Łukasiewicz
Lodz
Institute of
Technology

HEALTH CATALOG

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1 Biodegradable lactide fabrics

Description:

The materials are made from commercial lactide (PLA) yarns, manufactured from renewable plant-based sources (e.g., corn). The materials exhibit functional characteristics similar to polyester materials. Various structural variants of fabrics have been developed based on the devised solutions, which can be further customized according to the needs of the end-user.

Potential use:

The developed materials can be used for manufacturing wound dressings and specialized clothing.

Developed as part of the project:

Key Project BIOGRATEX. POIG.01.03.01-10-007/08-00, Biodegradable fibrous products. Patent Protection PCT/2012/000069 Biodegradable fibrous materials and method of their production. Łukasiewicz - LIT

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2 Functional biomaterials based on polymeric hydrogels

Description:

Developed based on natural polymers, hydrogel dressings meet basic functional and biological requirements. Research on the pharmaceutical availability of active substances from developed hydrogel materials has shown that the release of these substances follows first-order kinetics and is controlled by the diffusion process.

The use of hydrogel dressings for treating chronic wounds in humans and animals provides greater benefits compared to traditional gauze dressings because they accelerate the healing process, facilitate painless dressing changes, and prevent the formation of hard-to-remove tissue or material fragments on the wound.

Potential use:

- Wound dressings for chronic wounds
- Cosmetics
- Pharmacy
- Veterinary medicine
- Dentistry
- Tissue engineering
- Controlled drug release systems
- Disinfectant hygiene products with additional moisturizing properties, enriched with bacteriostatic action of nanoparticles
- Hydrogel granules as carriers in enzyme immobilization and LDL cholesterol adsorption
- Bone implants and adhesives in bone surgery

Developed as part of research projects:

Research project No. 7 T08 E 068 20
- "Development and evaluation of polymer compositions containing chitosan for use in the treatment and care of animals."

Research project No. N 507 447434
- "Functional polymer biocomposites for wound healing."

International project "The European Polysaccharide Network of Excellence (EPNOE)" under fundamental theme 6
- "Polysaccharides in human technology."

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3

Fibrous products for medical and hygiene applications

Description:

Flat textile products are manufactured using classical nonwoven techniques such as needle punching, spun-bond, and melt-blown. These materials can serve as raw materials for producing composite elements of hygienic or cosmetic materials for medical and near-medical applications.

Potential use:

The demand for nonwoven products is associated with the medical and hygiene products industry, where the majority of manufactured products are in the form of nonwoven or at least one of the structural elements of the products is nonwoven.

Developed as part of the project:

Key Project BIOGRATEX. POIG. 01.03. 01-10-007 /08-00,
Biodegradable fibrous products.

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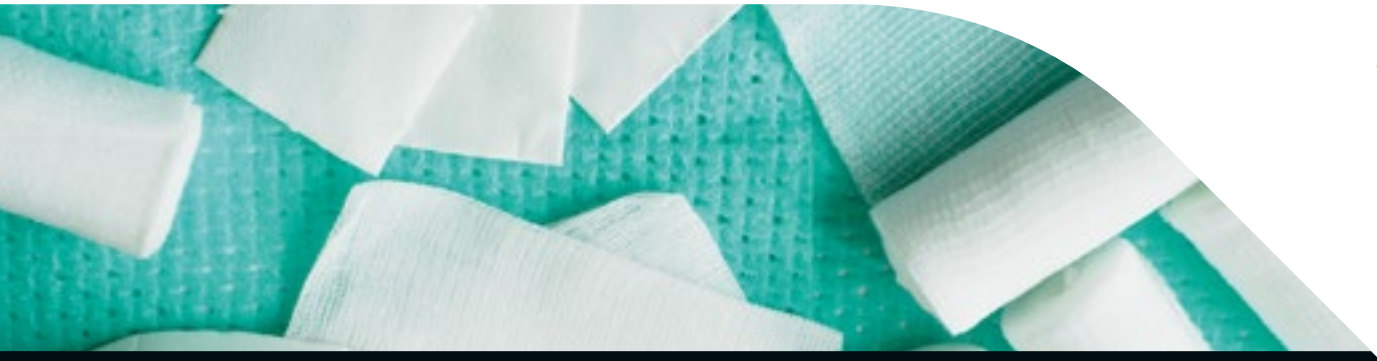


4 Fabric used in preventing pressure sores

Description:

The structure of the fabric is characterized by the presence of elastic yarn in the warp and the use of gauze weave instead of the standard weave. By using the gauze weave, a product with multidirectional elasticity was achieved despite the presence of elastic yarn only in the warp direction. The fabric has sufficient tensile strength and elasticity to support the human body (approximately 120 kg) in a lying position. Its high multidirectional elasticity (approximately 100%) allows it to conform to the body shape, thereby reducing unit pressures on the body surface.

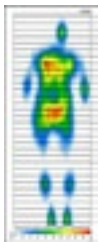
Unlike traditional mattresses, the fabric changes its structure under pressure, allowing for easier moisture and excess heat removal from the body-contacting surface with the substrate. These properties enable its use as a support surface in beds, seats, and wheelchairs to prevent pressure ulcers.

Patent P.224356 anti-decubitus bed

Potential use:

Due to its properties, the fabric can be used in the production of elastic orthoses, bandages, elastic bands, clothing, and other elastic materials.

Instantaneous pressure distribution for elastic fabric (83 kg/178 cm)



Instantaneous pressure distribution for foam mattress (83 kg/178 cm)

Developed as part of the project:

"Development of anti-decubitus mattresses from textiles with high multidirectional elasticity with controlled pressure on the body surface" project No. NR13 0127 10

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5 Tube filters for Blood Transfusion Apparatus Filtration Chambers

Description:

Tube filters are essential components of medical devices used in operations involving blood transfusions. The filter sleeve is woven from chemically neutral yarn, ensuring the proper functioning of the blood transfusion filtration chamber.

The sleeve acts as a barrier against potential contaminants or blood clots that may form during prolonged blood storage.

The developed blood filtration sleeve fully meets the requirements for utility parameters (mesh size of 160 x 160 µm ±10 µm, sleeve width of 20 mm ± 1 mm) and chemical neutrality towards the blood being transfused. The width of the sleeve in the folded state is 15-30 mm.

Potential use:

Medical industry - as a filter for sets designed for blood transfusions.

