Electrospinning at UGent

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Nanofibres

Diameter below 500 nm

Surface properties are extreme

Pores are extreme

Applications: filters, cosmetics, protection, nanosensors, elektronica, artificial organs, prostheses, biomedical applications such as wound dressings

Production of nanofibres

Process	Status	Versatility	Limitations	Controllability
Stretching	Industrial	Good	Breakage, cohesion	+
Screen synthesis	Lab	Good	Fibre length (µm)	+
Self assembly	Lab (basic)	-	Tedious, fibre length	?
Phase separation	Lab	Average	Time consuming (many steps)	+
Electrospinning	Lab/industrial	Good	Solvent spinning	+

Electrospinning: mechanisms

Forces on droplet in electrical field:

- *Electrostatic force*
- Coulomb force
- Surface tension
- Hydrostatic force
- Gravity

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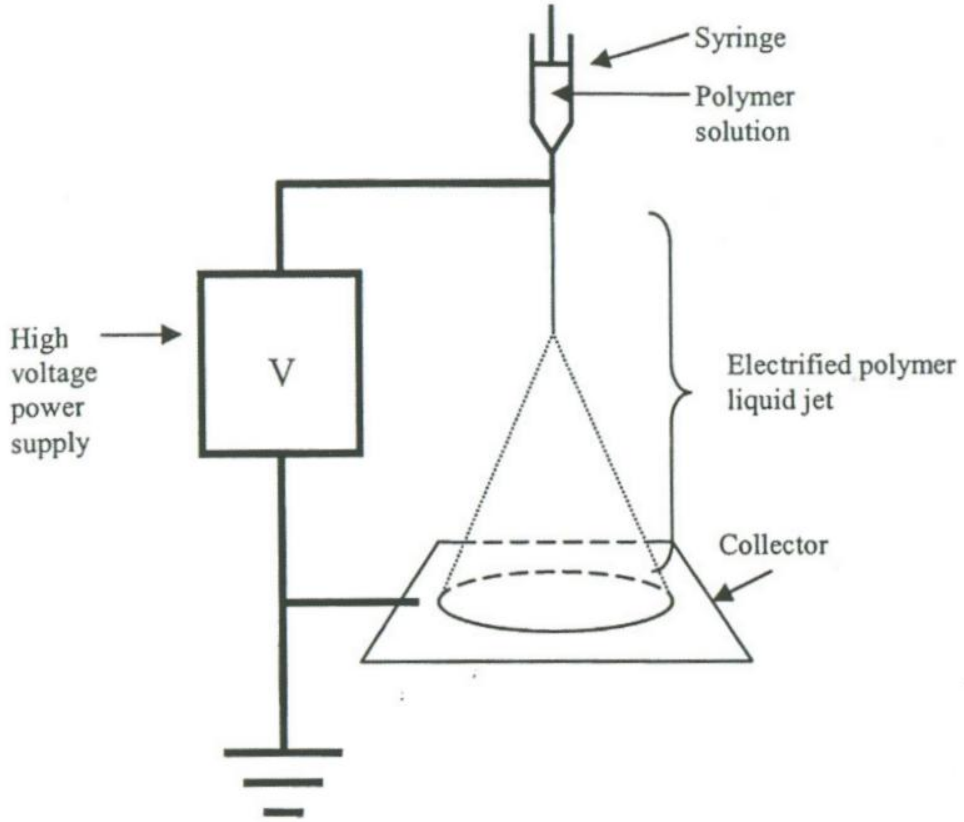
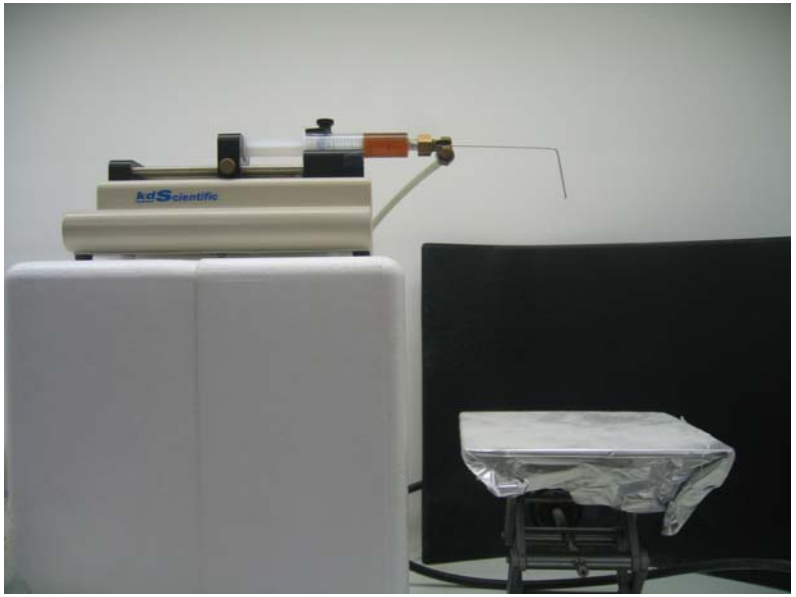
Set up of electrospinning





