemical hazards: Flammable; 3. Hazards for the environment: During fluoropolymer production, the emissions can have a negative environmental impact. Moreover, PCDF is not biodegradable.	Yes. Also, PVDF has piezo-, pyro-, and ferroelectric properties.	PVDF conductivity strongly depends on temperature and frequency	Product contains no hazardous ingredients liable to be disclosed.
18	Piezoresistive sensing in chopped carbon fiber embedded PDMS yarns	Chopped carbon fiber (CCF)/polydimethylsil	Flexible sensors/actuators	Composite materials: Chopper carbon fiber integrated into polymeric matrix PDMS.	Piezoresistive CCF/PDMS composite for strain sensors development.	Injection	Injection device based syringe	1. mechanical blending of CCF and PDMS base polymer; 2. CCF/PDMS injection using syringe.	N/A	-	Conductive	-
19	Stretchable conductive yarn with extreme electrical stability pushes fabrication of versatile textile stretchable electronic	Multi-layer helical yarn (MLHY)	Flexible sensors/actuators	Woven or knits structures based on MHLY yarns.	Textile stretchable sensors.	Wrapping; Weaving, Sewing and Knitting.	Wrapping machine; Weaving loom; Knitting machine; Sewing machine	A. MHLY yarns fabrication 1. Cu fibers were wrapped around a pre-stretched polyurethane fiber forming the first layer; 2. Polyamide 66 yarns were wrapped on the first layer forming the second layer. 3. The second layer was coated with waterborne polyurethane (WPU) forming the third layer.; B. Sensors fabrication: MHLY yarns are weaved, knitted or integrated on textile surface through Sewing, Knitting, Weaving	-	no	conductive	-
20	Optimization of electroless nickel plating on polyester fabric	-	Textiles for electromagnetic shielding	Nickel coated polyester fabric	Flexible electromagnetic shields	Plating technology	Electroplating Plants	Electroless plating	Health risks: skin irritation, allergy, cardiovascular and kidney diseases, lung fibrosis, lung and nasal cancer.	-	conductive	Health risks: skin irritation, allergy, cardiovascular and kidney diseases, lung fibrosis, lung and nasal
21	In Situ Loading of Polypyrrole onto Aramid Nanofiber and Carbon Nanotube Aerogel Fibers as Physiology and Motion Sensors	ANF/CNT/PPy aerogel fiber	Textiles for electromagnetic shielding	Porous aramid nanofibers (ANF), carbon nanotube (CNT) aerogel fibers (CNT) coated with polypyrrole (PPy) layers	ANF/CNT/PPy aerogel fiber used for motion sensors	wet spinning	Wet spinning machine	wet spinning	Health risks: CNT exposure can lead to asthma, bronchitis, emphysema and lung cancer	no	conductive	-
22	Energy Harvesting from Piezoelectric Textile Fiber	Piezoelectric textile bi-component fiber	Flexible sensors/actuators	PVDF sheath, Conductive composite core	Piezoelectric fibers for energy harvesting devices	Melt Spinning, Electrospinning	Melt spinning equipment (Extrusion Systems Limited, UK), Electrospinning equipment	Melt Spinning, Electrospinning	-	Yes	-	-
23	Knitting and weaving artificial muscles	-	Flexible sensors/actuators	Textuator	Actuators based textiles and electroactive polymers: artificial muscles	weaving, knitting, coating	Weaving loom, Knitting machine, Film Coating Machine	weaving, knitting, coating	-	-	conductive	N/A
24	Energy harvesting textiles for a rainy day: woven piezoelectrics based on melt-spun PVDF microfibres with a conducting core	-	Smart flexible sensors/actuators non-invasive wearable	Textile bands with yarns of melt-spun PVDF microfibres with conductive core	Energy harvesting textile	Weaving	Weaving loom	weaving	N/A	-	conductive	-
25	Energy harvesting textiles for a rainy day: woven piezoelectrics based on melt-spun PVDF microfibres with a conducting core	Piezorezistive microfibre based carbon	Smart flexible sensors/actuators non-invasive wearable	PVDF (sheath), Core (carbon black/polyethylene), Outer layer: silver paste	Piezorezistive microfibre coated with silver paste for sensors for heartbeat and respiration sensors	Melt spinning, coating	Melt spinning machine, Yarn coating machine	melt spinning, coating	Health risks: inflammation, allergies in case of skin contact with a surface coated with silver (rarely reported).	-	conductive	N/A