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6

Air Filtration Materials

Description:

Melt-blown filtration materials are materials with filtration properties that find wide applications in various fields. The nonwoven fabric used for filtration materials is produced by melting and stretching polymers (PP), creating a structure with microscopic pores. This forms a kind of barrier, protecting against various types of air pollutants, such as fungal cells, bacteria, allergens, soot particles, and dust.

Nonwovens produced by the melt-blown method have many applications and are used, among others, in the production of air filters, medical masks, medical protective clothing, and disposable items. They are also used in the food, pharmaceutical, and chemical industries to ensure product purity and environmental protection. Our materials are highly effective and meet the highest utility requirements.

Potential use:

- Filtration inserts for air purifiers
- Filtration inserts for ventilation, air conditioning, industrial heating
- Vacuum cleaner filters
- Measuring filters for determining airborne dust pollutants

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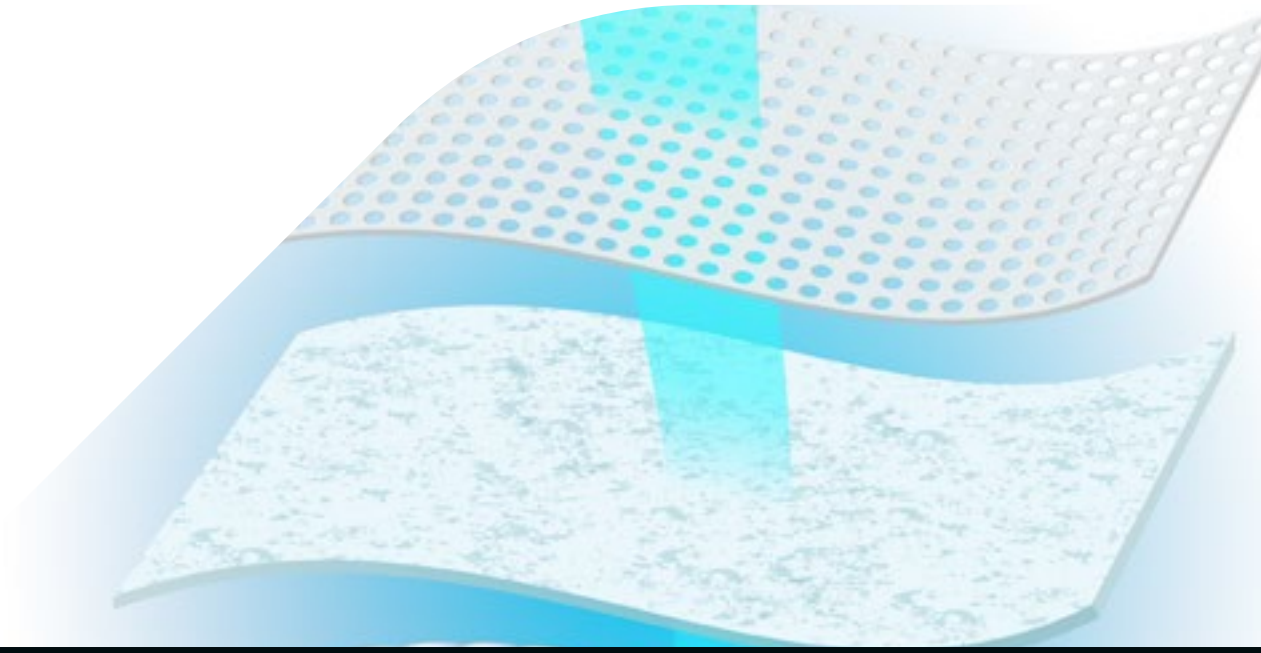

7 Fabric used in preventing pressure sores

Description:

Functionalized fibrous and composite materials serve as scaffolds for cells with a supporting function in tissue regeneration processes and the ability to monitor the biomaterial after implantation.

Carbon materials produced based on precursor nonwovens, surface-modified using the PVD method, enabling implant imaging.
In subsequent stages, they undergo functionalization using appropriate polysaccharide polymer matrices and peptides.

Potential use:

The developed material can be used as a scaffold for cells in bone and cartilage tissue regeneration.

Developed as part of the project:

Project funded by the National Science Centre in Krakow,
UMO-2018/31/B/ST8/02418

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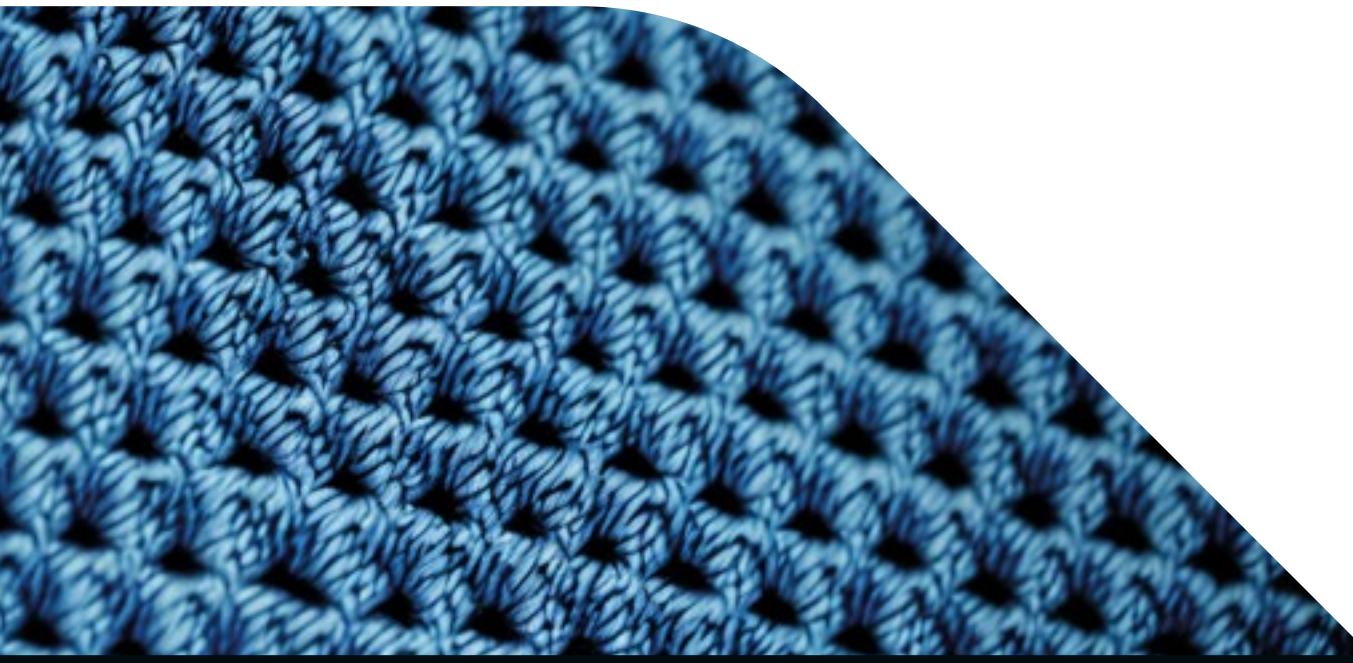

