최근 기술섬유 개발동향(총괄)

주창환
충남대학교

Technical Textiles Research Lab.

전시회 개요

□ 개요
○ 전시회명 : Techtextile Frankfrut 2009
○ 전시기간 : 2009. 6. 16 ~ 2009. 6. 18 (3일)
○ 전시장소 : Frankfrut am Main (독일 프랑크푸르트)

○ 콩그레스 센터에서는 전시된 제품의 개발내용을
- 테크 텍스타일(Techtextil)과 아반텍스(Avantex) 심포지엄에 발표함.
- 세계 '천연섬유의 해'로 천연섬유 컨퍼런스(Natural fiber congress)

□ 전시회 배경
○ 본 전시회는 1986년 시작하여 테크텍스타일과 부직포 분야에 중점으로 관련 업체, 연구소, 교육기관, 협회 등 전문가 참여하는 매 2년마다 개최되는 국제 최대 규모임.

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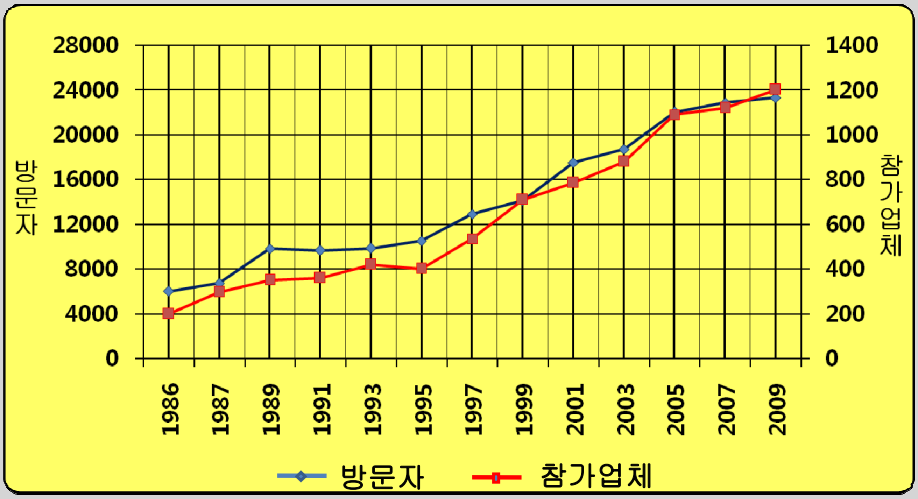
전시회 동향

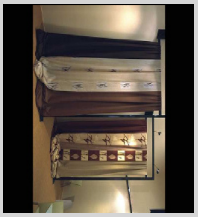
○ 이번 전시회는 43개국 1,201개 전시업체와 23,300명 방문자로 2007년에 비해 전시업체는 8%, 방문자는 2% 증가함.



개발방향(기초내용)

○ 미래 사회환경을 고려한 3가지 핵심 개발주제
- 하이테크기술에 기초한 범용제품에서 특수 차별화된 제품
- 새로운 용도전개와 시장 확대를 위한 첨단재료 사용에 의한 섬유 제품화
- 대량생산에서 맞춤화, 섬유공정간 지식 정보화에 의한 제품 전주기에 서비스 개념을 둔 차별화 제품

○ 향후 시장 확대가 큰 5개 분야에 우선적 기술 개발을 추진함



- 건축 및 인테리어,
- 보호 및 헬스케어,
- 수송 및 에너지,
- 자원 및 환경보호,
- 패션 및 창조성

개발방향(기초내용)

○ 장기간 사회적 여건을 고려한 주제와 향후 시장전개가 큰 5개 분야로 7개 연구개발 주제를 우선적으로 추진 중.

