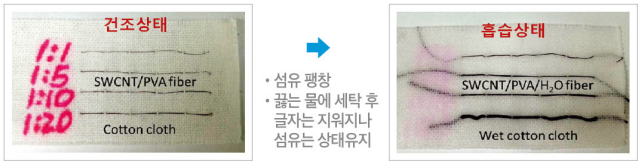
수분 감지 Wearable Textile 센서 기술

Wearable Textile Sensor for Moisture Detection

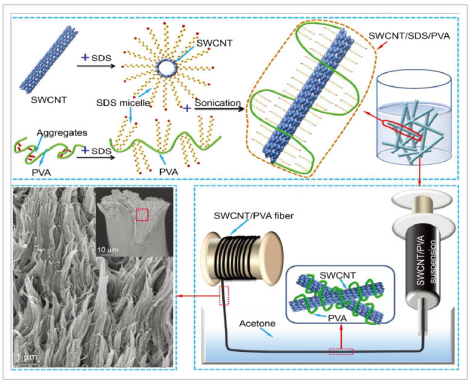
TRL2

기술내용

- 습식방사(wet-spinning)에 의한 SWCNT/PVA 복합섬유 제조:계면활성제 SDS 사용, SWCNT/PVA 용액을 응고제에 압출 후 공기중에 건조시켜 섬유 제조 ; 섬유 인장강도 750 MPa
- 흡습에 의한 섬유 팽창으로 SWCNT 간의 간격이 벌어져 저항이 급격히 증가; 섬유의 저항치 변화를 측정하여 습도 센싱
- 높은 인장강도와 washable 특성으로 wearable textile 응용가능

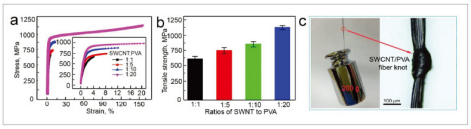


- 섬유 팽창
- 끓는 물에 세탁 후 글자는 지워지나 섬유는 상태유지

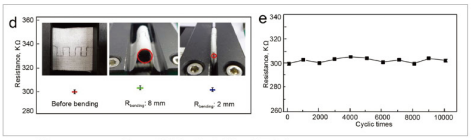


개발기술

- SWCNT 균일 분산기술 : SWCNT 함량에 대한 적정량 분산제 사용, 최적의 sonication 시간
- 최적의 SWCNT 포함량 : 높은 인성 및 인장강도, 전기전도성, 수분 swelling 특성 발현 SWCNT/PVA 무게 비율 결정
- 습식 방사 기술: SWCNT 의 일방향 배열을 위한 최적 바늘 직경 결정, 분산제 제거를 위한 응고제 사용



SWCNT 포함량에 따른 섬유의 인성 및 인장강도 특성



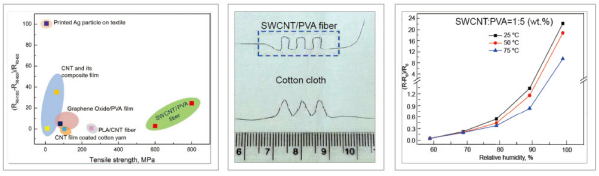
Bending-extension 시험: 우수한 내구성

우수성

우수한 인장강도 및 민감도
강도 750MPa

Wearable 센서
바느질 가능

우수한 민감도 및 응답속도
전기저항 증가 25배
응답속도 40초



보유기술

- SWCNT 균일 분산기술
  - 분산제, sonication
- 최적의 SWCNT 포함량 결정
  - SWCNT/PVA 혼합 비율
- 습식 방사기술
  - 최적의 바늘 직경
  - 분산제 제거를 위한 응고제

- **[특허] KR10-2016-0153277 고강도 단일벽 탄소나노튜브/고분자 복합체 필라멘트의 제조 방법 및 이에 의해 제조된 고강도 단일벽 탄소나노튜브/고분자 복합체 필라멘트**

사업성

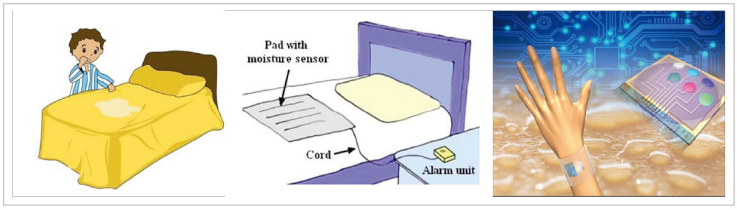
- 현재는 주로 금속재료를 이용한 센서이거나 전도성 필름 센서로서 착용감과 내구성이 떨어지고 반응속도가 느리며 소수성 패브릭에 사용하기 어려운 단점이 있음

