BIOAPPLICATION FOR ELECTROSPUN POLYMERS

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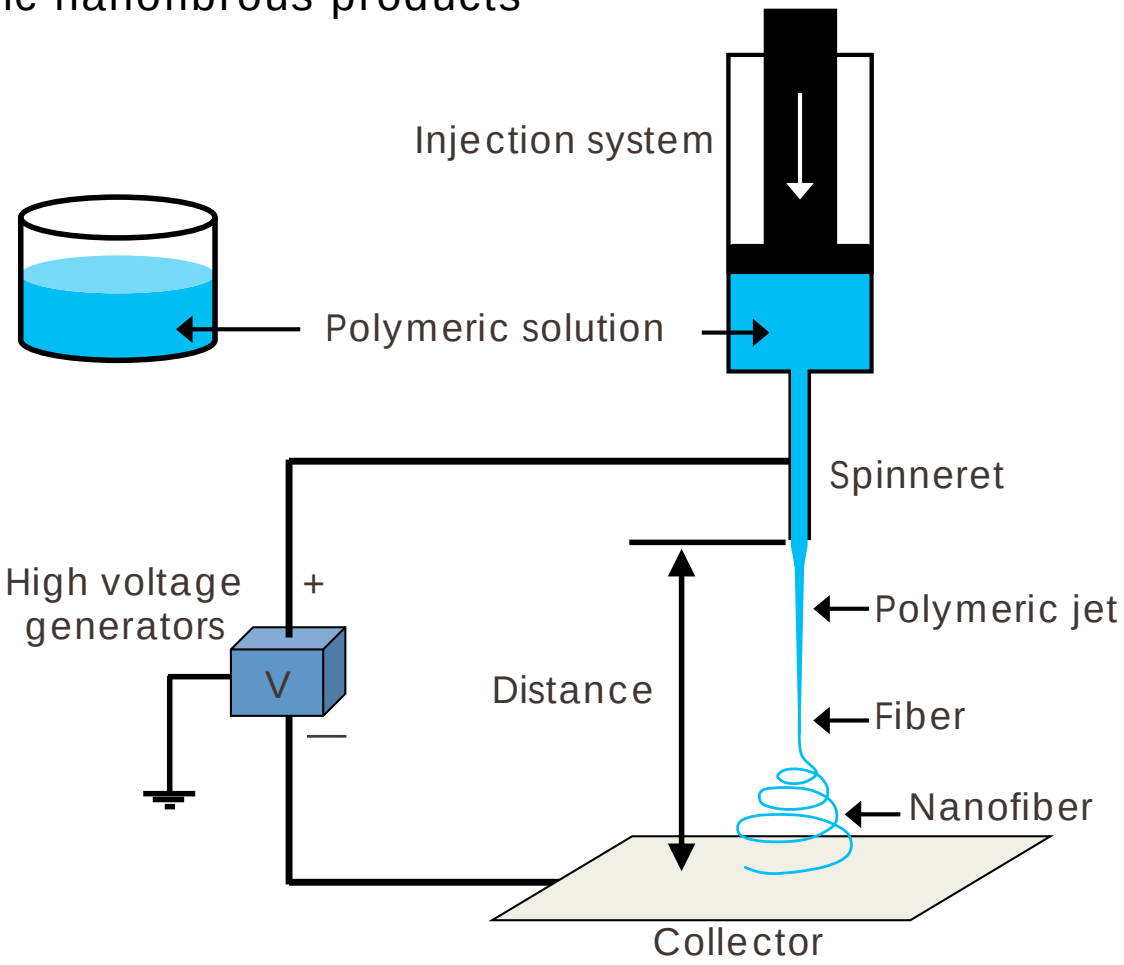
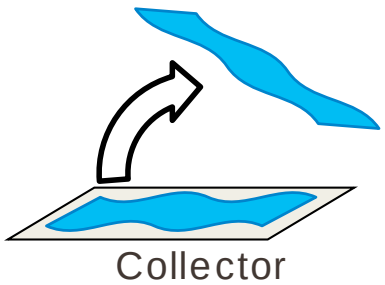
OUTILINE

- Electrospinning technique
- Bioapplication
  - Filtration
  - Biosensor
  - Regenerative medicine
  - Biotechnologies
- Conclusions