1. 새로운 특수섬유와 섬유복합재료 개발
2. 섬유재료의 기능화와 관련공정 개발
3. 바이오베이스 재료, 기술 및 환경친화형 섬유공정 개발
4. 인간 건강 및 복리향상을 위한 신섬유 및 제품 개발
   (보호, 헬스케어, 스포츠 및 웰리스)
5. 혁신적인 새로운 기술(technical) 섬유 및 제품 개발
   (건축용, 수송용, 에너지용, 토목용, 농업용, 산업용)
6. 스마트섬유 및 의복
7. 맞춤형 대량생산 기술 개발

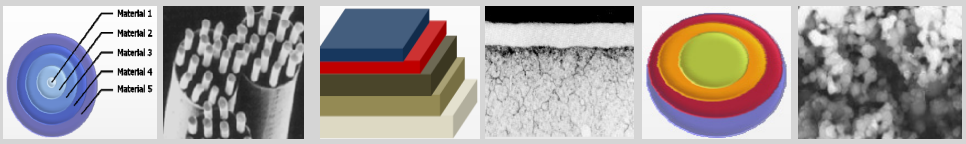
Eco-Tex-Design
EU-funded BioSys Project
FlexiFunBar
FLY-BAG
MICROFLEX
MODSIMTex
PROETEX
STELLA

기술개발(핵심내용)

○ 산업용 섬유 개발방향은 기존제품의 다기능성 및 지능화를 부여하여 경량화와 고성능 목적으로 용도전개 및 시장 확대에 초점을 둠

○ 전시회 출품된 제품개발에 응용된 기술을 종합적으로 정리하면
- 잉크제트 프린트 기술 (Inkjet Printing Technology)
- 삼원방사 기술 (Tricomponent fibre extrusion)
- 전기방사를 이용한 나노섬유 제조기술 (electrospinning)
- 화학증착 및 유전가열 코팅기술 (CVD & Dielectrophoretic coating)
- 다층 고분자 증착 기술 (Polymer Multilayer deposition)
- 메그네트론 스퍼터링 기술 (DC/pulled Dual Magnetron Sputtering)
- 와이어 공급 금속 증발 기술 (Wire Feed Metal Evaporation)
- 핫멜트 코팅기술 (Hotmelt coating)

● Trends in New Materials & Processes



At the fibre level | At the fabric/foil/film level | At the particle level

기술개발(핵심기술)

● Trends in New Materials & Processes

Plasma	Flame retardant	Metals
CVD	Anti-bacterial	Metal oxides
Sputtering	Hidrophobic	Nanostructured carbon materials
Metallization	Hidrophilic	Ceramic materials
Hot-melt	Oleophobic	Speciality polymers
UV curing	Anti-UV	Hybrid materials
Ultrasounds	↗ Adhesion	Composites
Laser	Self-cleaning	.....
Ink-jet printing	Antistatic	
	Conductive	
	↗ Dye affinity	

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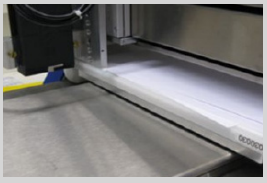
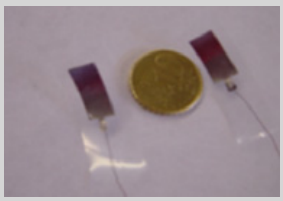
기술개발: 핵심기술(1)

● Inkjet Printing Technology

- Integration of electroactive materials for sensor-actuator systems directly on polymeric/fabric surfaces
- Development of RFID systems on novel polymeric/fabric substrates
- Development of new printable formulations for non-conventional substrates



• R&D in new metallic nanoparticles suspensions with low curing temperatures
• Printing of metallic thin films (silver and copper nanoparticles) in polymeric substrates
• Patterning of metallic foils (circuit patterning)
• R&D in printing of new semiconductor and conductive polymers (PEDOT based) and UV curable polymer films in polymeric substrates



Deposition of patterned metallic electrodes for Sensor-Actuators

Printing on textile substrates – Non Wovens

Micro-Wave Reactor

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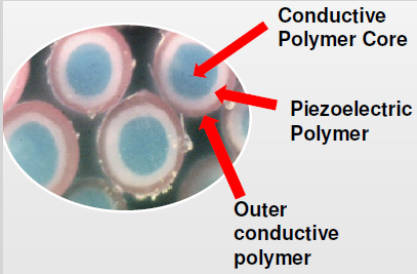
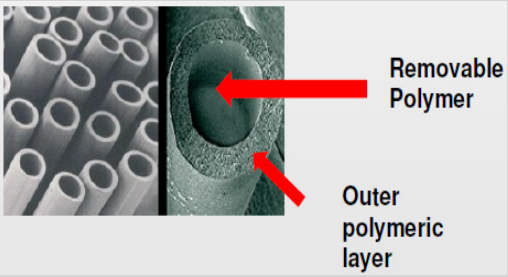
기술개발:핵심내용(2)

