



Sveučilište u Zagrebu / University of Zagreb  
**Tekstilno-tehnološki fakultet**  
Faculty of Textile Technology



**Dan Znanstveno - istraživačkog centra za tekstil  
Tehnički muzej Nikola Tesla, 26. rujna 2022.**

**BIO I/ILI ZELENO - NOVE PARADIGME ZA TEHNIČKE TEKSTILJE**

**NAJNOVIJA DOSTIGNUĆA PRIMJENE ELEKTROISPREDANJA  
TEHNIČKOG TEKSTILA**

**Emilija Zdraveva**



## Pregled

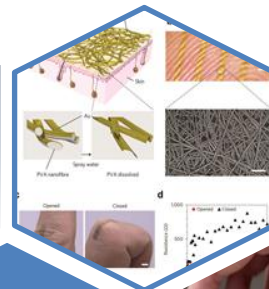
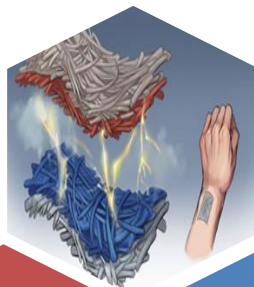
1. Istaknuta područja primjene elektroispredenog tehničkog tekstila
  - Nanovlakna i nanopređe
2. Primjeri istraživanja u pojedinim područjima
  - Biomedicina
  - Nosiva elektronika
  - Pohrana/transformacija energije
  - Kozmetička industrija
  - Pakiranje hrane