Parameters

solution:
viscosity
Polymer concentration
molecular weight
electrical conductivity
dielectric constant
Surface tension

process:
Voltage
Distance between needle and collector
Flow rate
Dimensions of needle

environment:
temperature
humidity
Atmospheric pressure
Air velocity

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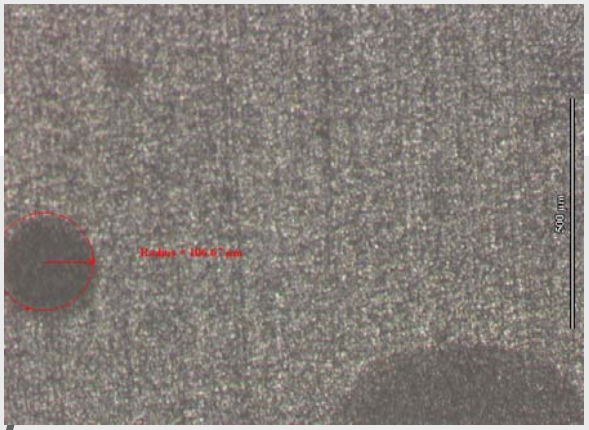
Problems



Viscosity too high

Charge density not right

Polymer concentration too low

Evaporation too slow

Formation of solvent layer

Voltage too low

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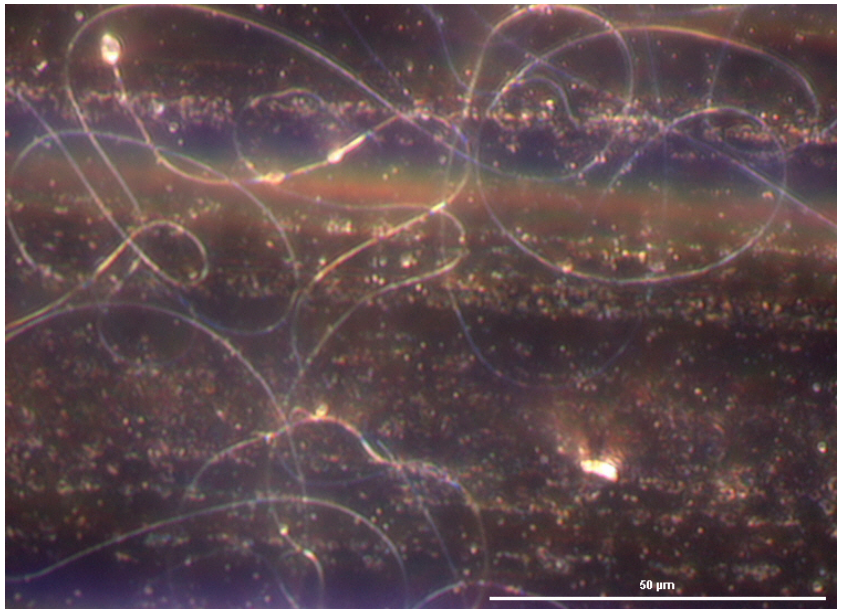
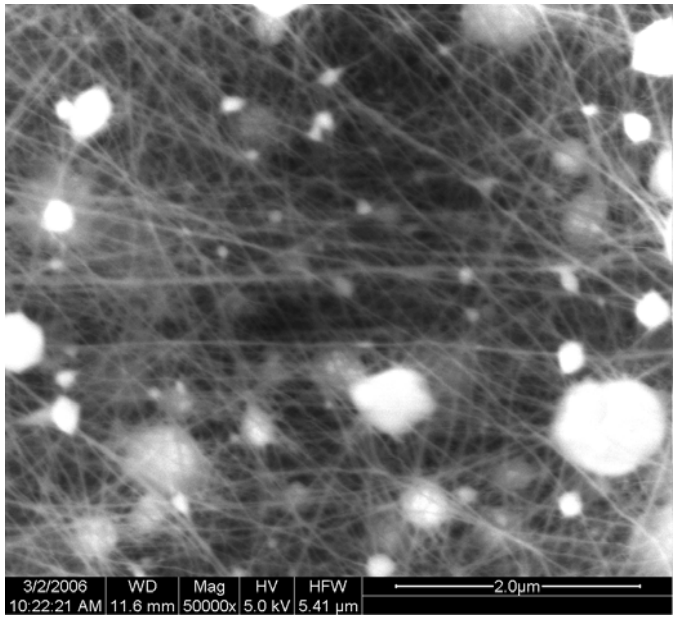
Instabilities