● Tri-componet fiber technology

- Development of new bi and tri-component fibers
- Development of new fiber geometries
- Development of new Bi-component conductive fibers (sensor-actuator application)
- Integration of electroactive materials directly at the fiber core
- Development of Tri-component piezoelectric fibers (sensor-actuator application)
- Development of fiber micro structure with controlled porosity using extrusion process
- Processing of new hollow fiber structures

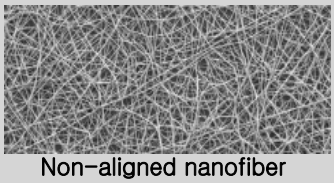


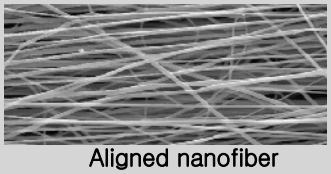


기술개발:핵심내용(3)

● Nanofiber technology

- Electrospinning and Melt-spinning Technology
- R&D in electrospun electroactive fibers with controlled porosity
- Processing of fibers with controlled aspect ratio and alignment


Non-aligned nanofiber


Aligned nanofiber

● Multi Functional Coating Technology (atmospheric plasma treatment)

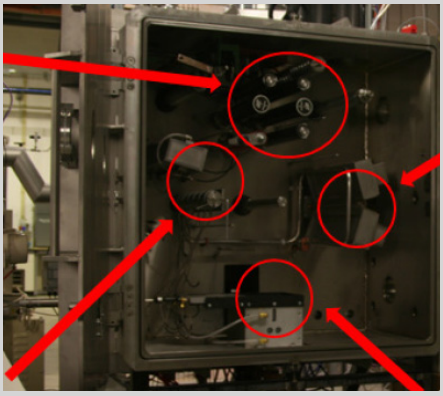
- Plasma pre-treatment, ultrasonic deposition, nano-film formation, IR drying/curing, UV curing

o Nanoscaled surface engineering
o Incorporation of polymers, nanoparticles, etc…
o No solvents/water; no waste
o Atmospheric plasma

기술개발:핵심내용(4)

● Multi Functional Coating Technology

Roll-2-Roll, Yarn and Fiber and web substrate coating



Low Pressure CVD

Polymer Layer Deposition w/ E-Beam

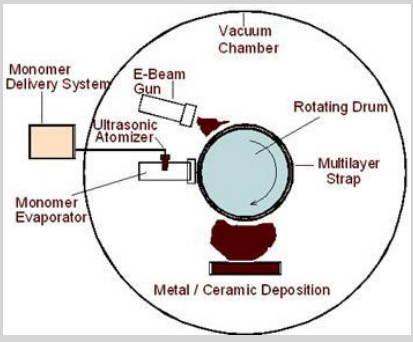
Wire Feed Metal Evaporation

- In-line multi-process vacuum chamber
- Coating and substrate treatment technology
- Yarn Roll-to-Roll deposition system
- Web substrate Roll-to-Roll deposition system for textile substrates

기술개발:핵심내용(5)

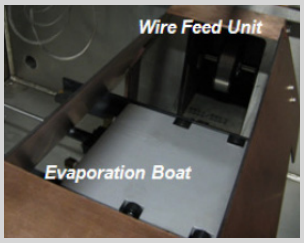
● Polymer Layer Deposition w/ E-Beam

- In line monomer/oligomer deposition
- E-Beam polymerization
- High control of film thickness (from 10nm to 1000nm
- Protective polymer coatings with controlled thickness
- High barrier coatings with high transmittance
- Electroactive polymer film and in-situ polymerization



Formation of nanolayers: metal, metal oxide, polymer (cured by electron beam, plasma), dyes, other.