26	Gold coated para-aramid yarns through electroless deposition	gold coated paramide	Flexible sensors/actuators	pararamide and gold	none	none	none	yes	none	no	yes	not relevant
27	Copper-coated textiles: armor against MDR nosocomial pathogens	copper coated paramide	Microparticles nonferrous for flexible semiconductors	paramide and copper	none	none	none	yes	none	none	yes	none
28	Metallization of synthetic fibres by nickel	nickel coated PAN	Smart flexible sensors/actuators non-invasive wearable	nickel and PAN	no	no	no	yes	skin irritation due to nickel	no	yes	skin irratation due to nickel
29	Antimicrobial properties of gold and copper-coated textile electrodes produced though electro-less deposition	Gold and copper-coated textiles	Smart flexible sensors/actuators non-invasive wearable	gold copper and pararamide	yes	none	no	yes	no	no	yes	no
30	Electrical Characteristics and Performance of Yarns made of Gold Coated Fibers	gold coated fibers	Smart flexible sensors/actuators non-invasive wearable	gold and paramide	yes	none	none	yes	none	none	yes	none
31	Textile Sensors for Bio-Physiological Signals	copper coated paramide fiber	Flexible sensors/actuators	copper coated paramide fabric	yes	no	no	no	no	no	yes	none
32	Development of conductive threads using experimental laboratory device	cooper coated yarn	Textiles for electromagnetic shielding	copper and paramide	yes	yes	electroless coating bath	yes	no	no	yes	no
33	DEVELOPMENT OF GOLD COATED THREADS AND IMPLEMENTATION INTO A WEARABLE SYSTEM	gold coated thread	Flexible sensors/actuators	gold coated thread	yes	no	no	no	no	no	yes	no
34	Design and prototyping of wearable measuring system for trunk movement using textile sensors	nano electro active polymer	Flexible sensors/actuators	nano electro active polymer	yes	yes	motion detector	no	no	no	yes	no

35	Continuous spinning aligned liquid crystal elastomer fibers with a 3D printer setup	Liquid crystal elastomer (LCE)	Flexible sensors/actuators	Acrylate liquid crystal (LC) monomer (RM82, 95% purity) spacer 2,2'-(ethylenedioxy)diethanethiol vinyl spacer 1,3-divinyltetramethyldisiloxane (DVS, 97% purity), vinyl cross-linker 1,3,5-triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione (TATATO, 98% purity) and 2,4,6,8-tetramethyl-2,4,6,8-tetravinylcyclotetrasiloxane (TVCS, 95% purity)	The LCE fibers can be knit, sewn, and woven to form a variety of smart textiles. The fiber is also used to mimic bicep muscles with both large activation force and activation strain. By incorporating further intelligent characteristics, such as conductivity and biosensing into a single fiber, the LCE fibers could be potentially used for smart clothing, soft robotics, and biomedical devices	3D printing, spinning	A proof-of-concept device for spinning LCE fibers, collecting the thread extruded from a 3D printer head onto a motor-controlled collector bobbin, with UV light completing the crosslinking in the fiber	It can be produced by using direct ink write (DIW) printing. Other methods are based on electro-spinning or micro-fluidic techniques	too-weak light intensity does not bestow enough cross-linking points to the stretched oligomer ink in a short time, so the fiber would eventually break by tapering off while travelling to the collector. On the other hand, too-strong UV light, while preventing the fiber breaking in flight, may cause immediate strong gelling of the extruded oligomer filament before alignment, and causes jamming the nozzle.	Considerable stored elastic energy density; able to thermally actuate, with a much faster response due to the fast heat diffusion across thin material.	Additional components can be incorporated to donate conductive properties	N/A