Electrospinning technique

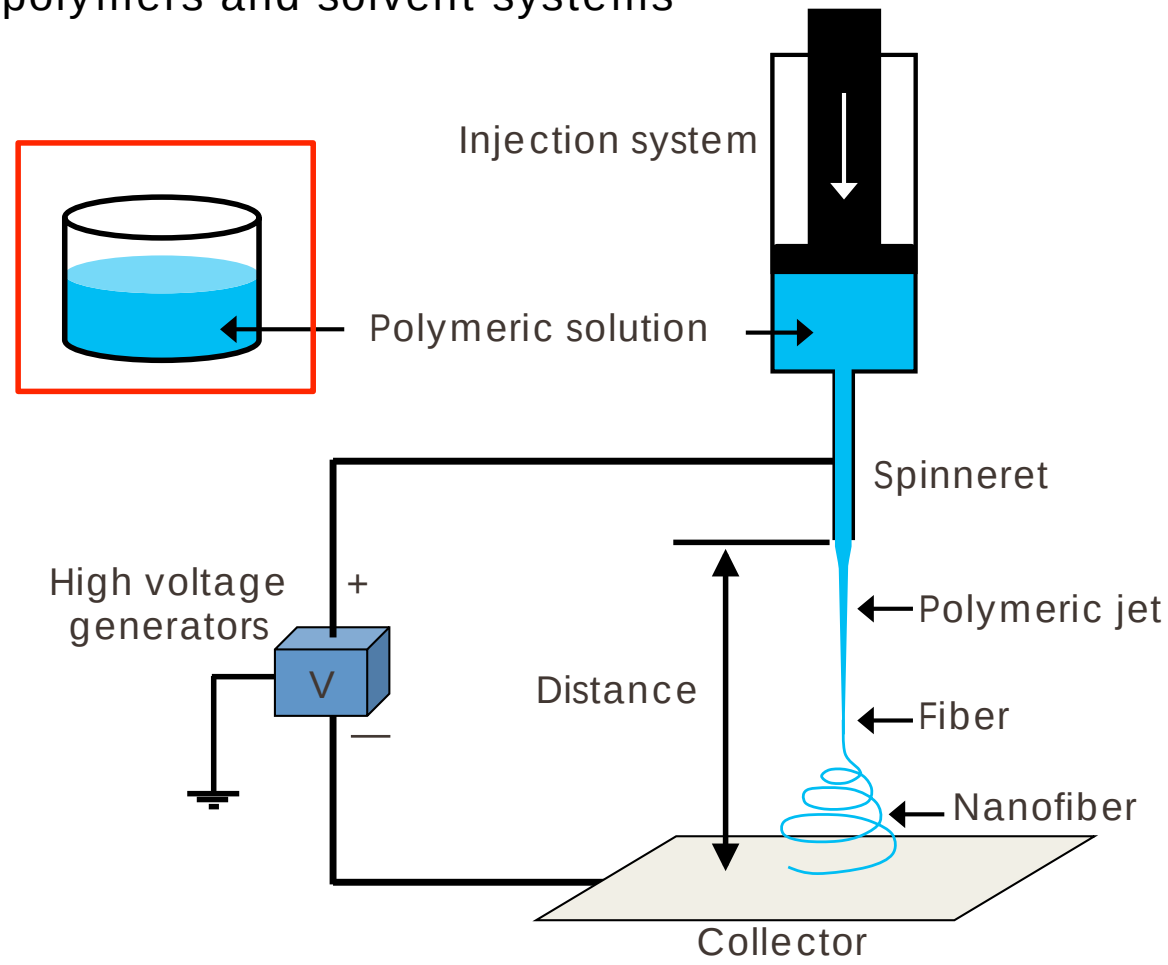
Polymeric nanofibrous products

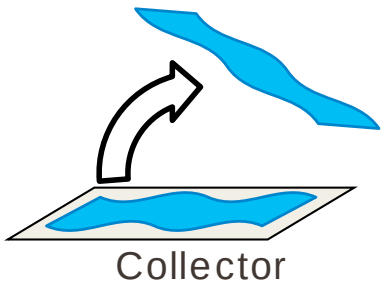




Electrospinning technique

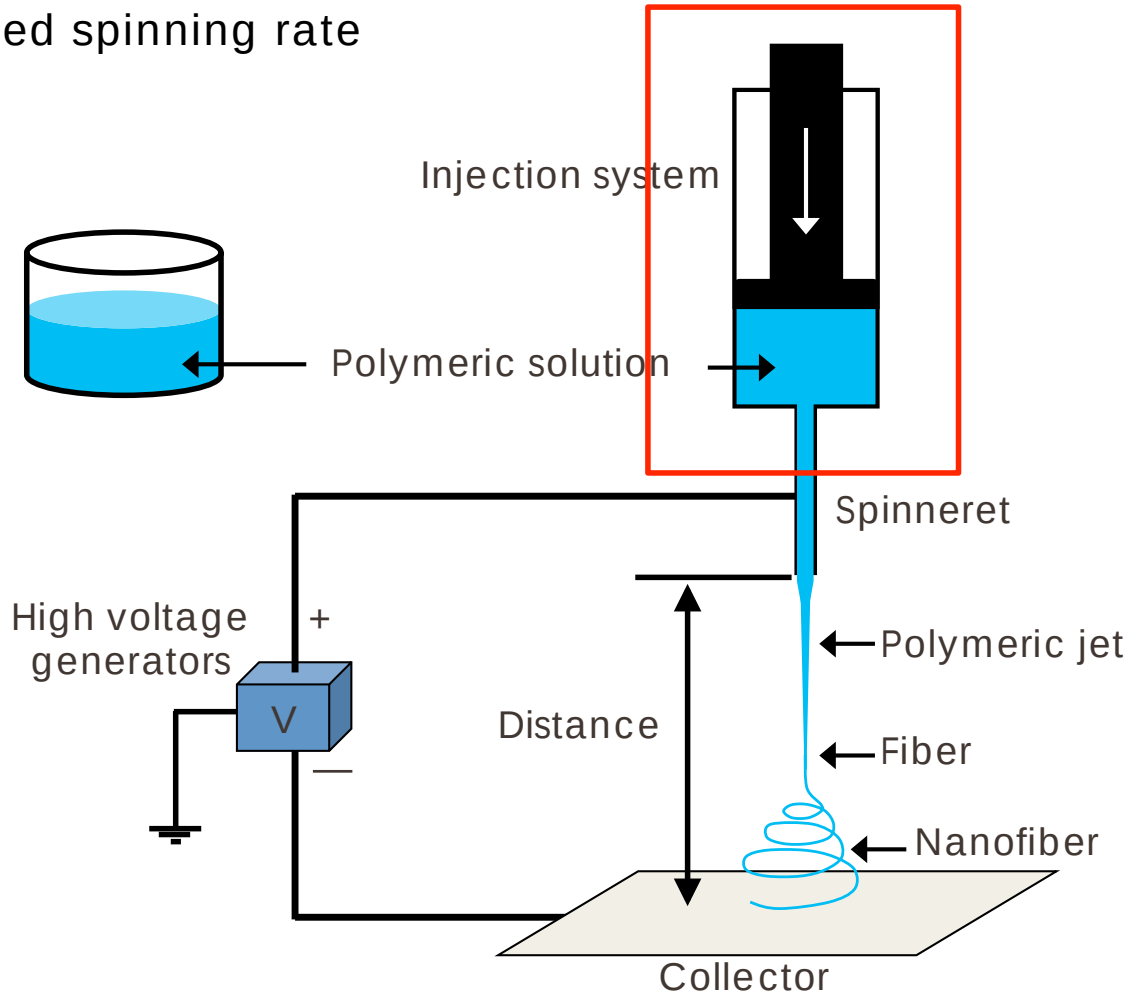
Many polymers and solvent systems

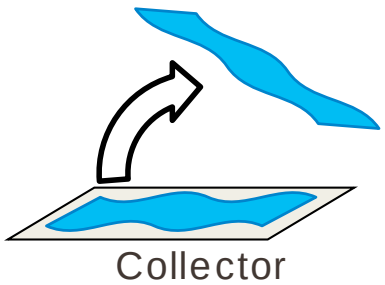