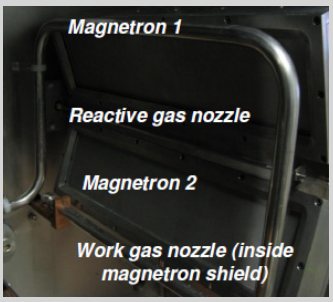
기술개발:핵심내용(6)



● Metal Evaporation

- Metal Evaporation process with continuous wire feed system
- Possibility of evaporating Al, Ag and Cu
- 2D and 3D metallization process
- Yarn metallization process
- Processing of conductive textile substrates and yarns,
- Processing of heat reflective surfaces

● DC Sputtering, Vacuum Plasma and CVD unit



- DC Dual Magnetron Sputtering thin film deposition
- CVD using reactive gas thin film deposition
- Plasma treatment of substrates also possible (fiber/yarns and web substrates – textiles)
- Deposition of Metal Oxide thin films (Aluminum oxide, Silicon oxide)
- Deposition of metallic thin films Al, Cu,

기술개발(핵심내용)

□ 응용 가능한 잠재 적용분야

○ 나노섬유, 스마트섬유, 슈퍼섬유, 생분해성 섬유 등의 고유특성을 부여하는 기술로 신 용도전개가 가능함.

- 바이오센서용 전도 및 압전성 섬유 (예, 심장박동 모니터링)
- 고성능 섬유 (High performance fiber)
- 웨어러블과 정전방지 의복용 전도성 섬유
- 약물전달 시스템용 다공 및 중공섬유
- 섬유수준의 유기광기전과 OLED 디바이스

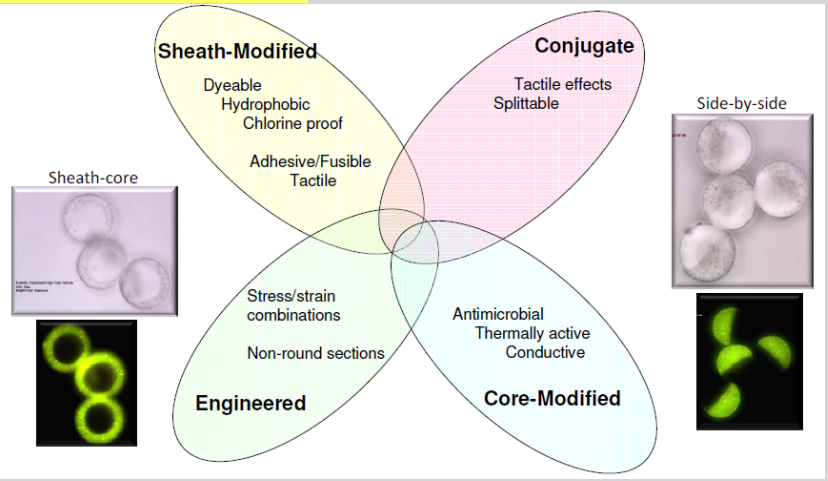
- 개인용 섬유융합 웨어러블 제품 (예, 터치패드, 센서)
- 에너지 저장 및 에너지 생성 분야 (예, 압전섬유)
- 섬유집합체 기재에 열반사 필름
- 고성능 절연재료
- 기체 및 액체 조절 보호 섬유집합체 (예, 헬륨, 가스)
- 초발(소)수성, 초친수성, 초발유성 재료

개발예시(1-1)

● Spinning Technologies For Elastic Yarns Dry Spun Elastomers

- Bi-component / Bi-constituent Spin Technology
- PU based
- Several configurations possible

◆ Potential Product Areas

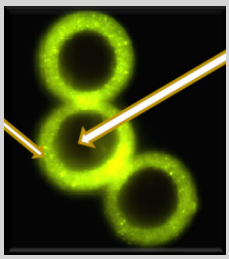


개발예시(1-2)