36	High-sensitivity, fast-response flexible pressure sensor for electronic skin using direct writing printing	N/A	Smart flexible sensors/actuators non-invasive wearable	Graphene nanoplatelets and multi-walled carbon nanotubes, PEO, ethanol	energy production, biomedicine, bionic robots, wearable electronics. In particular	direct-write printing technology based on Weissenberg principle	self-made direct-write platform used to fabricate the sensitive structure of the sensor, direct writing printing system	GNPs/MWCNT filled conductive composite flexible pressure sensors on PDMS substrates	The increase in the bending number of the sensitive structure inevitably lead to an increase in the sensor area, which was not conducive to integrated manufacturing. It is needed to select a moderate bending number of the sensitive unit to obtain a good detection effect.	Artificial electronic skin simulates the basic characteristics of human skin (such as pressure perception, stretchability and transparency	three-dimensional conductive network providing more transmission channels and enhancing the conductive stability	N/A
37	Flexible Textile Strain Sensor Based on Copper-Coated Lyocell Type Cellulose Fabric	Lyocell	Smart flexible sensors/actuators invasive wearable	Potassium hydrogen L-tartrate, Tin(II) cloride X 2 hydrate, formaldehyde, copper sulphate pentahydrate, ethanol, ammonia, sodium carbonate, silver nitrate, sodium hydroxide, woven cellulose lyocell fabric	Energy storage devices, photodetectors, pressure sensors, light emitting displays	knitting, wowing, electrospinning machines,	knitting, wowing, electrospinning machines	Coating of metallic copper layers on woven cellulose lyocell fabrics through electroless deposition	Permanent stress and deformation of conductive textiles could lead to demages.	temperature sensing	introduced electrical conductivity through the coating	Cellulose is an important textile substrate due to its biodegradable, biocompatible, eco-friendly, non-toxic and renewable properties
38	Application of Polyaniline for Flexible Semiconductors	Wool, polyamide	Nanoparticles nonferrous for flexible semiconductors	Aniline 99%, polystyrene sulfonate acid, ammonium persulfate, distilled water, chloroform, wool, polyamide	Conducting polymers, such as polyaniline (PANI), are used in numerous applications in sensors, in textiles with antimicrobial properties, or in smart textiles for data transfer, electrotherapy, defense technology and electromagnetic materials for monitoring health. The templated polyaniline- wool Nylon Lycra fabrics were suitable for application such as wearable strain gauge materials that can be used for biomechanical monitoring.	Attenuated Total Reflectance (ATR), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM)	Attenuated Total Reflectance (ATR), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM)	Conducting textiles (wool, polyamide), coated with polyaniline (PANI)–polystyrene sulfonic acid (PSSA), obtained through two synthesis methods: water based and emulsion in chloroform.	N/A	low moisture retention	Electronic and ionic conductivities	N/A
39	Polymeric textile-based electromagnetic interference shielding materials, their synthesis, mechanism and applications – A review	Flexible electromagnetic interference (EMI) shielding materials	Textiles for electromagnetic shielding	Term radar absorbing materials. 1D (metallic nanowires, carbon nanotubes), and 2D (graphene, boron nitride) fillers owing high aspect ratio, are required in lesser to make the conductive path in the matrix.	Large range of applications from everyday use to high-tech applications	Knitting, Spinning	Knitting, Spinning	Extensively physically and/or chemically manipulation of various polymeric textiles such as fibers, yarn, woven, nonwoven, knitted, as well as their hybrid composites to make them act as shielding against harmful radiations. For attenuation of waves, conductive metal fibers/filaments are used solely or mixed with natural/synthetic fibers (both conventional and elite fibers like carbon, Kevlar etc.) [68,69], nonconductive fibers are coated with conductive materials including metals and intrinsically conducting polymers. These yarns are used to make fabrics suitable for EM shielding purposes.For attenuation of waves, conductive metal fibers/filaments are used solely or mixed with natural/synthetic fibers (both conventional and elite fibers like carbon, Kevlar etc.) [68,69], nonconductive fibers are coated with conductive materials including metals and intrinsically conducting polymers. These yarns are used to make fabrics suitable for EM shielding purposes. For attenuation of waves, conductive metal fibers/filaments are used solely or mixed with natural/synthetic fibers (both conventional and elite fibers like carbon, Kevlar etc.) [68,69], nonconductive fibers are coated with conductive materials including metals and intrinsically conducting polymers. These yarns are used to make fabrics suitable for EM shielding purposes.	