# Nanovlakna

Zavoji za rane

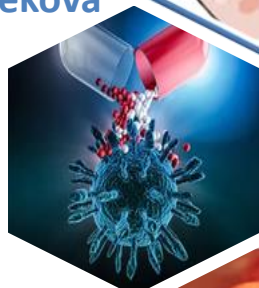


Senzori



Vodiči

Prijenos lijekova



Pakiranje hrane

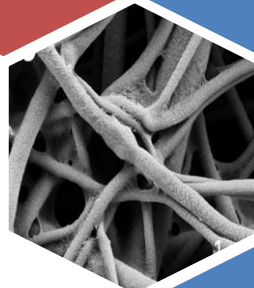


Nosiva elektronika



Rektene

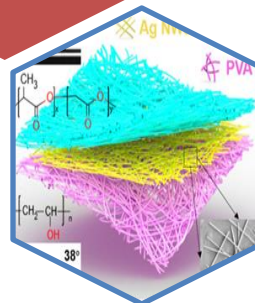
Biomedicina



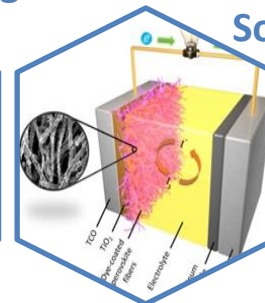
Kozmetika



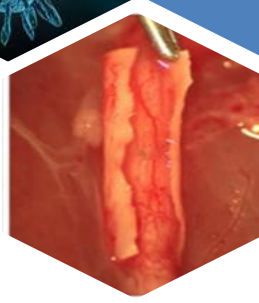
Nanogeneratori



Solarne ćelije