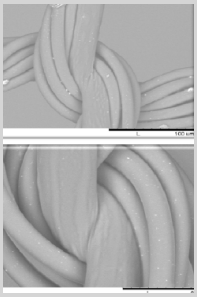
● LYCRA® Fusion Fiber

- Core-sheath dry-spun product
- Core for elastic, sheath for fusion properties

Sheath polymer/ fusing agent



Core polymer / elastic properties



- Adhesive fuses during steam-setting process

● Other Potential Applications of Fusing Yarns

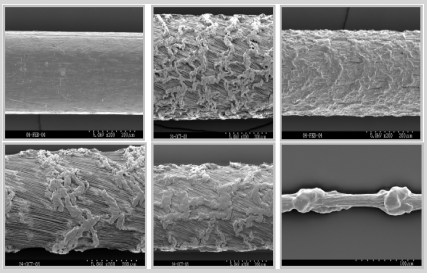
- Elimination of seams
- More cost effective garment making
- More comfortable garments
- Better looking garments
- Prevention of seam slippage
- Elimination of a key quality issue


Hosiery from LYCRA® Fusion fiber

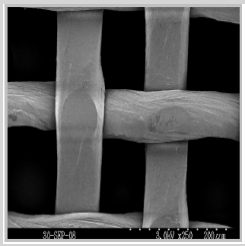

Hosiery from standard yarns

개발예시(2-1)

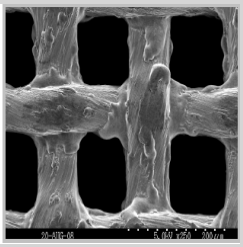
● Innovation ePTFE Fiber Technology – Surface Texture



Before Stabilization



After Stabilization



- Tailored surface texture in 100% ePTFE fibers
- Large improvements in abrasion resistance
- Fiber processing benefits (handle, durable)
- Ideal surface for coatings/fillers
- Range of fiber luster options

NEW 100% ePTFE Weaves with Amazing Dimensional Stability

- More consistent spacing/pore opening
- Excellent fray resistance
- Very low shrinkage (<1% at 300°C/20min)
- Ideal for use filtration/membrane reinforcement

개발예시(2-2)

● Difference b/w expanded PTFE (ePTFE) and Matrix Spun PTFE Fibers

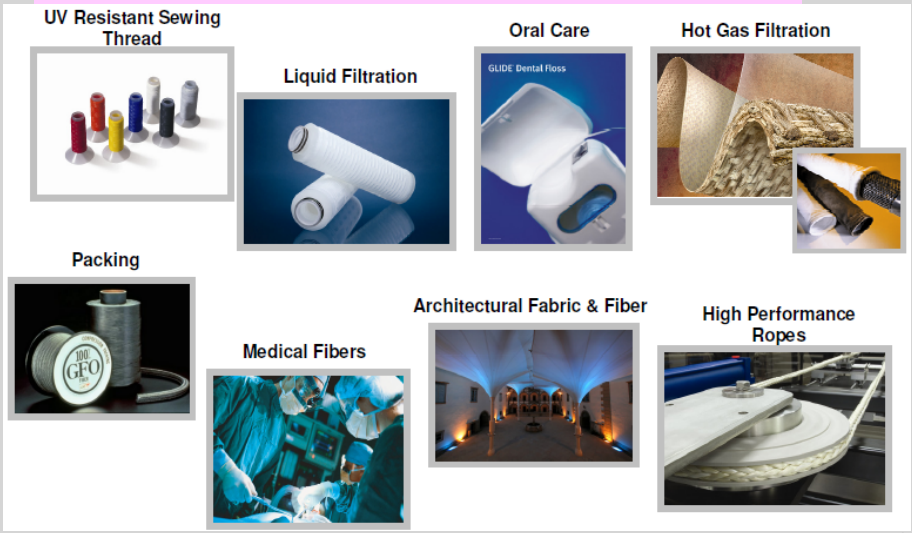
• Matrix Spun PTFE Fibers
- Spinneret process with viscose carrier
- Brown in color (process residues)
- Multi-filament
- Low tensile / high shrink properties

• Expanded PTFE (ePTFE) Fibers
- Extrusion / Stretch at high temperatures
- White, pure PTFE – no process residues
- Mono-filament and multi-filament fibers available
- Higher tensile / lower shrink properties

GORE™ TENARA® Architectural Fabric Covers Wimbledon's Center Court

개발예시(2-3)

- Innovations in ePTFE Fiber Technology
  New Capabilities, New Applications, New Opportunities



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개발예시(3-1)

TEIJIN MONOFILAMENT kaypla

- High Performance Tapes for Thermoplastic Composites
  - Price level of current high performance fibers:
    carbon > 20 €/kg, aramid > 30 €/kg, UHMWPE > 35 €/kg
  - Need for fiber reinforced structures which are light weight but are 100% recyclable (thermoplastic, all-(homo) Polymer)

Polyolefines:
High molecular weight Polyethylen (HDPE)

Polypropylen (PP)

Well known end-uses of Polyolefines:
Fridge-bags, waste-bags, Shampoo-bottles, pipes, cable-insulation, shrink-foils, etc.