The dielectric loss depends on conductivity and polarization loss. A positive relationship exists between conductivity and dielectric loss. On the other hand, polarization loss depends on material selected and its fabrication processes; and is based on electronic, ionic, dipole orientation and interfacial polarization.	The absorbed energy by EM radiations is dissipated in the form of thermal energy through dielectric loss and/or magnetic loss. To fulfill the needs of rapid technological advancements, an efficient shield must possess other characteristics such as lightweight, minimum thickness, environmental stability, flexibility, tuneable morphology, ease of fabrication, and cost-effectiveness, and textile structures are best suited for the fulfillment of these requirements.	For EM waves having frequency >300 MHz, higher electrical conductivity is required for equal attenuation of both electric and magnetic components. But in case of lower frequency radiations (<30 MHz) shielding from the magnetic component is very difficult and possible with ferromagnetic materials.	Safe
40	Textile integrated sensors and actuators for near-infrared spectroscopy	Cotton	Flexible sensors/actuators	cotton yarn, LEDs, transistors, photodiodes and transimpedance amplifiers	Smart textiles with integrated electronics and in particular optic devices are of high interest for the near-infrared spectroscopy and imaging (NIRS and NIRI) community. NIRS and NIRI are applied in many clinical applications, using different types of instruments to track oxygenation and blood flow in tissue	The system consists of two major building blocks: the sensor textile with LEDs, transistor devices to control the LEDs, photodiodes and transimpedance amplifiers to convert the photocurrent into a voltage. The second building block is the control and data acquisition hardware, consisting of a control board with a microcontroller to switch the LEDs on and off and to sample the output voltages of the transimpedance amplifiers. The control board sends the data via a USB connection to a host computer for storage and post processing	INdustrial narrow fabric loom	Integration of the light emitting diodes (LEDs) and photodiodes necessary for near-infrared spectroscopy into a woven textile using flexible plastic strips	textile integration of sensors and actuators influences the NIRS measurements, especially with regards to known limitations of NIRS systems, such as distance variation between source and detector or motion artifacts	mechanically flexiblility	Conductive threads are integrated to establish interconnections among individual flexible plastic strips.	Safe
41	Epidermal Patch with Glucose Biosensor: pH and Temperature Correction toward More Accurate Sweat Analysis during Sport Practice	polyester	Smart flexible sensors/actuators non-invasive wearable	Polyester sheet, glucose sensor consisting of a three-electrode system, carbon ink, reference electrode (RE1) consisting of just the straight track made of Ag/AgCl, enzymatic layer	Flexible skin patch that comprises a microfluidic cell designed with a sweat collection zone coupled to a fluidic channel in where the needed electrodes are placed: glucose biosensor, pH potentiometric electrode and a temperature sensor	3D printer	3D printer	Glucose, pH, and T sensors fabricated on a flexible polyester sheet as the substrate. The sensor array is then attached to a 3D-printed microfluidic cell by using adhesive transfer tape , so that the electrodes were placed coinciding with the microfluidic channel	N/A	N/A	N/A	Safe
