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

TEXTILE SCIENCE RESEARCH CENTER

Dan Znanstveno - istraživačkog centra za tekstil
Tehnički muzej Nikola Tesla, 20. rujna 2016.

INOVATIVNI TEKSTIL - stvarnost ili znanstvena fantastika?

FUNKCIONALNA NANOVLAKNA – PROIZVOD NAPREDNE TEHNOLOGIJE ELEKTROISPREDANJA

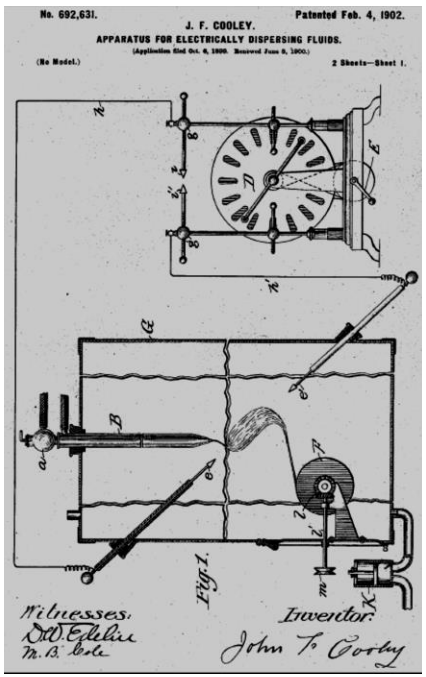
Dr. sc. Emilija Zdraveva

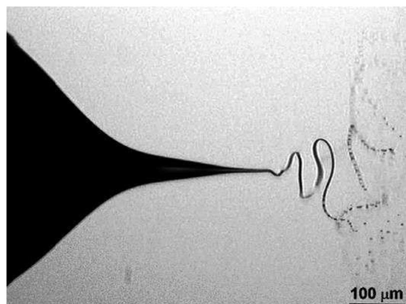
Pregled

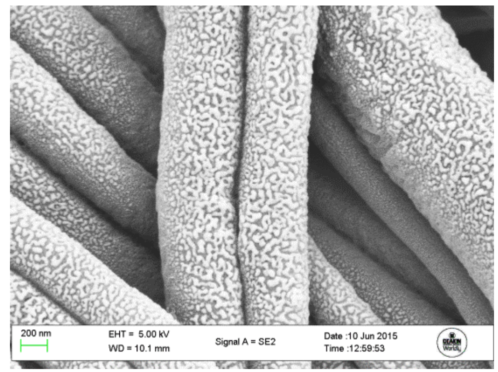
1. Elektroispredanje - od laboratorijske znatiželje do vodeće tehnologije 21. stoljeća
2. Najnovije inovacije u konfiguraciji uređaja – industrijalizacija
   - Bikomponentno elektroispredanje
   - BezigličIno elektroispredanje
   - Elektroispredanje nanopređe
3. Funkcionalna nanovlakna – dostignuća u primjeni
   - Pohrana energije, biomedicina i funkcionalni tekstil
4. Prilog području elektroispredenih materijala na bazi materijala s promjenom stanja
   - Biljna ulja i polikaprolakton – samoregulacija temperature

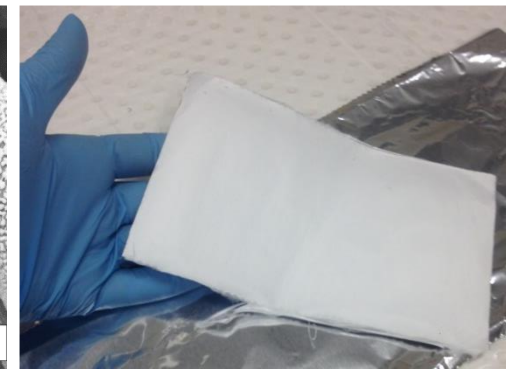
Elektroispredanje - od laboratorijske znatiželje do vodeće tehnologije 21 stoljeća

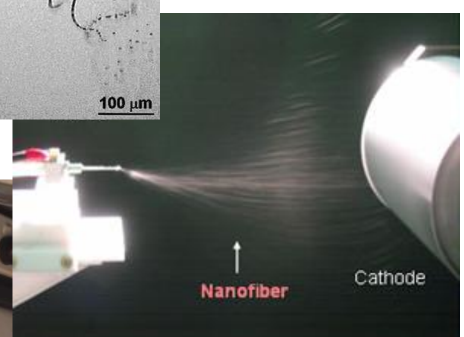
1600. g. - W. Gilbert
1902. g. - J. F. Cooleyu
1934.-1944. g. - A. Formhals
90-ih - D. H. Reneker

