

한국정밀공학회

KSPE 2023 Autumn Conference

2023 추계학술대회

2023. 11/15 WED - 17 FRI | **솔비치 삼척** (강원도 삼척시)



K-Precision
Smart & Green

주최 KSP E 대한 한국정밀공학회
Korean Society for Precision Engineering

후원 GWT O
강원관광재단

포스터발표 II

- 23APP08-018** 탄소나노튜브를 접목한 PCL 스마트 스텐트의 기계적 강도 향상
노민(전남대학교), 이동원(전남대학교)
- 23APP08-019** 다기능 캔틸레버 어레이를 이용한 전기 기계 평가를 통한 심장 독성 스크리닝
무재(전남대학교), 이동원(전남대학교), 노민(전남대학교), 김종윤(전남대학교), 정윤진(전남대학교)
- 23APP08-020** CFRP 드릴링 공정에서의 광섬유 레이저를 활용한 마이크로 디버링
박형진(한양대학교), 이성환(한양대학교), 김효정(한양대학교), 이주현(한양대학교)
- 23APP08-021** 웨어러블 의료 기기를 위한 자가 부착성 및 자가 치유 특성을 갖춘 3D 프린팅 가능한 이온 트로닉 하이드로젤
이성진(UNIST), 정훈의(UNIST), 최건준(UNIST), 김소미(UNIST), 김재일(UNIST)
- 23APP08-022** 초소수성 및 자가부착 특성 기반 전도성 유연 패치 개발
송원우(UNIST), 정훈의(UNIST), 박성진(UNIST), 김재일(UNIST), 김진서(UNIST), 강동관(UNIST), 김소미(UNIST)
- 23APP08-023** 혈관 내 이식 가능한 효소 바이오 연료 전지를 위한 생체 적합한 형상 기억 고분자 이중층 기판의 특성화
경도경(경북대학교), 곽문규(경북대학교), 하륜 칸(경북대학교)
- 23APP08-024** 미세구조 기반 PDMS 패드를 활용한 반도체 제조에서의 금속 불순물 제거 개선
박한준(경북대학교), 곽문규(경북대학교), 김태현(경북대학교), 이한수(경북대학교), 김재홍(경북대학교)
- 23APP08-025** 포아송 효과를 활용한 복제 리소그래피 기술과 그 적용
김민수(경북대학교), 곽문규(경북대학교), 경도경(경북대학교), 박진원(경북대학교), 권도형(경북대학교), 권주완(경북대학교)
- 23APP08-026** Fine Pitch Packaging 대응 탄소계 언더필 복합소재 개발
이강후(서울테크노파크), 박만석(서울테크노파크), 송인협(서울테크노파크), 신소원(서울테크노파크), 김민식(서울테크노파크)
- 23APP08-027** 스마트 의류 적용을 위해 면직물에 잉크젯 프린팅된 웨어러블 촉각 센서
허보웅(연세대학교), 김종백(연세대학교), 배규빈(연세대학교), 강윤성(경북대학교), 표순재(서울과학기술대학교)
- 23APP08-028** 고속 멤스 미러 스캐너를 이용한 마스크리스 리소그래피
조준희(한국기계연구원), 장원석(한국기계연구원), 임형준(한국기계연구원)
- 23APP08-029** 다이아몬드 나노구조체의 진동 특성 분석 및 응용방법
한상욱(한국과학기술연구원), 김철기(한국과학기술연구원), 이동근(한국과학기술연구원)

I 바이오헬스

- 23APP09-001** 양방향 굽힘이 가능한 공압식 소형 소프트 웨어러블 장치
유한유(서울대학교), 안성훈(서울대학교), 김형중(건국대학교)
- 23APP09-002** 인공신경망을 이용한 경동맥 점탄성 특성 기반 심혈관질환 위험도 예측 관한 예비 연구
한윤호(명지대학교), 이계한(명지대학교), 김수환(명지대학교), 오성진(명지대학교)
- 23APP09-003** 고주파 정상 상태 체성감각 유발 전위 분류를 위한 합성곱 신경망 기반의 사용자-전이 프레임워크
김근태(한국과학기술연구원), 이승주(한국과학기술연구원)

탄소나노튜브를 접목한 PCL 스마트 스텐트의 기계적 강도 향상 Increase mechanical strength of PCL smart stent incorporated with carbon nano tubes

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*Nomin-Erdene Oyunbaatar, #Dong-Weon