⇨ **Melt extruded**

⇨ **Ultra highly drawn:** > 40:1 with new patented process provides extraordinary properties

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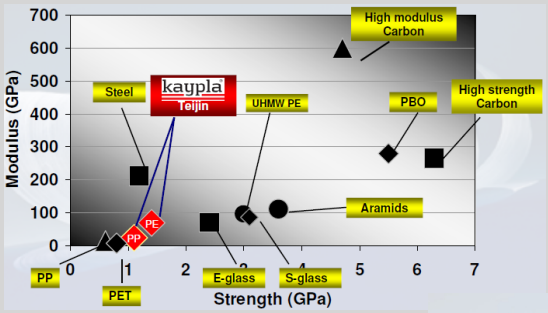
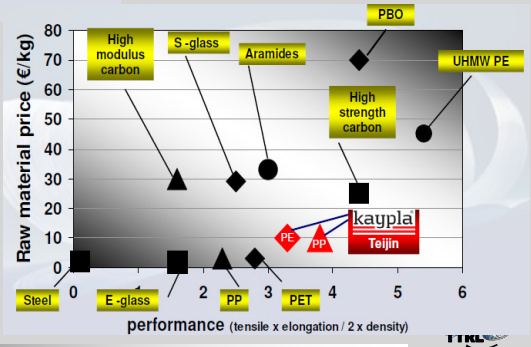
개발예시(3-2)



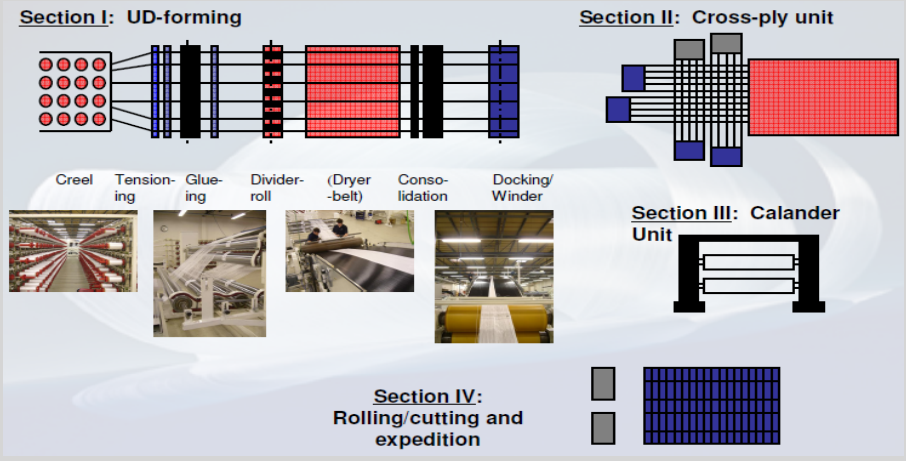
Properties of new HMW PE tape are moderate compared to high performance materials

Newly developed HMW PE provides good mechanical properties at reasonable price level



개발예시(3-3)

● Composite Panels Manufacturing



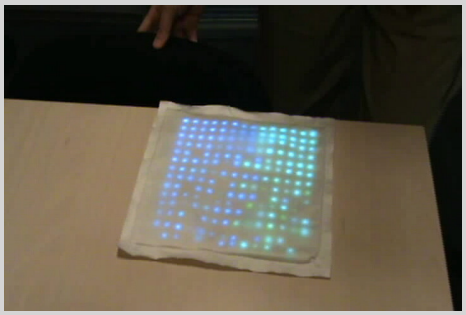
개발예시(4-1)