8

Protective Materials Against Ticks, Insects, and Microorganisms

Description:

The materials have been manufactured using a special single- or dual-functional finishing technology developed to protect against ticks, insects, and additionally against microorganisms, to ensure users of the products have hygienic comfort in conditions conducive to body sweating.

The agents used in the finishing process are certified for safe use on products in contact with human skin. The material can offer various raw materials, structural, and color solutions, depending on the needs of the recipient and the range of the final product.

Potential use:

The presented materials are intended for use in protective clothing against ticks and insects, providing hygienic comfort in conditions conducive to body sweating.

The anti-tick and anti-insect properties of the materials are determined according to Lukasiewicz - LIT's procedure, while the antibacterial action is assessed in microbiological studies conducted using accredited methods at Lukasiewicz - LIT.



Photos: Examples of products made from materials protective against ticks/insects and microorganisms.

Developed as part of the project:

International Eureka Initiative Project E! 8083 TickoTex.
Tick-repellent multifunctional protective textile materials. NCBR. Lukasiewicz-LIT

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9

Innovative, Safe Clothing Protecting Against UV Radiation Using UV Absorbers

Description:

The World Health Organization (WHO) has recognized all ranges of UV radiation (UVA, UVB, and UVC), both natural and artificial, as carcinogens for humans. WHO recommends the use of appropriate clothing that covers as much of the body's surface as possible to protect against harmful UV radiation. Popular summer and workwear, mainly made of cotton or viscose and dyed in pastel colors, do not provide sufficient protection.

At Lukasiewicz-LIT, technology has been developed for functional, safe, environmentally friendly, and human-friendly materials for clothing that protect against harmful UV radiation.
This technology is based on the use of a new generation of organic UV absorbers in the form of reactive or direct dyes, which are applied during the conventional dyeing process.

The products have obtained compliance certificates with the UV Stop ® mark requirements and with the OECD Guidelines for the testing of chemicals, Test no 404, confirming that they are safe for the skin and do not cause irritations. The use of materials made from natural fibers complies with the requirements for workwear and aligns with the principles of the circular economy - eco-design.

Potential use:

Clothing, gloves, and headgear protecting against UV radiation is intended for:

- Outdoor workers exposed to sunlight and UV radiation, such as construction workers, road workers, farmers, gardeners
- Individuals with fair skin prone to sunburn and photoallergies Closed Loop Economy Center

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10

Innovative, Safe Clothing Protecting Against UV Radiation Using Natural Dyes

Description:

Excessive exposure to UV radiation can cause sunburns, skin photoaging, various phototoxic reactions, immune system disorders, and life-threatening skin cancer. Breathable products made from cellulose fibers (cotton, organic cotton, viscose, linen), whether white or dyed in light shades, do not provide adequate protection against UV radiation.

The barrier properties of such products can be enhanced by using natural dyes of plant or animal origin, applied during the dyeing process, using a patent-pending method developed at Lukasiewicz-LIT and tested in industrial conditions by JANIS Sp. z o.o. Sp. k. Research has shown that such materials protect against the growth of microorganisms.

The products have obtained compliance certificates with the UV Stop ® mark requirements and with the OECD Guidelines for the testing of chemicals, Test no 404, confirming that they are safe for the skin and do not cause irritations. The use of natural materials and dyes is in line with ecological trends in fashion and aligns with the principles of the circular economy - eco-design.

Potential use:

Summer clothing protecting against UV radiation intended for:

- Individuals with fair skin
- Individuals with sensitive skin prone to photoallergies
- Children
- Individuals with increased ecological awareness
- Closed Loop Economy Center

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11

Innovative, Safe Clothing Protecting Against UV Radiation with Naturally Colored Cotton

Description:

Due to climate change and the increasing number of hot days in European countries with a moderate climate, including Poland, there is a growing interest among individual consumers and businesses in textile products with certified UV barrier properties. Sportswear and recreational clothing available on the market, made from certified textile materials, are predominantly composed of synthetic fibers such as polyester, polyamide, and their blends. There are relatively few certified garments made from cotton fibers on the market offer.

We propose UV barrier clothing made from naturally colored organic cotton, sourced from ecological cultivation without the use of pesticides, herbicides, and synthetic fertilizers, possessing GOTS and OCC certifications. The technological process of producing materials from naturally colored organic cotton eliminates the water- and energy-intensive dyeing process.

The products have obtained compliance certificates with the UV Stop® mark requirements and with the OECD Guidelines for the testing of chemicals, Test no 404, confirming that they are safe for the skin and do not cause irritations. The use of such materials is in line with ecological trends in fashion and aligns with the principles of the circular economy - eco-design.

Potential use:

Summer clothing protecting against UV radiation is intended for:

- Individuals with fair skin
- Individuals with sensitive skin prone to photoallergies Children
- Individuals with increased ecological awareness
- Closed Loop Economy Center

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12

Textronic measurement system

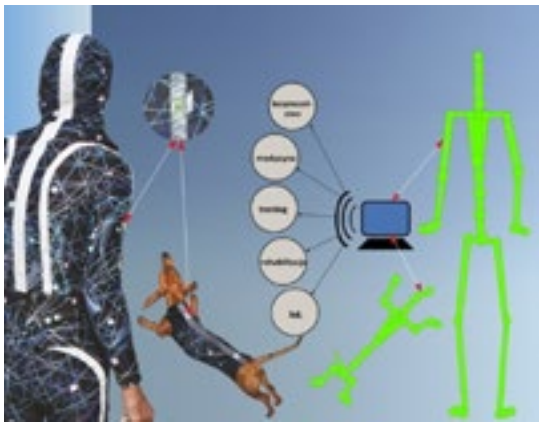
Description:

The universal, modular, textronic measurement system combines textile material with electronic elements and constitutes an integral solution for data transmission directly to and/or from the user. Textronic modules* are built with flexible textronic tape* and sensors. Non-linear conductive elements of the tape compensate for stresses and ensure a stable power supply. The modular tape allows for the creation of versatile networks of measuring points.