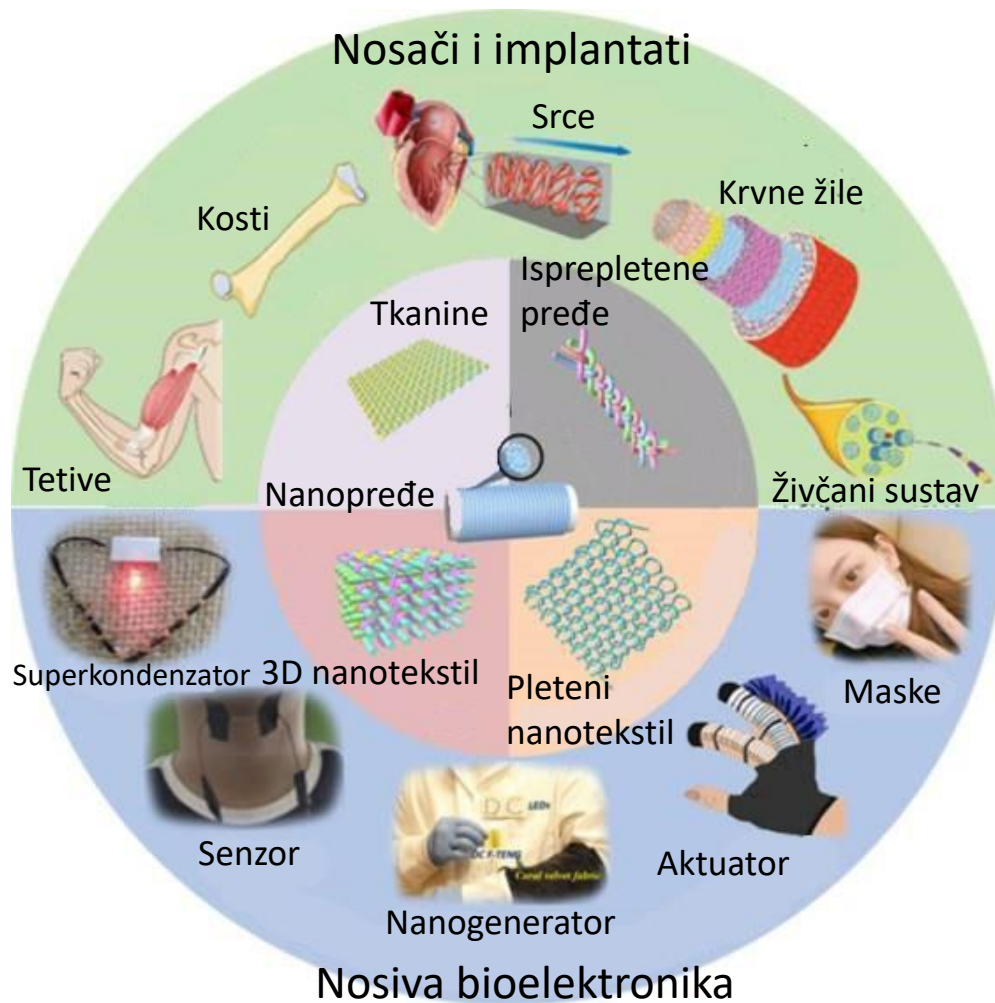
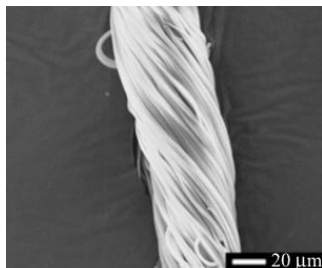
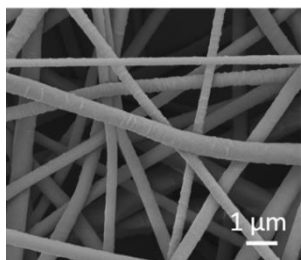
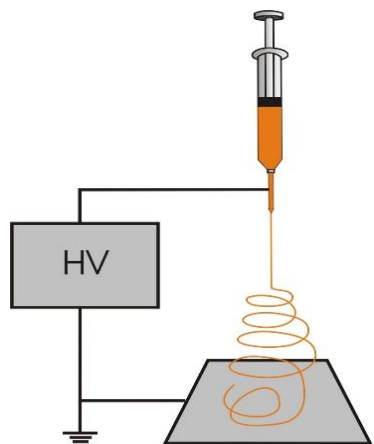
Tkivno inženjerstvo



Energija



## Nanopređe

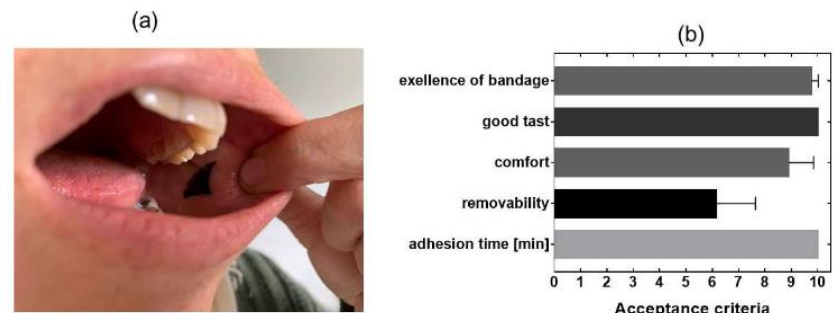
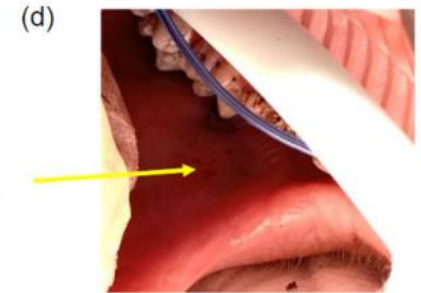
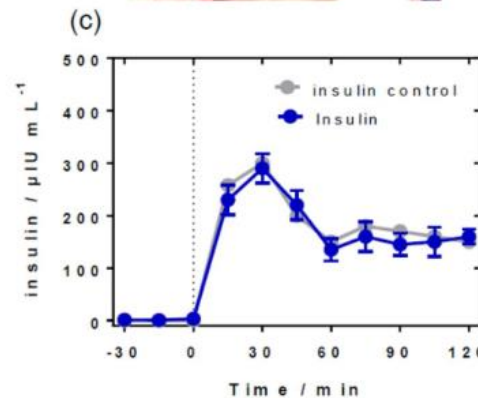
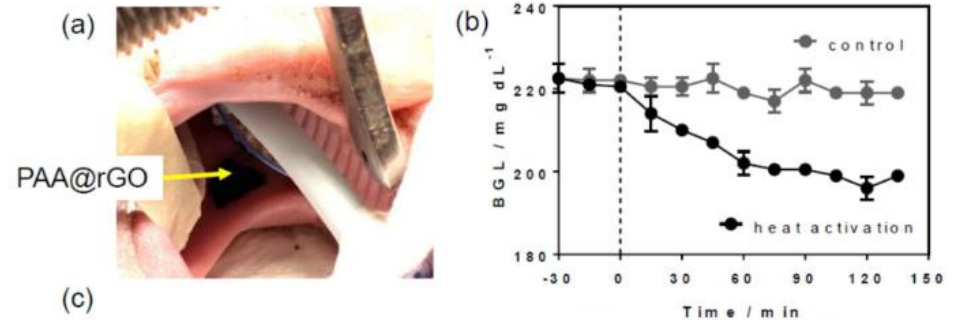


