

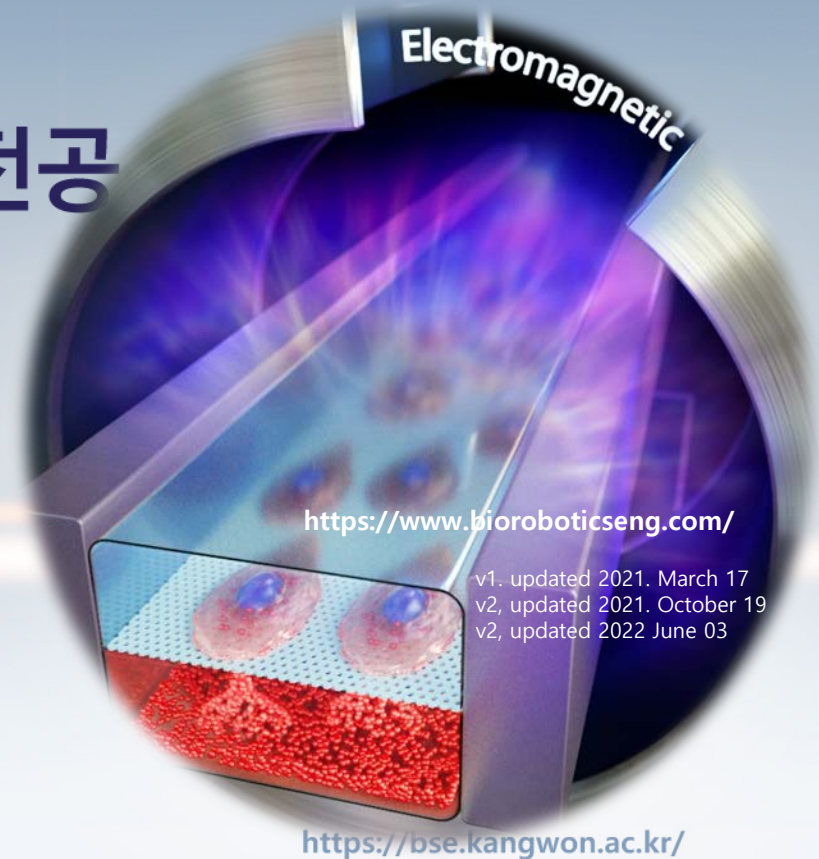


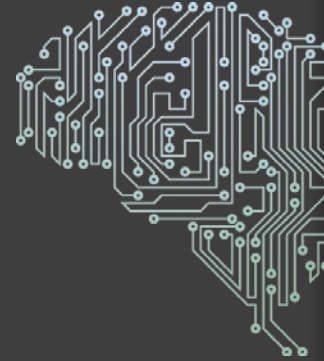
# 바이오산업공학부 바이오시스템기계공학전공

Department of  
Biosystems Engineering

**BiorobOtics Group**  
:Integrative Biology & Medicine

<https://www.bioroboticseng.com/>





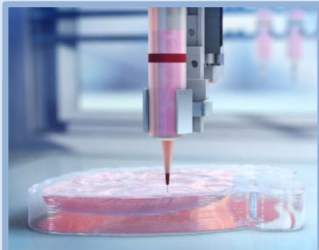
Ki-Taek Lim Ph.D. | Biorobotics Group



## Major Biorobotics & Tissue Eng.

### Researches

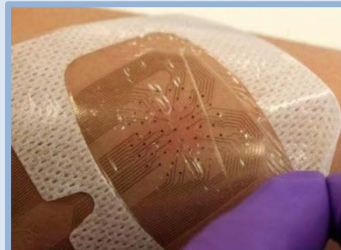
1. Wearable skin nanopatches
2. Nanomaterials-based biosensors
3. Bioreactor for cell-based therapies
4. 3D and 4D bioprinting technology for Tissue Eng.
5. Bio-nanorobotics: mimicking life at the nanoscale
6. Cancer targeting and drug delivery using quantum dots made from natural resources



3D and 4D Bioprinting



Bio-Nanorobotics



Wearable skin dressing



Biosensing patches



Bioreactor for therapies

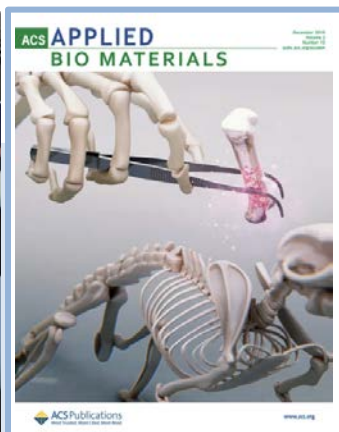
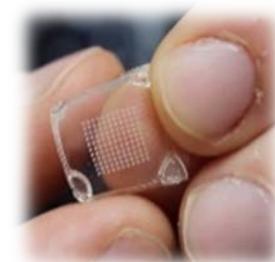
**Biorobotics**

**Nanobiosensing**

**Bioprinting**

## Research projects for dealing with industrial challenges

1. **Bioreactors for stem cell-based therapies** (Korea Technology and Information Promotion Agency)
2. **Tissue platform development using functional cellulose nanocrystals** (NRF Key central project)
3. **Innovative cultured meat for cow-free burger** (Alchemist-Ministry of Trade, Industry and Energy)
4. **3D and 4D printed hydrogel based-smart wound-dressings** (NRF)
5. **Bioprinted tooth tissue guidance** (Korea Technology and Information Promotion Agency)





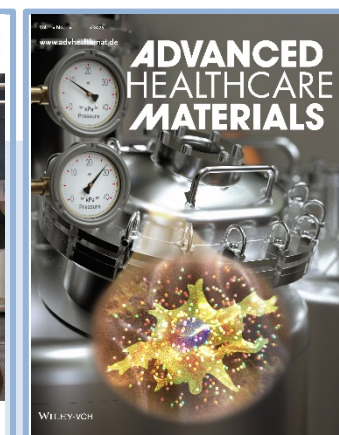
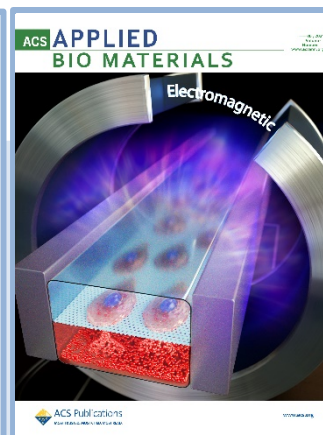
Biorobotics

Nanobiosensing

Bioprinting

## Research projects for dealing with industrial challenges

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# Biosystems Engineering > Faculty > Lab intro. > Biorobotics Group

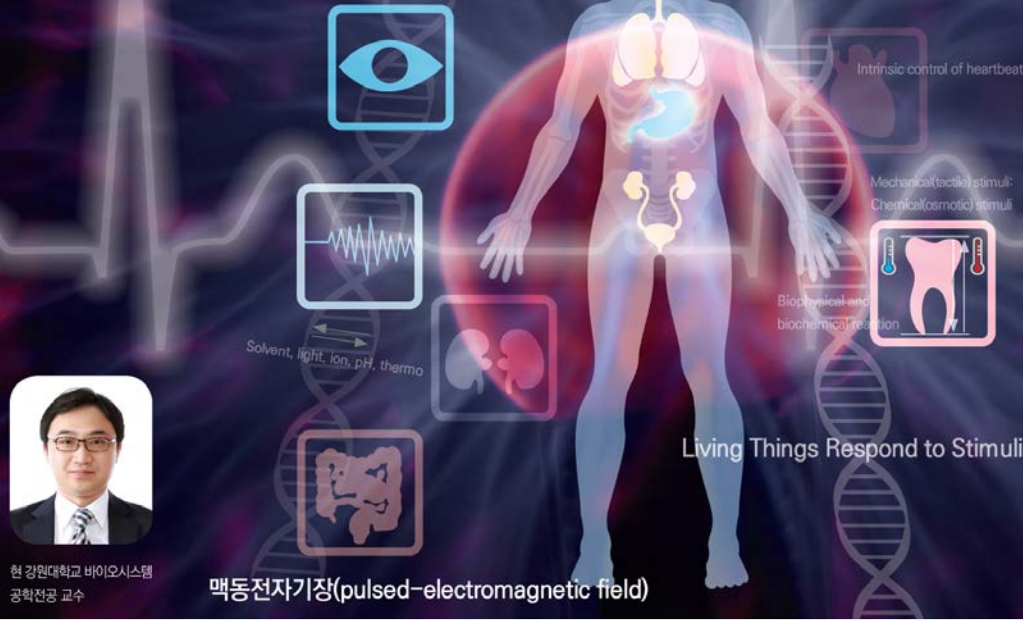
special theme

김  
일기택 교수

빛->눈(망막)  
소리->귀(청각)  
움직임->귀(평형)/피부  
맛->코/혀  
열->피부

생체자극 기술(Bio-Stimuli Technology)

자극에서 응답(response to stimuli)  
자극-반응(stimulus-response)  
자극-환경내 일상적 이벤트(stimulus-casual event in environment)  
반응-일상적 이벤트에 대한 반응(response-reaction to casual event)



원 강원대학교 바이오시스템 공학전공 교수

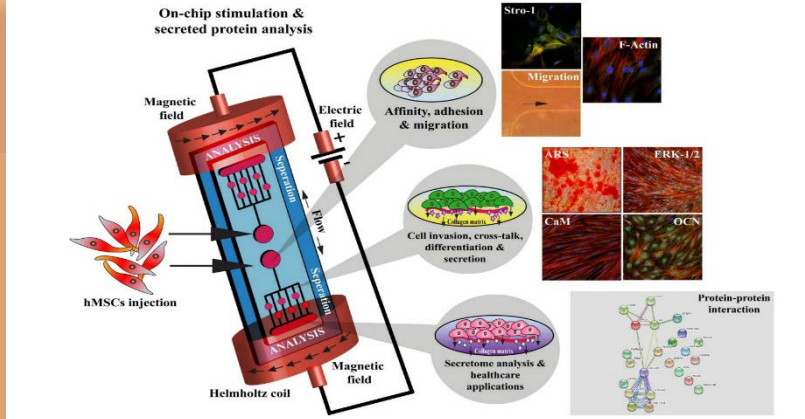


세포치료제 생산시스템의 로봇 활용

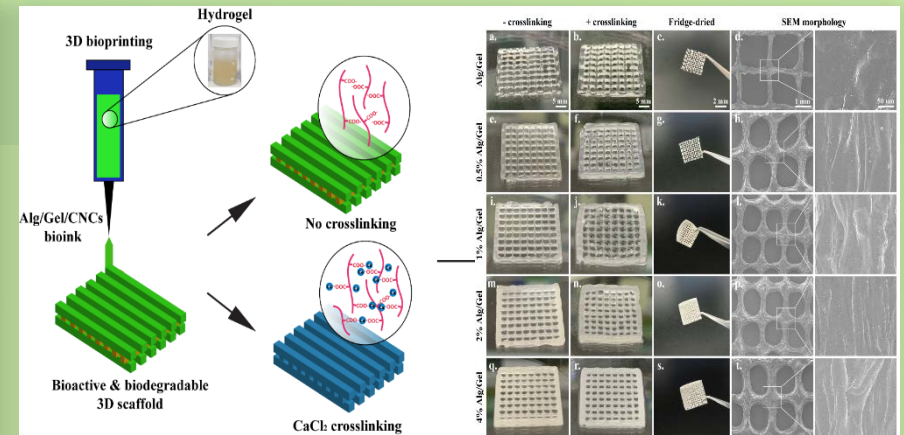
원료 세포 분주로부터 배양 완료 세포의 Harvest 까지의 전 공정 자동화

Figure 1. 줄기세포 배양 시스템의 종류

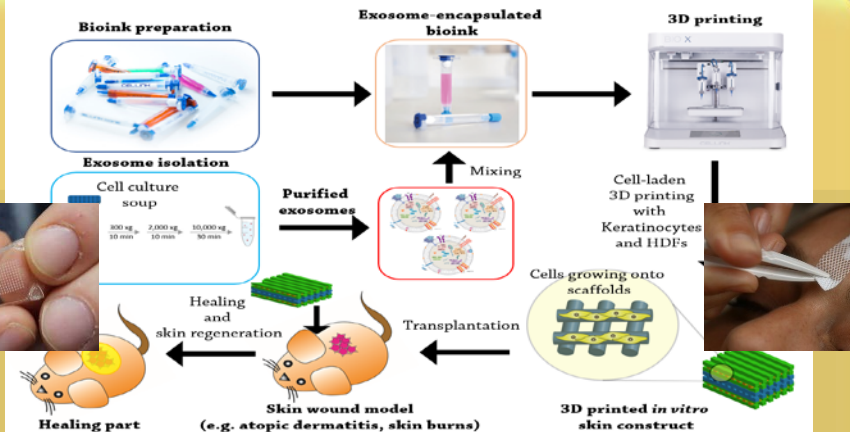




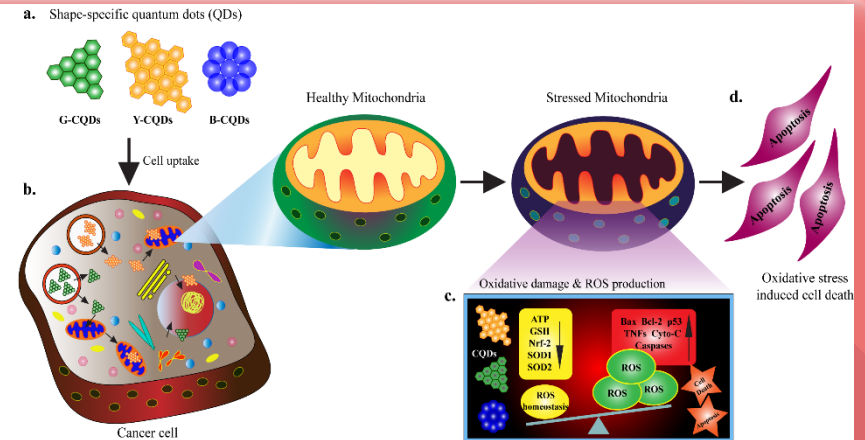
**Analysis of stem cell behavior and secretion by electromagnetic fields induction:** (1) Pulse electromagnetic fields (2) Magnetic nanomaterials



**3D bioprinting of human skin and tissue substitutes using biocompatible inks:** (1) Skin patches, (2) Conductive scaffolds, (3) Photo-curable bioinks