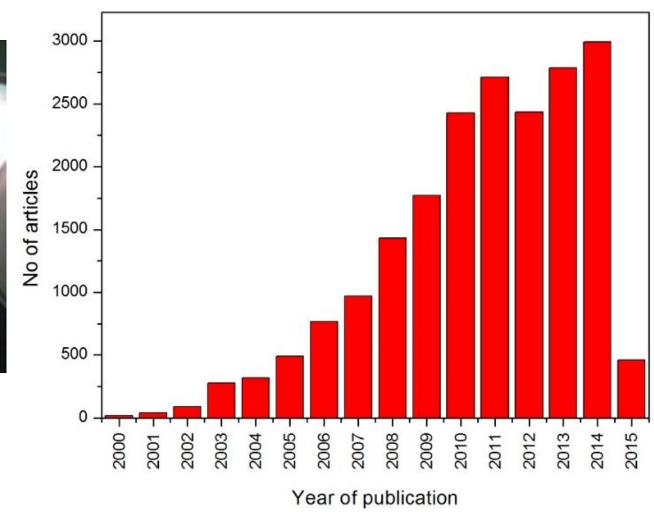










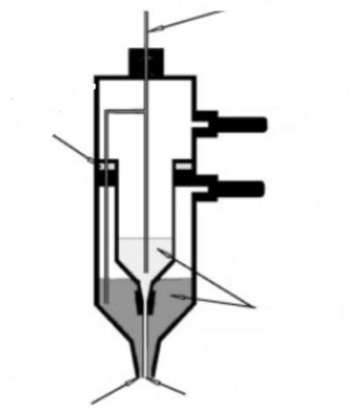


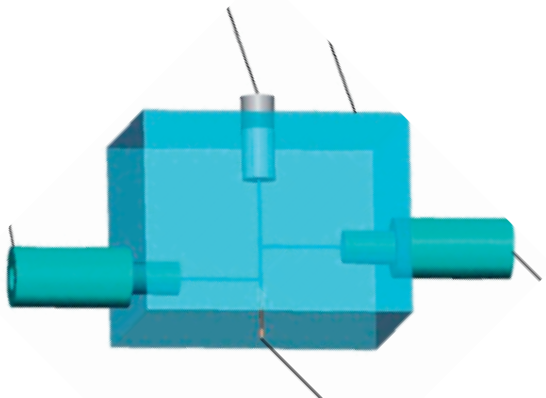
Sci Finder, 03.02.2015.

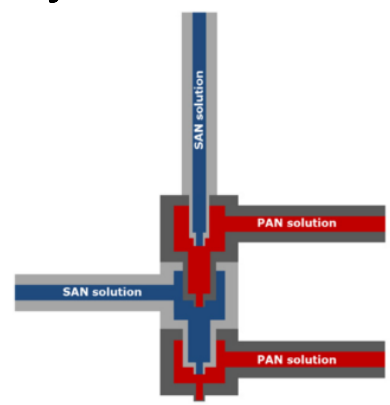
Najnovije inovacije u konfiguraciji uređaja – ka industrijalizaciji

Bikomponentno elektroispredanje

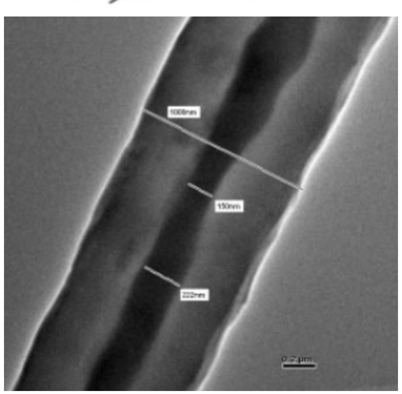
Osnovna konfiguracija, te kasnije nadogradnje

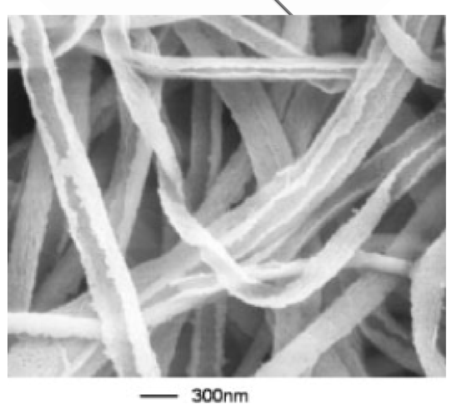


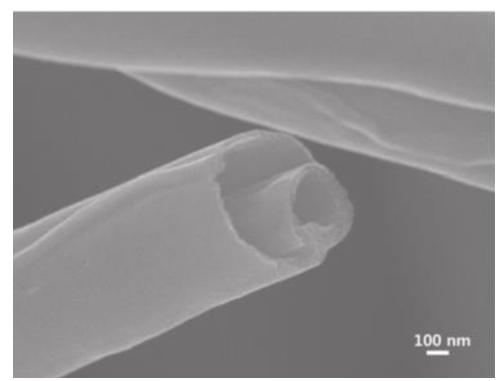




Ko-aksijalno;
Multi-aksijalno;
“Side by side”
elektroispredanje.







Najnovije inovacije u konfiguraciji uređaja – industrijalizacija

Bezigličnoelektroispredanje

Veća produktivnost!

1979. g., W. Simm i sur.

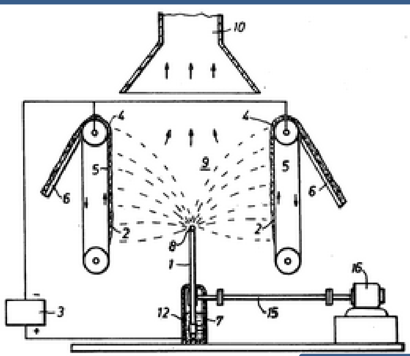


FIG. 1

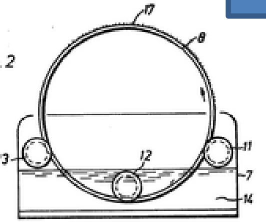
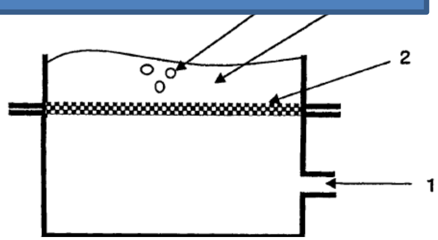
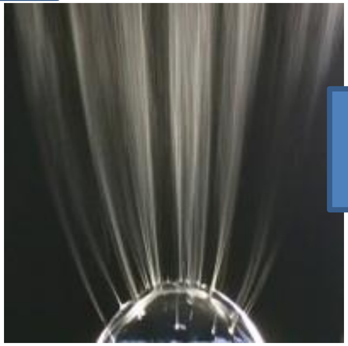


FIG. 2



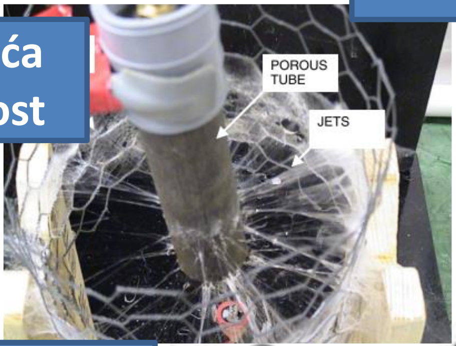


2006. g., Kishimoto Z.