활용분야

- Wearable 습도센서 (underwear-wetting 센서 등)
- 의복의 microclimate control 센서
- 환자 관리용 센서 (혈액누출, 피부병리 등)
- Bed wetting 센서
- 보유기술 현황 : 특허출원 중

이전 가능기술

SWCNT 균일 분산기술, 습식방사 기술



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A Wearable Textile Sensor for Moisture Detection

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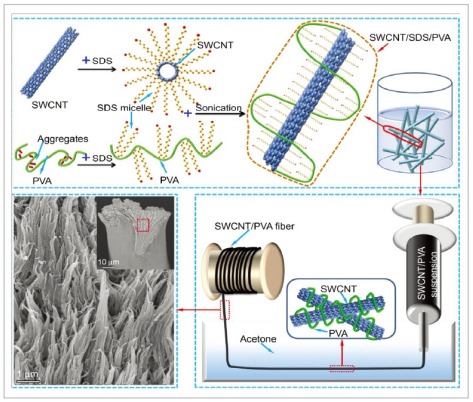
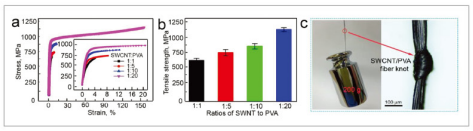
Technology Overview

- Fabrication of SWCNT/PVA composite fiber using wet spinning: SWCNT/PVA solution is extruded into coagulant using surfactant SDS, and air-dried to make fiber (with tensile strength of 750 MPa)
- The fiber swells upon moisture absorption, resulting in wider gap in SWCNT and rapid increase of electrical resistance. Humidity is sensed by measuring the resistance change
- Applicable to wearable textile thanks to high tensile strength and washability

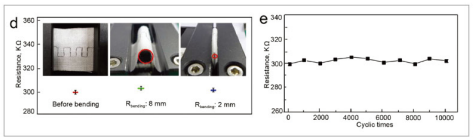


Technology developed

- Uniform dispersing of SWCNT: Optimal content of surfactants with respect to SWCNT, optimal sonication time
- Optimal SWCNT content: Determination of SWCNT to PVA ratio enabling high toughness, tensile strength, electrical conductivity, and moisture swelling
- Wet spinning: Optimized needle diameter to ensure well-aligned SWCNT, Coagulant for removing surfactant



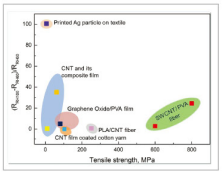
Toughness and tensile strength depending on SWCNT content



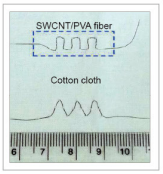
Bending-extension test: Good durability

Highlights and Strengths

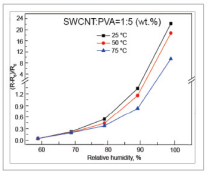
Good tensile strength and sensitivity
- Strength 750 MPa



Wearable sensor
- Needlework allowed



Good sensitivity and response speed
- 25 times higher electrical resistance, response time (40 s)



KIMS's technologies

- Uniform dispersing of SWCNT
  - surfactant, sonication
- Determination of optimal SWCNT content
  - Ratio between SWCNT and PVA
- Wet spinning
  - Optimal needle diameter
  - Coagulant for removing surfactant

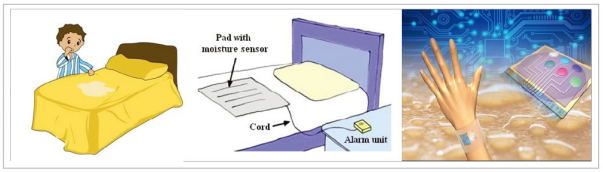
- [Patent] KR10-2016-0153277 A METHOD FOR PREPARATION OF ULTRA-STRONG SINGLE-WALLED CARBON NANOTUBE)/POLYMER COMPOSITE FILAMENT AND ULTRA-STRONG SINGLE-WALLED CARBON NANOTUBE)/POLYMER COMPOSITE FILAMENT BY THE SAME

Business Cases

- Currently, most sensors are metal based or conductive film based, often causing irritation and having lower durability. Hardly applicable to hydrophobic fabric.

Applicable products/services

- Wearable humidity sensor (i.e. underwear-wetting sensor)
- Micro-climate control sensors for apparel
- Sensors for patient care (blood spill, dermatopathology)
- Bed wetting sensors



- KIMS's technologies: Under patent application
- Transferable technologies: Uniform dispersing of SWCNT, wet spinning

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