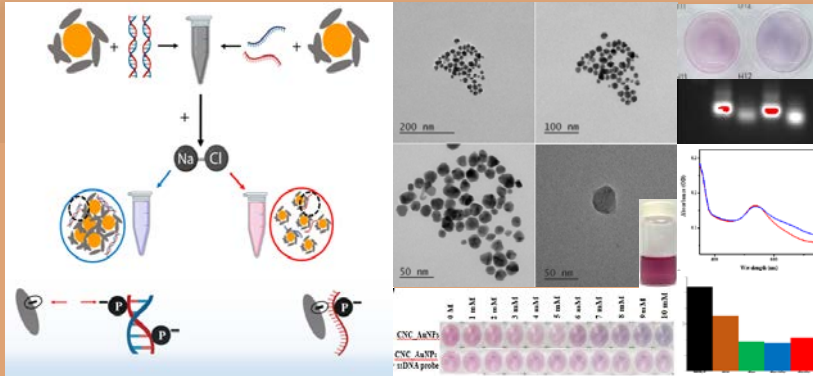


**Exosome-based cosmetic skin-care and cow-free meat development:** (1) Immunogenic exosomes from NK cells and cancer cells, (2) 3D printed burger, (3) Exosome-based skin dressings



**Anti-cancer therapy using carbon-based nanomaterials:** (1) Carbon dots (2) Graphene dots

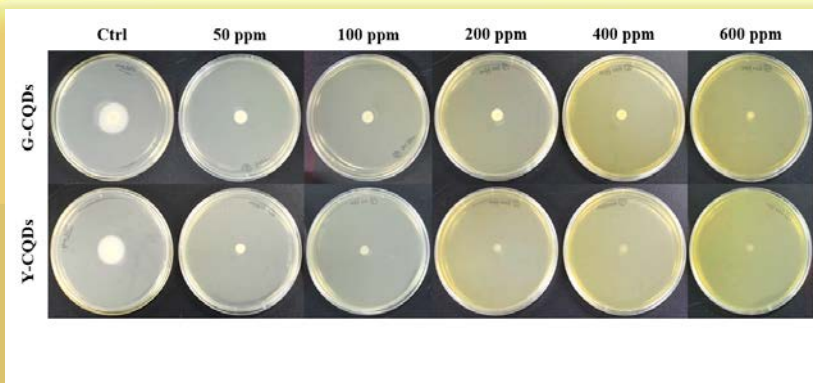




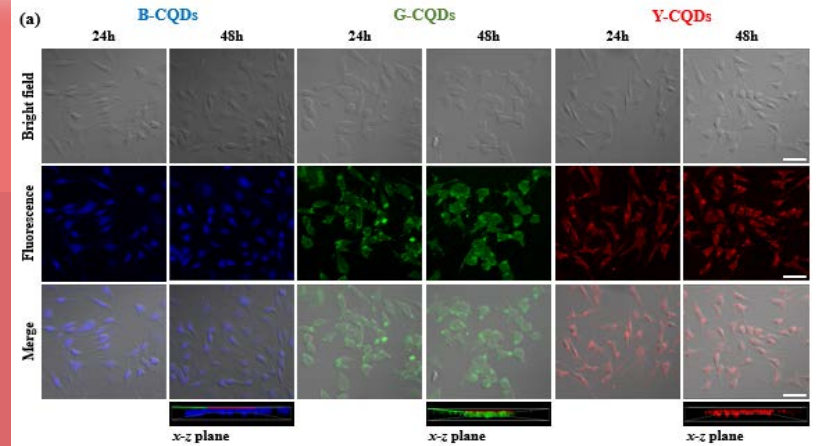
**Colorimetric detection of bacterial pathogen by functionalized gold nanoparticles:** (1) CNCs@AuNPs, (2) Dextrin-AuNPs, (3) Citrate-AuNPs



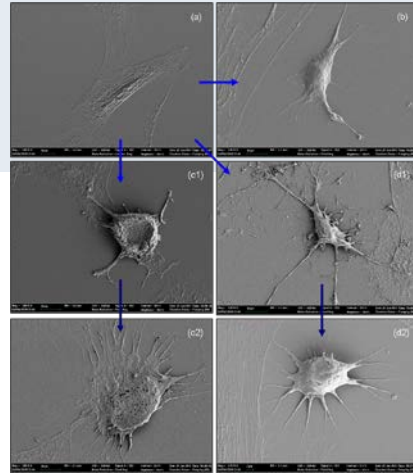
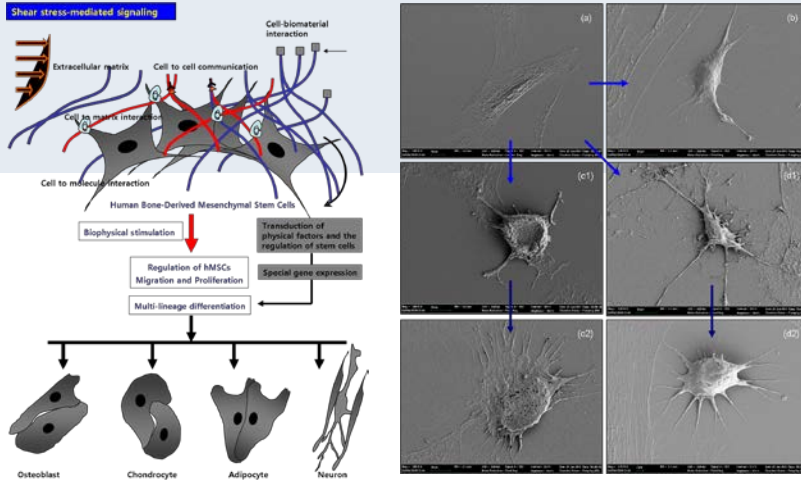
**Multi-functional Bioreactor system for stem cell organoid culture and cell-based therapies**



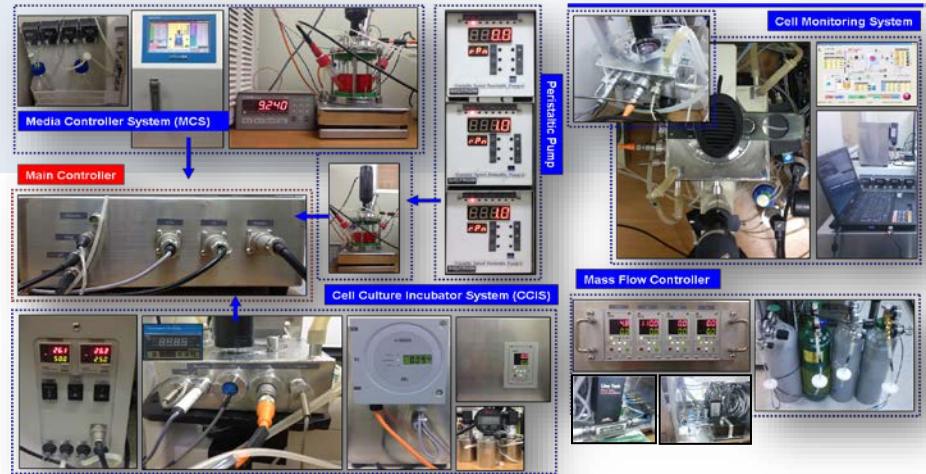
**Antimicrobial nanomaterials for wound dressing and biosensing**  
 (1) Carbon dots (2) Graphene dots



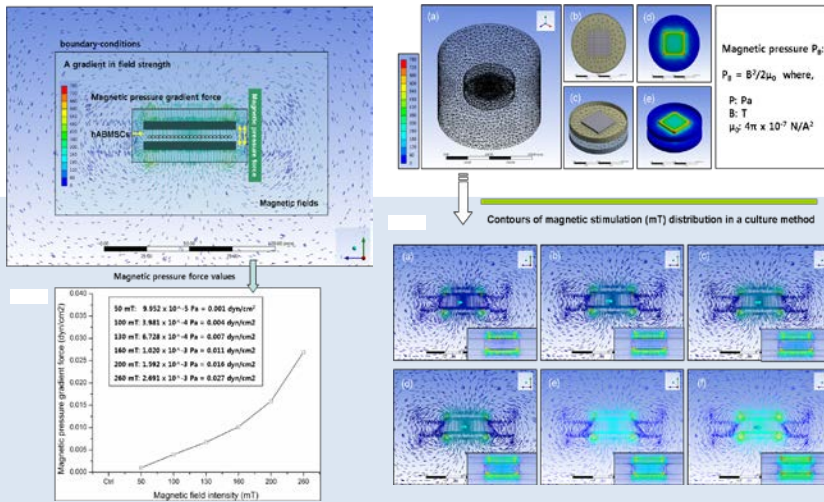
**Bioimaging using fluorescence nanomaterials**  
 (1) Carbon dots (2) Graphene dots



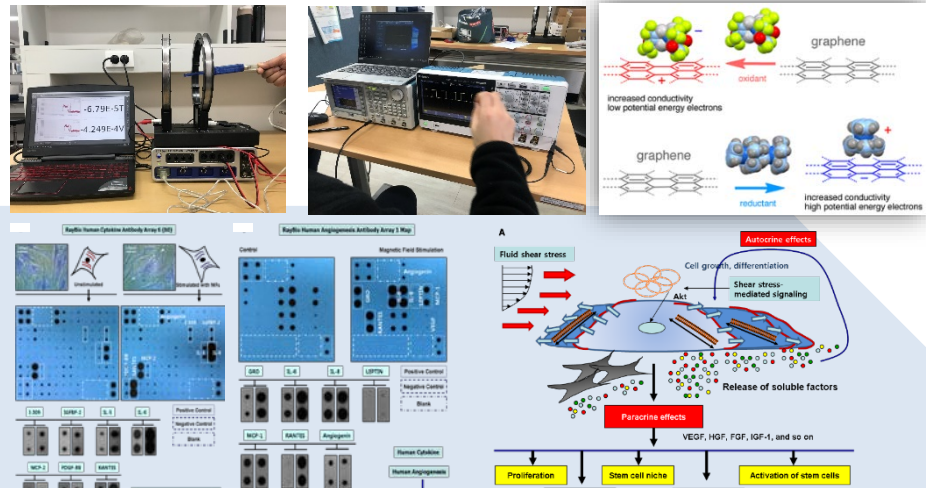
A Method for promoting proliferation and osteogenic differentiation of Human Alveolar Bone-derived Mesenchymal Stem Cells and a composition thereof | Granted Patent No. : 10-1890889(2018.08.16)



An automated bioreactor system for precise control of cell proliferation and differentiation and use of the same | Granted Patent No. : 10-2040691(2019.10.30) | 10-1327209(2013.11.04)



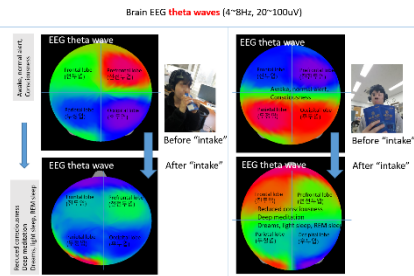
A method for inducing enhanced adhesions and osteogenesis on mesenchymal stem cells using the magnetic field | Granted Patent No. : 10-1952761(2019.02.21)



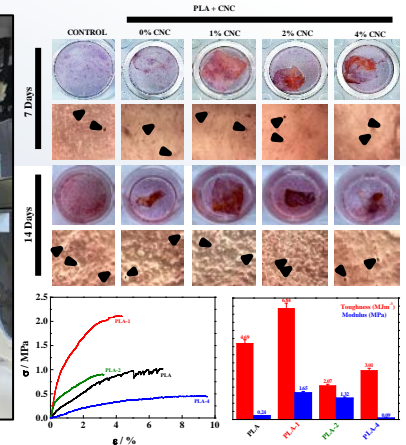
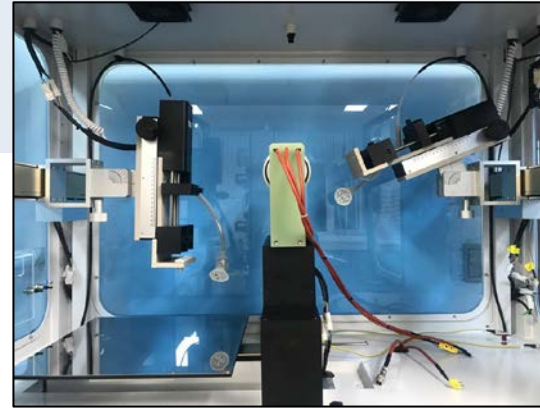
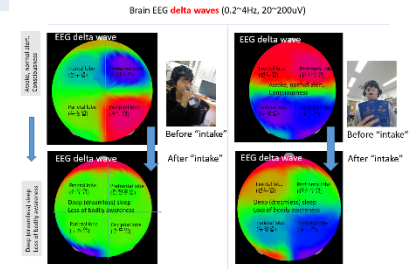
A method for multi-differentiation of human mesenchymal stem cells using pulsed-electromagnetic-field-assisted reduced graphene oxide substrate | Granted Patent No. : 10-1952761(2019.02.21) | G10-1856723(2018.05.03)



Brain Waves – Electroencephalogram **EEG theta** “Slight Sleep, Drowsiness” 4-8 hz waves



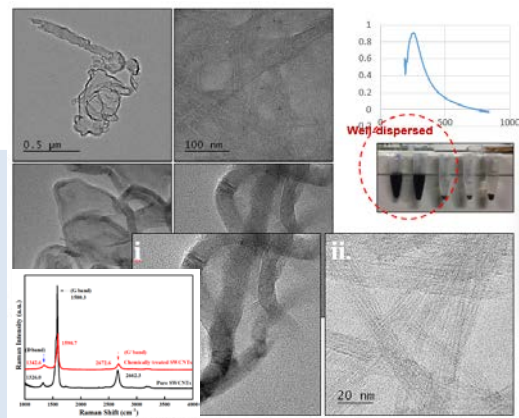
Brain Waves – Electroencephalogram **EEG delta** “Sleep, Dreaming” 0.2-4 hz waves