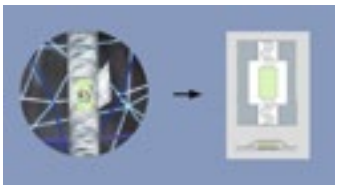
Potential use:

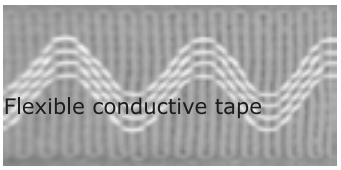
A measurement system with sensors adapted to measured parameters constitutes an integral solution with monitoring, recording, and regulating properties, used in smart medical and protective products, etc. Textronic tape can also be used in independent accessories.

Textronic costume with modules



Textronic module





*P. 240360 Textronic module and product with such module
*P. 236008 Linear, flexible textile product for textronic applications

Developed within the framework of the project:

Costume for human motion capture based on IMU sensors with data collection, visualization, and analysis software, KAARIMU. Applied Research Program, Agreement PBS1/A3/10/2012.

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13 Comfortable Custom Insoles

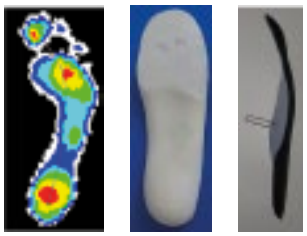
Description:

Comfortable custom insoles are made using a thermoplastic method. The client molds the insole to their foot. Additionally, based on previously conducted clinical studies and pressure distribution on the sole side of the foot, the insole is equipped with corrective and/or pressure-reducing elements in various areas of the foot.

The insole can be finished with various materials depending on the needs (conditions, foot deformities, use in various sports disciplines).

In sections:

- Clinical assessment
- Biomechanical analysis
- Design and manufacture of insoles
- Verification of functionality



Potential use:

- Treatment of foot disorders
- Prevention of deformities

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14

Composite Materials Protecting Against Electromagnetic Fields

Description:

The rapid development of technology and improvement in many areas of our lives is also associated with increasing exposure to electromagnetic fields (EMF). The issue of protecting the environment and human health from the negative effects of EMF is becoming increasingly relevant. An innovative product developed by scientists at Lukasiewicz-LIT is a material that attenuates electromagnetic radiation over a wide range, from several MHz to several GHz. Protective screens against EMF are becoming almost an ideal alternative to all available solutions on the market and can be used in environmental protection and health protection. Importantly, our product is manufactured using an innovative, environmentally friendly, zero-waste technology involving the deposition of thin layers of metals, metal alloys, or metal oxides onto fibrous materials using the gas-phase deposition method.

In sections:

- Materials protecting against electromagnetic radiation (ionizing, non-ionizing, including UV radiation).
- Antibacterial polymer composite materials.

Potential use:

- Health protection (e.g., hospitals, nurseries, the protective clothing industry).
- Public administration (e.g., offices, tax chambers, courts, prosecutor's offices, data centers).
- Collective housing buildings (e.g., nursing homes, dormitories, children's homes).
- Military facilities (e.g., airports, communications, transportation, radar stations).

Developed as part of the project:

"Next-generation barrier materials protecting humans from the harmful effects of the environment - ENVIROTEX". Project ENVIROTEX No. POIG.01.03.01-00-006/08 implemented under the Operational Program Innovative Economy 2007-2013, co-financed by the European Union from the European Regional Development Fund.

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1 Technology for Manufacturing Environmentally Friendly Agricultural Products for Plant Protection and Growth Stimulation

Description:

The technology involves the production of an innovative, environmentally friendly product for the protection and growth stimulation of various plant species. The manufacturing process is based on combining selected bioactive natural polymers with products from the metabolism of endophytic bacteria.

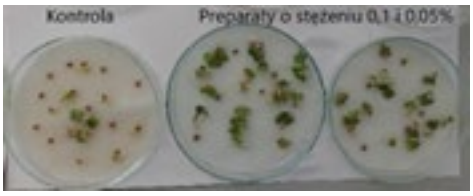
The action of the product aims to:

- Reduce the number of organisms harmful to plants,
- Increase the population of chitinolytic microorganisms inhibiting the growth of soil pathogens (fungi),
- Promote plant biomass growth,
- Enhance efficacy compared to other products available on the market.

Potential use:

The developed product, depending on its application form, can be used as a spray or applied to the soil.

- Organic farming
- Urban agriculture
- Allotment gardening
- Home gardens



Patent: P.441772

"Method of obtaining a biological preparation for growth stimulation and plant protection".

The product was developed as part of the project:

„Ekologiczne kompozycje biopolimerowe do ochrony i stymulacji wzrostu roślin - badania podstawowe”

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2

Coating Technology with Chitosan for Surgical Meshes Used in Hernia Surgery

Description:

Inguinal hernia is the abnormal displacement of abdominal cavity organs beyond their anatomical boundaries. The integrity of the abdominal cavity is maintained by properly formed abdominal walls. The surgical method for treating inguinal hernias in adults involves implanting a polypropylene mesh.

Introducing a resorbable chitosan layer onto the surface of the semi-finished surgical mesh reduces the adhesion of the implant to internal organs, limits the formation of fistulas and obstructions, and shortens hospitalization time (one-day surgery).
As a result, patient well-being and comfort in the long postoperative period will be improved.

Additionally, the biological properties of the applied biopolymer will be utilized, including antibacterial properties, fibroblast activation, and susceptibility to biodegradation in the lysozyme environment (degradation products undergo natural metabolism).

Potential use:

- General surgery
- Aesthetic medicine
- Personalized medicine

Developed as part of the research project:

Project No. 3T08E 03727 on "Partially resorbable surgical meshes for hernia repair".

Patent application: PL 380861

Surface-modified polypropylene surgical mesh with chitosan.