Worms and buds



Nanodrops

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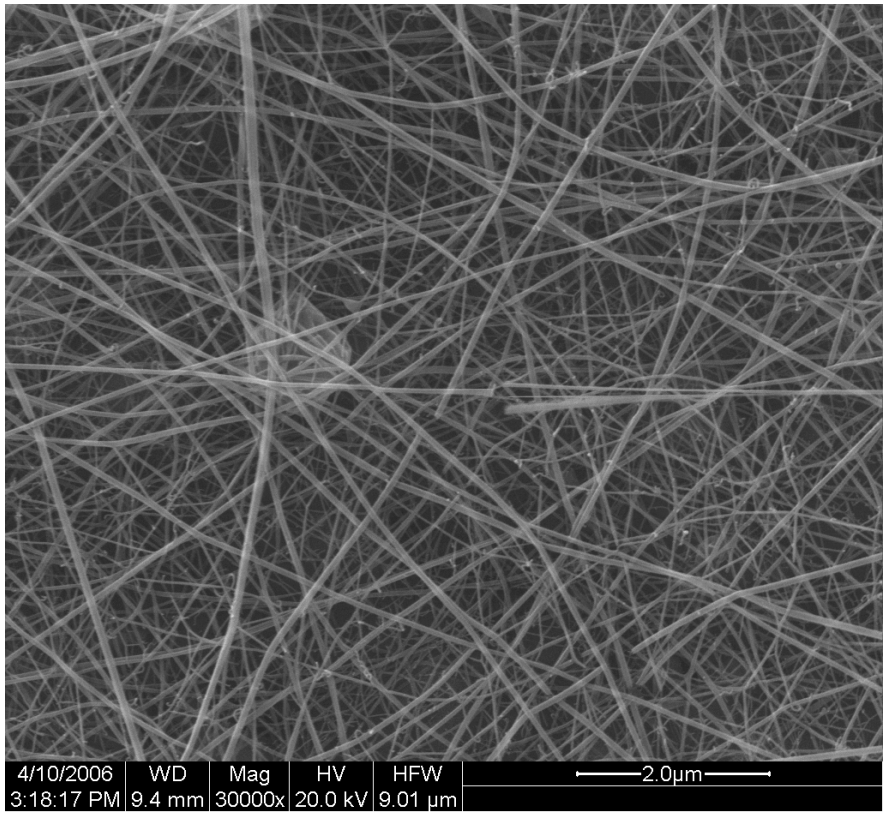
Stable production