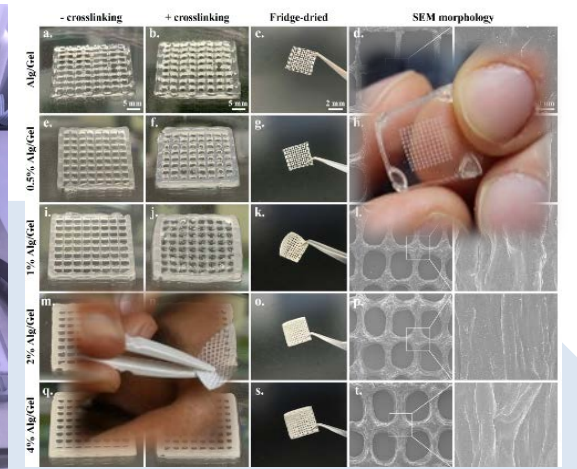
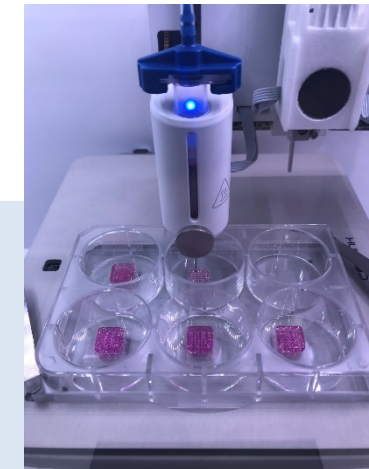
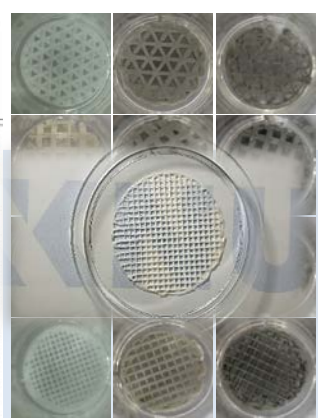
A composition for sleep induction comprising an extract of rice bran and Sarcodon aspratus | Granted Patent No. : 10-1918249 (2018.11.07) | Granted Patent No. : 10-2020-026015(2020.03.02)

A composition for tissue engineering comprising alginate, gelatin, and cellulose nanocrystals and use of the same | Granted Patent No.: 10-2019-001204 (2019.01.04) | 10-2019-0015523 (2019.02.11)

CNTs 20nm TEM Morphologies

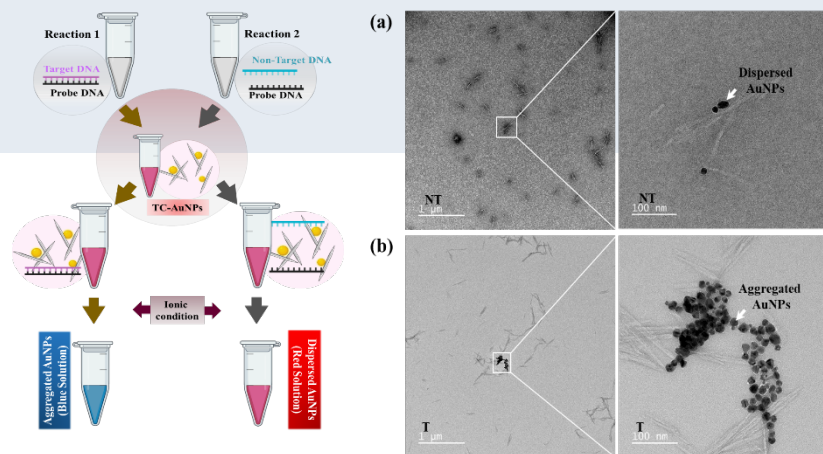


3D printing scaffolds

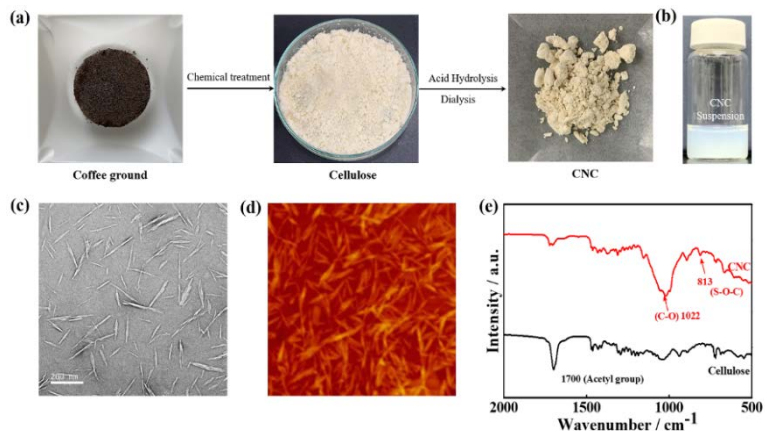


A method for single-walled carbon nanotubes for mesenchymal stem cells' osteogenesis : Granted Patent No.: 10-2133820(2020.07.08)

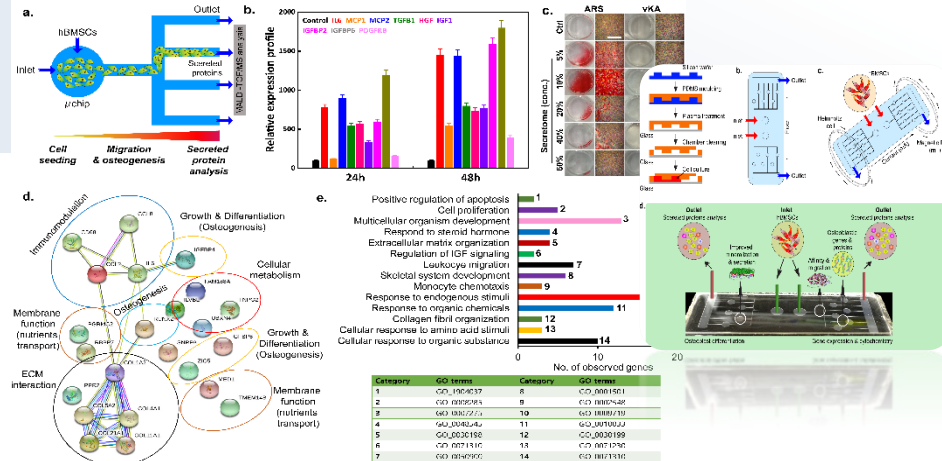
A composition for tissue engineering comprising alginate, gelatin, and cellulose nanocrystals and use of the same : Granted Patent No.: 10-2020-0020501(2020.02.19)



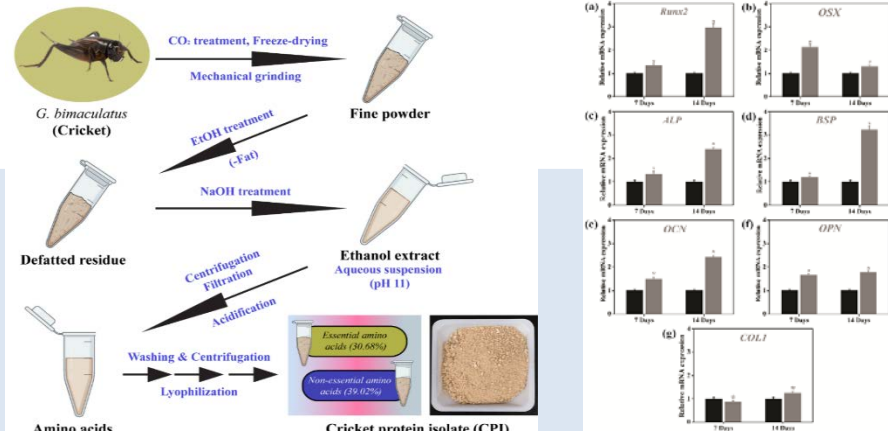
TEMPO-CNCs-capped gold nanoparticles for colorimetric detection of pathogenic DNA | Patent APN : 10-2021-0006000(2021.01.15)



Extraction, preparation, and characterization of cellulose nanocrystals derived from coffee byproducts : Patent APN : 10-2020-0001088967-61(2020.10.15)



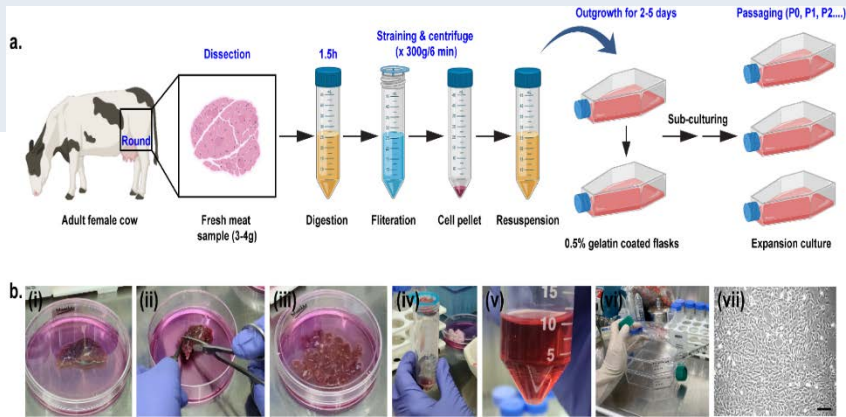
Electromagnetic fields-directed bone marrow-on-a-chip system for monitoring differentiation and secretome of human mesenchymal stem cells | Patent APN : 10-2020-0106965 (2020.08.27)



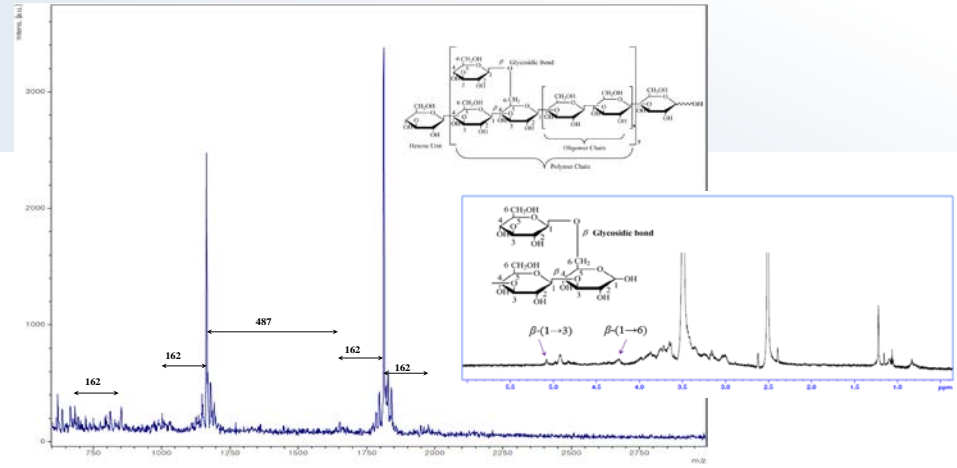
Antioxidative and osteogenic differentiation potentials of *Gryllus bimaculatus* protein isolates : Patent APN: 10-2021-0003914(2021.01.12)



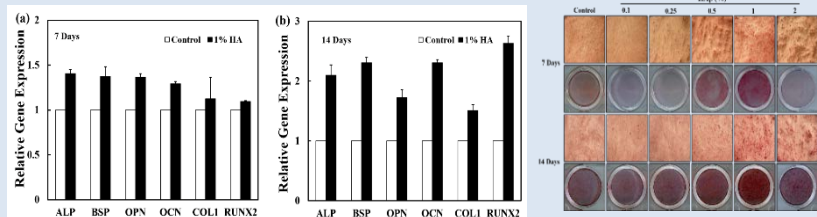
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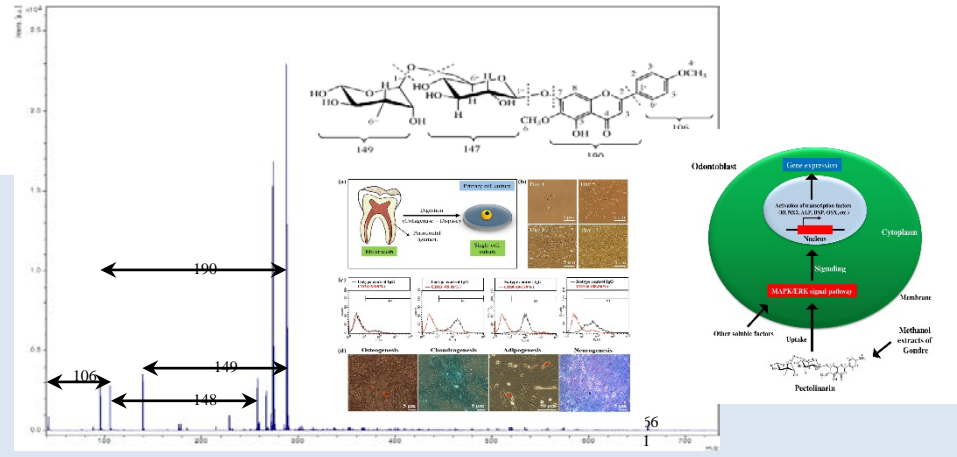
A simplified method for isolation, characterization, and culture optimization of bovine muscle satellite cells | Patent APN : 10-2021-0006000(2021.03.18)



A method for structural elucidation and immune-enhancing effects of a novel p-olysaccharide from *Grifola frondosa* | Granted Patent No. : 10-2182507 (2020.11.18)

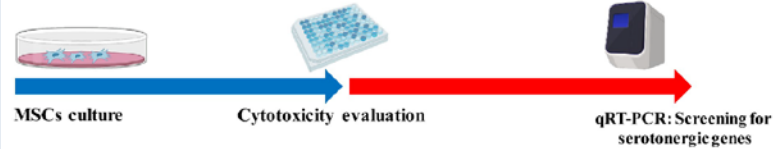


A method for hydroxyapatite extracted from eggshell : Granted Patent No. : 10-2249137 (2021.04.30)