Electrospinning technique

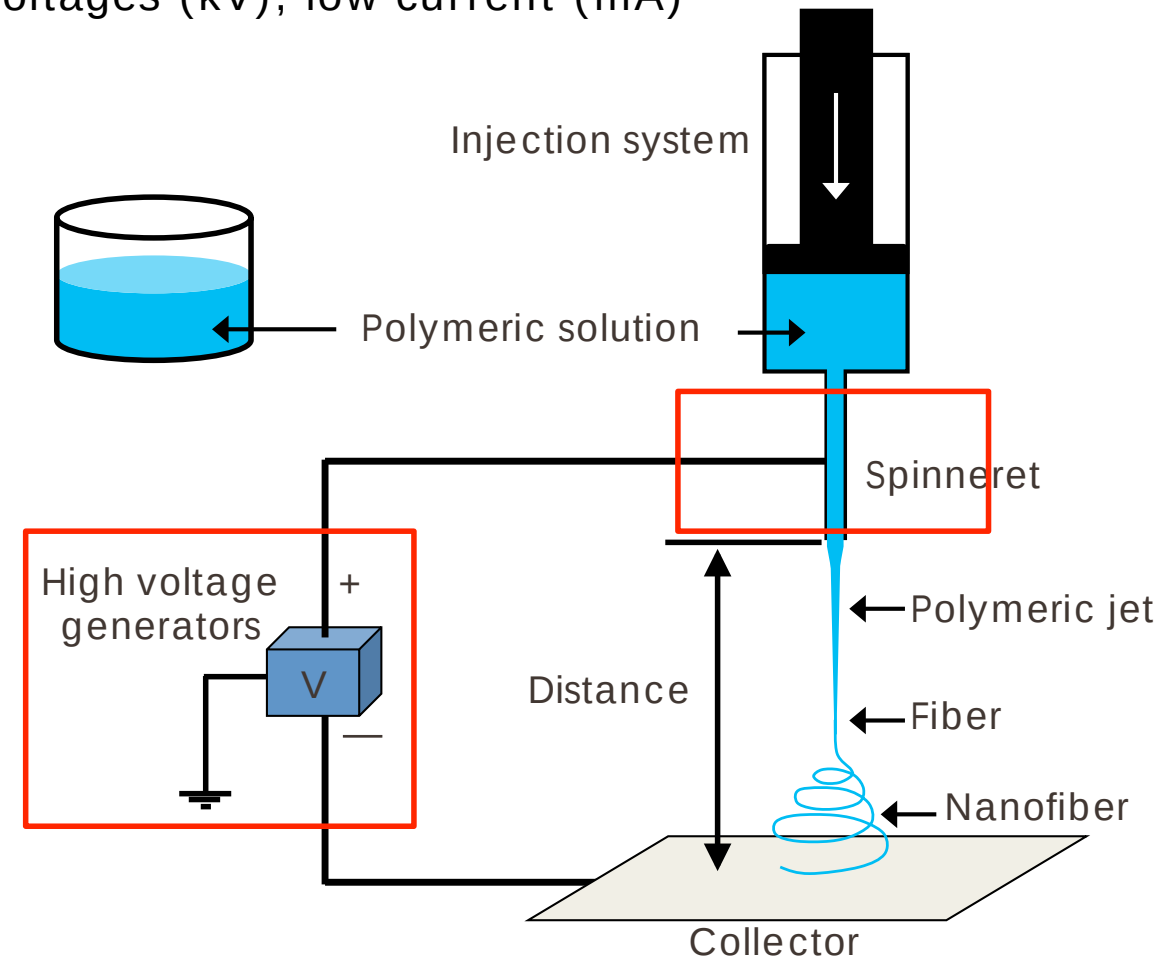
Controlled spinning rate

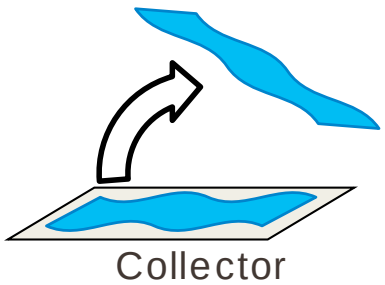




Electrospinning technique

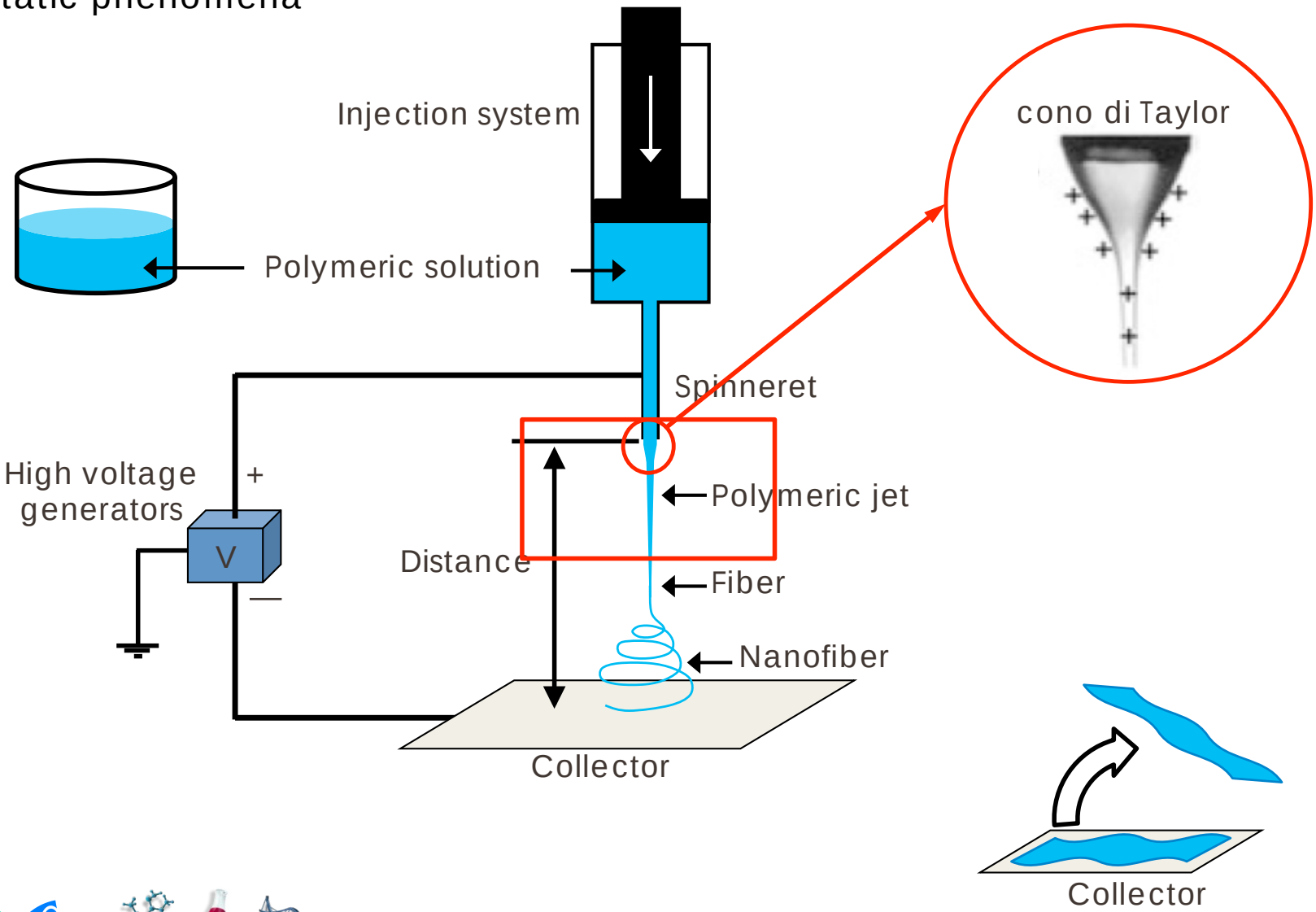
High voltages (kV), low current (mA)