# Kontrolirani prijenos hormona kod dijabetičara

PAA+beta-ciklodekstrin/rGO  
 fototermička svojstva  
 Inkorporacija inzulina namakanjem

1. Otpuštanje inzulina u usnoj šupljini mini svinja
2. Klinički test – placebo u usnoj šupljini volontera

Anna Voronova et al., 2022.



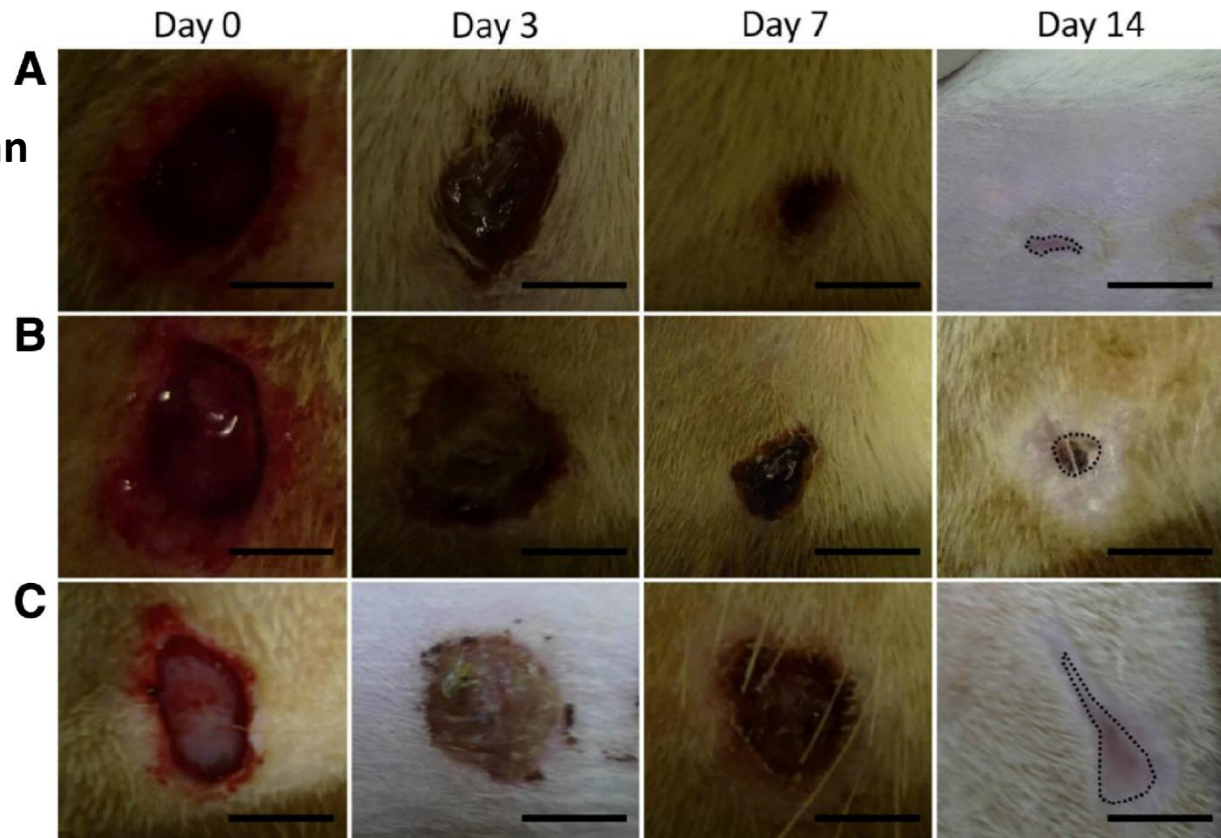
## Zacjeljivanje dijabetičkih rana

**A** – kolagen/PLGA inkorporiran s metforminom (aktivno otpuštanje tijekom 3 tjedna)

**B** – kolagen/PLGA

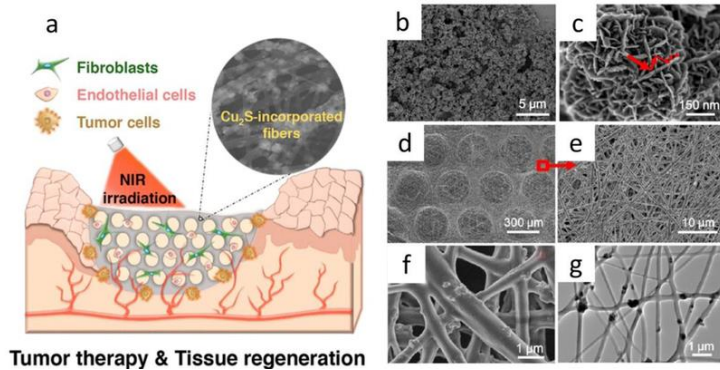
**C** – tradicionalna gaza

Antiupalni efekt, povećana količina kolagena, gušće mekano tkivo u dermalnom sloju, kompletna epitelizacija rane 14-og dana