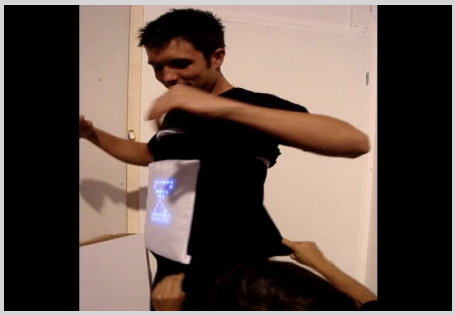
Lumalive's LED Canvas Technology

Lumalive

PHILIPS

Lumalive's woven LED Canvas allows freedom of form factors because it is made from fabrics

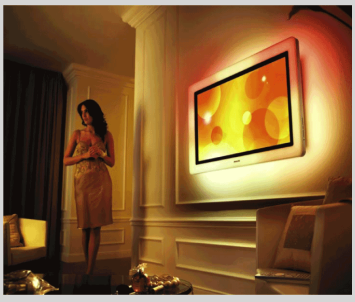




Integration of LED Canvas into Garments
- Modular approach to system integration
  – LED Canvas can be inserted and removed from the Lumalive Garment
- The garment design and engineering is important

개발예시(4-2)

● Taking brand experiences to the next level



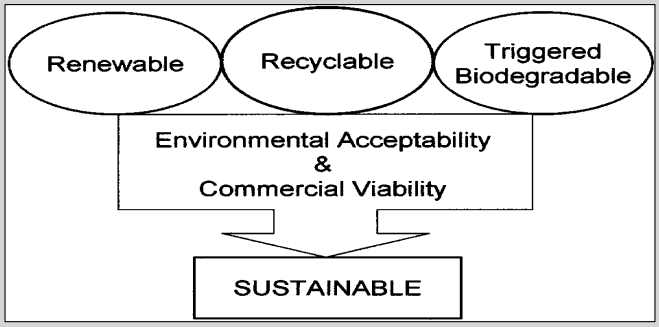
- Consumers want to be entertained, emotionally affected, and creatively challenged by "experiencing" products and services
- Traditional marketing techniques, like TV and radio, are becoming less effective

- New marketing driven by experiences
  "experiential marketing" is generally a more effective strategy to establish a position in consumers' minds
  - **Something different**
  - **Something interactive**

기술개발: 친환경(1)

Concept of Bio-based Products

- Basic idea of biopolymers is taken from nature's cycle.
- Most of it is subsequently converted back into the starting products, carbon dioxide and water by micro-organisms.
- The cycle is the role model for biopolymers, that are often made from renewable raw materials obtained from agricultural production.
- Biodegradable products have served their purpose.



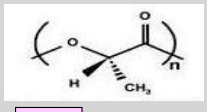
➢ Key Words: (Bio, Biodegradable, Green, Sustainable, etc)
Materials (Polymer, Fiber, Film), Product (Textiles, Plastic, Composite)

기술개발: 친환경(2)

Manufacture of PLA Fibers

Poly (lactic acid) (PLA)
- Cargill has developed several processes that use corn and other renewable sources to produce ECO-PLA, a renewable biopolymer based on poly(1actic acid).

PLA polymer → Melt spinning → 5000m/min winding (direct) / Spin drawing(2stage) → PLA fibers



Analysis: Thermal properties, Tensile properties and so on.

Form

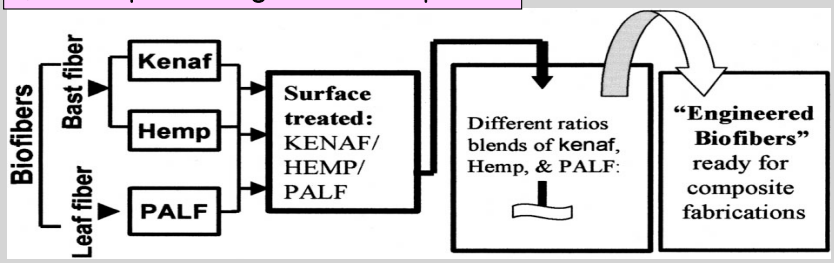
L-form	High crystallinity and transition temp. related to Mw
D,L-form	High non-crystallinity and low Melting point Stereo complex