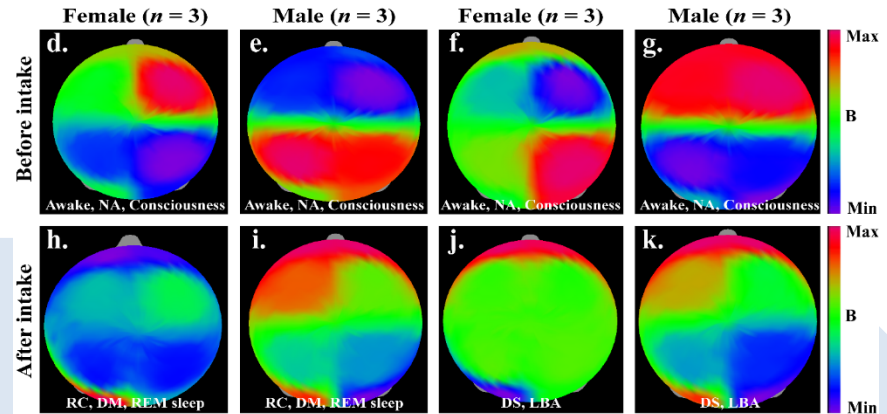
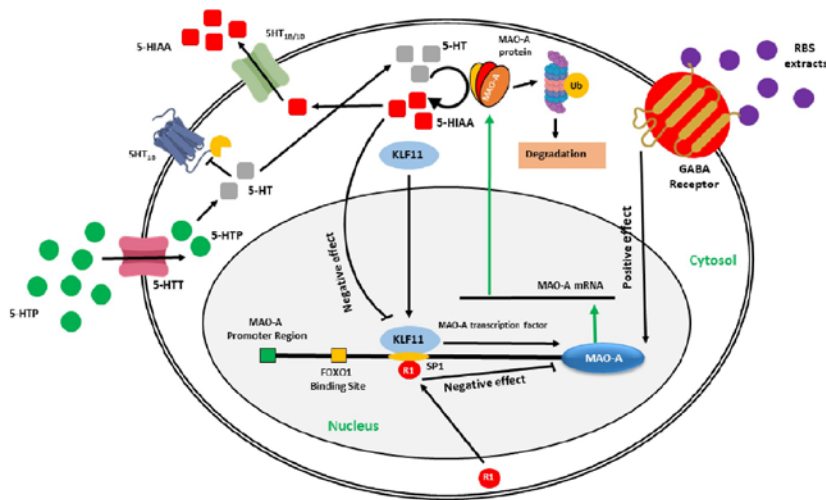
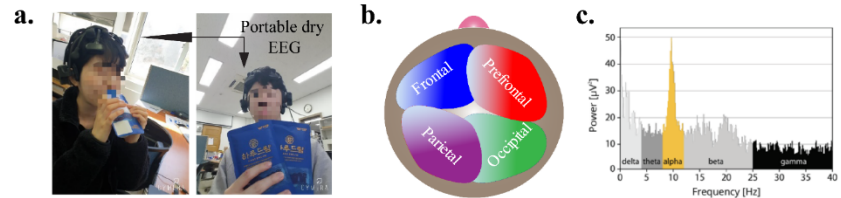
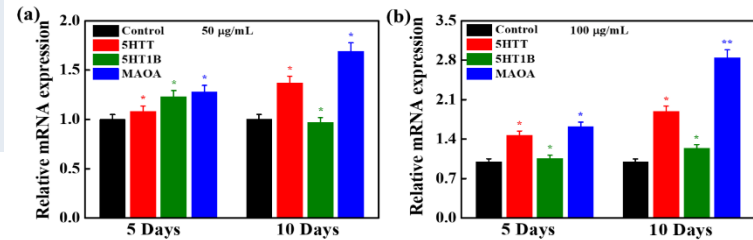
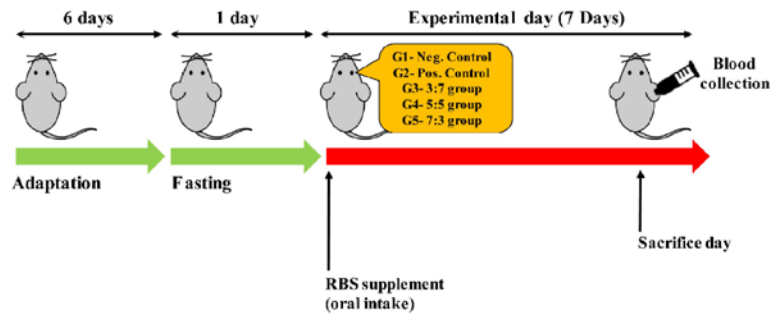


A composition for promoting osteogenic differentiation of stem cells comprising an extract from *Cirsium setidens* (Dun n) Nakai: Patent APN : 10-2020-0153666(2020.11.17)

(a) Experimental procedure: *in vitro*



(b) Experimental procedure: *in vivo* (Total No. of Groups, N = 5, in each group n = 3)

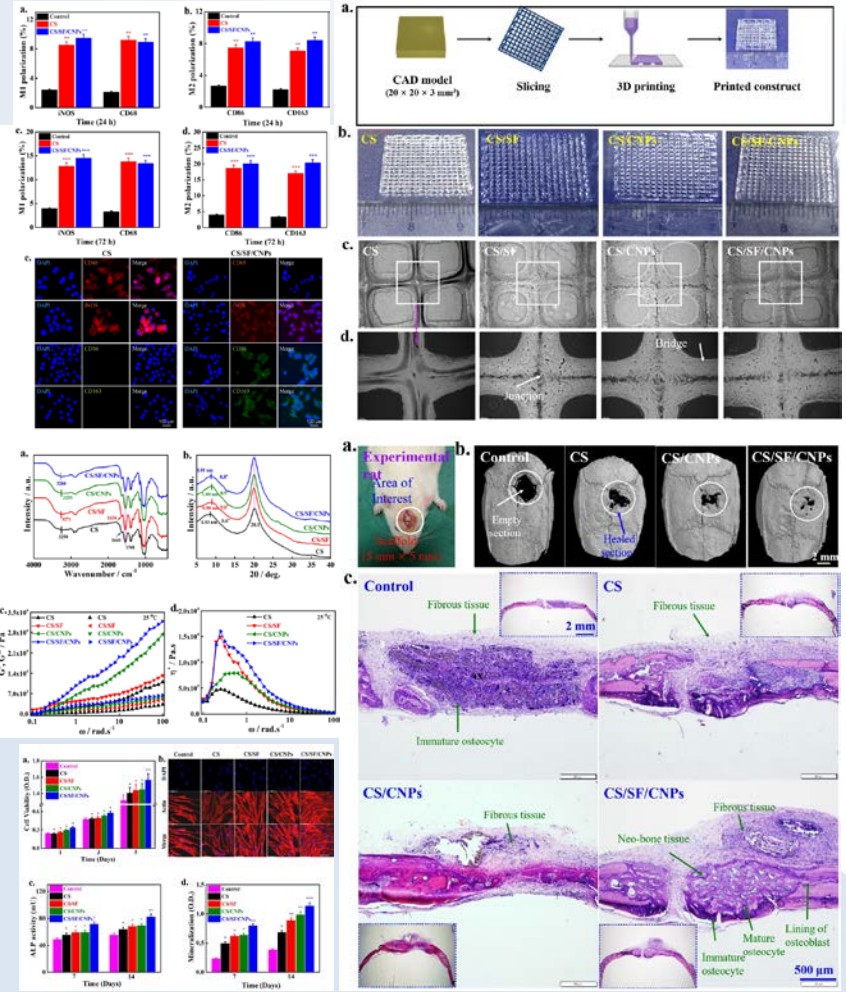
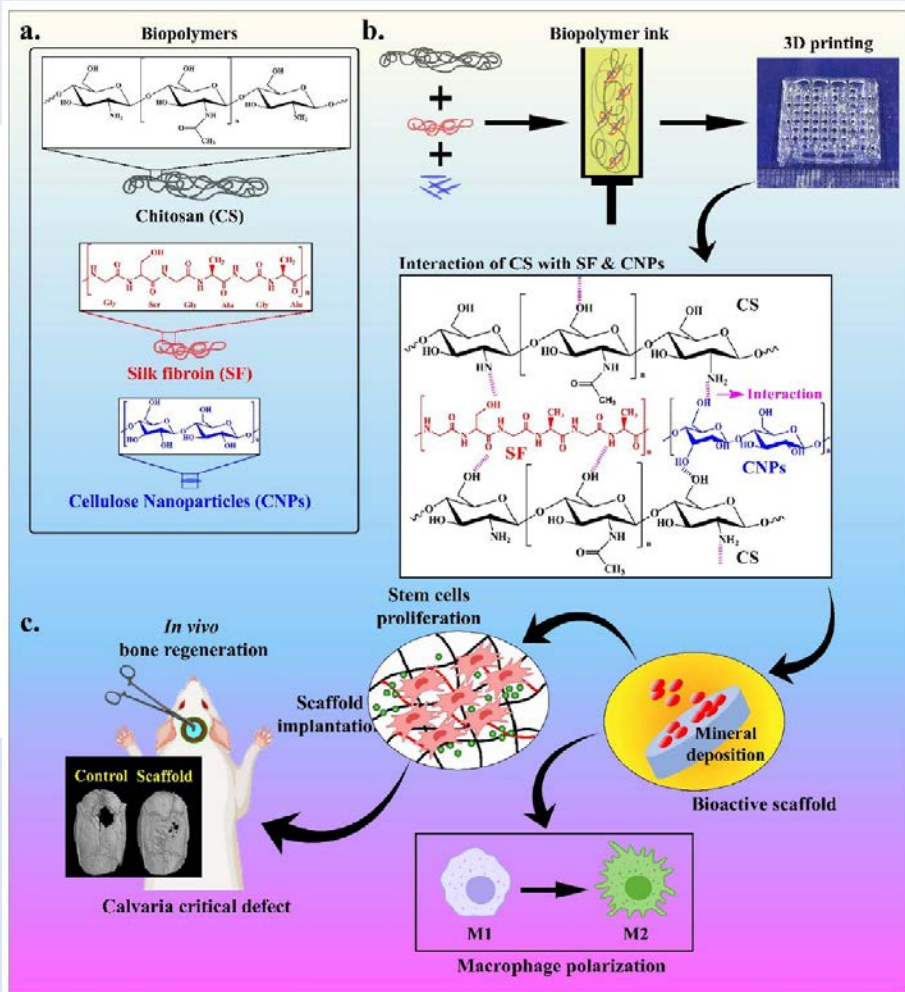


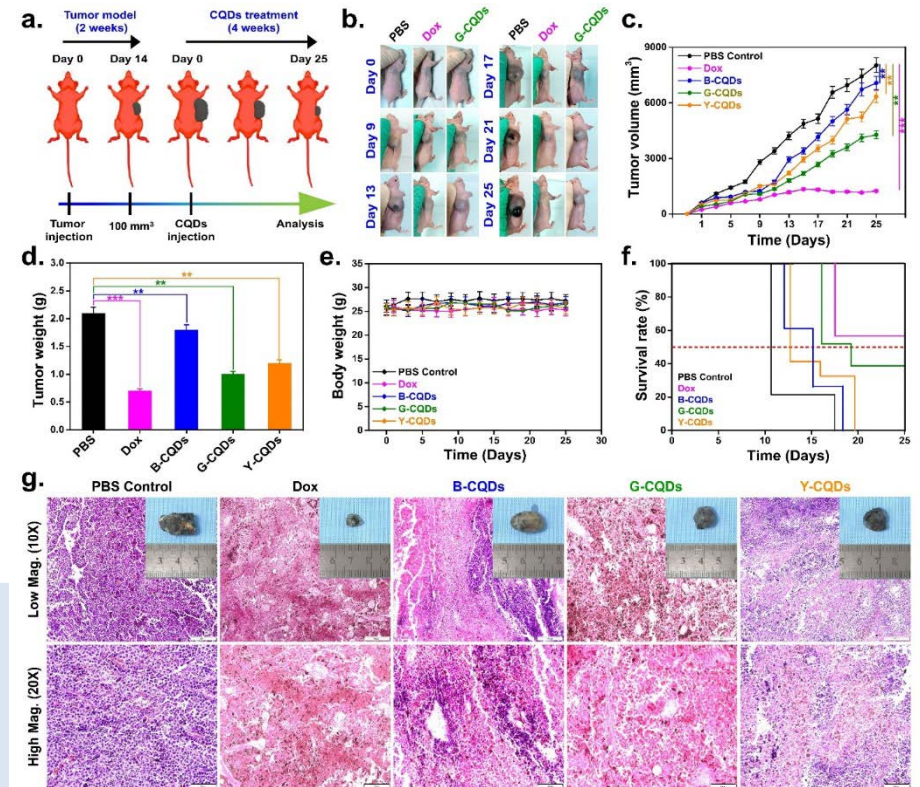
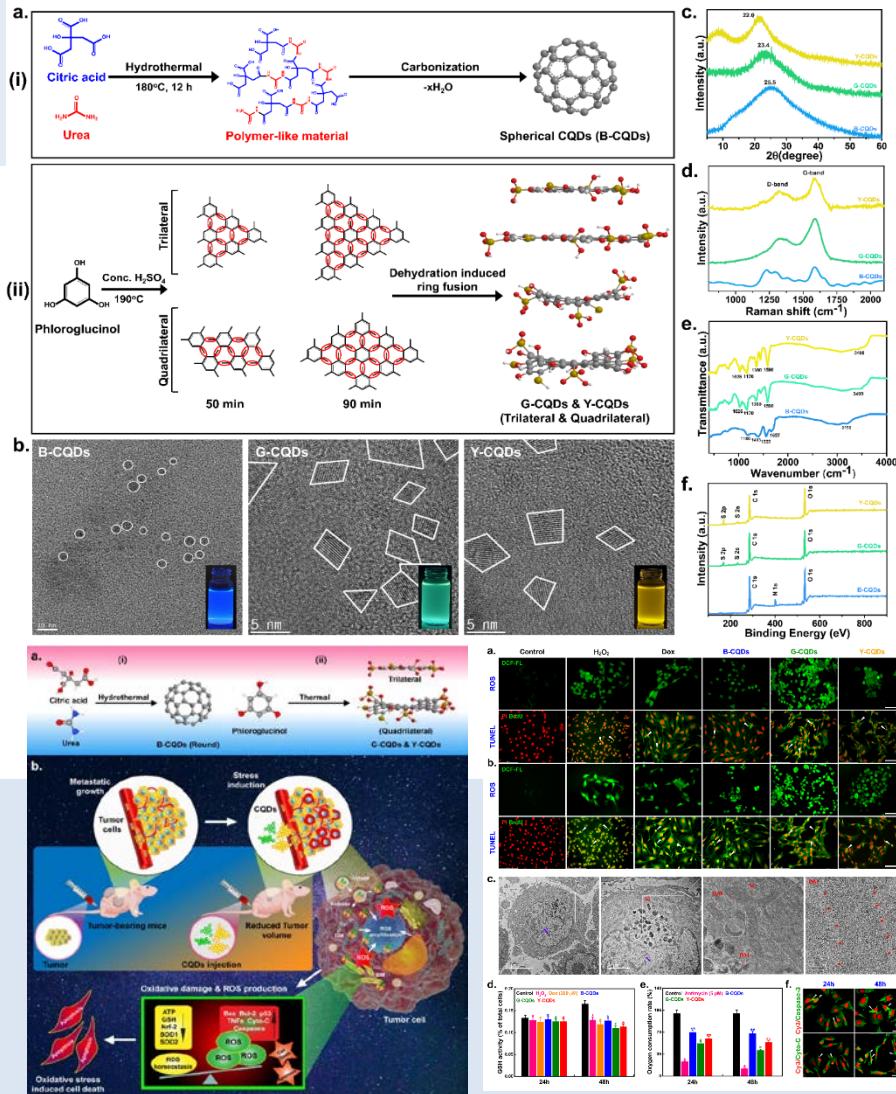
**Theta wave**  
(4-8 Hz, 20-100 µV)