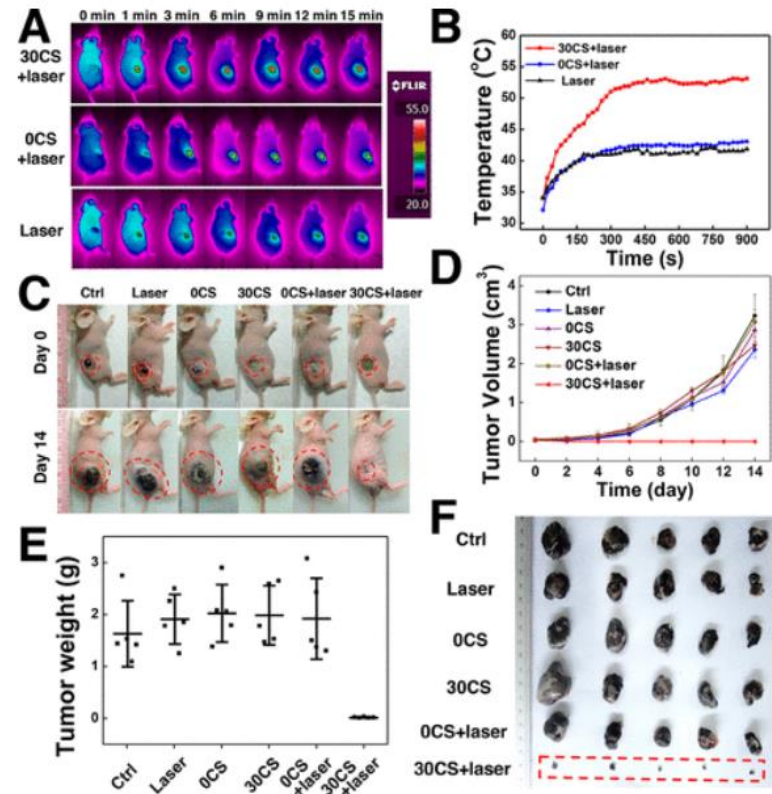
*Cheng-Hung Lee et al., 2015.*

# Lokalna terapija malignih oboljenja kože

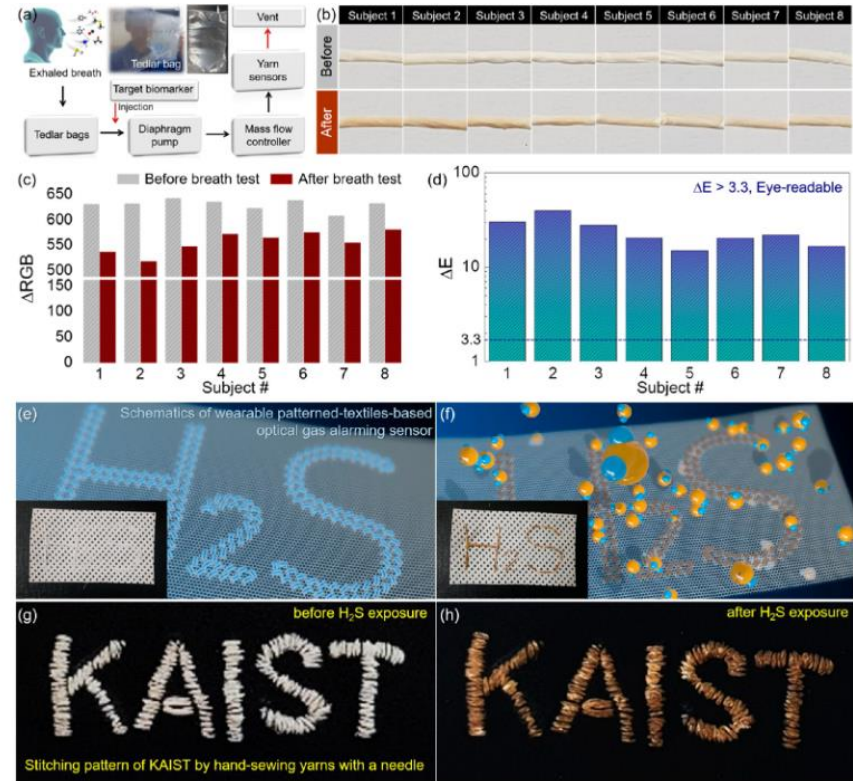
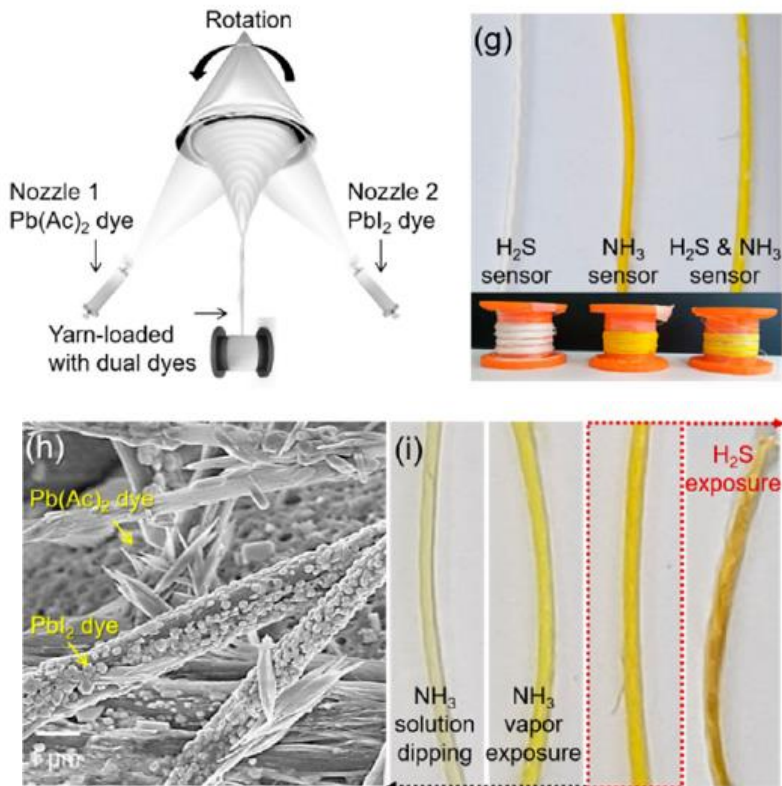