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3 Biomaterials Based on Cellulose and Chitosan

Description:

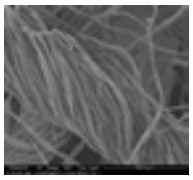
There is currently growing interest in the development of fibrous dressing products modified with polymers from the polysaccharide group (cellulose, chitosan, and alginates). These polymers are characterized by good biodegradability, non-toxicity, as well as antimicrobial properties.

The modification of commercial cellulose-based wound dressing and hygiene raw materials for everyday use involved the use of bioactive polysaccharide nanoparticles to functionalize cellulose to improve its physicochemical (sorption, absorbency), mechanical, and biological properties (antibacterial and antifungal properties). Research was conducted on the development of a method for producing nanoparticles from natural polymers using sonochemical techniques.

The developed method of modifying fibrous cellulose material with natural polymer nanoparticles using sublimation drying allowed for obtaining material with increased moisture sorption capacity compared to the starting material, very good bacteriostatic activity against gram-negative Escherichia coli and gram-positive Staphylococcus aureus bacteria, and good antifungal activity against Candida albicans and Aspergillus niger fungi, leading to close to 100 percent reduction.

Potential use:

- Medical materials
- Hygiene materials
- Medicine
- Personalized medicine
- Pharmacy
- Veterinary medicine
- Dentistry
- Medical gauze
- Hygienic wipes



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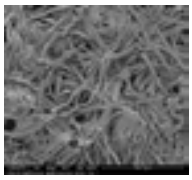

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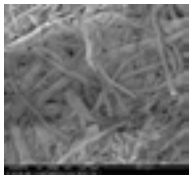

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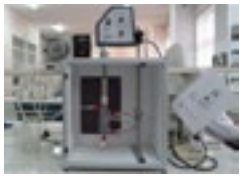

Sonificator UP200S (Hielscher)

Modyfikowane wyroby handlowe nanocząsteczkami polimerów naturalnych

Developed as part of the research project:

Project No. NCBR/ERA-NET-MATERA/01/2011
"Advanced Cellulose Materials - AdvanCellMat"

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4

Manufacturing Technology of Polymeric Scaffolds for 3D Cell Cultivation Using Electrospinning Method

Description:

Tissue engineering is a modern, interdisciplinary field of regenerative medicine. It utilizes various advanced and non-standard materials as functional substitutes for damaged tissues and also involves the development of methods for cell proliferation on scaffolds. 3D structures perfectly simulate natural conditions present in living organisms.

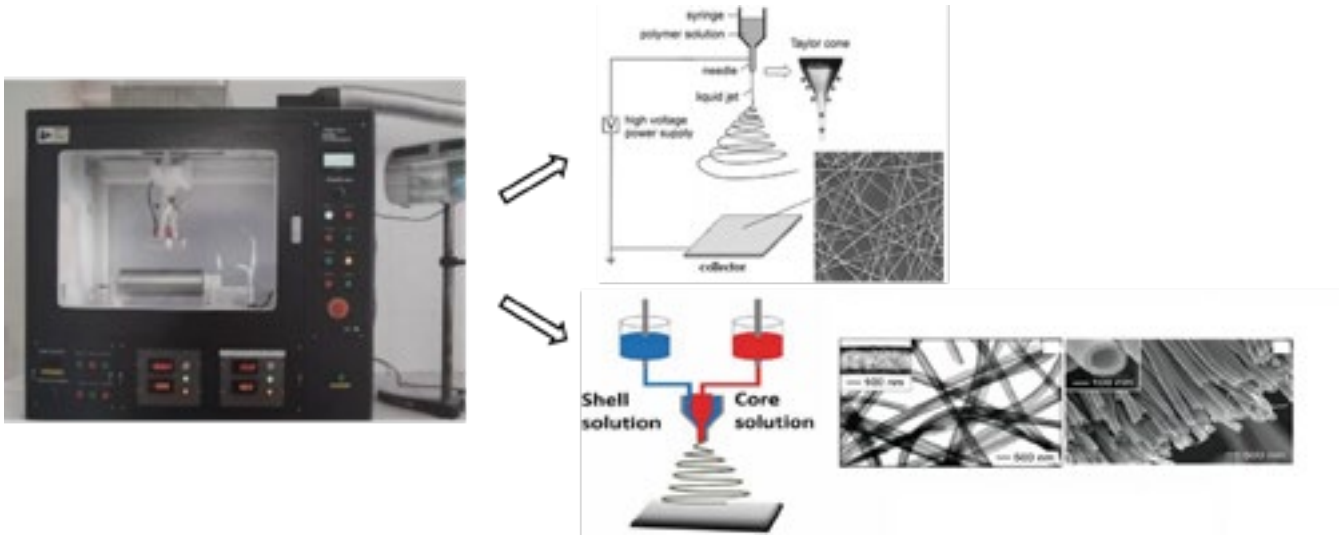
Cell culture requires ensuring the appropriate environment for cell growth, including temperature, suitable medium, as well as proper porosity, depending on the type of cultured cells. 3D cell scaffolds can be fabricated from both synthetic and natural polymers. They have an advantage over traditional 2D cultures and can be used as in vitro and ex vivo tissue models.

Electrospinning is a method that allows the production of three-dimensional scaffolds (made of micro- and nano-fibers), both containing active particles and unmodified. Under the influence of an electric field, a droplet is drawn into fiber form between the nozzle and the collector. Nanofibers have a relatively large specific surface area.

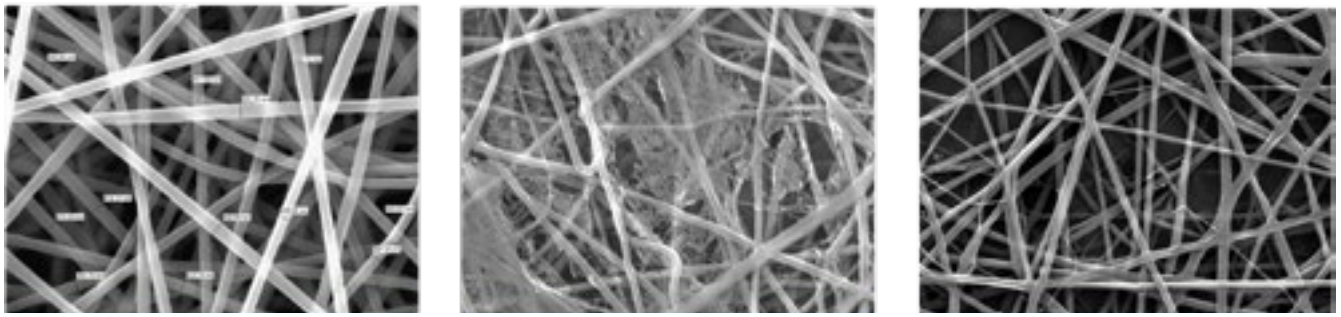
The versatility of the method enables the production of various types of fibers, both uniform and complex core-shell structures. The properties and structure of the produced fibers can be controlled through a number of variables including solution concentration, polymer molecular weight, type of solvent used, electric field intensity, flow rate of the solution, and distance between electrodes.