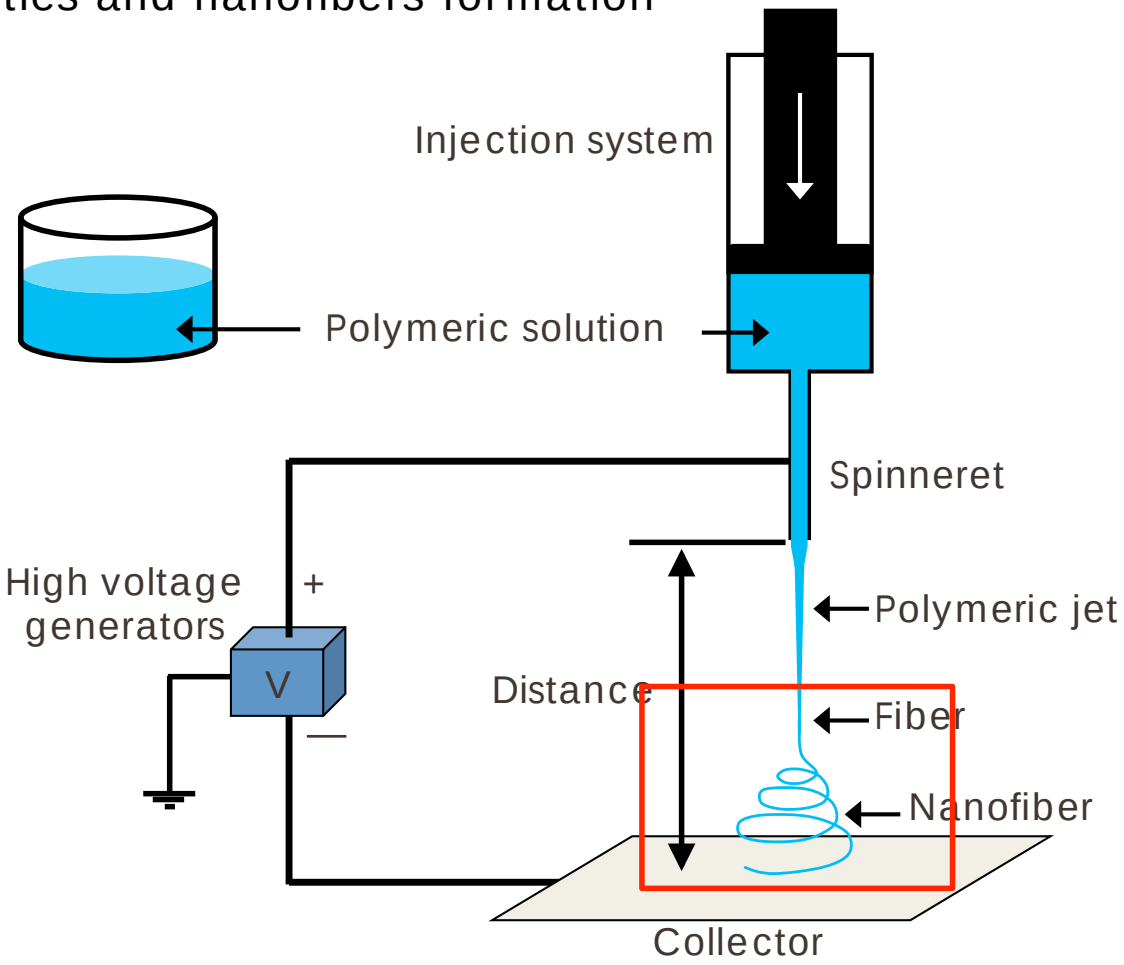
Electrospinning technique

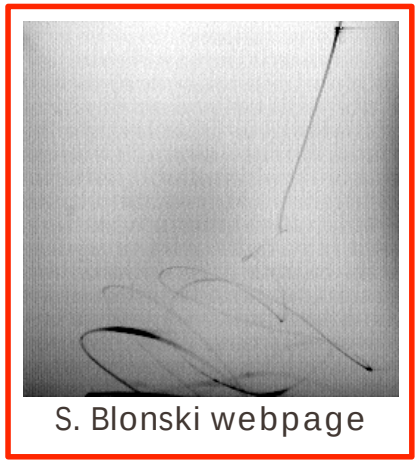
Electrostatic phenomena

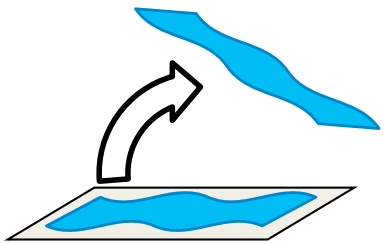


Electrospinning technique

Instabilities and nanofibers formation

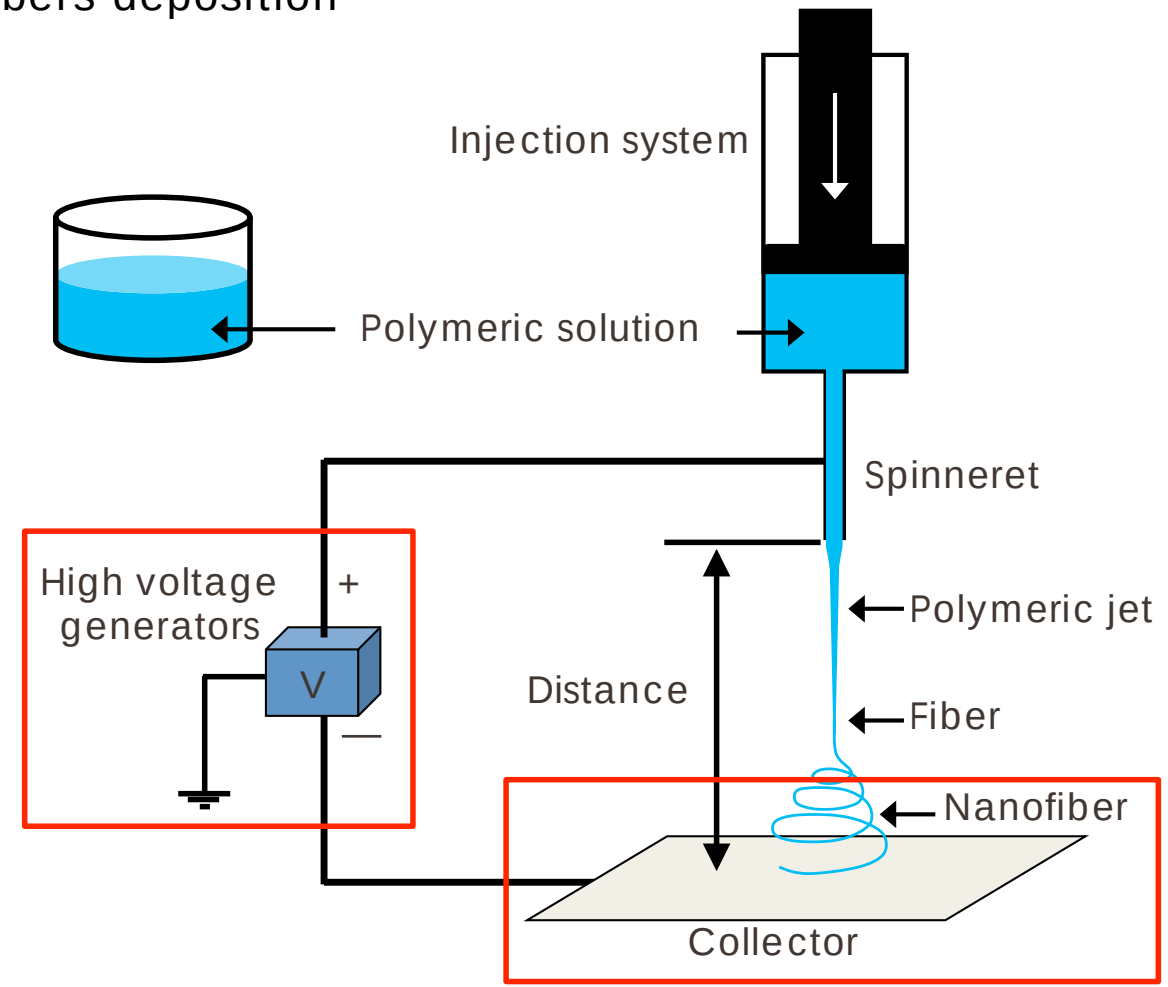


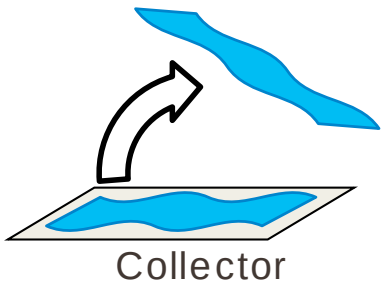

S. Blonski webpage



Electrospinning technique

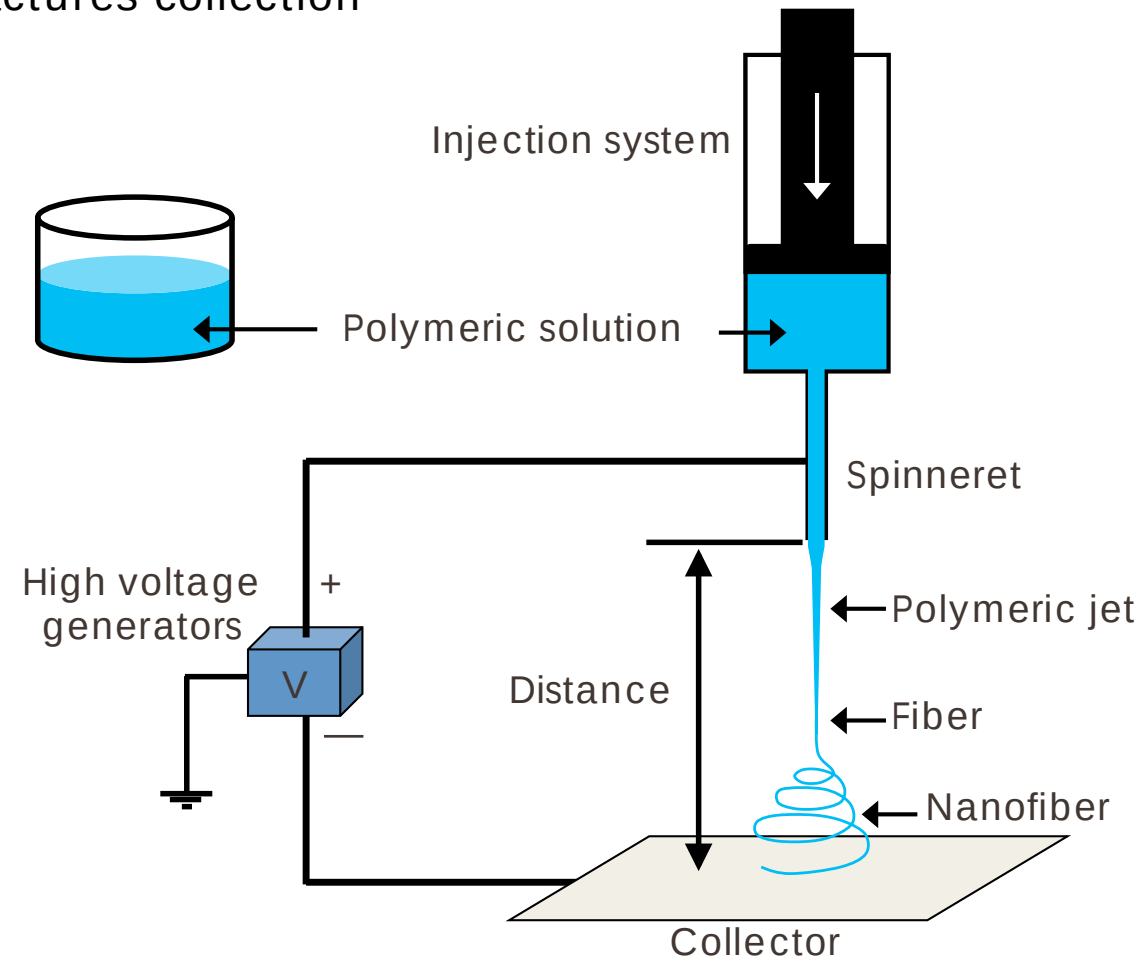
Nanofibers deposition

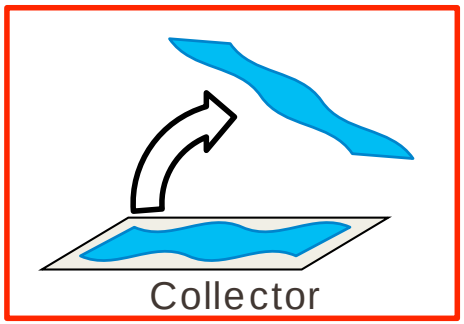




Electrospinning technique