**Mikrouzorkovani  $\text{Cu}_2\text{S}$ -PLA/PCL**  
**Fototermaalna terapija**  
*In vivo* životinjski model (stražnji dio)

Xiaocheng Wang et al., 2017.



# Kolorimetrijski plinski senzor za dijagnostiku halitoze (1 ppm H<sub>2</sub>S) ili bolesti bubrega (ppm NH<sub>3</sub>) – simulacijski i klinički test

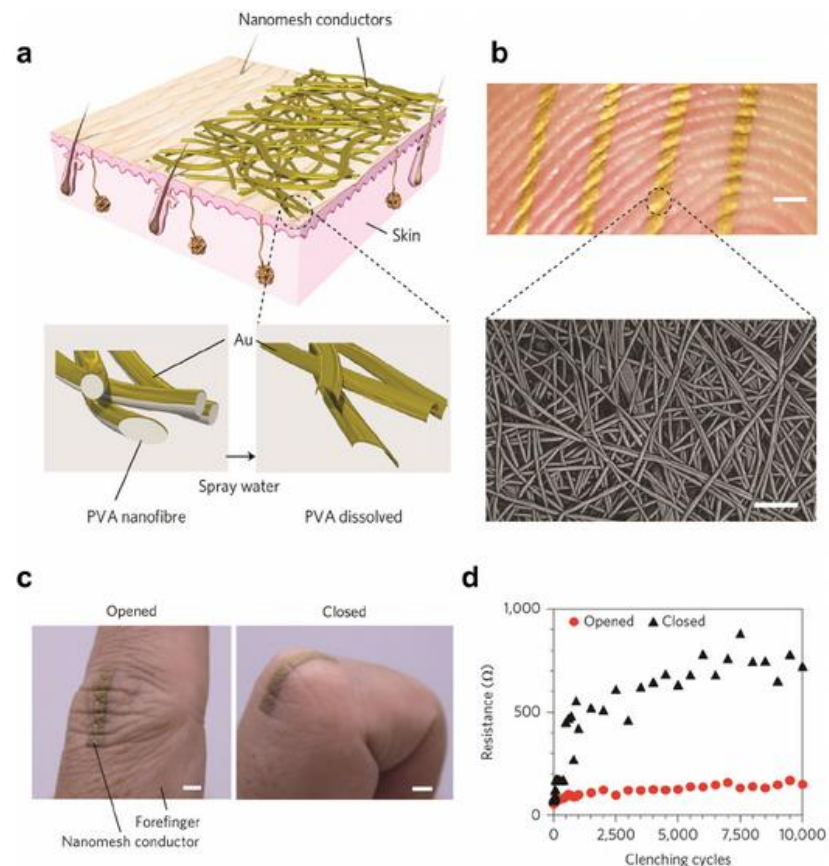


*Dong-Ha Kim et al., 2020.*



## Netransparentan fleksibilan vodič za praćenje ljudskog zdravlja

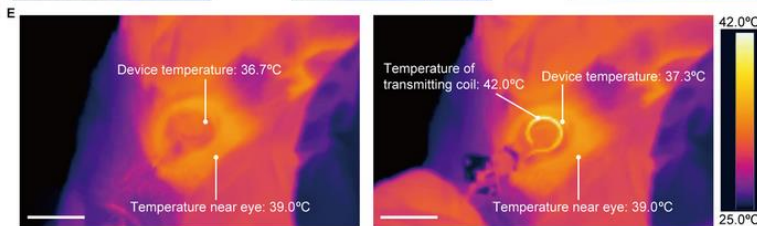
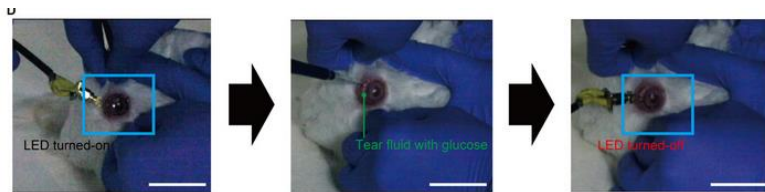
**Au nanos na elektrospredeni PVA**  
**PVA donji sloj uklonjen sprejanjem vodom**  
**Savitljiva Au nanomreža**  
**Promjena električnog otpora kod savijanja**  
**Primjena kod senzora**



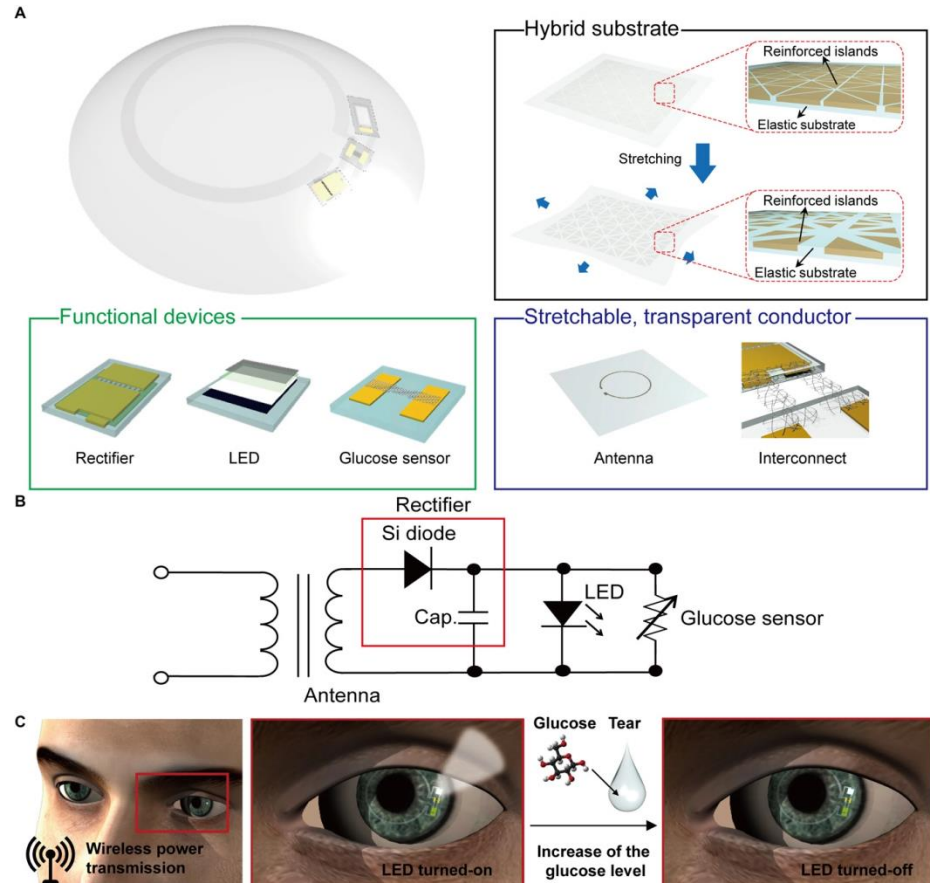
Akihito Miyamoto et al., 2017.