**Delta wave**  
(0.2-4 Hz, 20-200 µV)

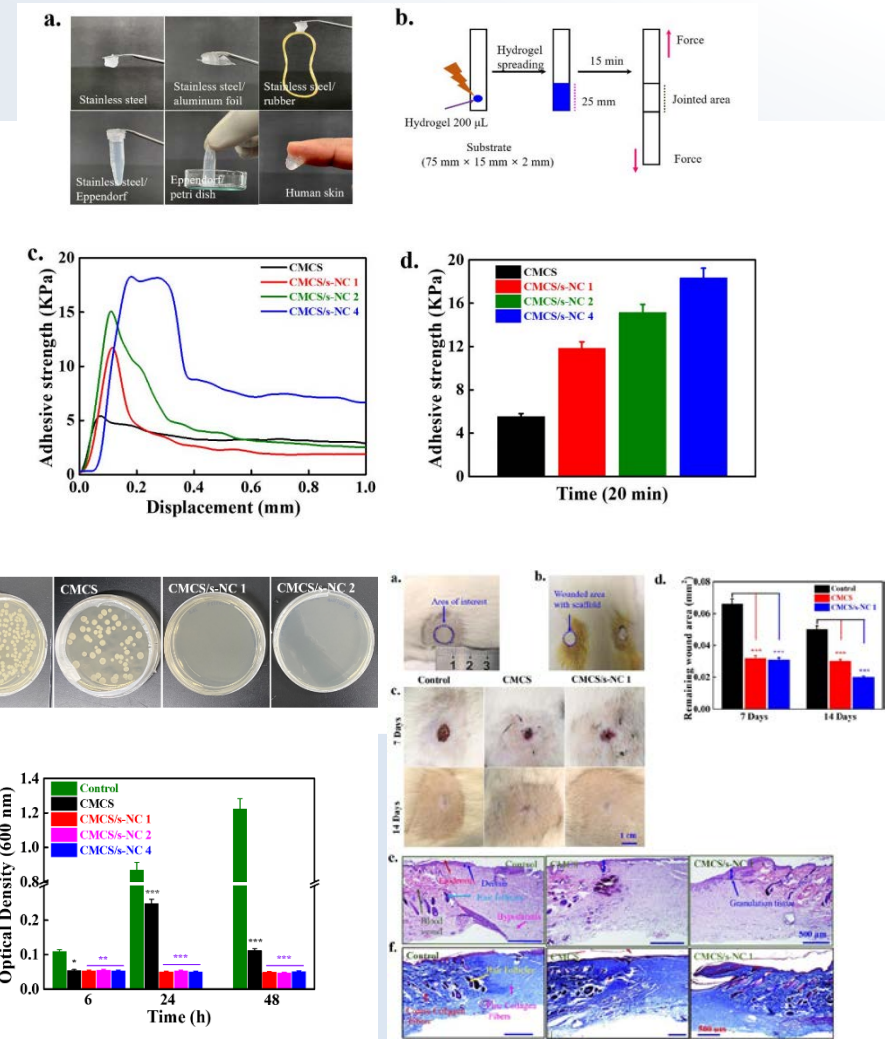
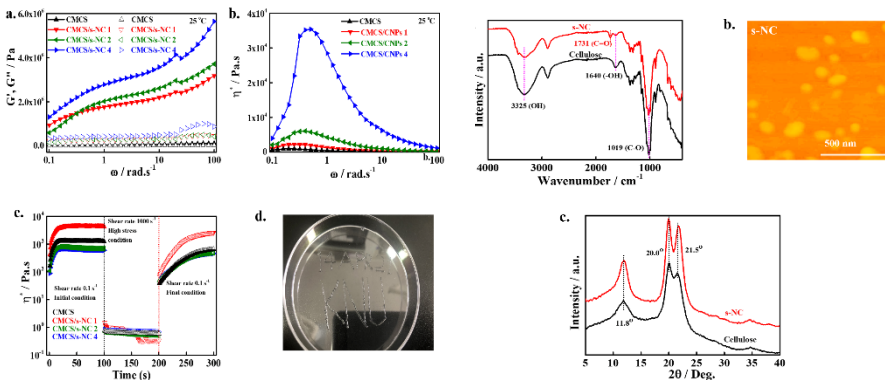
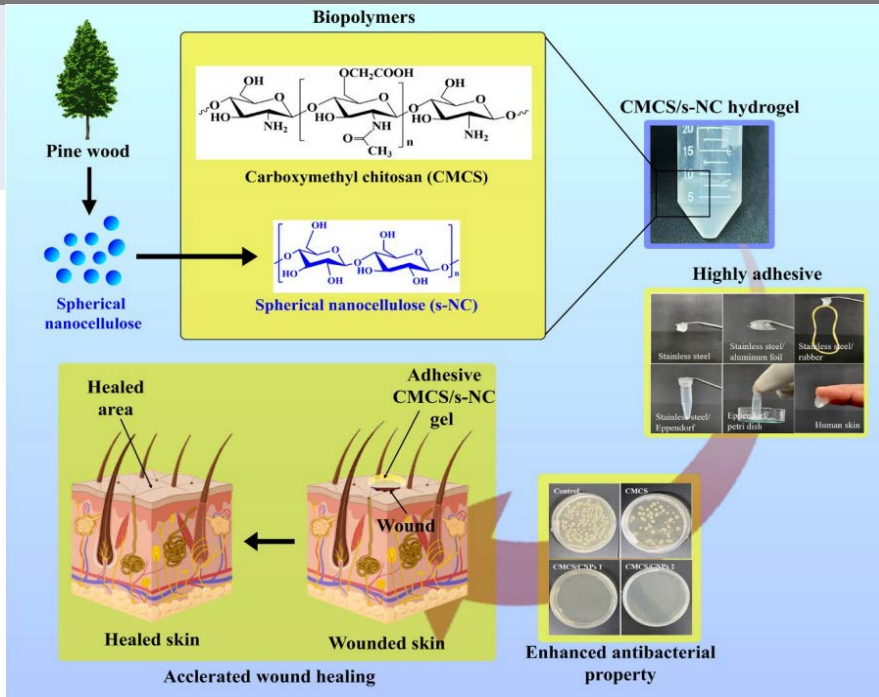
NA; normal alert, RC; reduced consciousness, DM; deep meditation, REM; rapid eye movement; DS; deep (dreamless) sleep, LBA; loss of bodily awareness.

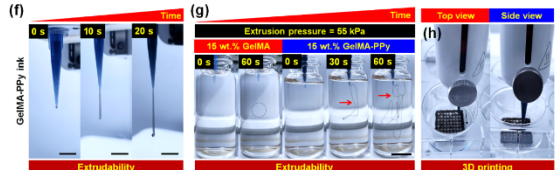
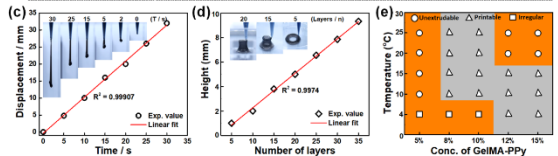
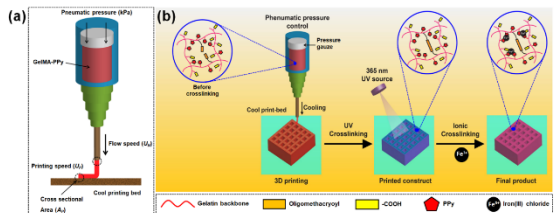
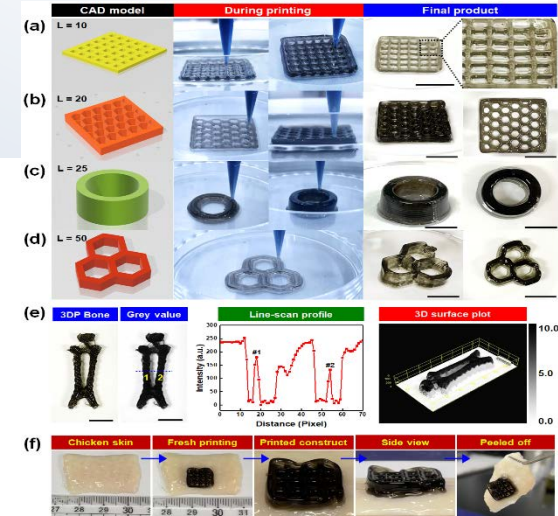
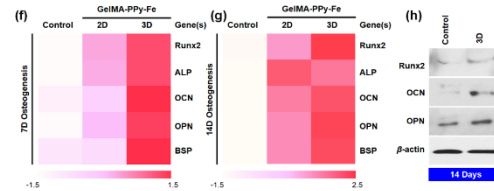
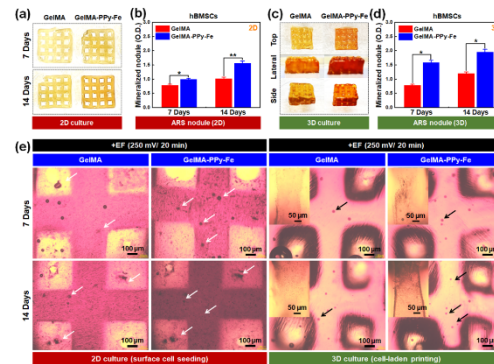
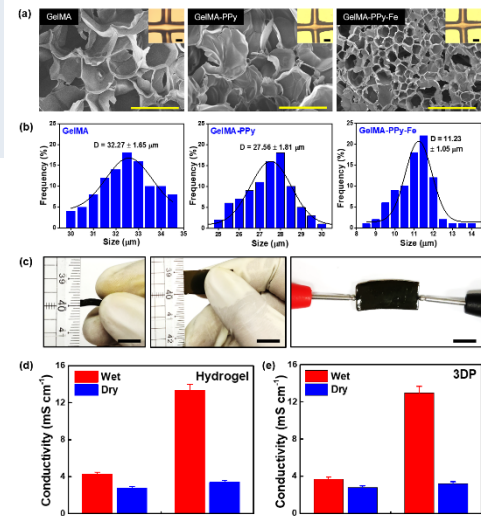
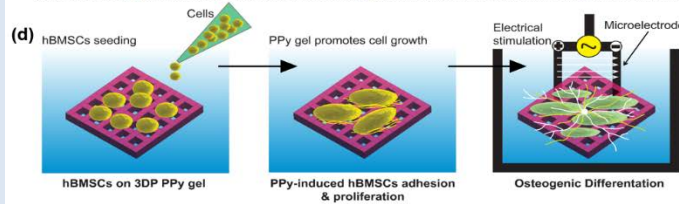
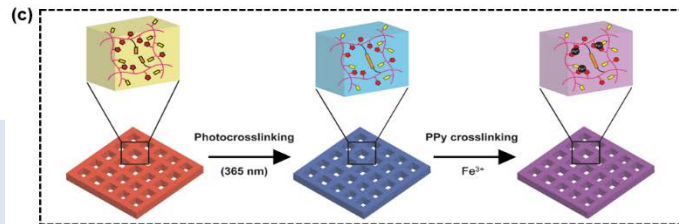
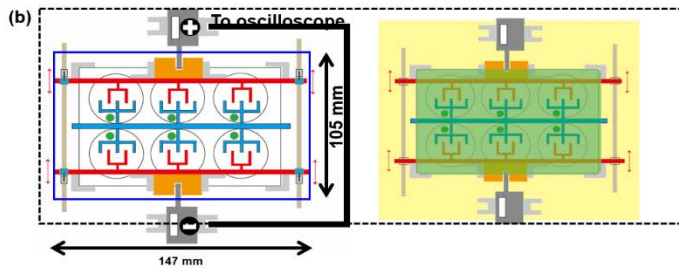
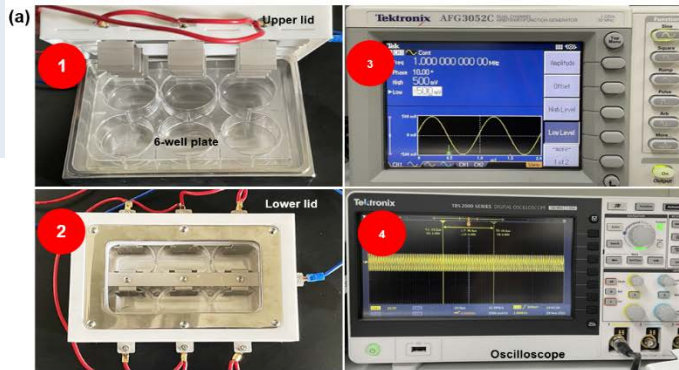