42	Three-Dimensional Au/Ag Nanoparticle/Crossed Carbon Nanotube SERS Substrate for the Detection of Mixed Toxic Molecules	3D bimetal Au/AgNP/crossed CNT substrate	Microparticles ferrous for flexible semiconductors	Si/SiO2 substrates, CNT powder, AgNP colloidal solution	diverse applications in toxin sensing, environmental monitoring, foodsafety, clinical diagnosis and cultural heritage	electron microscopy equipped withX-ray energy spectrometer, and transmission Electron Microscope, equipped withX-ray energy spectrometer, and transmission Electron Microscope, UV-vis Spectrophotometer, -ray photoelectron spectroscopy instrument, Raman spectrometer	electron microscopy equipped withX-ray energy spectrometer, and transmission Electron Microscope, equipped withX-ray energy spectrometer, and transmission Electron Microscope, UV-vis Spectrophotometer, -ray photoelectron spectroscopy instrument, Raman spectrometer	Three-dimensional (3D) Au/Ag nanoparticle(NP)/crossed carbon nanotube film SERS substrate.	N/A	N/A	wide-range electric field distribution	Safe
43	Application of Fe3 O4 nanoparticles on cotton fabrics by the Pad-Dry-Cure process for the elaboration of magnetic and conductive textiles	cotton	Nanoparticles ferrous for flexible semiconductors	Cotton (CO) woven fabric, Iron oxide nanoparticles Fe3O4, Ethanol	applications in the fields of medical treatment, smart clothing, electronic textiles, biomedicine, sportswear, protective clothing, and space exploration activities	Fourier Transform Infrared Spectroscopy, Scanning Electron Microscope	Fourier Transform Infrared Spectroscopy, Scanning Electron Microscope	treatment of cotton using magnetic iron oxides nanoparticles in order to design a multifunctional material with interesting magnetic, thermal and electrical properties characterized by VSM, TGA and Resistivity measurements, respectively. The principle is based initially on the deposition of the Fe3O4 nanoparticles on the surface of the cotton fabric by the Pad-Dry-Cure method.	N/A	N/A	The coating of cotton fabric by Iron oxide nanoparticles gives an electrical conductivity to the fabric which makes it a semi-conductor material	Safe
44	Smart Nanotextiles: Materials and Their Application. In Encyclopedia of Materials: Science and Technology	E-textiles	Smart flexible sensors/actuators invasive wearable	Textiles	medical devices, sport equipment, defence devices	Weaving, knitting	weaving loom, knitting machine	a thread can be made to conduct electricity by either coating it with metals like copper or silver. it can also be made by combining metal fibres with cotton or nylon fibres when it is spun.	damages of e-textiles at washable process: temperature, mechanical action, chemical now as Sinners factors	N/A	yes	Safe
45	Overview of wearable electronics and smart textiles	Washable electronics	Smart flexible sensors/actuators invasive wearable	Textiles	wearable electronics	knitting, weaving	knitting machine, weaving loop	same as e-textiles	no	yes	yes	safe
46	E-Textile and its Applications	passive smart textile	Smart flexible sensors/actuators non-invasive wearable	Fabric	UV protective, Antimicrobial	knitting, weaving	knitting, weaving	they do not use electronics or internet connection. This means that all of its functions will allow it to remain in a static state the entire time it's worn.	N/A	yes	yes	safe
47	E-Textile and its Applications	active smart textile	Smart flexible sensors/actuators non-invasive wearable	fabric	healthcare industry	knitting, weaving	knitting machine, weaving loom	These fabrics will actually change to adjust the conditions of the wearer. these fabrics can also be connected to the internet	N/A	yes	yes	safe
48	E-Textile and its Applications	very smart textiles	Smart flexible sensors/actuators non-invasive wearable	Fabric	healthcare industry, sport industry	knitting, weaving	knitting machine, weaving loom	able to sense, react and adapt their behaviour to the given circumstances	mechanical and friction risks due to washable process	yes	yes	safe