# Rektene - pametne kontaktne leće

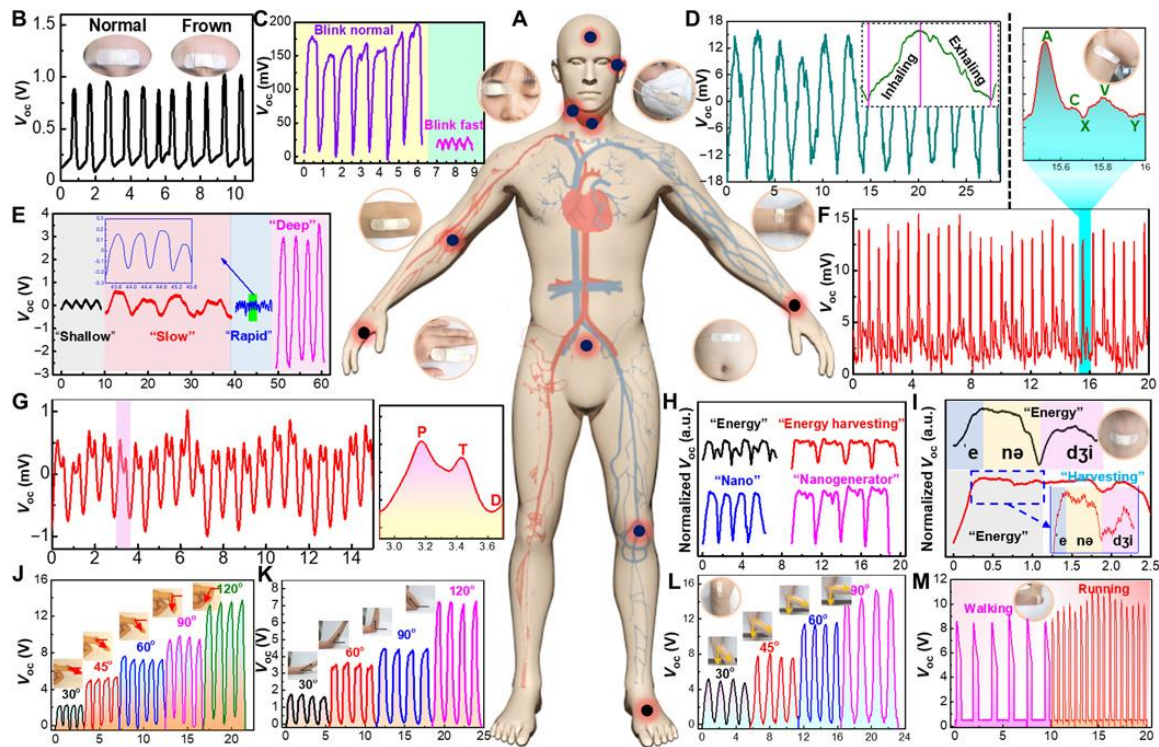
**Hibridni sustav**  
**Ag elektroispredena nanovlakna**  
**Senzor za razinu glukoze u oku**  
**LED i antena**



*Jihun Park et al., 2018.*



# Triboelektrični nanogenerator - samonapajajuća e-koža



*Xiao Peng et al., 2020.*

Elektroispredeni PVA +  
 Ag nanomreža vakuum filtracijom  
 + elektroispredeni PLGA

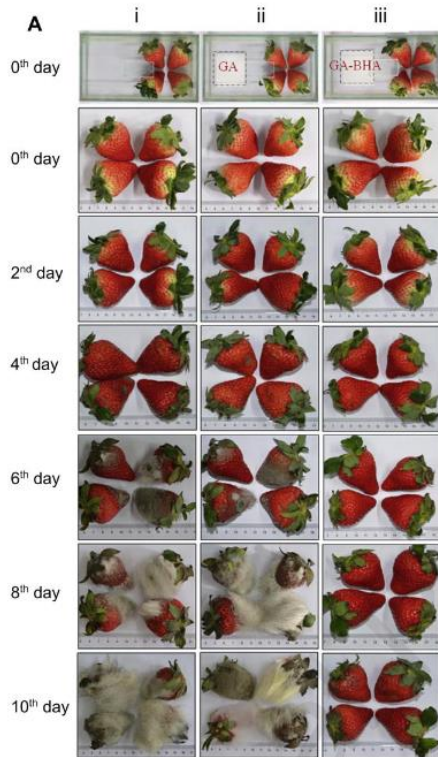
- Permeabilna
- Antibakterijska
- Biorazgradljiva
- Za praćenje zdravstvenog stanja
- Kod sportskih aktivnosti
- Za rehabilitaciju pacijenata
- Praćenje ljudskih kretnji

# Pakiranje hrane – antifungicidni, antibakterijski učinak

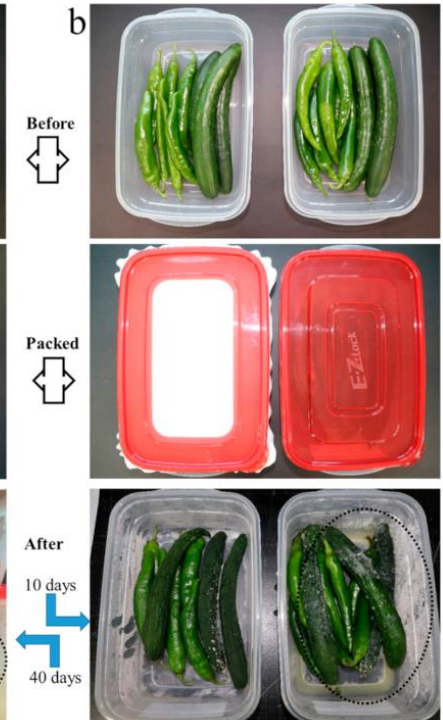
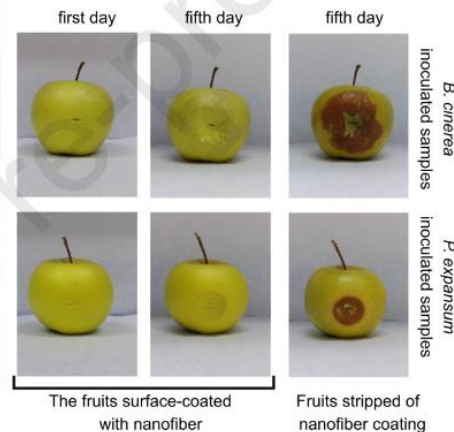
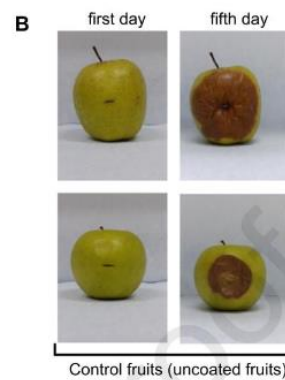
Butilat hidroksianizol/želatina