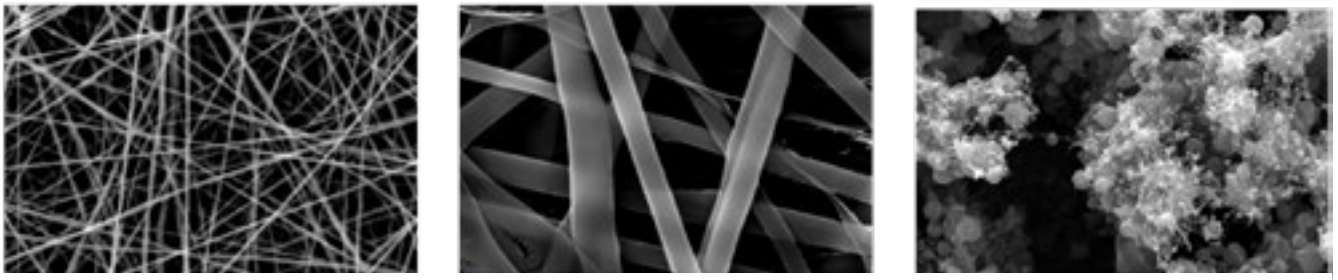
Potential use:

- Regenerative medicine for treating cartilage tissue defects
- 3D scaffolds for cell cultivation
- Drug delivery systems
- Surface modifications of polymeric matrices



Technology for manufacturing cell scaffolds.





Examples / Possibility of processing various polymers using the electrospinning method.

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5

The technology of manufacturing chitosan fibers and chitosan/alginic fibers as biocomposite medical materials.

Description:

Modern wound dressings intended for the treatment of wounds in the granulation and epithelialization phases largely meet the requirements of biomaterials containing polymers with wound healing-stimulating properties. Polysaccharides, especially chitosan, and alginate, due to their specific biological properties, are ideal materials for the construction of dressings intended for wound treatment in all phases of healing. The development of a bioactive biomaterial for such a purpose requires not only the selection of a polymer with appropriate biological properties but also the selection of its appropriate dosage form.

Chitosan microfibers and chitosan/alginic microfibers are a convenient dosage form for the construction of wound dressing materials in the form of sponges or films, whose functional properties such as absorptive capacity, absorbency, and biological properties (cytotoxicity, hemostatic properties) qualify this material for wound treatment in all phases of healing.

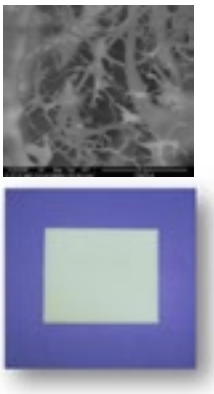
Potential use:

- Multifunctional wound dressing materials with a wide spectrum of action intended for wound treatment in all phases of healing.
- Polymer matrix as a drug carrier with extended/long-lasting action.
- Substrates for cell culture used in tissue engineering due to their unique physicochemical and biological properties, including broad cellular compatibility and compatibility with components of living organisms.

Developed within the research project:

No. 3 T08E 012 28 titled "Research on the use of chitosan fibers and chitosan/alginic fibers for biocomposite medical materials."

Patent applications: P 385031 i P 385032



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6

Active therapeutic footwear for patients with diabetic foot syndrom

Description:

The technology aims to create therapeutic footwear dedicated to professionally active patients with diabetic foot syndrome, with the mission of reducing the consequences of the condition, such as progressive disability and associated work absenteeism.

- Implementation of the CoPtheN (Comprehensive Physical Therapy for Neuropathy) technology in specialized footwear meeting the standards of "Diabetic Footwear."
- In vitro verification of the impact of introduced structural modifications during adaptation work on the therapeutic effectiveness of the solution.

Potential use:

Specialized footwear

Developed as part of the project:

Science for Society: Therapeutic Footwear dedicated to patients with Diabetic Foot Syndrome NdS/547732/2022/2022

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7

Isolation of Collagen from Waste Materials for Medical, Food, and Cosmetic Applications

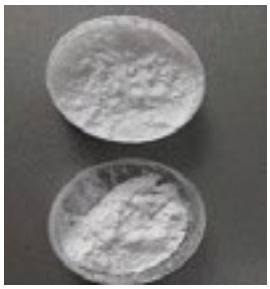
Description:

The developed technology focuses on extracting collagen from waste material and includes research methods for the structure and quality of collagen. Collagen isolation with appropriate structure, properties, and forms (solution, lyophilization, gel) for various applications (medical, food, cosmetic).

- Isolation of collagen from waste material (fish, beef, pork)
- Collagen with confirmed structure, molecular weight, and properties
- Possibility of collagen cross-linking to expand the range of applications
- Potential to produce collagen hydrogels
- Obtaining collagen lyophilizes

Potential use:

- Biomedical (dressings, cell scaffolds, hydrogels)
- Food (dietary supplements, thickener)
- Bioactive ingredient in cosmetics (wrinkle fillers, cosmetic masks - cross-linked collagen)



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1 Differential Scanning Calorimetry (DSC)

Description:

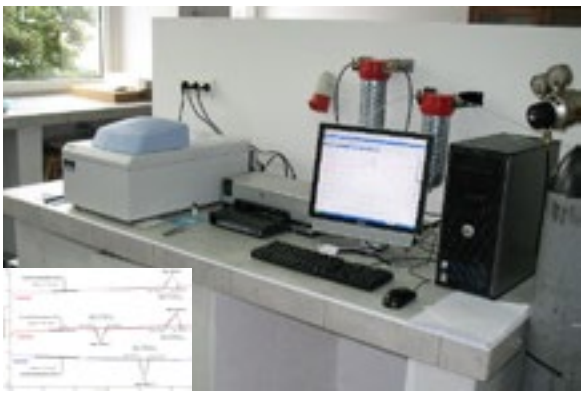
Differential Scanning Calorimetry (DSC) is the most commonly used technique in thermal analysis. The DSC method is used to analyze phase transitions in samples under the influence of changes in their physical and chemical properties as a function of temperature or time.