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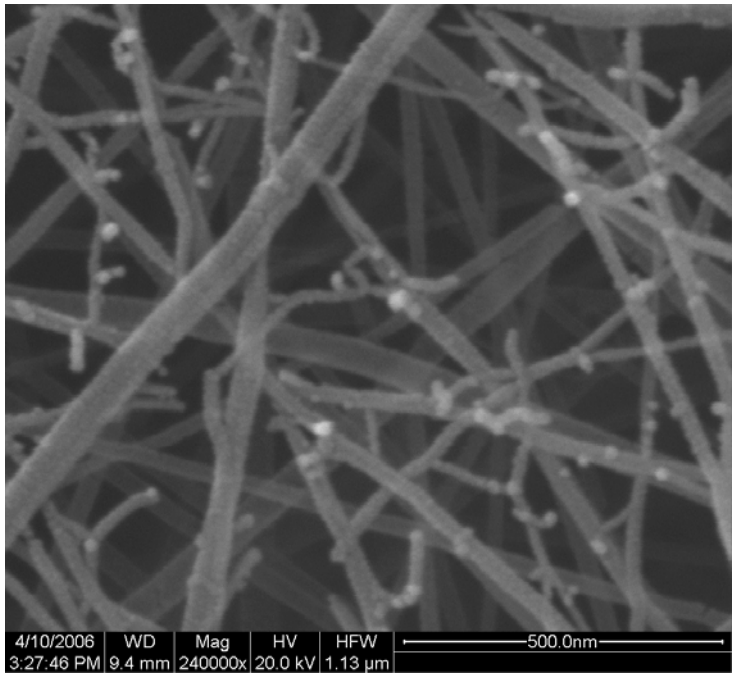
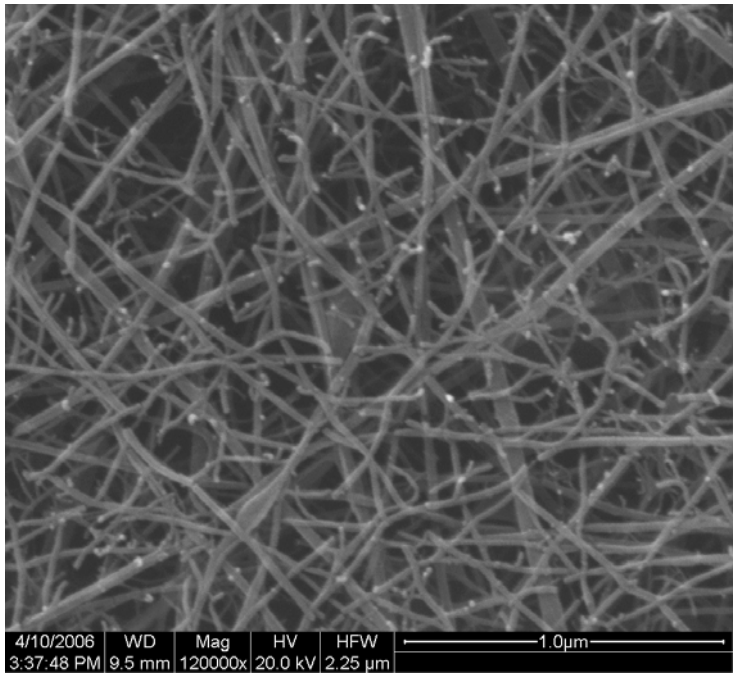
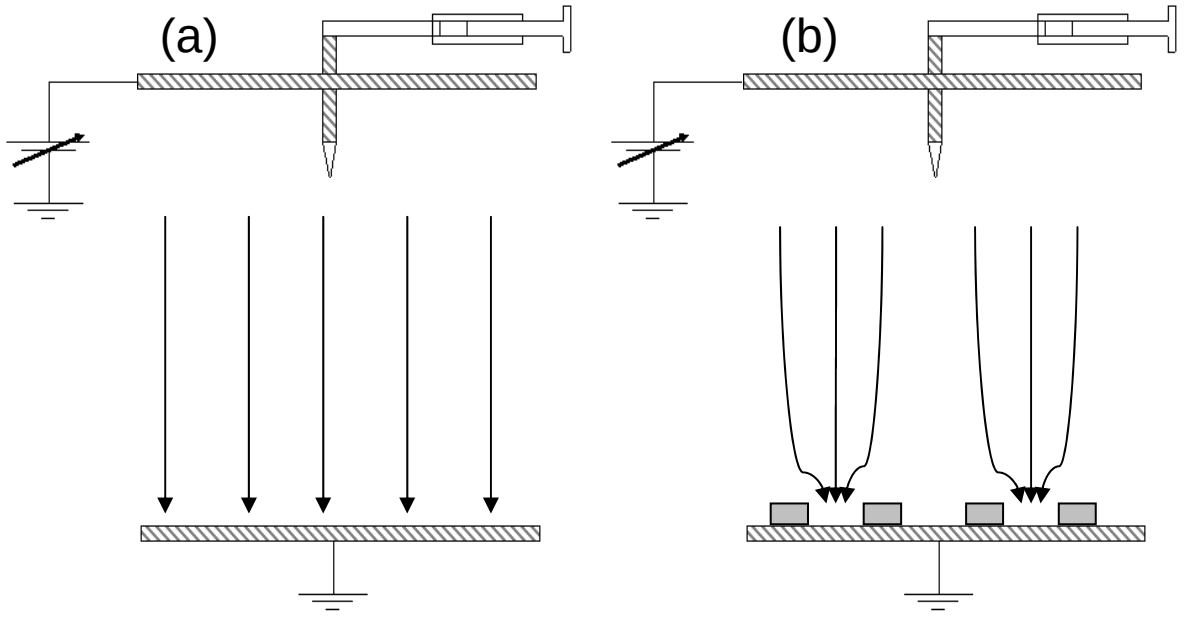
Secundary jets: branches