2,3 – 5,25 g/sat

250 puta veća produktivnost

Iglično: 0,3 g/sat



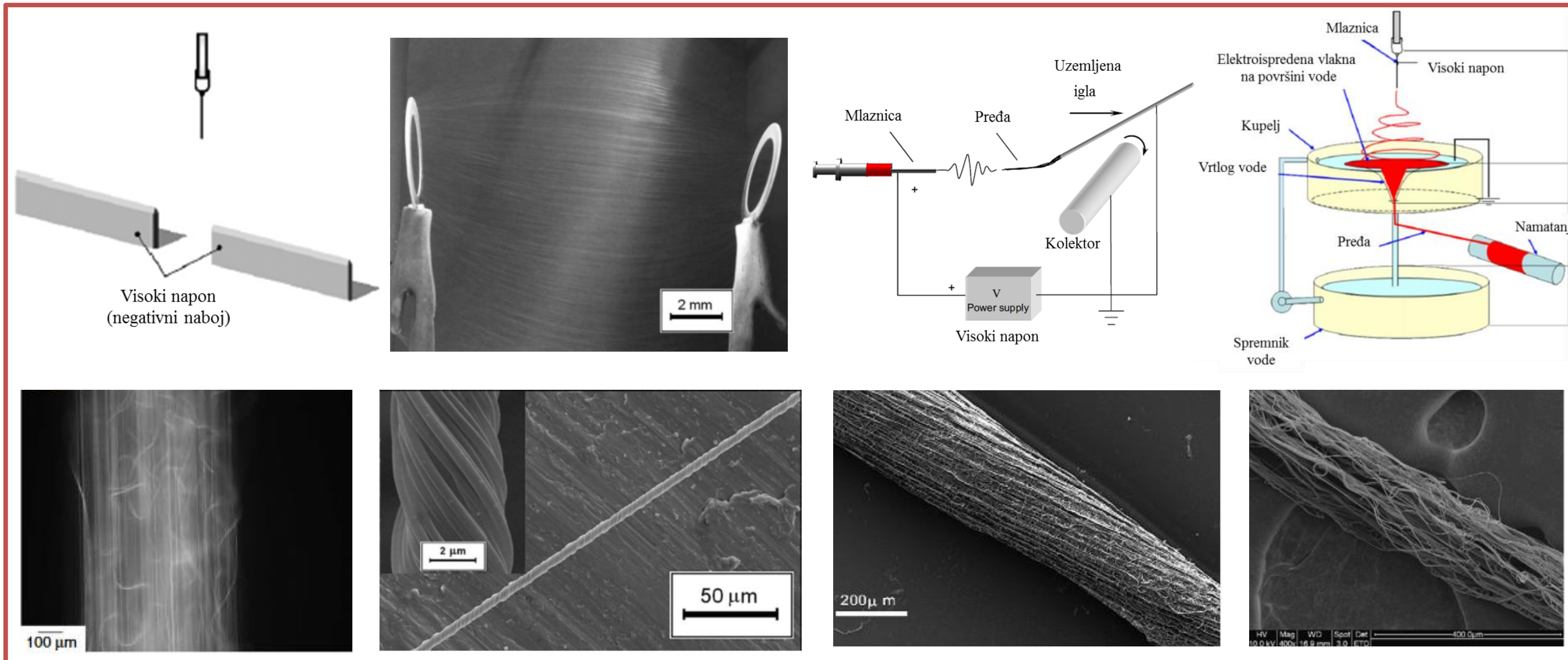
Spirala: 16 g/sat
cilindar: 8.6 g/sat
disk: 6.2 g/sat
kugla: 3.1 g/sat