Applications

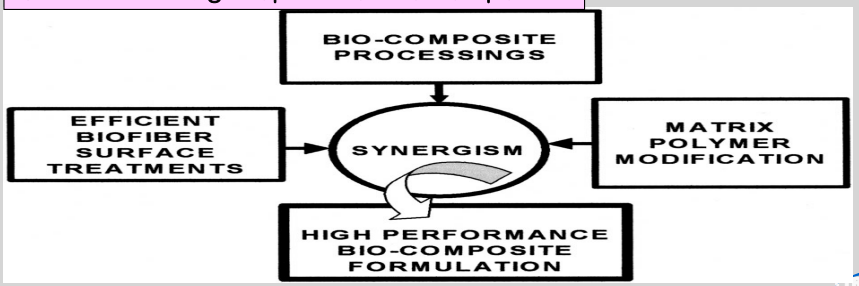
Past	Surgical and biomedical - High cost
Nowadays	Bottle, film, fiber and many substitute plastic

기술개발: 친환경(3)

◆ Concept on design of bio composites



◆ Manufacturing Propcess of bio composites



기술개발: 친환경(4)

Application of PLA Polymers

Green (Bio) Textiles

- Fibers
- Apparel
- Carpet
- Furnishings
- Nonwovens

Bio Plastics (Composites)

- Bottles & Preforms
- Cards & Graphic Arts
- Consumer Goods Packaging
- Display Packaging & Folding Cartons
- Extrusion Coated Paper
- Films & Converted Film Products
- Injection Molding & Compression Molding
- Labels
- Thermoformed Packaging
- Threaded Containers & Jars

기술개발: 친환경(5)

Automotive Applications

Corn-based
headrest

Natural fiber reinforced PP

Sugarcane-based
PP side shields

Corn-based fabric

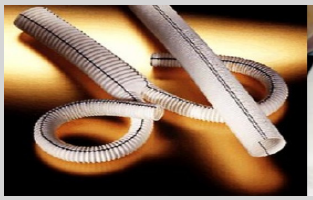
Soy-based PU foam

Upcycled water bottles to
PBT
seat clips

Ford's Enviro Seat (source: Ford)

기술개발 향후전망

❖ Existing Materials already in development
- Shape changing materials (SMA's, SMP's)
- Color and optically changing materials (chromics)
- Energy exchanging 'smart' materials
- Materials exchanging 'smart' materials



❖ Materials developments in the near future
- Electroactive Polymers
- Photoactive Polymers
- Bio responsive Hydrogels
- Electro Luminescent Fibers and Films
- Photovoltaic Fibers and Films
- Photonic Fibers and Films
- Biomimetic Materials

미래기술개발 방향

❒ 기존기술의 고부가가치화

- 기업보유 기술 활용으로 기능성 부여(첨가제, 표면가공)
- 부직포분야: 생분해성, 중공, 이형단면, 복합방사부직포
- 용도분야: 환경, 메디컬, 위생, 스포츠레져, 항공 등

❒ 신성장 동력산업 진입기술(장기간 프로젝트)

- 섬유복합재료 기술: 고성능(탄소, 아라미드) 섬유의 제품화
- 생분해성 섬유 제조기술: PLA, PCL 및 천연섬유
- 바이오섬유 제품화 기술: 부직포, 그린컴포지트
- 스페이서직물 제조기술: 복합화 및 입체적 구조

미래 기술개발 및 시장전략

- 향후 개발 및 시장전략
  - 특수수지 및 천연소재의 섬유화 및 기능화 부여 기술개발
    (필터, 병원용, 생리용, 와이퍼 등)
  - 특수 기능섬유의 제품화 기술 확립 및 신용도 개척
    (PVDF, PPS, PTFE, PI, PLA 등)
  - 향후 시장개척을 위한 산업용 섬유의 필수 다기능성 기술확립
    (신축성, 전도성, 생분해성, 위생성, 항균성 등)

"Future of textiles is very bright,
but we need more efforts to make the creative
products and these can be achieved by only hard
workers who have dream and ambitious."

...경청해주셔서 감사합니다...

Technical Textiles Research Lab .