49	Textile-Based Strain Sensor for Human Motion Detection	textile strengh sensors	Flexible sensors/actuators	Fabric	textile industry, protective industry	knitting, weaving	knitting machine, weaving loom	a new generation of devices, they combine strength sensing functionality with weareability and high stretchability	mechanical and temperature risks at washable process	yes	yes	safe
50	A stretchable carbon nanotube strain sensor for human-motion detection	resistive strain sensor	Flexible sensors/actuators	Sensor	textile industry	-	-	is a sensors which respond to strain deformation that the microstructure changes in the conductive materials	-	yes	yes	safe
51	Textile-Only Capacitive Sensors with a Lockstitch Structure for Facile Integration in Any Areas of a Fabric	capacity stain sensor	Flexible sensors/actuators	Sensors	textile industry	-	-	is a electronic component consisted in 2 oposite electrons from active materials which are separated by one electric layer of insulating materials between	no	yes	yes	safe
52	Conductive Textiles: Types, Properties and Applications	conductive textile materials	Smart flexible sensors/actuators non-invasive wearable	fabric	textile industry,	weaving	weaving loom	Conductive fabrics are materials that are made from, coated or blended with conductive metals including but not limited to gold, carbon, titanium, nickel, silver, or copper. Base fabric materials include cotton, wool, polyester, and nylon	safe	yes	yes	safe

53	A wearable multifunctional fabric with excellent electromagnetic interference shielding and passive radiation heating performance	Electromagnetic shielding EMs	Textiles for electromagnetic shielding	process	textile industry, automotive	woven, non-woven fabric, knitting fabric	weaving loop, knitting machine	Ems is the process of restricting the diffusion of electromagnetic fields into a space	-	no	yes	safe
54	para-Aramid Fiber Sheets for Simultaneous Mechanical and Thermal Protection in Extreme Environments	para-Aramid	Smart flexible sensors/actuators non-invasive wearable	porous, continuous para-aramid fiber sheets (pAFS)	Fabricated a non-woven fabric with ballistic and thermal protective properties	immersion Rotary Jet-Spinning	Nakanishi E3000 Motor (NR-3080S Spindle, EM-3080J Brushless motor, E3000 Controller, AL-C1204 Airline Kit	immersion Rotary Jet-Spinning	N/A	High antiballistic performance	Low thermal conductivity	Chemically Stable
55	Magnetic, conductive textile for multipurpose protective clothing and hybrid energy harvesting	Polydimethylsiloxane (PDMS) strips	Textiles for electromagnetic shielding	Carbon nanotubes (CNT) and Neodymium Iron Boron (NdFeB) microparticles on PDMS matrix	Flexible textile for multipurpose protection and hybrid energy harvesting	Triboelectric nanogenerator (TENG); Electromagnetic generator (EMG)	Chemical laboratory equipment; laser cutter	Heat curring or suspension; megnetisation	Includes nanoparticles	Electromagnetic shielding	Electric conductivity	Safe
56	Ultralight aerogel textiles based on aramid nanofibers composites with excellent thermal insulation and electromagnetic shielding properties	Aramid aerogel with modified carbon nanotubes	Textiles for electromagnetic shielding	Poly(p-phenylene terephthalamide) (PPTA), Carbon nanotubes	Thermal insulation and electromagnetic shield textileing equipment under harsh environments	Sonification; Wet Spinning; Freeze drying	No specified	Sonification; Wet Spinning; Freeze drying	Use of CNT during production	Electromagnetic shielding properties	High electric conductivity; Low thermal contactivity	Safe
57	Facile and scalable fabrication of stretchable flame-resistant yarn for temperature monitoring and strain sensing	Spandex/CNT@Aramid/Aramid (SCAA) yarn	Smart flexible sensors/actuators non-invasive wearable	Spandex; narbon nanotube (CNT)-coated aramid silver fibres; aramid silver fibres	Stretchable flame-resistant yarn for temperature monitoring and strain sensing for sensing e-textiles towards applications in harsh environment	Spray-coating; Friction spinning	Air brush; oven; friction rollers	Spray-coating; Friction spinning	Use of CNT during production	Anti-fire dissipation properties	Electric conductivity; Low thermal conductivity	Safe