Elmarco - Nanospider™

60 m/min
z: 1-500 µm
x: 1,6 m
d: 50-250 nm

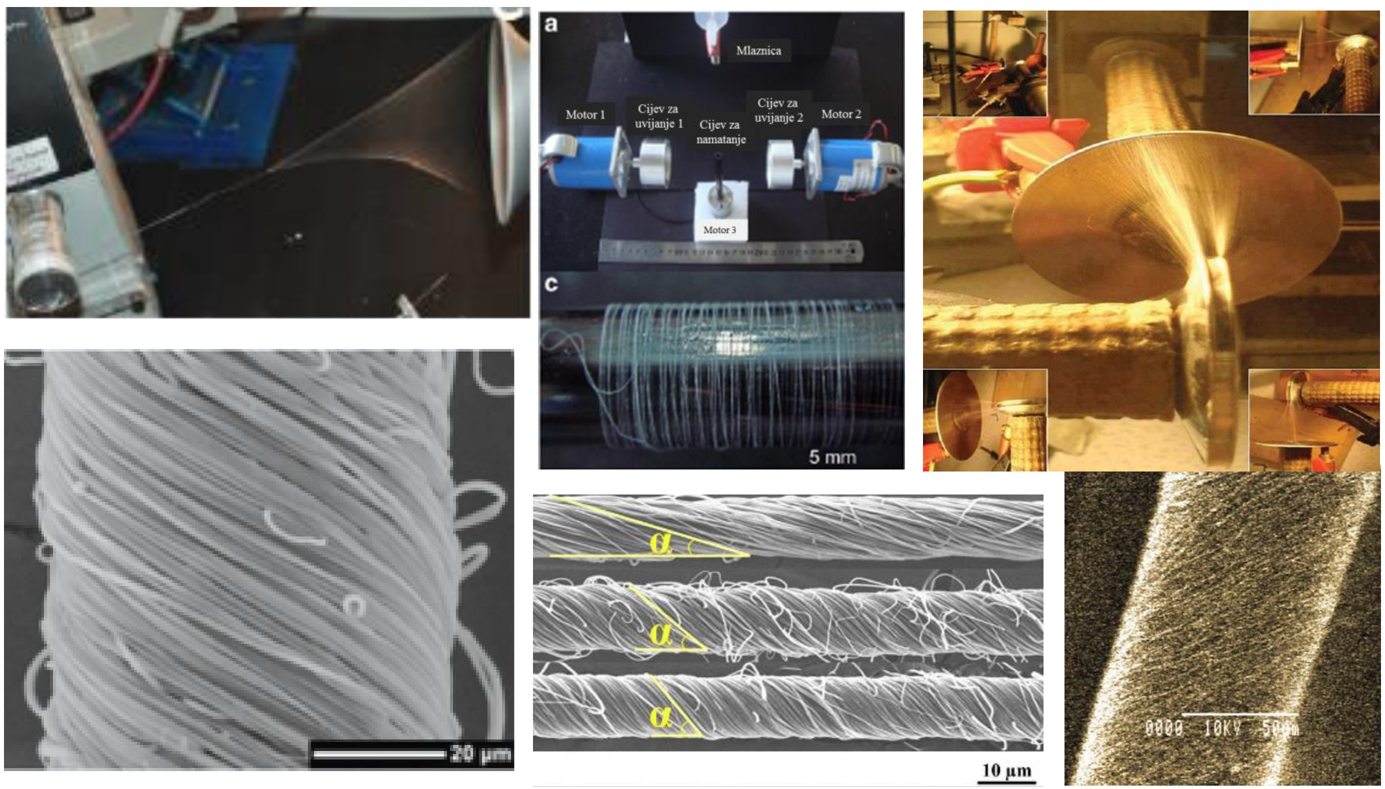
Najnovije inovacije u konfiguraciji uređaja – ka industrijalizaciji

Elektroispredanje nanopređe



Najnovije inovacije u konfiguraciji uređaja – ka industrijalizaciji

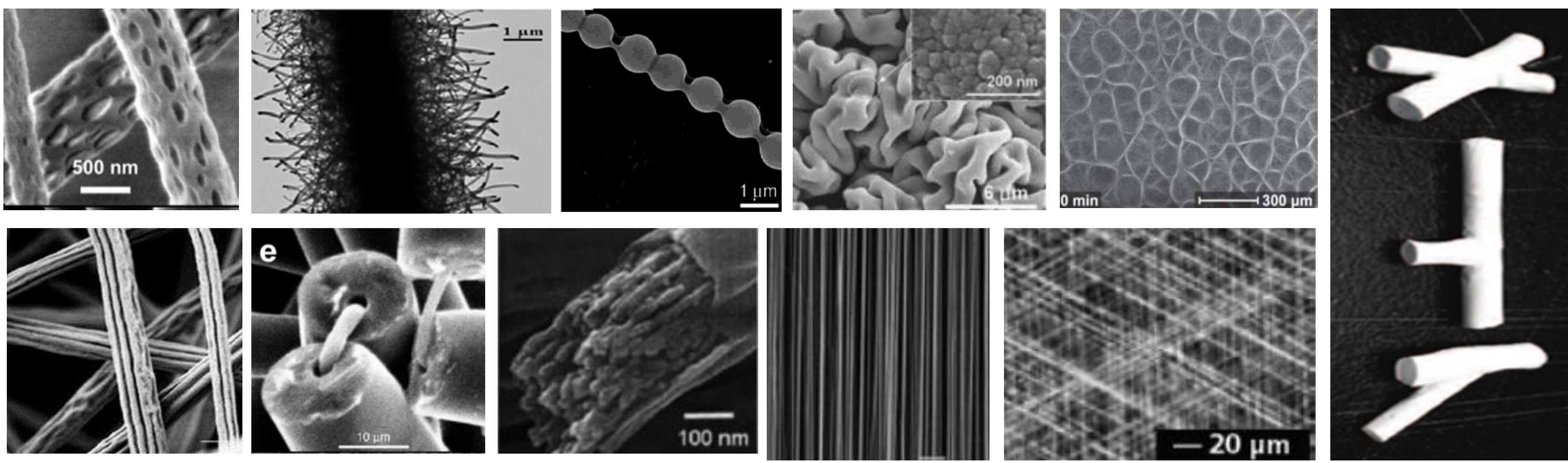
Elektroispredanje nanopređe



Elektroispredanje paralelnih vlakana bez uvijanja;
Ručno uvijanje nakon elektroispredanja;
Automatsko uvijanje pređe.