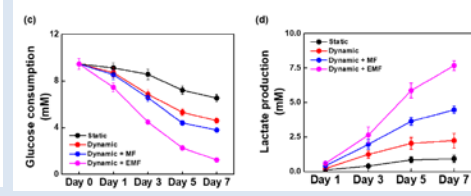
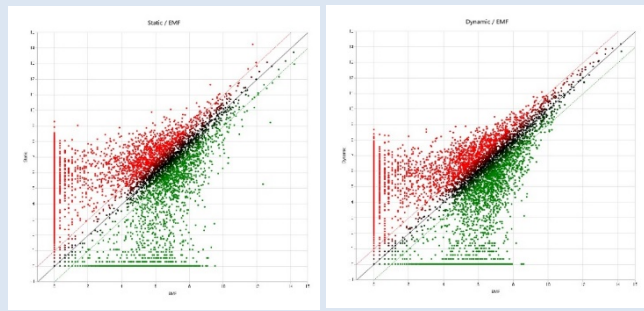
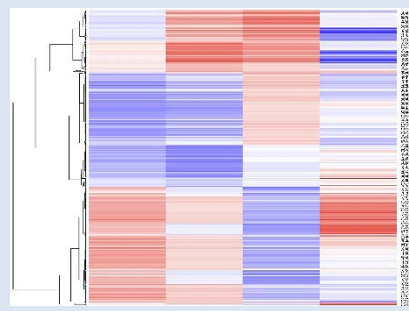
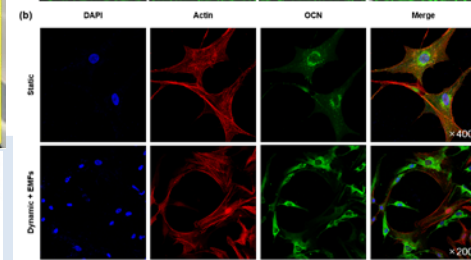
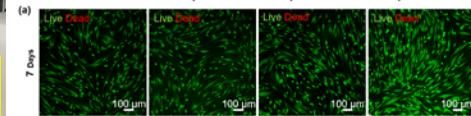
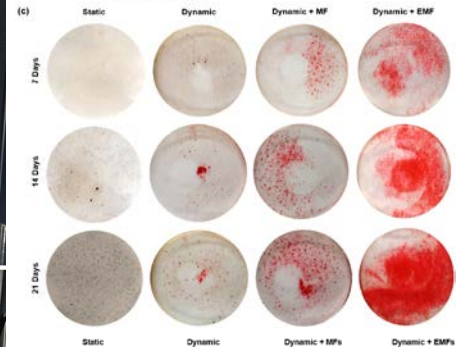
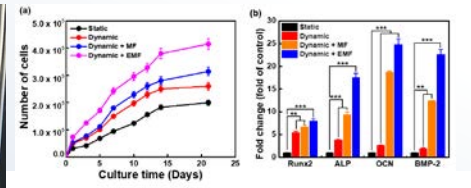
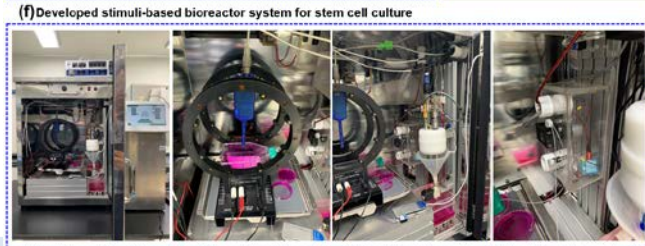
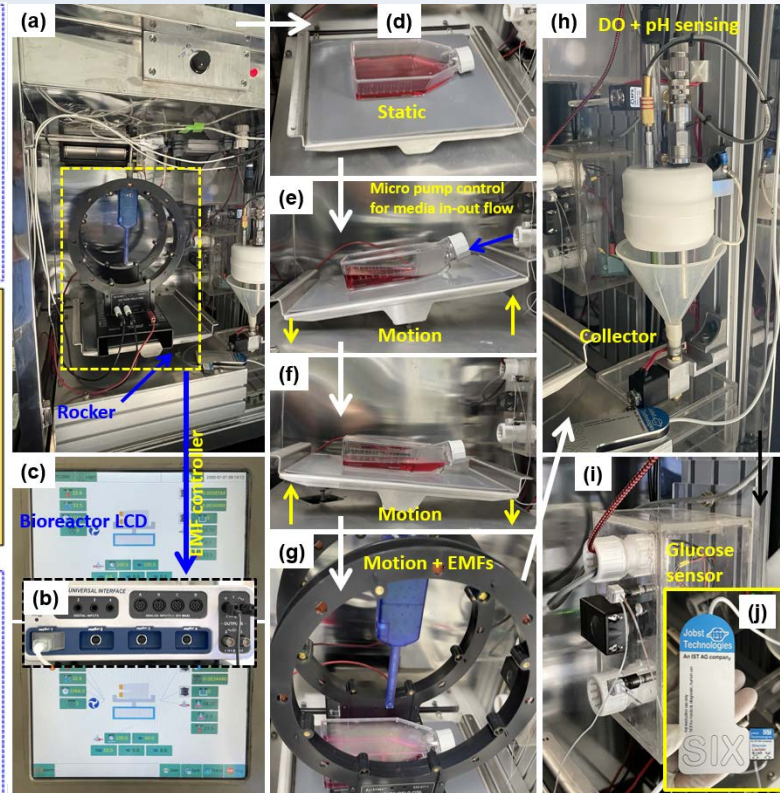
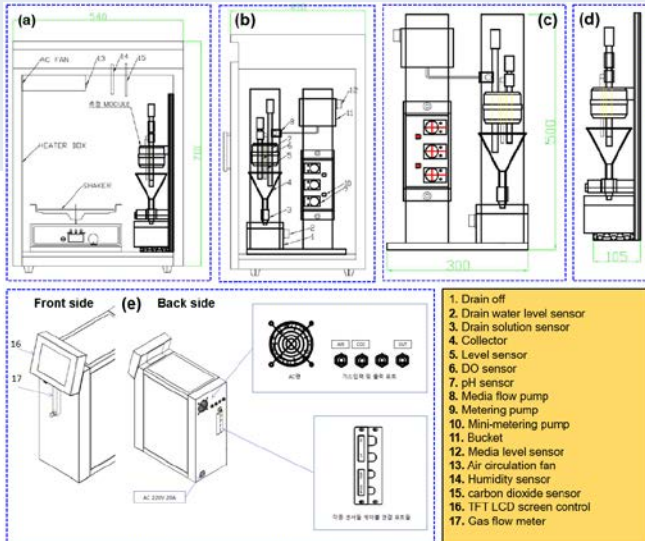






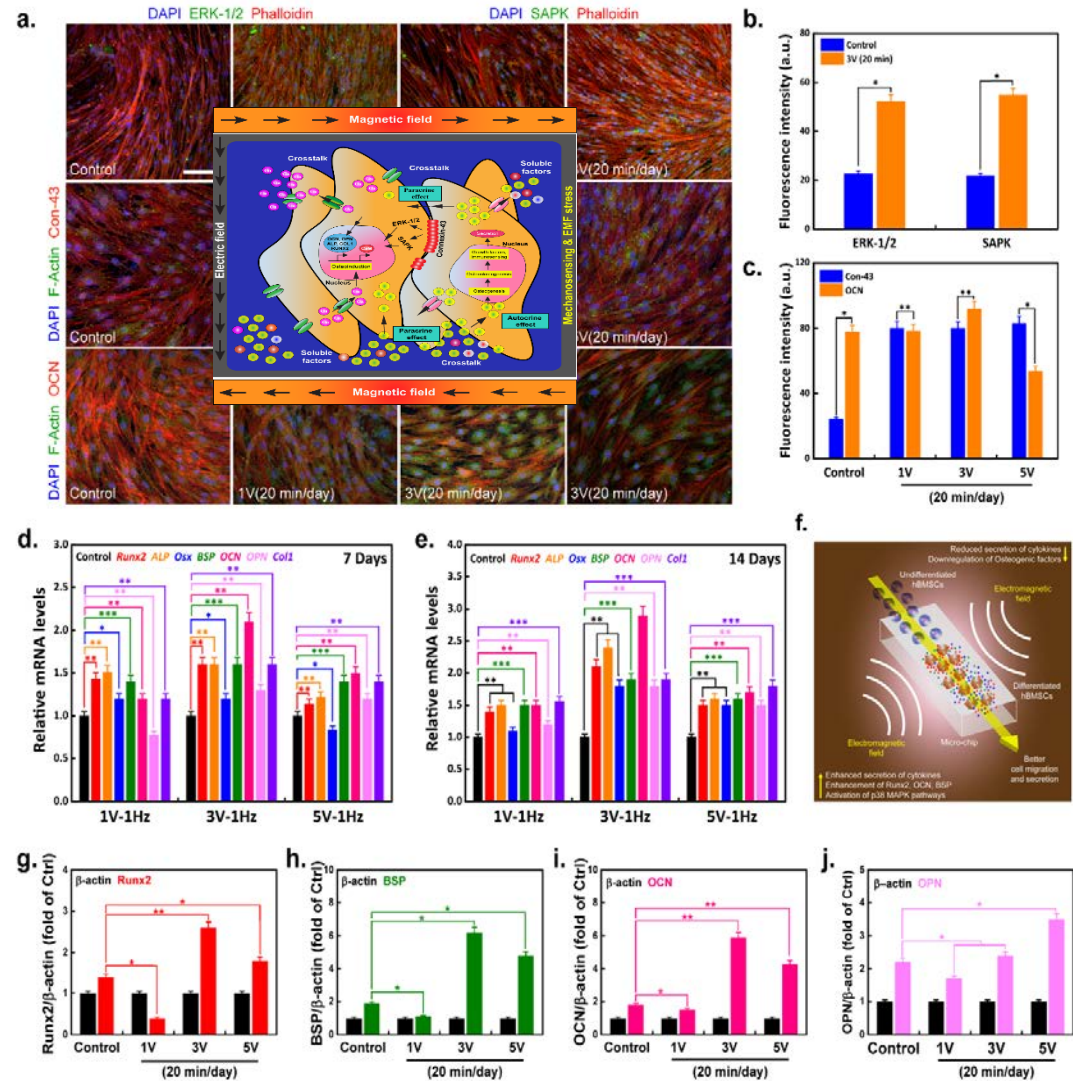
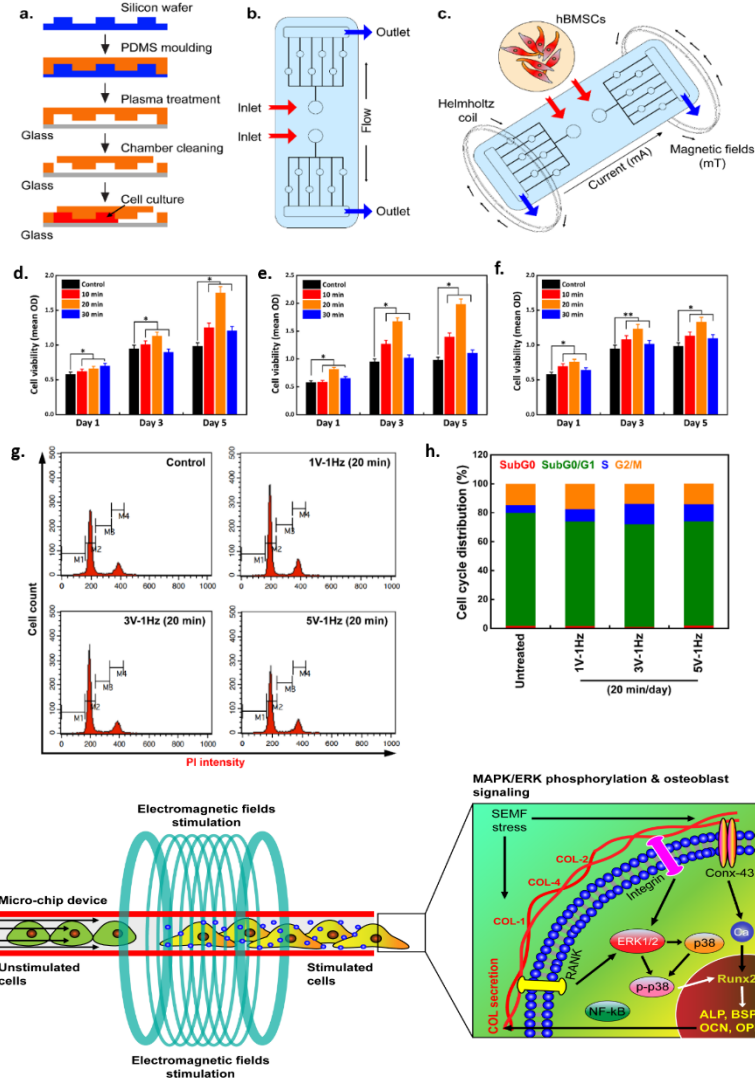


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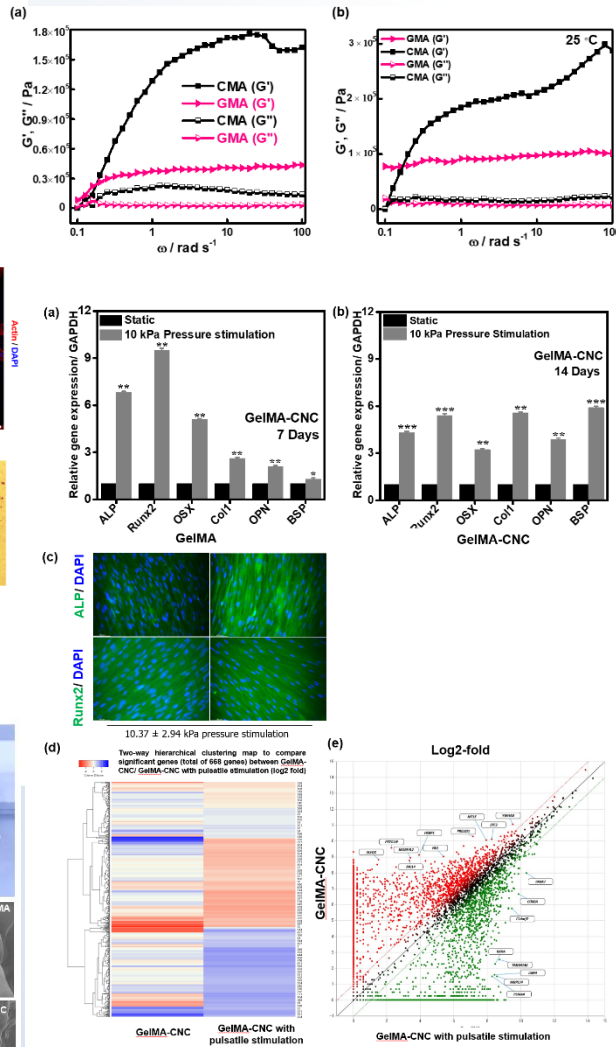
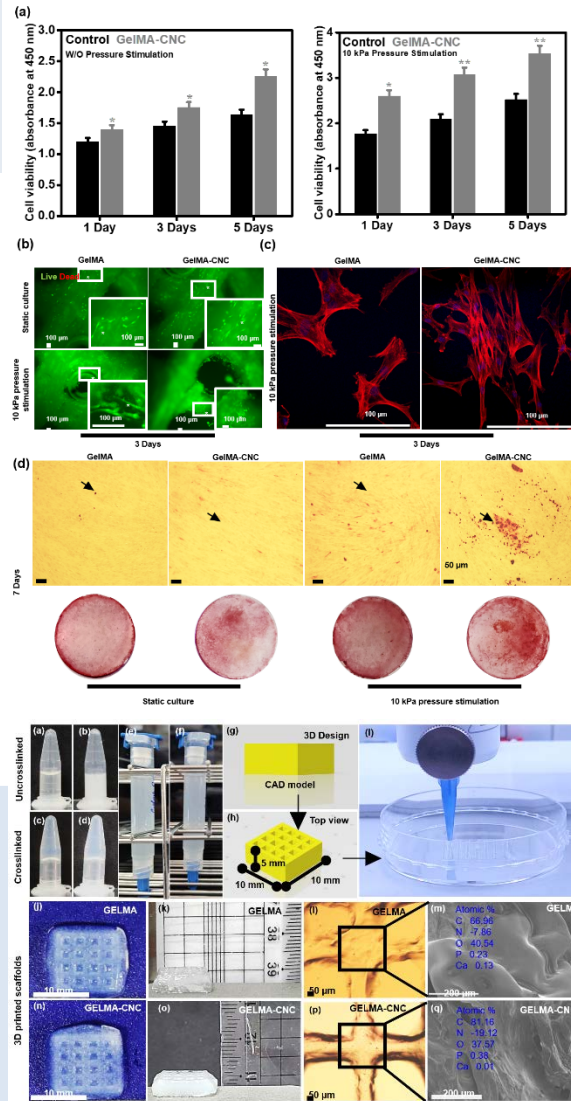
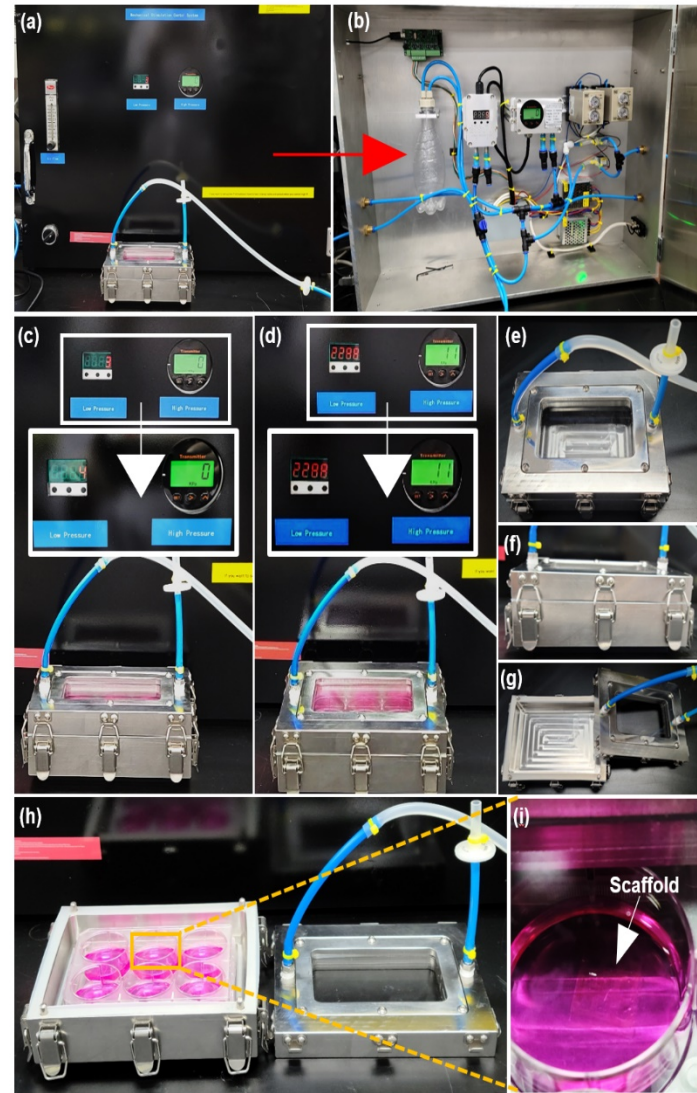