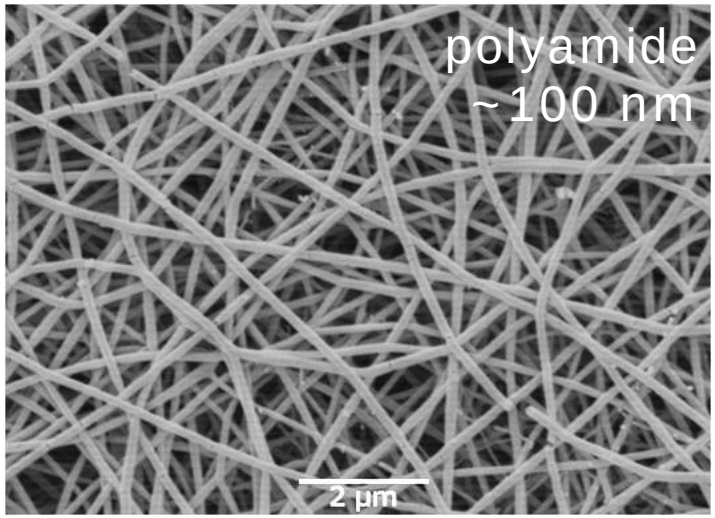
Manufactures collection

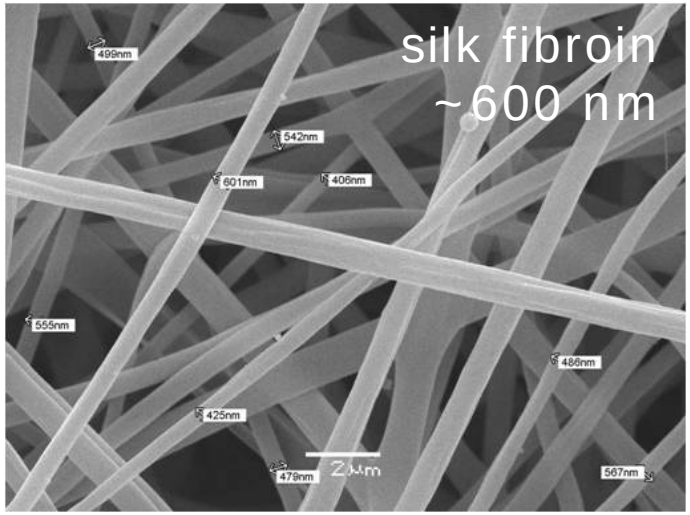


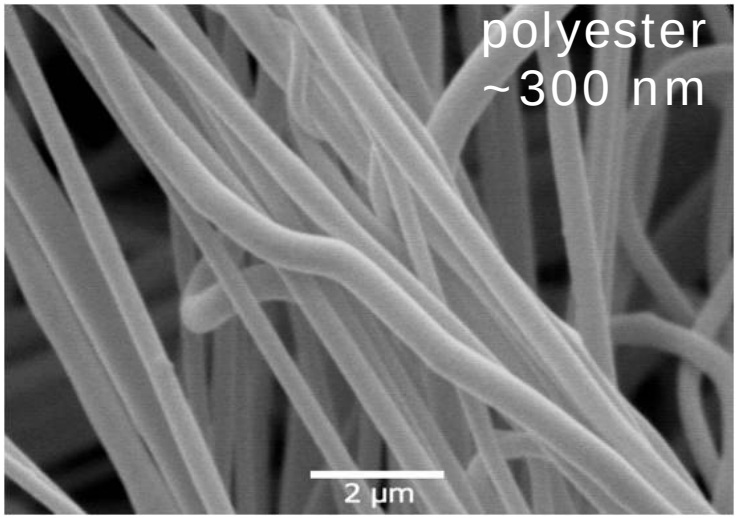


Electrospinning technique

Some examples







Electrospinning technique

Characteristic of electrospun products

- nanometric fibers
- nanometric pores
- low fiber volume fraction
- high surface/volume ratio (1000 times higher of microfibrous)
- high efficiency in surface functionalization
- possibility of functionalization of fiber bulk (“encapsulation”)