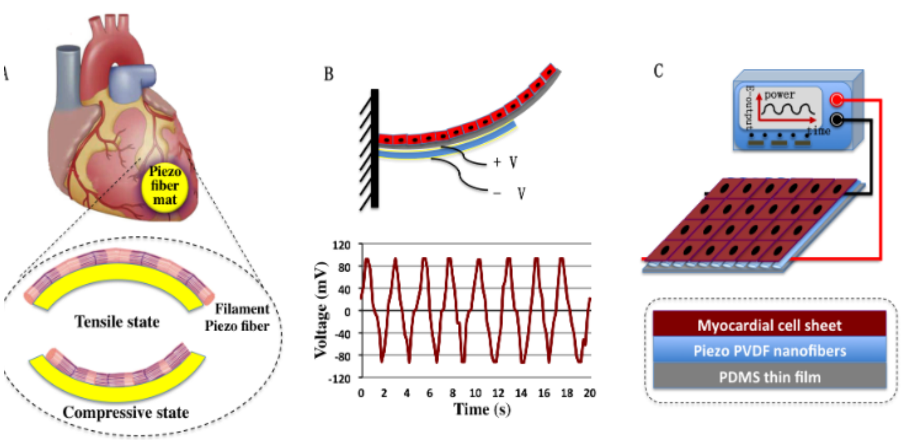
Funkcionalna nanovlakna – morfologija i pozicioniranje

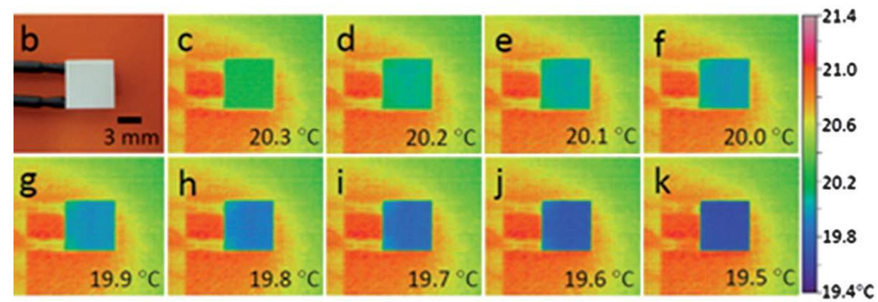
- **Površina – porozna, razgranata, valovita i sl.**
- **Unutrašnjost – diskontinuirana jezgra, kontinuirana jezgra, višestjenčana, više jezgrasta i sl.**
- **Kontrolirano pozicioniranje vlakana: paralelno, pod kutem, 3D struktura, hijerarhijska organizacija i sl.**



Funkcionalna nanovlakna – pohrana i transformacija energije

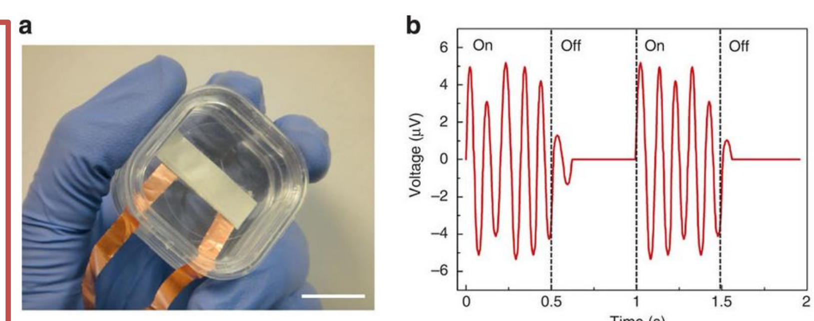
Piezoelektrični uređaji - nanogeneratori





20 min za punjenje kondenzatora > 15 V, da bi se pokrenuo rad uređaja za hlađenje (1 °C za 2 sek.)

Bio-hybridna energija pomoću živih kardiomiocita, PDMS podloga i elektroispredena PVDF nanovlakna Struja od 87.5 nA i napon od 92.3 mV	PVDF-TrFE zvučni senzor, 60-80 dB, 6-14 µV

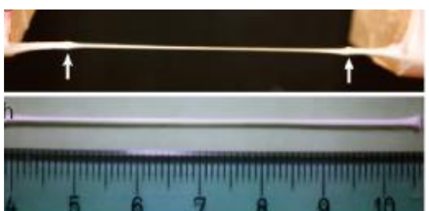


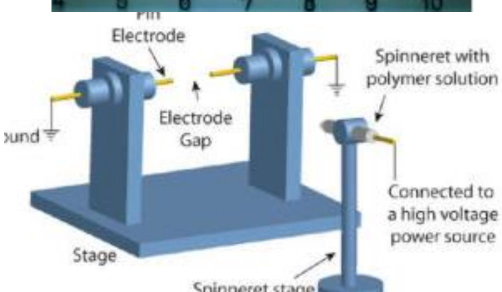
Funkcionalna nanovlakna – biomedicina

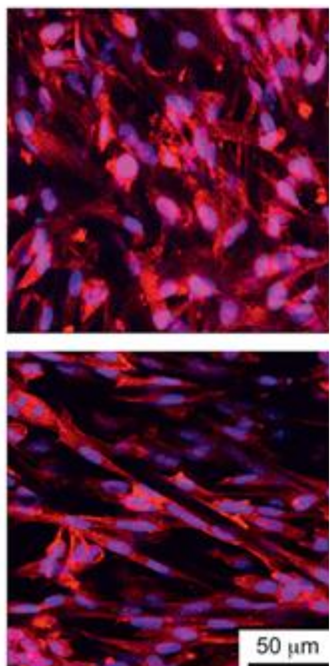
Tkivno inženjerstvo (uzgoj stanica tvrdih i mekih tkiva, implantati)