Keywords: Smart stent, Wireless pressure sensor, Carbon nano tubes, 3D printing

One major cardiovascular disease (CVD) is atherosclerosis, a condition in which plaques accumulate in the walls of the arteries, causing them to harden. This gradual narrowing of the arteries restricts blood flow and disrupts oxygen supply. To address this issue, one common treatment involves the insertion of a drug-eluting stent (DES) into the narrowed vessel. However, despite the effectiveness of various DES options in reducing the risk of recurrence, in-stent restenosis still poses the possibility of late thrombosis and subsequent heart attacks. Therefore, the development of a bioresorbable polymer stent has been desired for further application in this field. However, the use of bioresorbable stents, such as PCL-based stents, exhibit less mechanical strength and may lead to sudden collapse, thus falling short of meeting practical application requirements. In response to this challenge, we have developed a PCL stent incorporating carbon nanotubes (CNTs) to enhance its mechanical properties. Additionally, we have integrated a wireless pressure sensor for the early detection of stent restenosis. The proposed stent was manufactured using 3D printing technology, while the wireless pressure sensor was fabricated using MEMS techniques. The smart stent, as demonstrated through experiments, exhibits a fourfold improvement in mechanical strength compared to pure PCL stents.

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2020R1A5A8018367).

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탄소나노튜브를 접목한 PCL 스마트 스텐트의 기계적 강도 향상

Increase mechanical strength of PCL smart stent incorporated with carbon nano tubes

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Abstract

One major cardiovascular disease (CVD) is atherosclerosis, a condition in which plaques accumulate in the walls of the arteries, causing them to harden. This gradual narrowing of the arteries restricts blood flow and disrupts oxygen supply. To address this issue, one common treatment involves the insertion of a drug-eluting stent (DES) into the narrowed vessel. However, despite the effectiveness of various DES options in reducing the risk of recurrence, in-stent restenosis still poses the possibility of late thrombosis and subsequent heart attacks. Therefore, the development of a bioresorbable polymer stent has been desired for further application in this field. However, the use of bioresorbable stents, such as PCL-based stents, exhibit less mechanical strength and may lead to sudden collapse, thus falling short of meeting practical application requirements. In response to this challenge, we have developed a PCL stent incorporating carbon nanotubes (CNTs) to enhance its mechanical properties. Additionally, we have integrated a wireless pressure sensor for the early detection of stent restenosis. The proposed stent was manufactured using 3D printing technology, while the wireless pressure sensor was fabricated using MEMS techniques. The smart stent, as demonstrated through experiments, exhibits a fourfold improvement in mechanical strength compared to pure PCL stents.

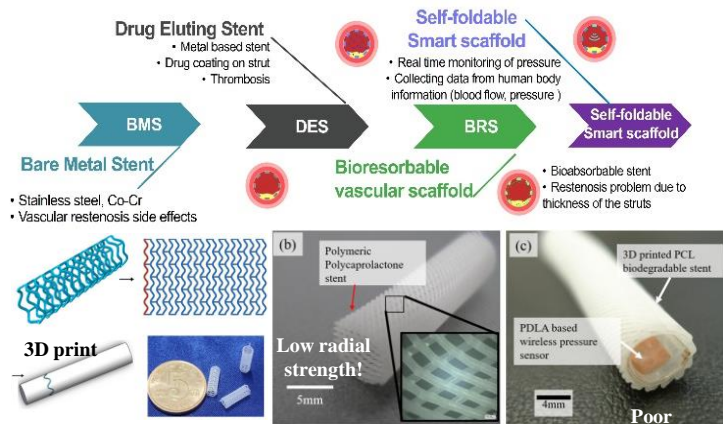
Keywords : Smart stent (스마트 스텐트), Carbon nano tubes (탄소나노튜브), Pressure sensor (압력 센서), Wireless monitoring (무선 모니터링)



MEMS & Nanotechnology Laboratory



Introduction



Device concept

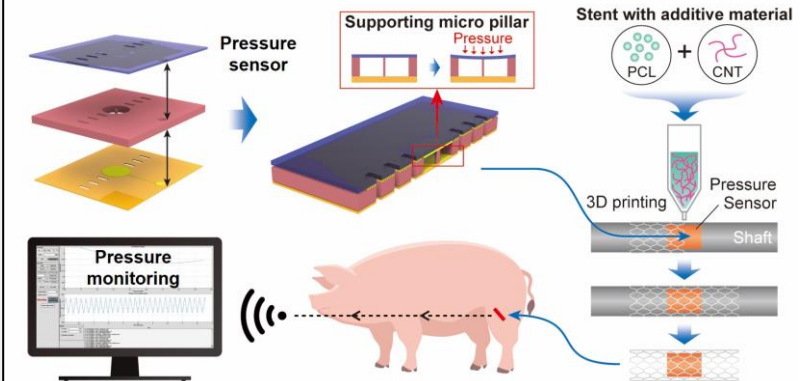


Fig. 1. (a) Concept of additive bioresorbable polymer stent integrated with LC type pressure sensor for sensing signal wirelessly to convert portable device