Bioapplication - Filtration

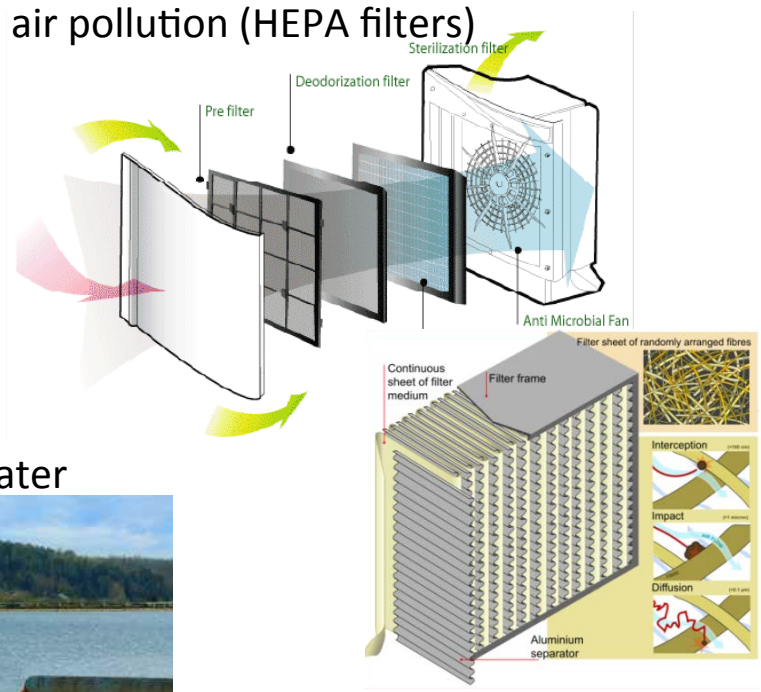
military

protective

food

wastewater

air pollution (HEPA filters)



medical

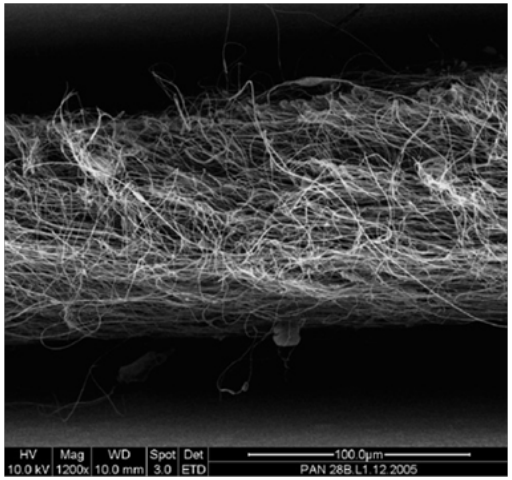
Bioapplication – Filtration

Advantages of nanofibrous filters

- low pore dimension
- low fibers volume fraction
- low filter mass
- low thickness
- high surface/volume ratio
- ...

efficiency higher than conventional filters

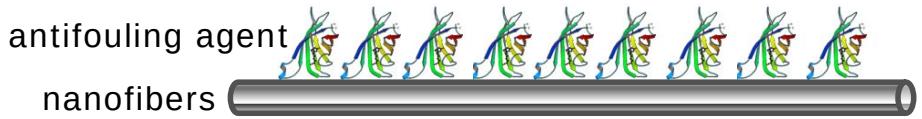
nanofibrous filter



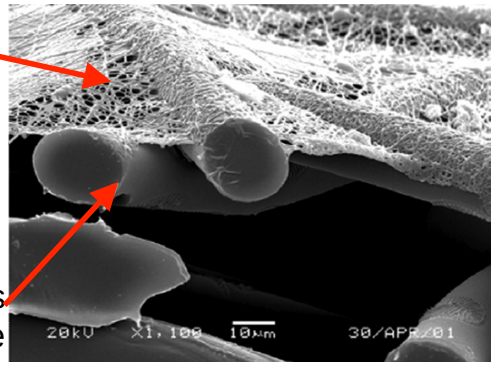
Drawbacks of nanofibrous filter

- low mechanical properties
- fouling
- ...

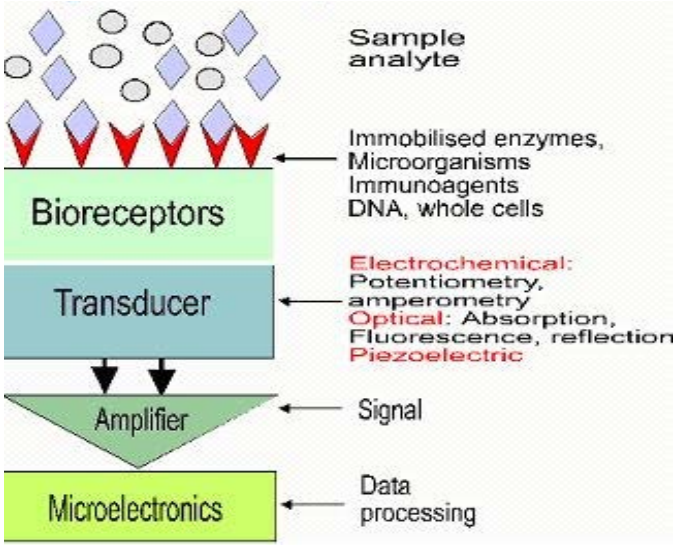
antifouling functionalization



micro-nano filter



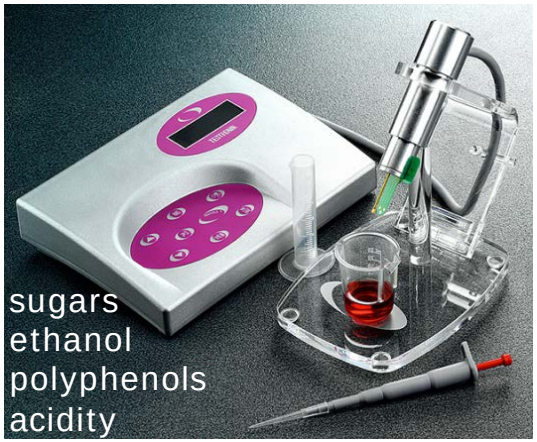
Bioapplication - Biosensor



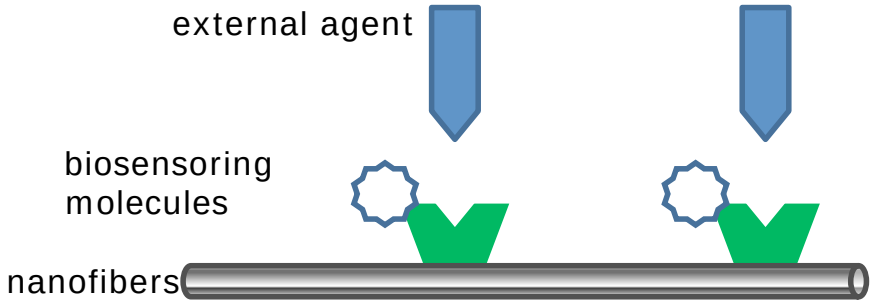
biological agent

glucose

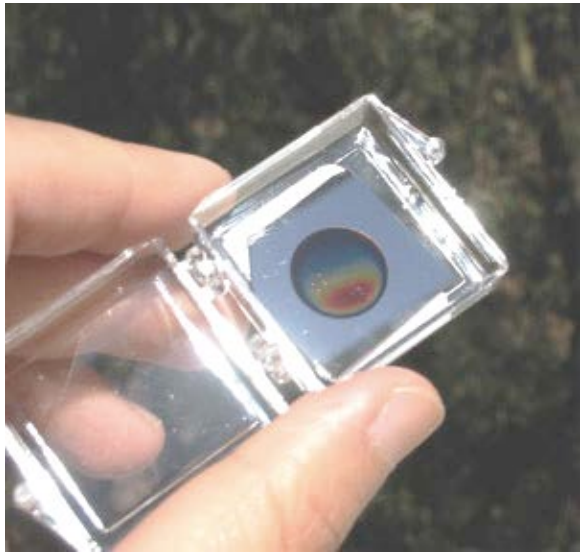
wine analyses



Bioapplication - Biosensor

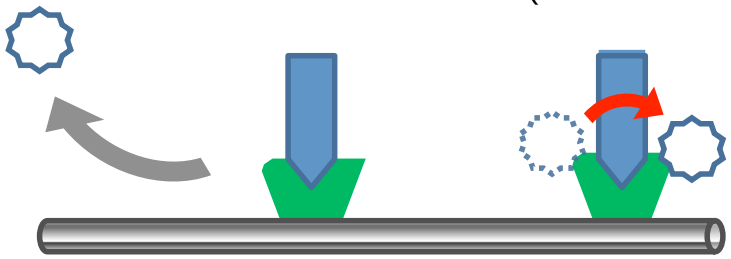


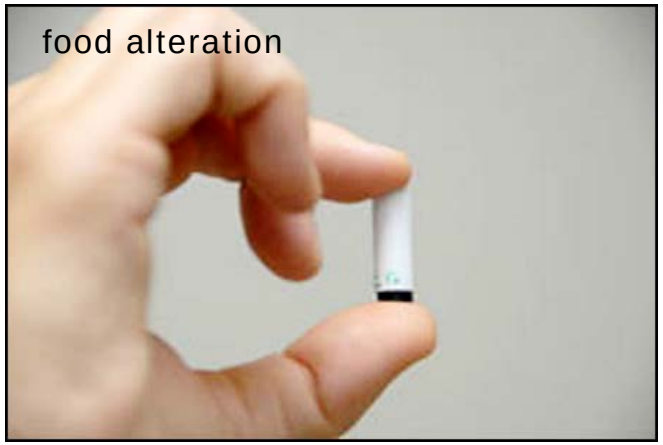
chemical agent



active agent release (colouring, ...)