The Perkin Elmer DSC calorimeter has a furnace connected to an intercooler, allowing the analysis of samples in the range of -75 to 550 °C. Measurements are conducted in an atmosphere of inert gas (nitrogen). The apparatus has the capability to select heating/cooling rates over a wide range.

Potential use:

Polymer testing by determination:

- Melting temperature, crystallization from melt, and cold crystallization
- Enthalpies of transitions
- Glass transition temperatures and energies
- Degree of polymer crystallinity
- Polymorphism



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2

Thermogravimetric Analysis (TGA)

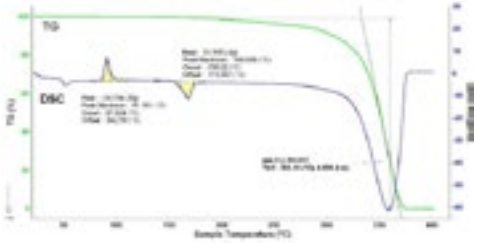
Description:

Thermogravimetric analysis belongs to the group of thermal analysis methods, where changes in sample mass are determined within a specified temperature range. The LABSYS EVO thermobalance by Setaram has a furnace allowing the analysis of samples in the temperature range from 20 to 1150°C (TG).

Measurements can be conducted in both air and inert gas atmospheres. The apparatus also enables simultaneous recording of temperatures and enthalpies of phase transitions occurring in the samples during their physical and/or chemical changes as a function of temperature or time in the range from 20 to 700°C (TG/DSC).

Potential use:

Study of materials by determining the temperature and degree of mass loss to assess their thermal stability.



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3

Degradation Processes Analysis of Polymer Materials

Description:

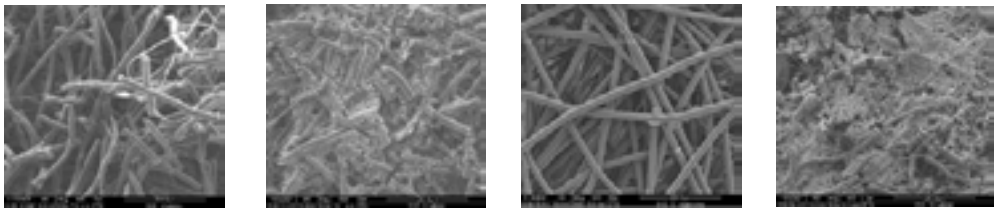
The analysis of degradation processes of polymer/biopolymer materials is conducted based on normative documents or proprietary procedures depending on the material's intended use. The analysis allows for examining the influence of degradation processes such as hydrolytic, thermal, and biodegradation on the material's structure under conditions simulating its usage. Within the analysis, a simulation of the degradation process is carried out at selected time intervals under specified conditions, such as temperature, humidity, and degradation environment (e.g., physiological saline, water, PBS), determined according to the material's purpose.

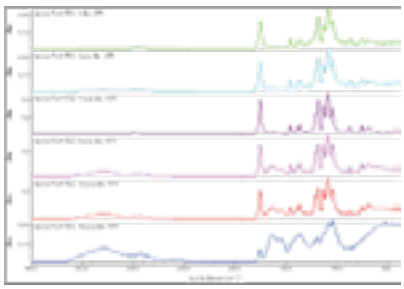
The analysis involves selected measurement techniques that allow assessing the material before and after the degradation process, such as DSC, TG, FTIR, GPC/SEC, SEM, and physicomechanical tests.

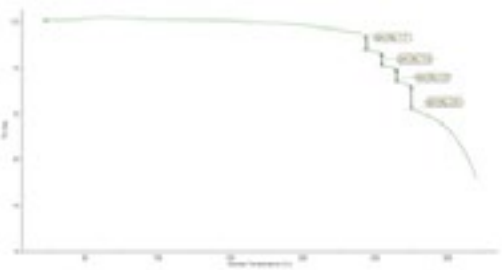
Potential use:

Study of polymers by determining:

- Evaluation of the process's impact on the material properties
- Determination of material degradation time
- Determination of degradation rate







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4

Analysis of Aging Processes in Polymer Materials

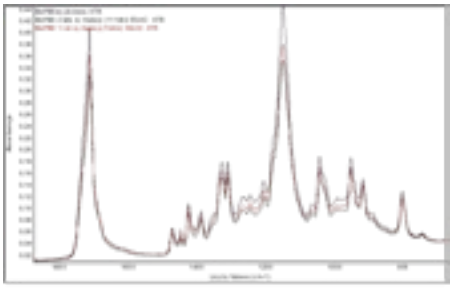
Description:

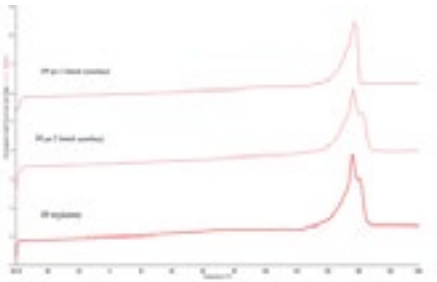
The analysis of aging processes in polymers/biopolymers is conducted based on normative documents, depending on the material's intended use. This analysis enables the study of the impact of accelerated aging processes on the material's properties, such as physical-mechanical, functional, or structural properties. Aging studies allow for determining changes occurring in the examined parameters and the material's structure, providing information regarding the material's shelf life under real conditions.

Within the analysis, a simulation of the aging process is conducted at selected time intervals under specified conditions such as temperature, humidity, and UV radiation, chosen according to the material's purpose. The analysis involves selected measurement techniques that allow assessing the material before and after the accelerated aging process, such as DSC, TG, FTIR, GPC/SEC, SEM, and physico-mechanical tests.

Potential use:

- Determination of material shelf life
- Evaluation of the process's impact on material properties





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5

Comprehensive Foot Examination

Description:

Comprehensive foot examinations include clinical assessment, biomechanical analysis, and 3D foot scanning. They allow for determining the health status of an individual's feet and diagnosing the causes of discomfort.