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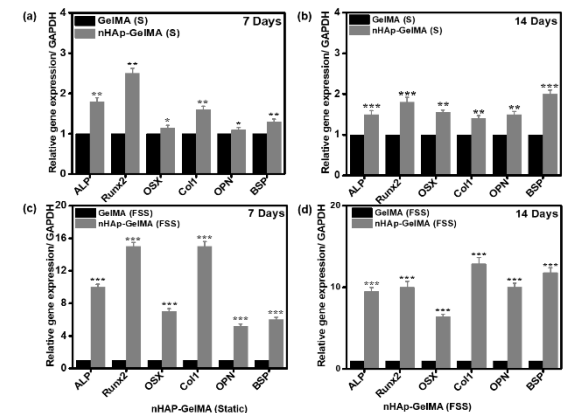
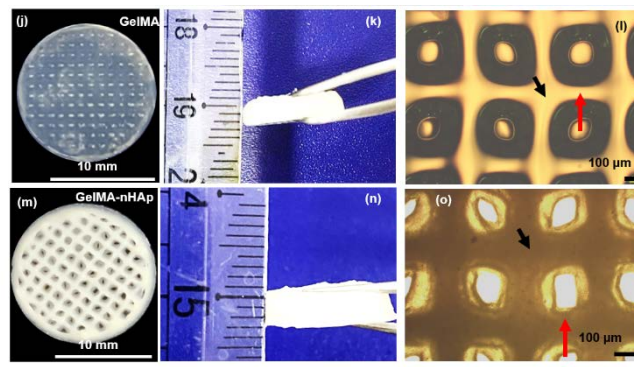
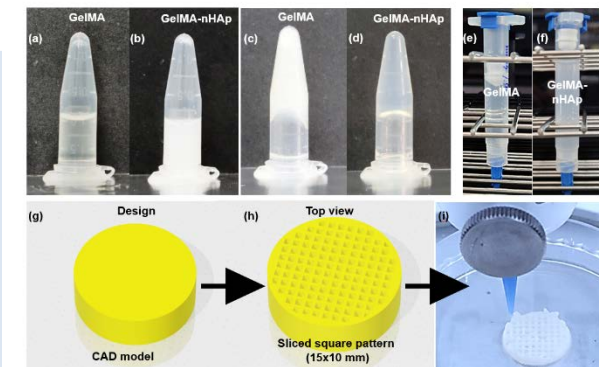
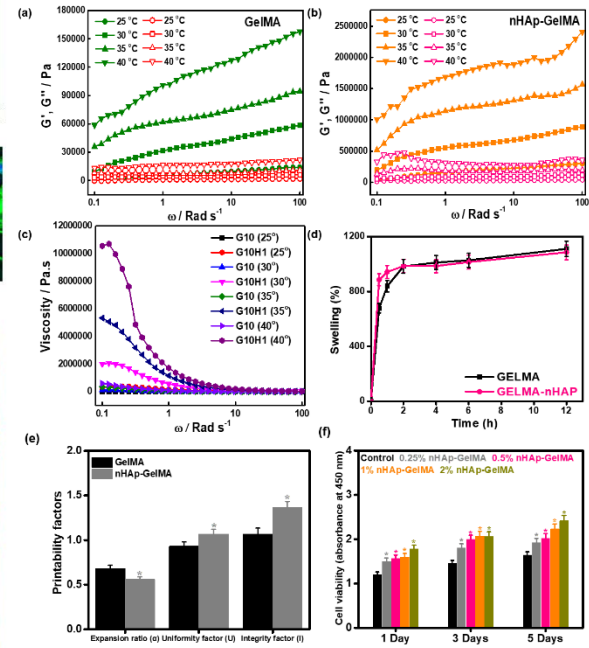
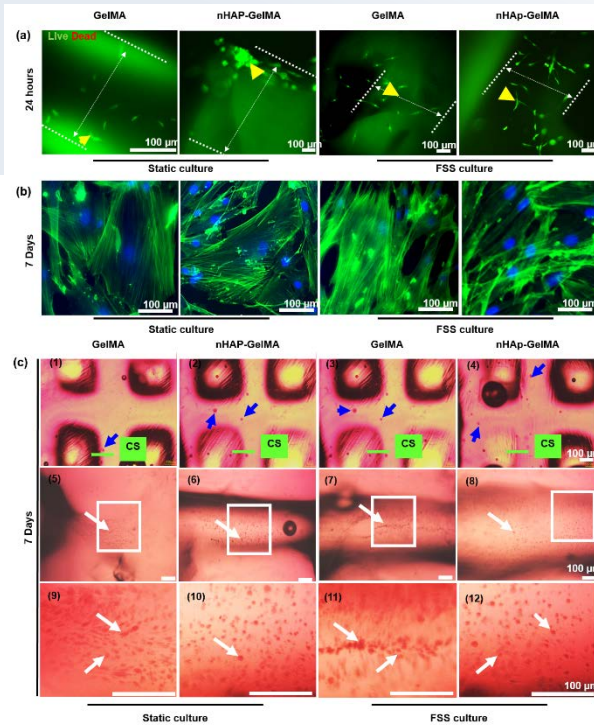




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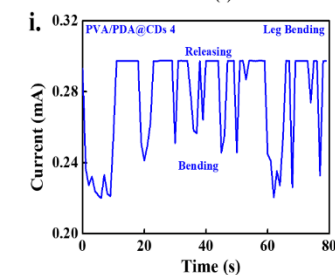
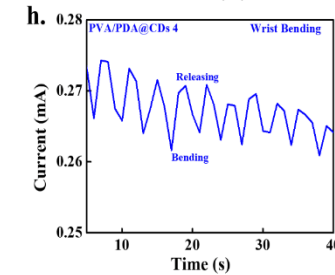
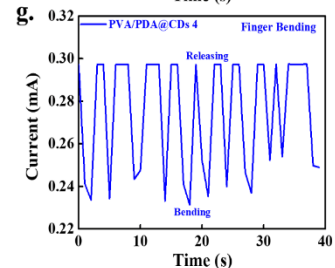
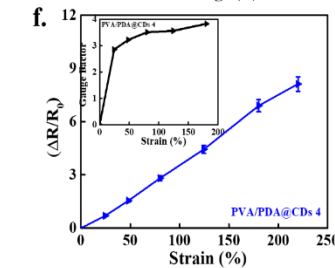
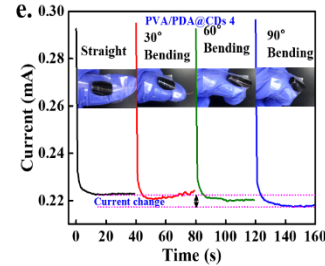
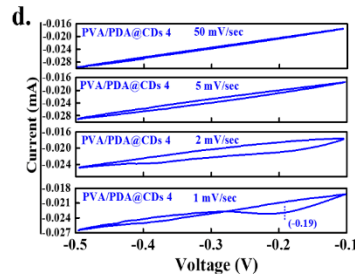
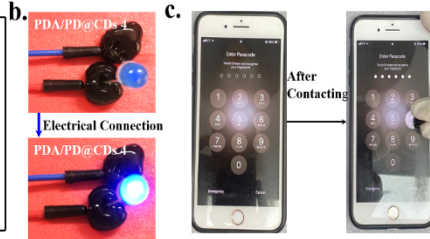
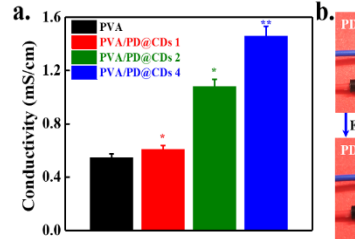
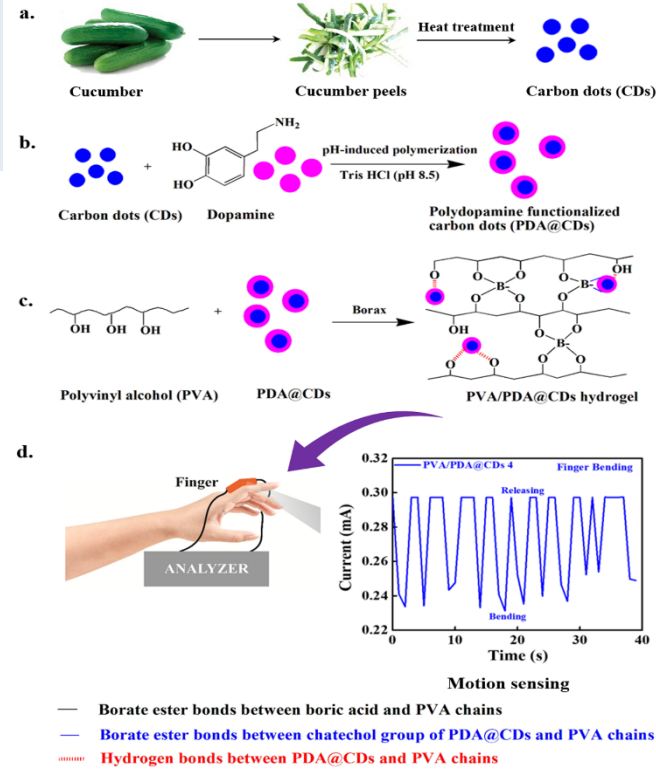