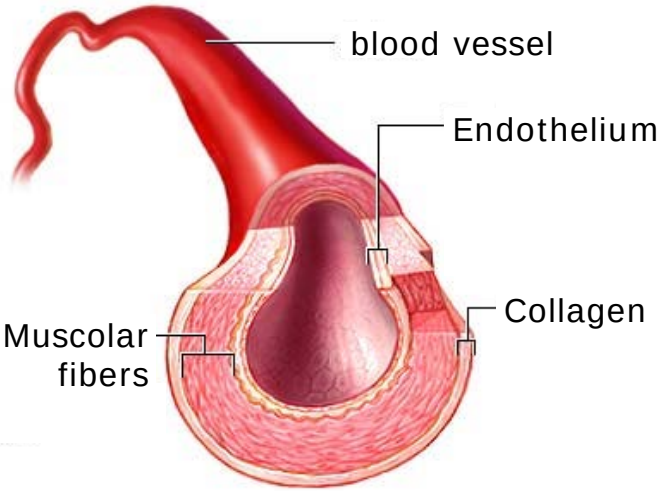
change in physical properties (reflection index, ...)



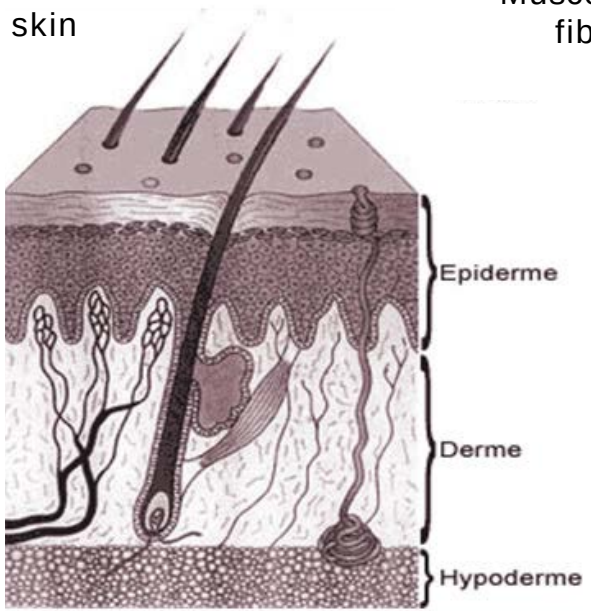


Bioapplication - Regenerative medicine

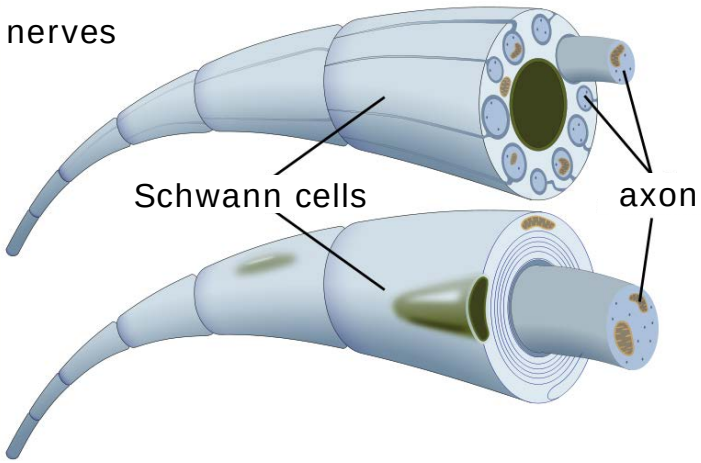
small arteries



skin



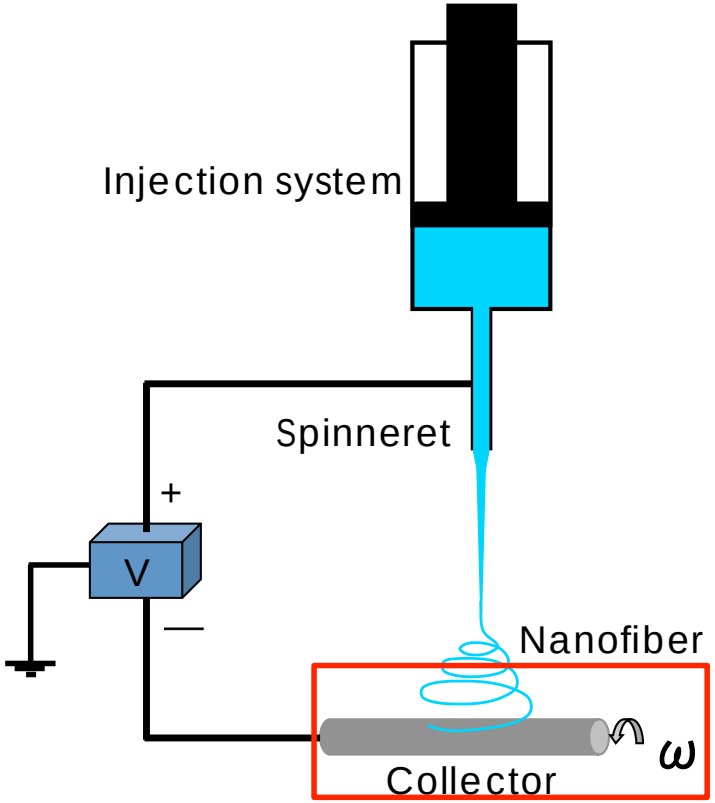
nerves

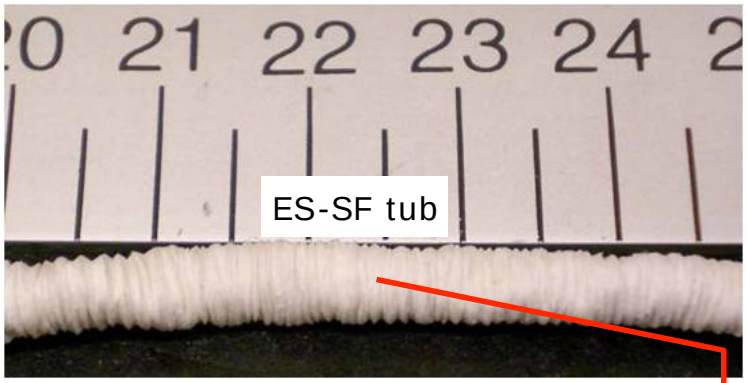


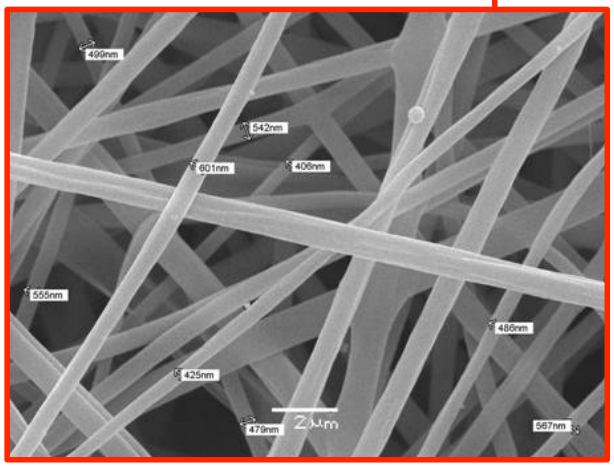
Bioapplication - Regenerative medicine

Our experience in small vessel regeneration

- material = Silk Fibroin
- vessel Ø = 6 mm
- collector = rotating mandrel

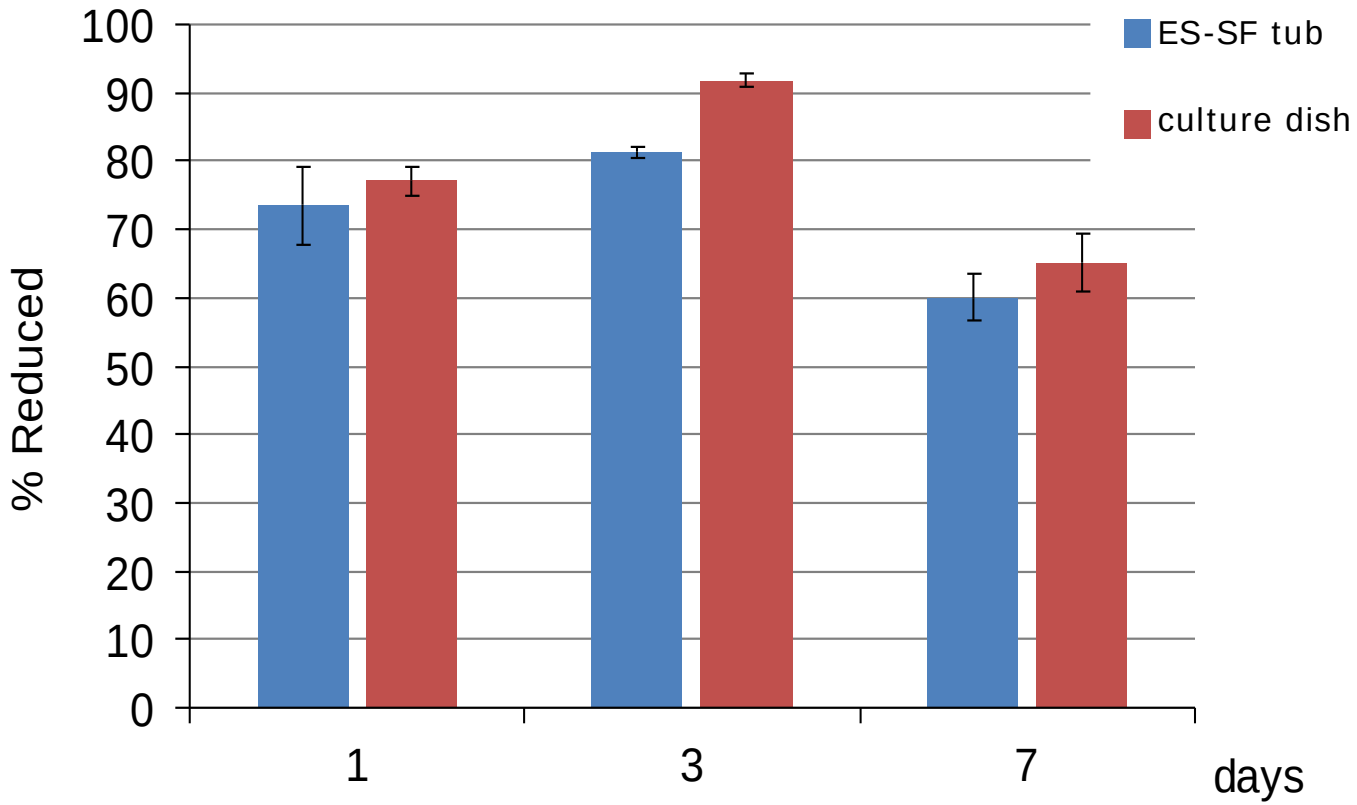






Bioapplication - small vessel regeneration

Cell interaction (fibroblast): cells vitality by Alamar Blue test

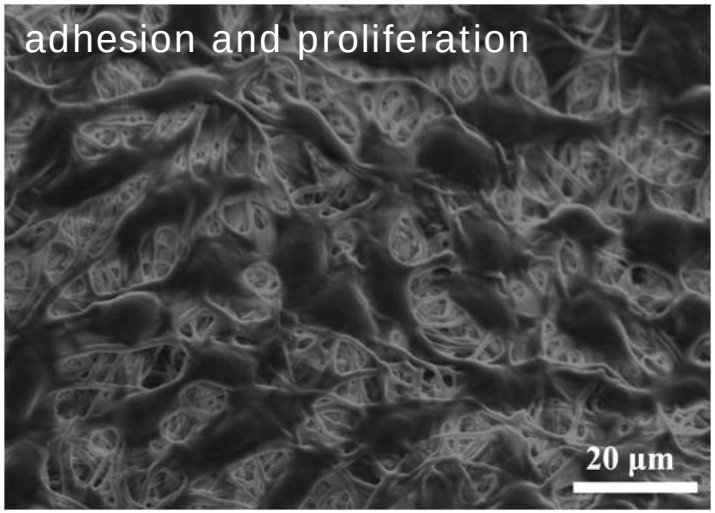


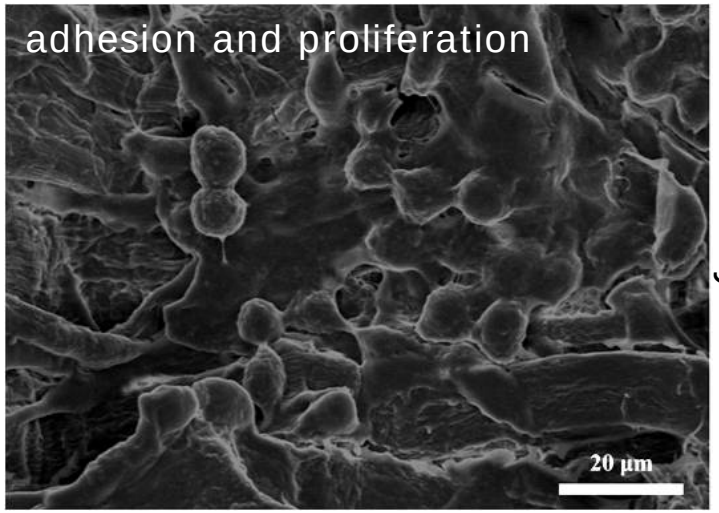
ES-SF tub similar to culture dish
decrease at 7 days due to confluence