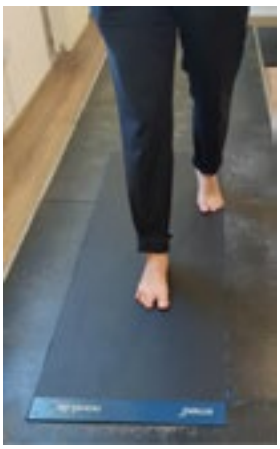
In sections:

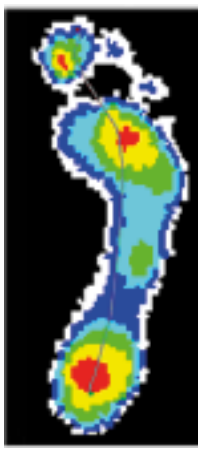
- Clinical Assessment
- Biomechanical Analysis
- 3D Scanning

Potential use:

Polymer testing by designating:

- Population studies
- Services for the public
- Orders for manufacturers, especially manufacturers of comfortable footwear





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6

Functionalization of Materials for Health Purposes

Description:

Functionalization of materials through the application of active substances (natural and synthetic), including new patented ionic liquids, aimed at protecting materials and users from microorganisms.

Possibility of functionalization in other directions such as self-cleaning, hydrophobic, stain-resistant, and hypoallergenic properties.

- Application of active substances to materials to impart specific properties.
- Microencapsulation of active substances to prolong their effects.
- Application using various techniques such as spraying, coating, and immersion.
- Evaluation of antimicrobial protection effectiveness.

Potential use:

- Textiles
- Leather materials
- Polymer processing

Developed as part of projects:

such as "Development of microbiologically active, user, and environmentally friendly materials for the light industry" NCBR, CORNET/28/1/2020.

Invention:

"New polymeric ionic liquids, their production method, and application" No. P. 440793

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7

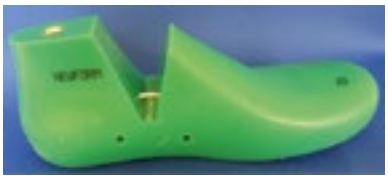
New footwear solutions

Description:

Optimal material and construction solutions in footwear for various user groups including children, individuals aged 60+, individuals with sensitive feet, diabetes patients, pregnant women, athletes, and others. Solutions involve the construction of soles, insoles, uppers, and various types of lasts are also evaluated and designed.

Services include:

- Last design
- Upper design
- Construction tailored to user needs



Potential use:

- Foot disorder therapy
- Prevention of deformities
- Prevention of Diabetic Foot Syndrome
- Services for footwear manufacturers

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8

Hydrogels

Description:

Production of hydrogels with desired properties using various polymers including natural, modified, and synthetic ones. In its simplest form, hydrogels are hydrophilic polymer networks capable of absorbing, swelling, and retaining large amounts of water.

Their high water content, permeability, adjustable viscoelasticity, and structural similarity to the extracellular matrix make hydrogels inherently suitable for biological applications.

These key properties make them attractive for biomedical applications.

- Synthesis of hydrogels with desired properties and in various forms using different polymers, natural, modified, and synthetic, with the possibility of attaching functional domains to regulate release kinetics.
- Possibility of implementing active substances with controlled release.

Potential use:

- Pharmacy
- Cosmetics
- Dressings



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9

IoT Solutions Design for Telemedicine

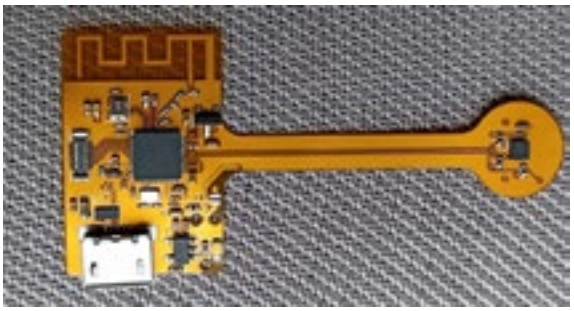
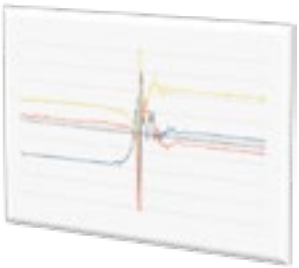
Description:

Designing IoT solutions for telemedicine will involve the following stages:

- Requirements analysis
- Electronic circuit design
- Development of an electronic prototype
- Implementation and production
- Conceptual design
- Prototype construction
- Prototype testing

Potential use:

Real-time monitoring of seniors' movement and activities, such as fall detection, stair climbing, etc. In the event of a senior's fall being detected, an immediate notification is sent to the security system. The developed algorithm analyzes data from sensors to accurately detect falls.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10

Designing AI Applications

Description:

Designing applications involves the following stages:

- Requirements analysis
- Data preparation
- Testing machine learning models
- Data collection
- Building machine learning models
- System integration with a dedicated application

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11

Food Analysis in Terms of Nutritional Value and Most Common Chemical and Microbiological Hazards

Description:

Researching various food matrices for the number of nutritional components, both basic (e.g., carbohydrates, proteins, fats) and health-promoting (including polyphenols, folic acid, amino acids, etc.).

Determining hazardous substances (heavy metals) and food additives (colorants, sweeteners, gelling agents) along with an analysis of the permissible levels contained in applicable laws.

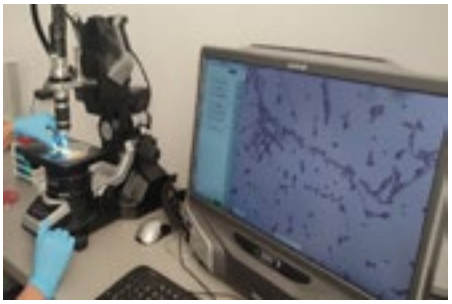
Microbiological assessment of food products.

- Examination of nutrient content
- Examination of health-promoting substances
- Examination of harmful substances
- Examination of food additives
- Microbiological assessment of food products, regarding both pathogens and "beneficial" bacteria

Potential use:

Food Industry:

- Food classification
- Healthy food
- Assessment of health-promoting properties related to the presence of ingredients with preventive effects
- Assessment of nutritional properties
- Safety assessment



Developed as part of the project:

Science for Society: Innovative system for the distribution of healthy and regional food
Project No. NdS/547066/2022/2022

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