kurkumin/zein

PVA/PVP/karboksimetil celuloza



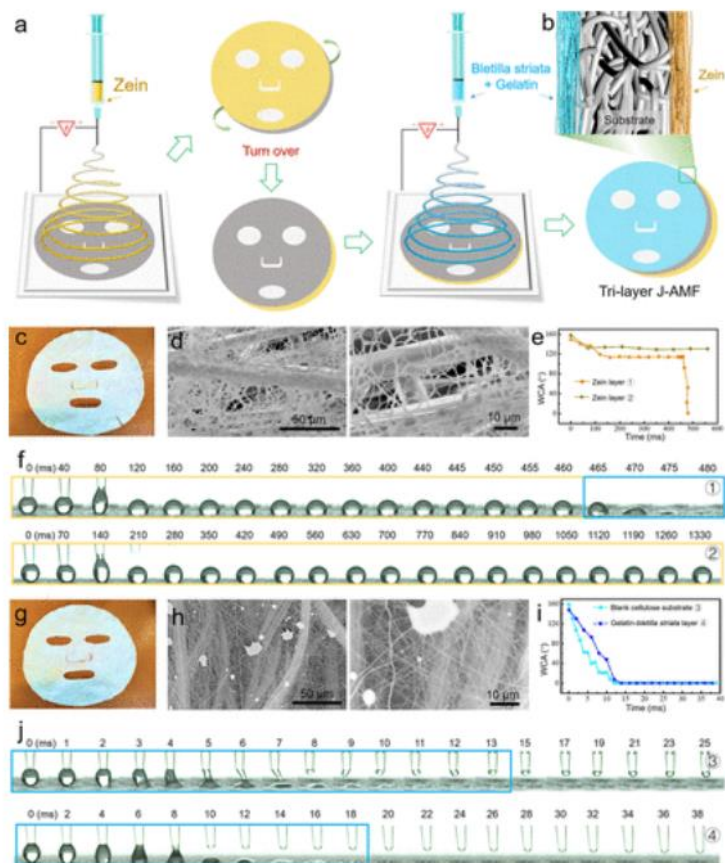
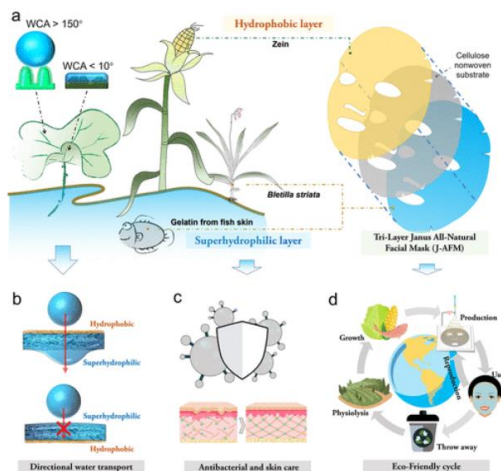
Fuat Topuz et al., 2021.



**Manje nakupljanje vlage**

Motahira Hasmhi et al., 2021.

## Prirodna suha Janus maska za lice s usmjerenim prijenosom vode



**Antibakterijska, biokompatibilna, 3 sloja**  
**Podloga od netkane celuloze**  
**Hidrofobni elektroispredeni zein (iz kukuruza)**  
**Hidrofilna elektroispredena želatina (iz riblje kože)**  
**Poboljšana svojstva kože (npr. pigmentacija, tekstura, kolagen, bore, vlažnost i sl.)**

*Yifan Si et al., 2022.*



## Korištena literatura

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- Akihito Miyamoto et al., Inflammation-free, gas-permeable, lightweight, stretchable on-skin electronics with nanomeshes, *Nature Nanotechnology* 2017.
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- Zhen Qin et al., Flexible Janus Electrospun Nanofiber Films for Wearable Triboelectric Nanogenerator, *Advanced Materials Technologies* 2020, 5(2), 1900859.
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- <https://www.iot-portal.cz/2021/04/28/3d-tistena-rektena-vyuziva-5g-site-jako-zdroj-energie/>
- <https://www.oktal-pharma.hr/hr/octenisept/vrste-rana-i-faze-zacjeljivanja-rane>



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**Hvala Vam na pažnji!**