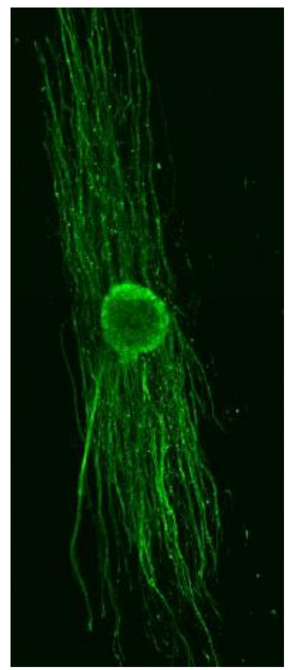
Prijenos lijekova i bioloških komponenti

2 mm i 84%, ~200 µm i 77%, ~175 µm i 92% iz PCL, hitozan/PCL, TiO_2/PVP, mišićno tkivo srca

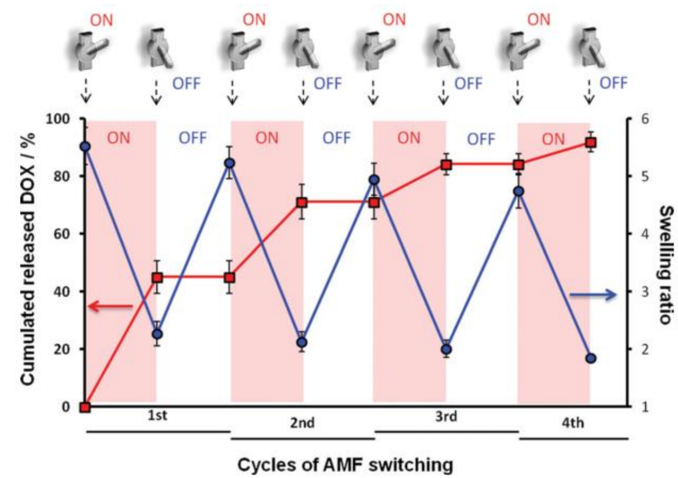






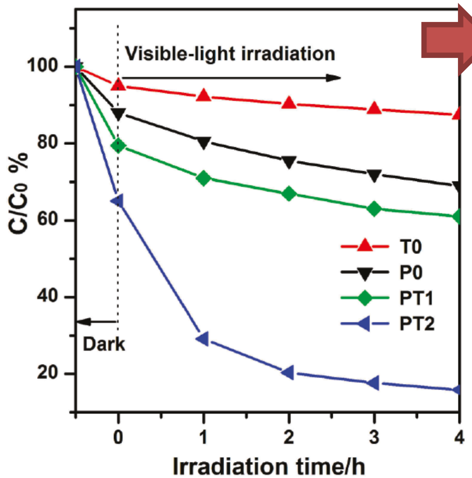


Tempirano oslobađanje doksorubicina
Princip "uključeno-isključeno"

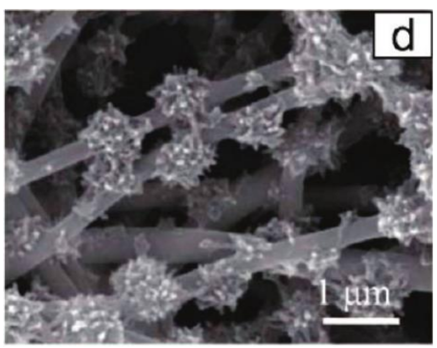


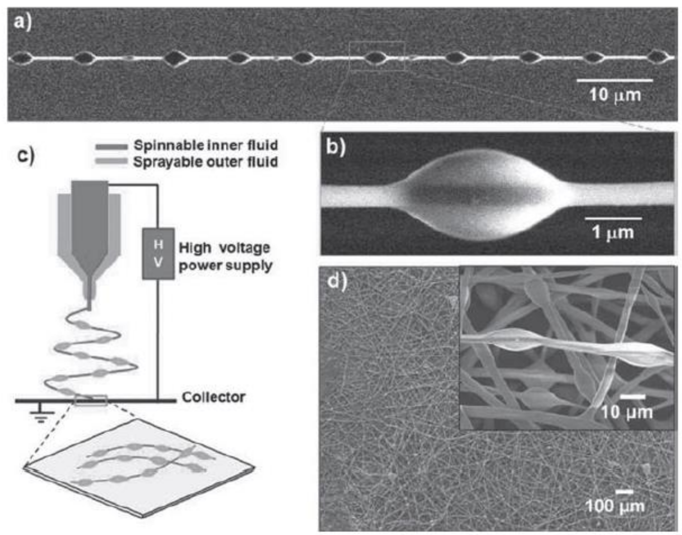
Funkcionalni tekstil

Zaštita okoline, sakupljanje vode, desalinizacija

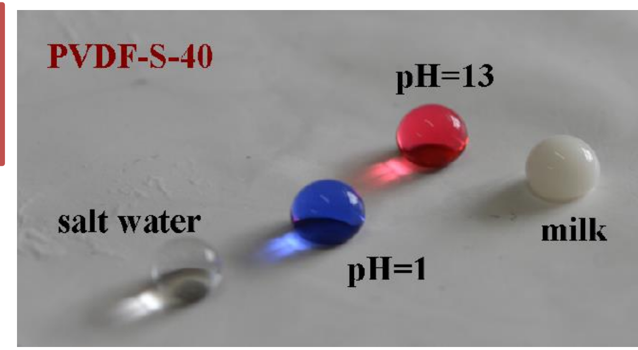


($TNCuPc$)/TiO_2 hijerarhijska struktura
Fotodegradacija Rodamina b

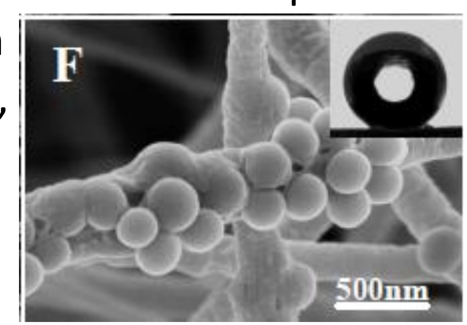




PEG-PS „bead-on-a-string” vlakna, reakcija na vlagu, bubrenje/ skupljanje



Superhidrofobni PVDF/SiO_2 za destilaciju
Permeabilni fluks vodene pare od 41.1kg/m^2h (3.5 % NaCl, 40 °C) 24 sata.