Preparation of the PCL/CNT

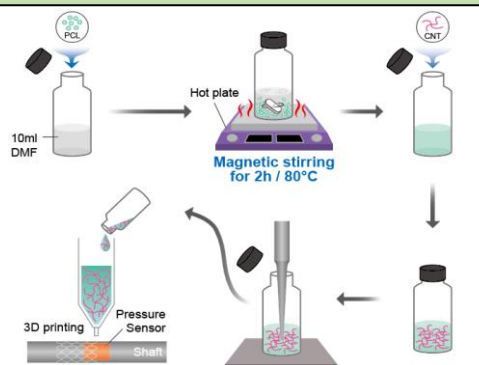


Fig. 2. Schematic illustration of preparing the PCL/CNT mixture for 3D printing a stent.

3D printed PCL, PCL/CNT stent

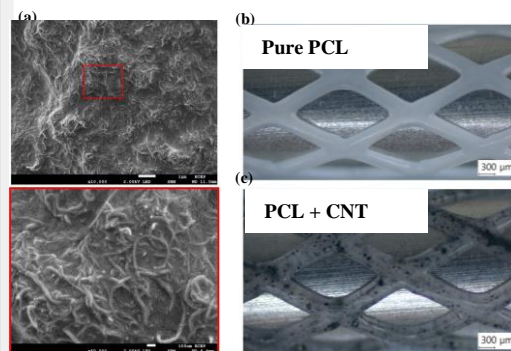


Fig. 3. (a) FE-SEM images of the PCL/CNT mixture, (b)-(c) 3D printed PCL and PCL/CNT stent.

Characterization of the stent

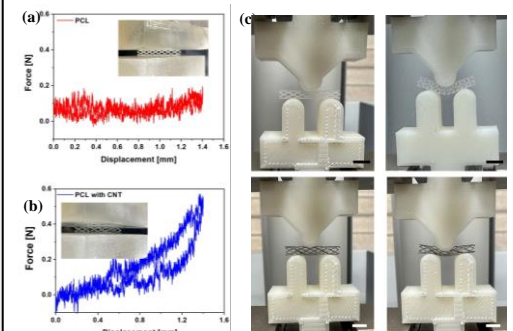


Fig. 4. (a) and (b) The graph of the radial force for the PCL and PCL/CNT stent. (c) PCL and PCL/CNT stent bending test for stent strength. (Scale bar: 5 mm)

Stent connected with the pressure sensor

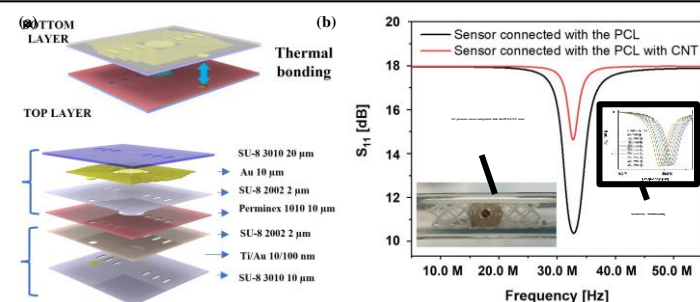


Fig. 5. (a) The schematic of the pressure sensor assembly, (b) The resonance frequency (RF) of pressure sensor connected with different stent (inset graph: RF changes versus applied pressure).

Conclusion

- We have developed a PCL stent incorporating carbon nanotubes (CNTs) to enhance its mechanical properties.
- A 0.2w% CNT mixture with the PCL stent was fabricated using 3D printing techniques.
- The radial force increased by 5 times compared to the pure PCL stent.
- An LC-type pressure sensor was integrated with the fabricated stent, and the RF signal was measured

Reference

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- N.E. Oyunbaatar, D.S. Kim, G. Prasad, Y.J. Jeong, and D.W. Lee, "Self-rollable Polymer Stent Integrated with Wireless Pressure Sensor for Real-time Monitoring of Cardiovascular Pressure." *Sens. Actuators A: Phys.* 346 (2022): 113869.

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2020R1A5A8018367)