Bioapplication - small vessel regeneration

Cell interaction (fibroblast): morphological analyses by SEM observation

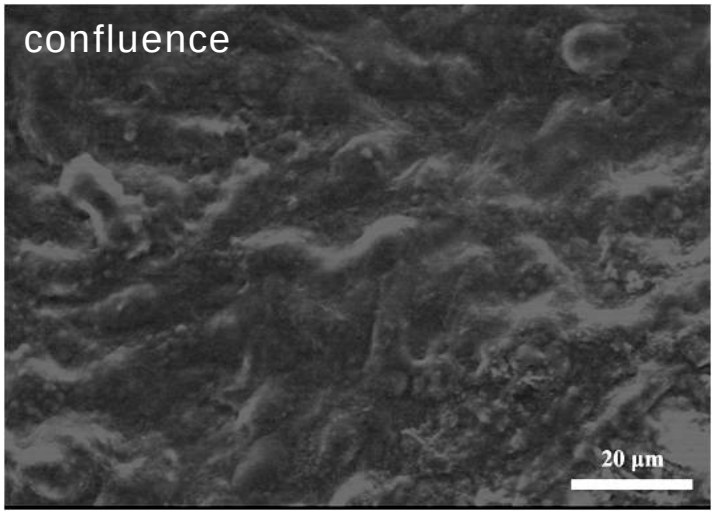
1 day

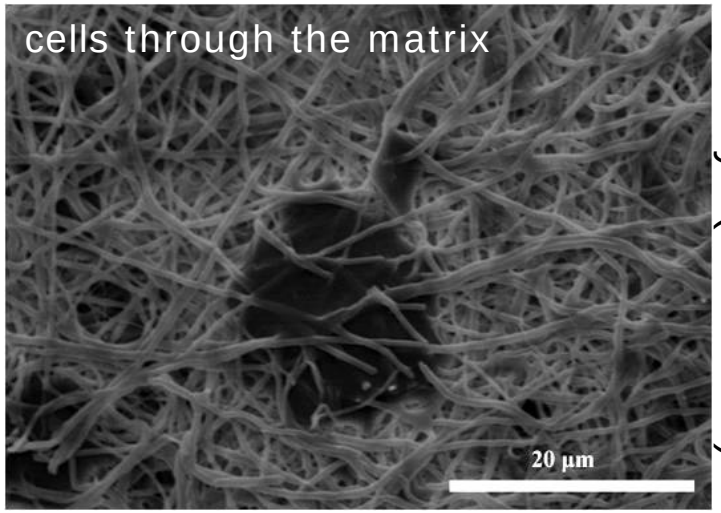




3 days

7 days



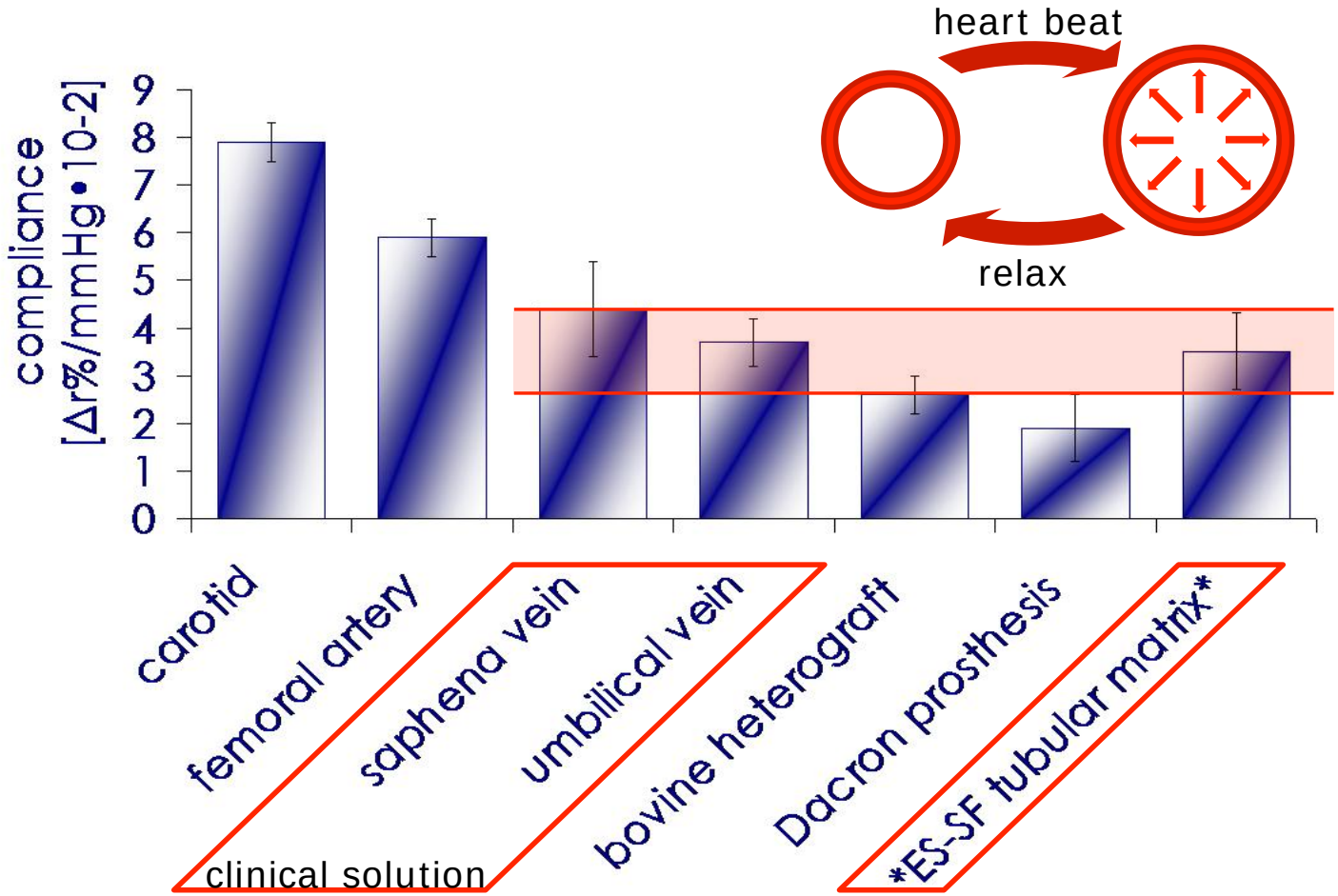


7 days (back side)

Bioapplication - small vessel regeneration

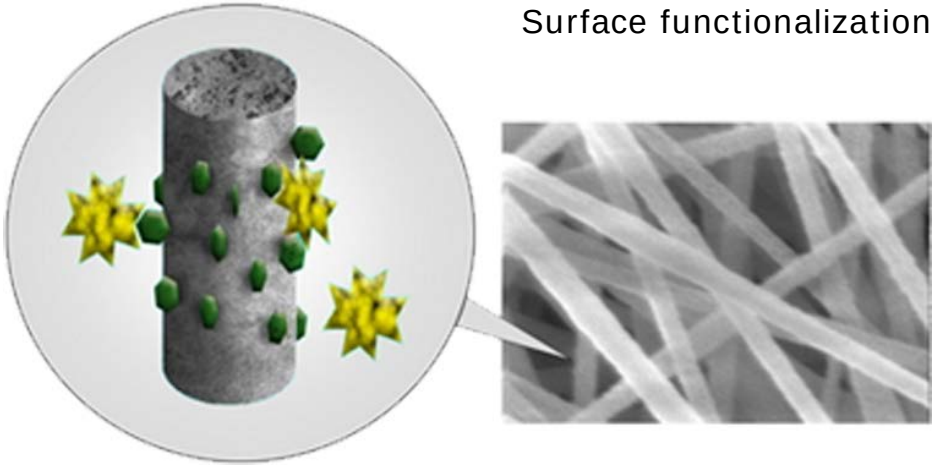
Mechanical test: compliance

Compliance is a measure of the tendency of a hollow organ to resist recoil toward its original dimensions upon removal of a distending or compressing force.



Bioapplication - Biotechnologies

Surface functionalization



encapsulation

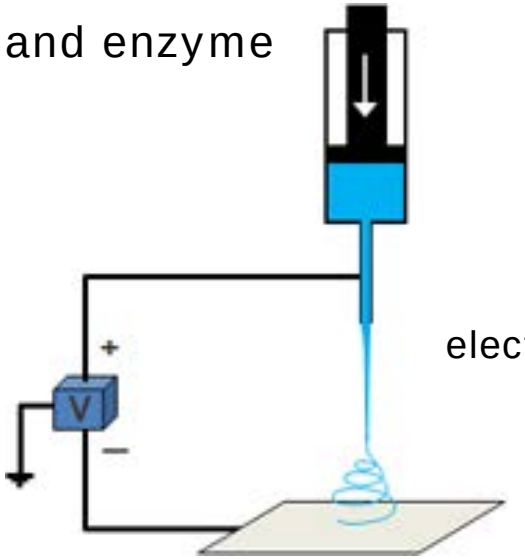
Bio-active fibers

functions	processes
• drug delivery	• dyeing
• antibacterial	• bleaching
• antimicrobial	• ...
• ...	• ...
• ...	

Bioapplication - Biotechnologies

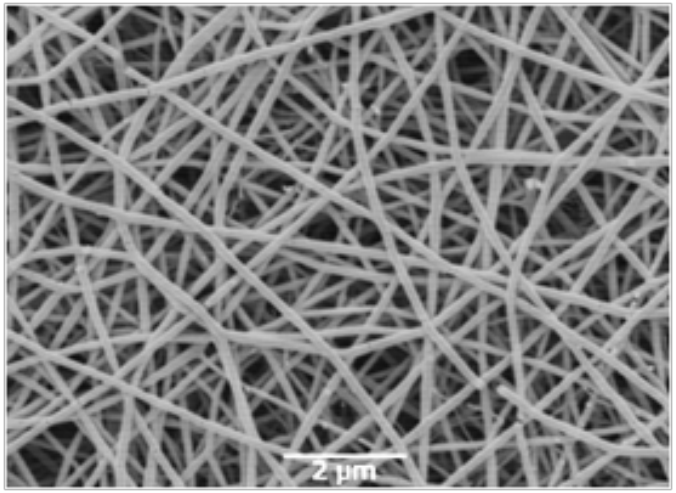
Our experience with polyamide (PA) and enzyme

polyamide chips



electrospinning

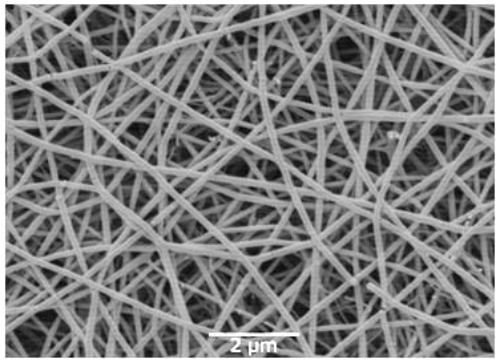
PA Solution in formic acid



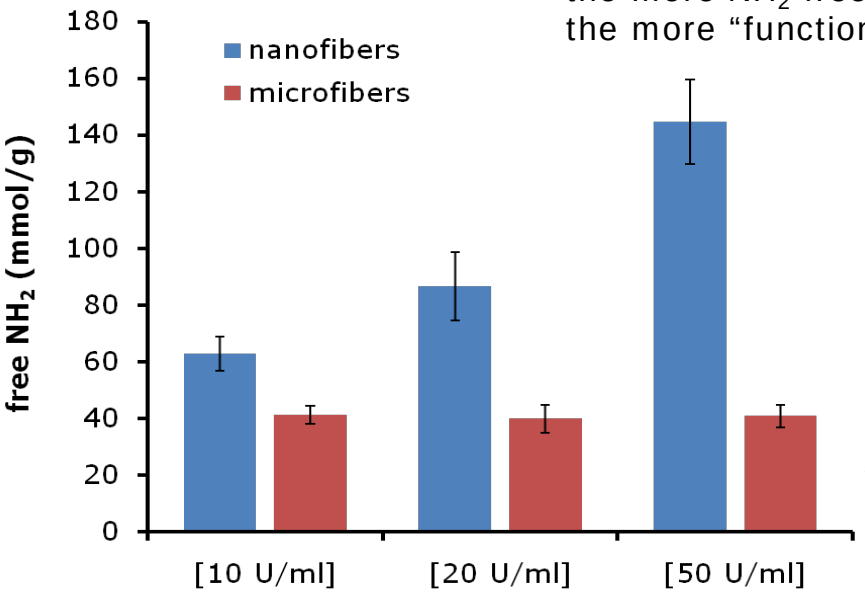
PA nanofibrous matrix (PA-mat)

Bioapplication - polyamide and enzyme

PA-mat

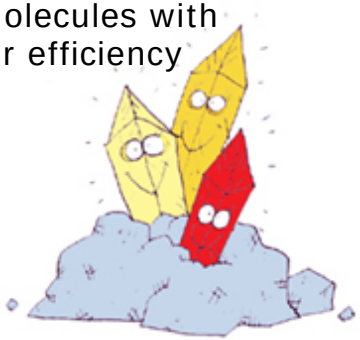


the more NH_2 free in PA
the more "functionalizable" PA is



new opportunity in bioactive textile

old molecules with higher efficiency



new molecules

Enzymatic treatment of PA-mat

- dipping in enzymatic aqueous solution
- enzyme = Protex Multiplus L (Genencor)
- T = 60°C
- [enzyme] = 10, 20, 50 U/ml

Bioapplication - Conclusions

Nanofibers useful in many technical fields

- high performance in filtration
- “flexibility” in biosensoring
- biomimicking in tissue regeneration
- high yield in biotechnological treatments
- new opportunity in functionalization

Bioapplication - Conclusions

Nanofibers useful in many technical fields

- high performance in filtration
- “flexibility” in biosensoring
- biomimicking in tissue regeneration
- high yield in biotechnological treatments
- new opportunity in functionalization

That's one small diameter for a fiber,

one giant leap for textile!

BIOAPPLICATION FOR ELECTROSPUN POLYMERS

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