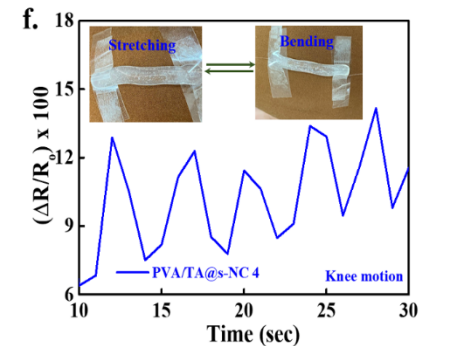
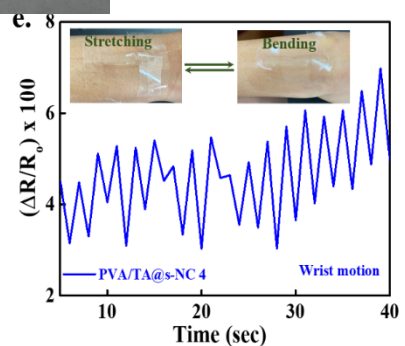
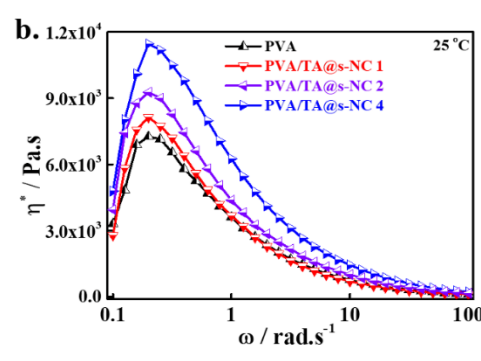
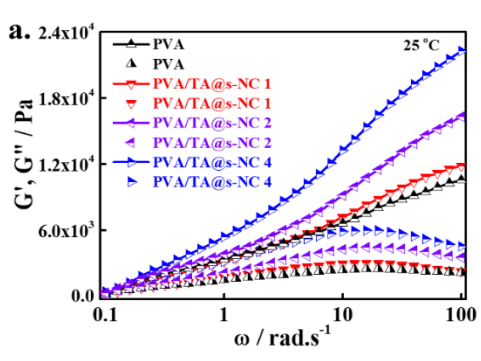
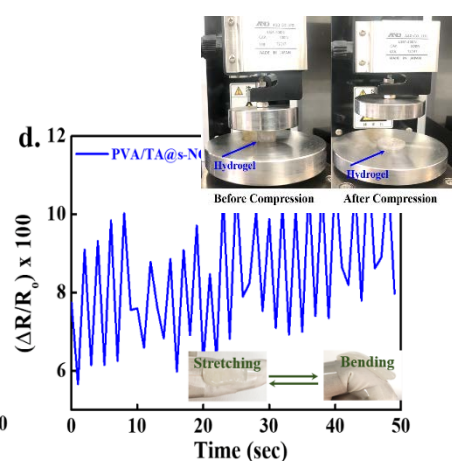
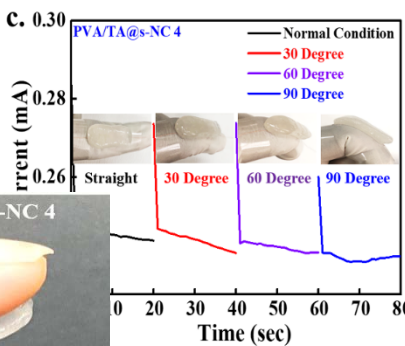
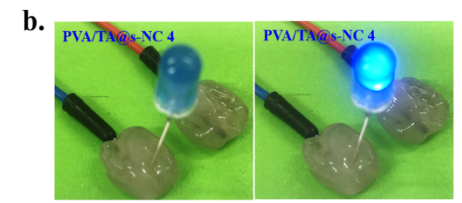
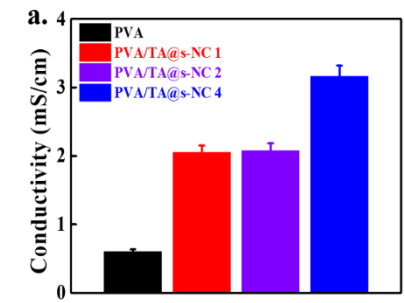
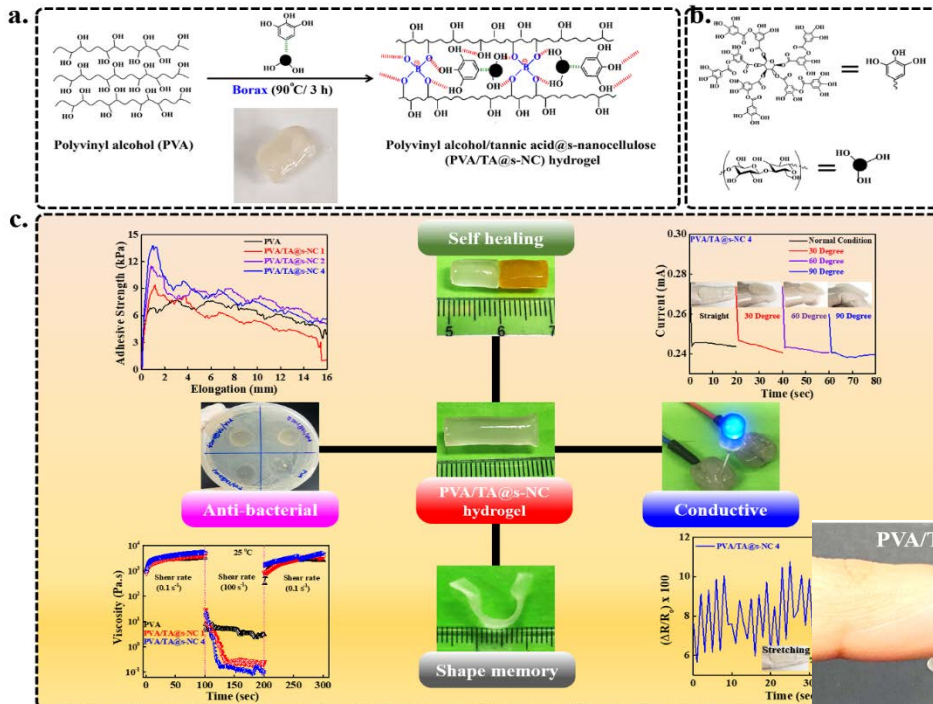






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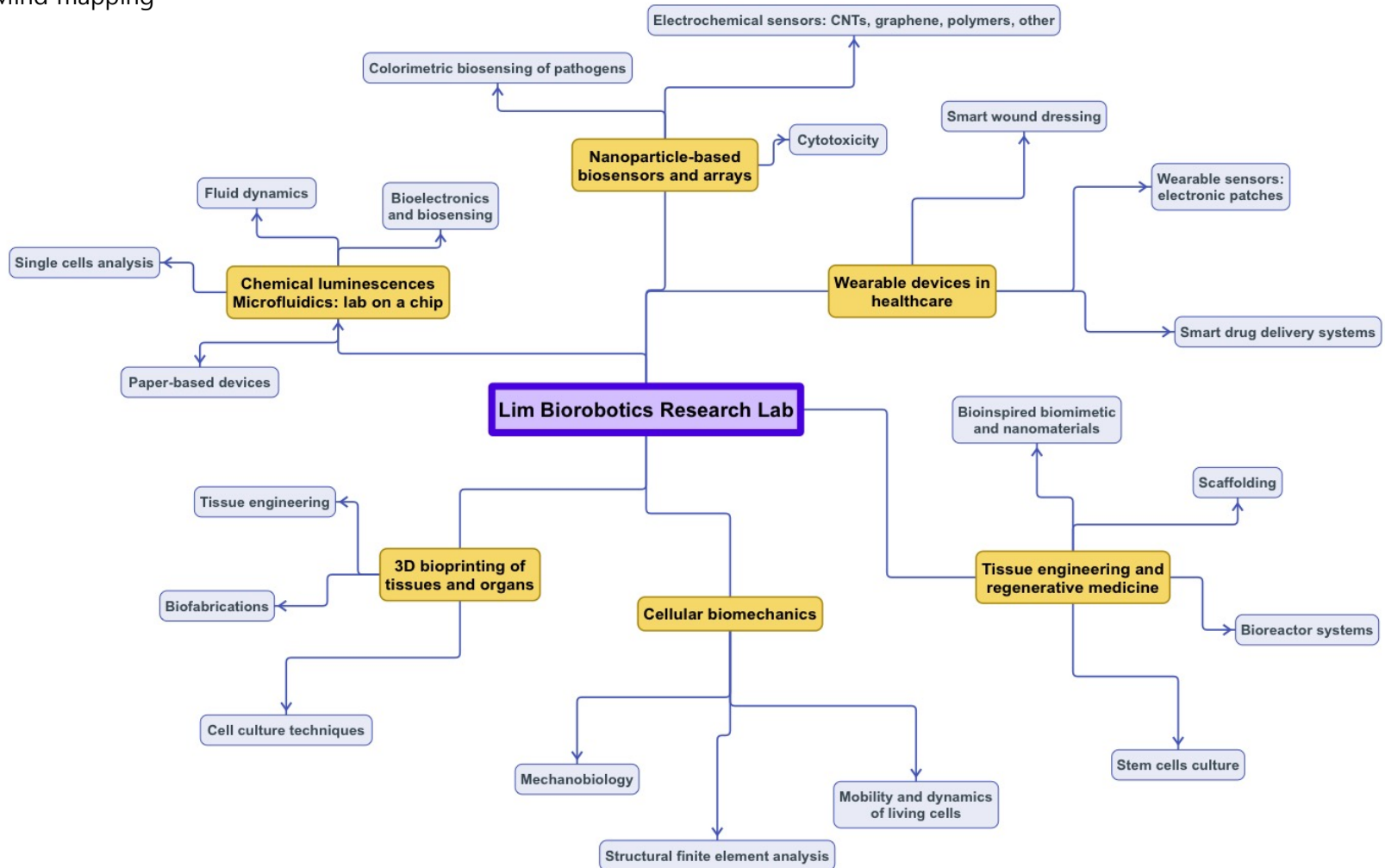








Mind mapping





Time table

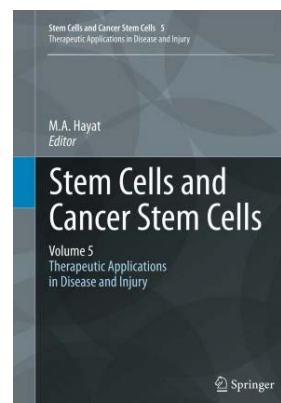
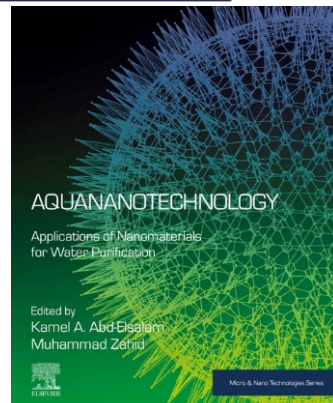
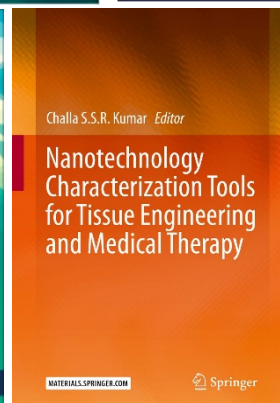
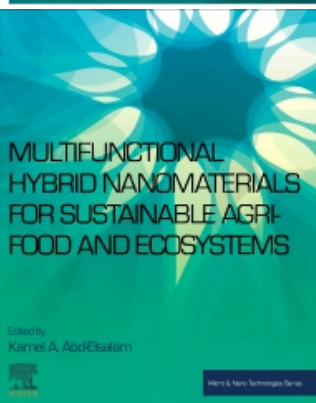
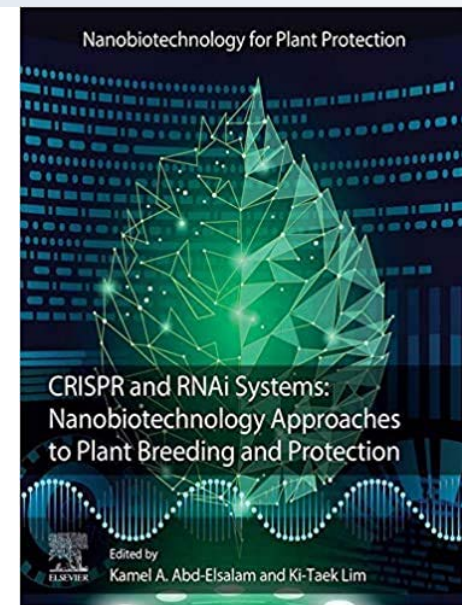
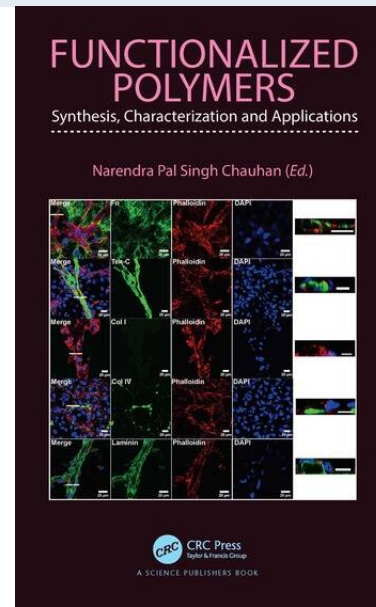
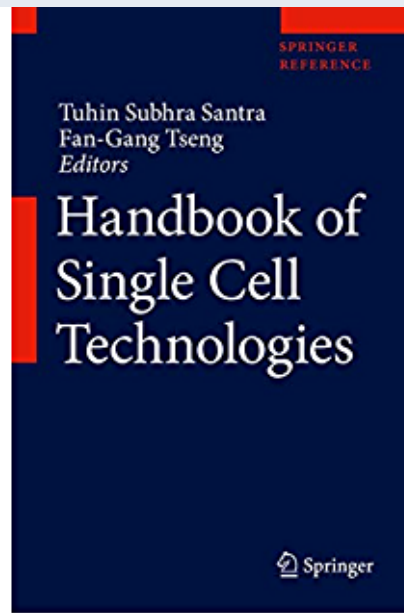
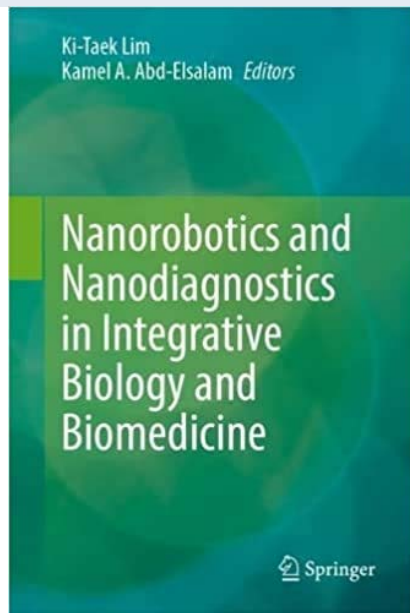




*A contributed book chapter out of the Biorobotics Group*



<https://www.amazon.com>





### 공학과 생명의 브릿지 III

## 3D 프린팅 기반기술을 위한 기능성 복합소재 융·복합 기술개발



3D 프린터는 설계 데이터에 따라 액체·파우더 형태의 폴리머 (수지), 금속 등의 재료를 기공·적층 방식(Layer-by-layer)으로 쌓아 올려 입체물을 제조하는 장비로서 3차원 CAD에 따라 생산하고자 하는 형상을 레이저와 파우더 재료를 활용하여 신속 조형하는 기술을 의미 한다. 3D 프린터의 장점은 임의 형상의 최하위 레이어의 단면을 프린팅하고, 다시 일정량의 파우더를 적층한 다음 레이어의 단면을 프린팅하는 반복된 과정을 통해 세밀한 부분까지 구현해 낼 수 있다는 점이다. 3D 프린터의 종류로는 크게 FDM(Fused Deposition Modelling), SLA(Stereo Lithography Apparatus), DLP(Digital Light Processing) 방식으로 구분된다. FDM 방식은 열가소성 플라스틱 필라멘트인 ABS, PLA, PCL

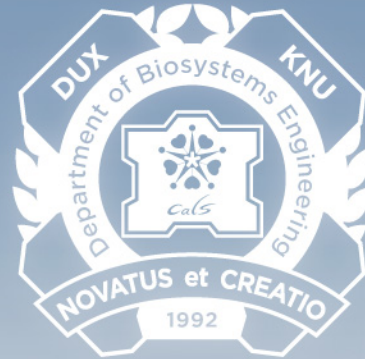
등을 녹여 아래층부터 적층하는 방식이다. 표면이 거칠게 표현되는 단점이 있지만 제작비용이 저렴하고 재료 강도가 높은 장점이 있다. SLA 방식은 광경화적인 특징을 가진 ABS, Wax등을 이용하여 레이어나 자외선을 사용하여 필요한 부분을 경화시켜 적층하는 방식이다. FDM 방식과는 다르게 표면이 매끄럽고 정밀한 장점이 있으나, 내구성이 떨어지고 강도가 약하다는 단점이 있다. 이러한 3D 프린팅기술은 미래 제조업 및 의료산업 분야의 혁신을 가져올 수 있는 기술로 이미 주목받고 있는 바(Murphy et al., 2014). 본 기고에서는 3D 프린팅 기반기술을 위한 고 기능성 복합소재 융복합 기술개발에 대한 중요 변수 및 환경조건을 제시하고자 한다.



THE **Biorobotics** LAB

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Where will I meet you?



기쁘게 인사합니다

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