Prilog području elektroispredenih materijala na bazi materijala s promjenom stanja

1. Elektroispredanje iz emulzije:

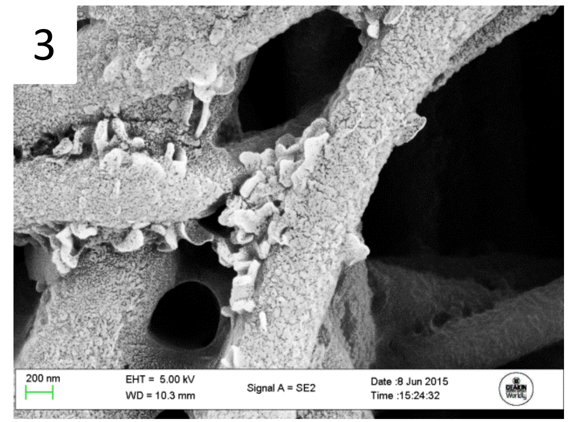
- Biljno ulje/PVA/voda 9 %, PVA/PCM: 100/10-70)

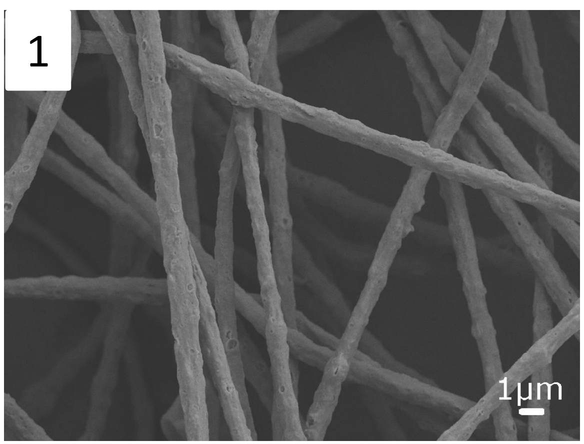
2. Elektroispredanje iz mješavine:

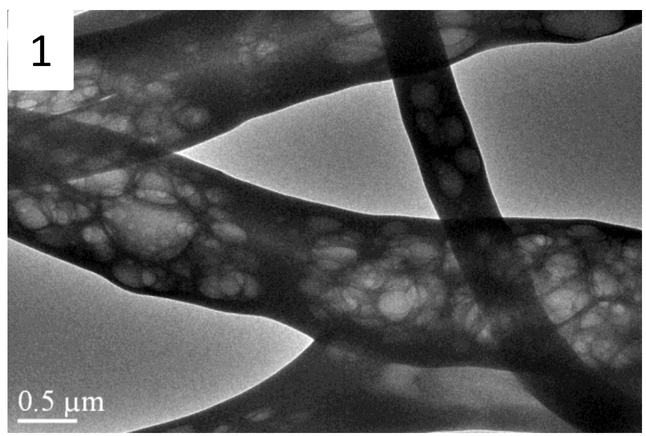
- PVDF/PCL/(DMF+THF) (mala Mr) = 14% 100/(25-100)
- PVDF/PCL/(DMF+THF) (veća Mr) = 8% 100/75

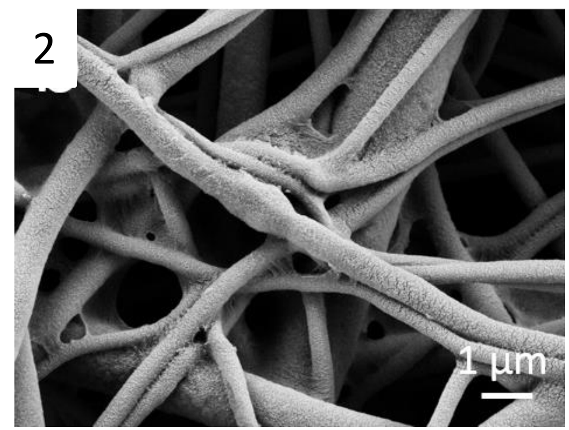
3. Obrada – nanos iz polipirola:

- PVDF/PCL/PPy bez i s r-GO









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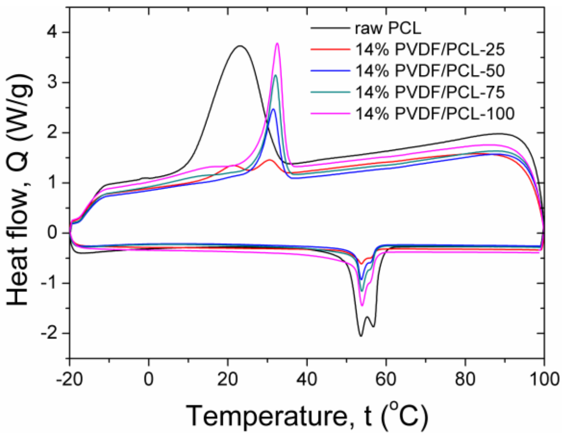
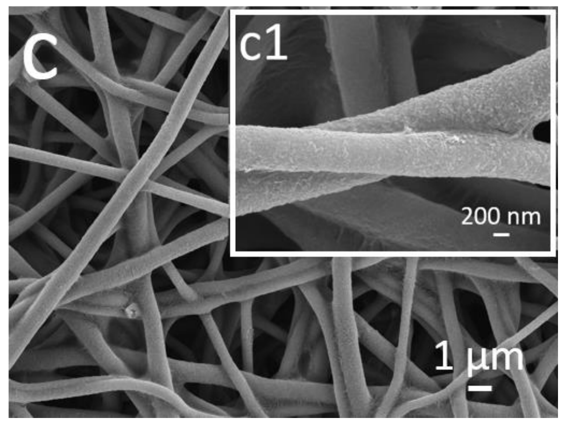
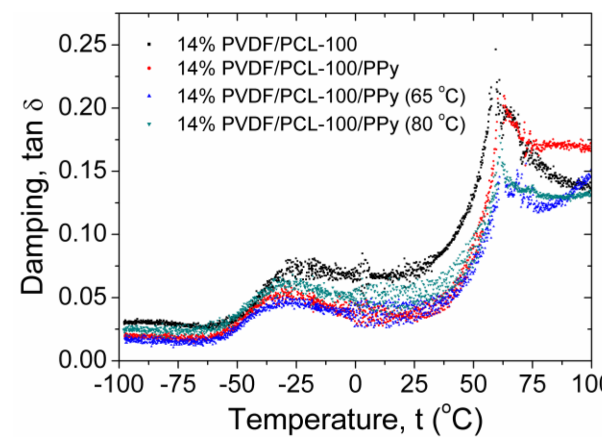
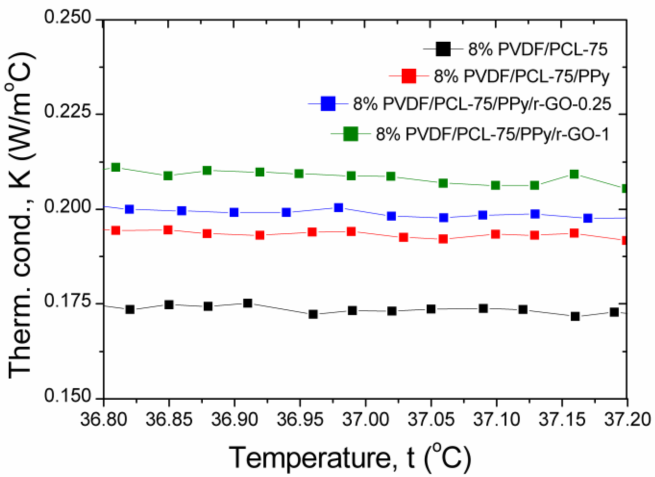
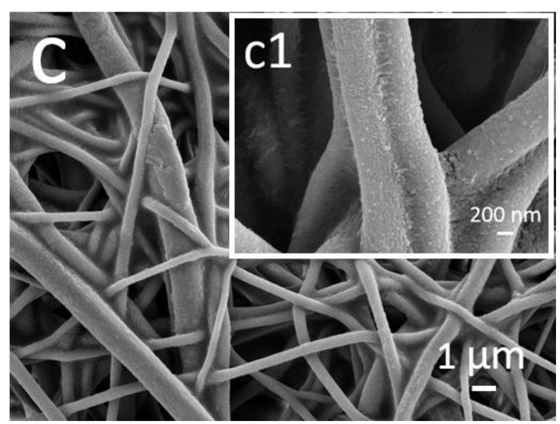
Prilog području elektroispredenih materijala na bazi materijala s promjenom stanja

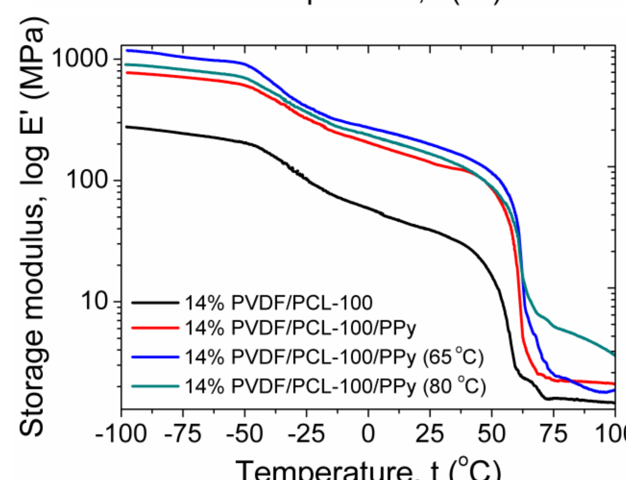












Prilog području elektroispredenih materijala na bazi materijala s promjenom stanja

- PVA/biljno ulje – pouzdanost u pohrani/oslobađanju toplinske energije nakon 100 ciklusa grijanja/hlađenja, max entalpija ~80 J/g
- Poboljšana čvrstoća nakon toplinske obrade zbog jednoličnije distribucije biljnog ulja po duljini vlakna
- Stabilnost morfologije vlakana pri visokim temperaturama u odnosu na točku taljenja biljnog ulja
- Učinkovitost kapsulacije PCL-a od max 50 % sa smanjenjem efekta superhlađenja uz PVDF kao matricu
- Nanos PPy poboljšava stabilnost vlakana nakon izlaganja materijala na temp. od 80 °C tijekom 24 sata
- Poboljšana čvrstoća kod PVDF/PCL(manja Mr)/PPy nakon izlaganja temperaturi od 65 °C
- Postepeno povećanje toplinske vodljivosti kod PVDF/PCL(veća Mr) u stanju krutine i to za 17%, 13% i 9.8% kod nanosa od PPy, PPy/r-GO-0.25 i PPy/r-GO-1

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Hvala Vam na pažnji!