58	Developing smart fabric systems with shape memory layer for improved thermal protection and thermal comfort	NiTi Filament for shape memory fabric (SMF)	Smart flexible sensors/actuators non-invasive wearable	NiTi shape memory filament; aramid; Teflon (PTFE) film	Four-layered smart fabric systems (SFSs) incorporating a SMF layer into aramid fabric.	annealing; shape memory training	cylinder moulds; weaving machinery	weaving	N/A	N/A	Low heat transfer	Safe
59	Porous polyetherimide fiber fabricated by a facile micro-extrusion foaming for high temperature thermal insulation	Porous polyetherimide (PEI) fiber	Flexible sensors/actuators	Porous polyetherimide fiber, silica nanoparticles/sol solution (for hydrophobic coating)	Porous PEI fibers and textiles	Micro-extrusion foaming, nanoparticles sol coating	Autoclave, extruder, fiber collector (KR-530 U, Keran Technology Co., Ltd. China)	Extrusion, weaving	N/A	Low fire dissipation/self-extinguishing	Low heat conductivity;	Safe
60	Thermal insulation property of graphene/polymer coated textile based multi-layer fabric heating element with aramid fabric	Aramid; cotton	Textiles for electromagnetic shielding	Aramid; graphene/polymer coating on cotton	Multilayer insulating/heat producing textile	Hot pressing of conductive polymer on cotton fabric	Not specified	Weaving; knitting; sawing	N/A	N/A	Electron conductive heating element; low heat conductivity	Safe
61	Textiles in Electromagnetic Radiation Protection	-	Textiles for electromagnetic shielding	Polyester fibers, polyamide fibers, polyacrylic fibers and cellulose acetate fibers	Conductive fabrics	-	-	-	-	-	-	-
62	E-Textile Sensors for Sensory Therapeutic Products	-	Smart flexible sensors/actuators non-invasive wearable	printed inks on flexible materials	therapeutic products	-	Flexible sensors	-	Safe	-	-	Safe
63	Comfort Evaluation of Wearable Functional Textiles	-	Flexible sensors/actuators	-	Health, well-being, and work productivity, on the lose the functional aspects	-	-	-	Safe	-	-	Safe
64	Development of smart wearable sensors for life healthcare	-	Smart flexible sensors/actuators invasive wearable	Graphene-based wearable sensors, Hydrogel-based wearable sensors, Paper-based wearable sensors, Textile-based wearable sensors	-	graphene oxide, humidity sensor, Loofah sponge, ultralight 3D hybrid piezoresistive sensor	-	-	-	-	-	Safe
65	Superhydrophobic conductive textiles with antibacterial property by coating fibers with silver nanoparticles	Silver nanoparticles	Nanoparticles ferrous for flexible semiconductors	cotton fibers	-	-	-	modification of the fibers coated by Ag NPs with hexadecyltrimethoxysilane led to superhydrophobic cotton textiles	-	-	yes	safe
66	Non-invasive wearable chemical sensors in real-life applications	-	Smart flexible sensors/actuators non-invasive wearable	paper, textile, and hydroge	health monitoring and medical diagnosis	-	-	-	-	-	yes	yes
67	Ionofibers: Ionically Conductive Textile Fibers for Conformal i-Textiles	-	Microparticles ferrous for flexible semiconductors	metal particles, carbon allotropes	-	-	-	-	-	-	yes	yes
68	Smart textiles using fluid-driven artificial muscle fibers	Artificial muscle fibers	Textiles for compression	Artificial muscle fibers	Compression sleeves	Weaving/Knitting	Weaving/Knitting loom	knitting/weaving	-	-		N/A
69	A Mass-Producible Washable Smart Garment with Embedded Textile EMG Electrodes for Control of Myoelectric Prostheses: A Pilot Study	-	Textiles to control muscles' activity	Embedded array of textile electrodes	Forearm sleeve	Knitting	Knitting loom	knitting	-	-	-	-
70	Smart textiles using fluid-driven artificial muscle fibers	Artificial muscle fibers	Textiles for compression	Artificial muscle fibers	Compression sleeves	Weaving/Knitting	Weaving/Knitting loom	knitting/weaving	-	-		N/A
71	A Mass-Producible Washable Smart Garment with Embedded Textile EMG Electrodes for Control of Myoelectric Prostheses: A Pilot Study	Embedded array of textile electrodes	Textiles to control muscles' activity	Embedded array of textile electrodes	Forearm sleeve	Knitting	Knitting loom	knitting	-	-	-	-

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