Branches: mechanism



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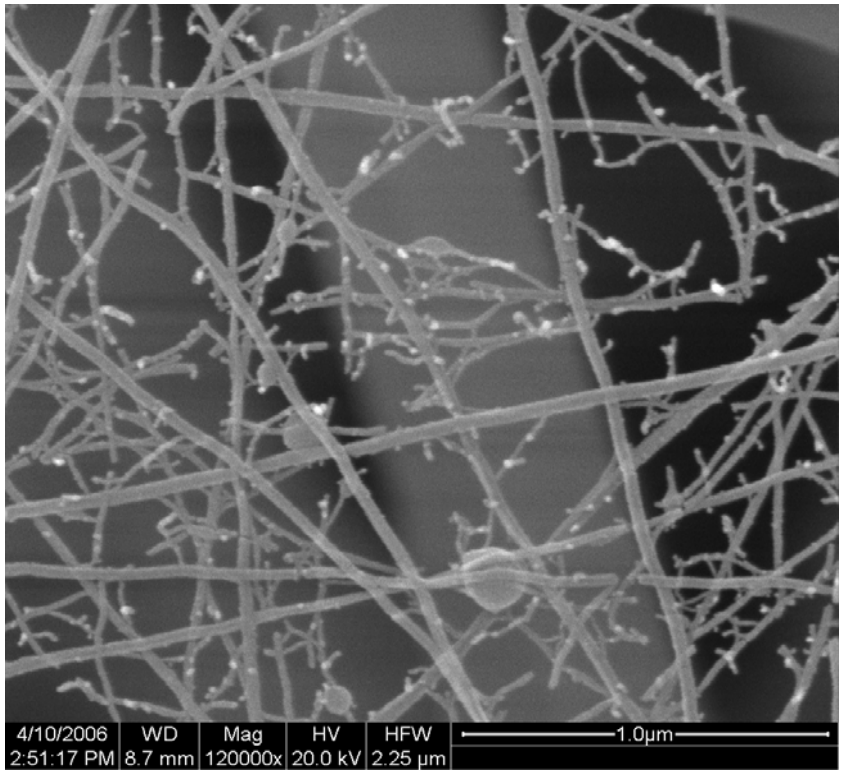
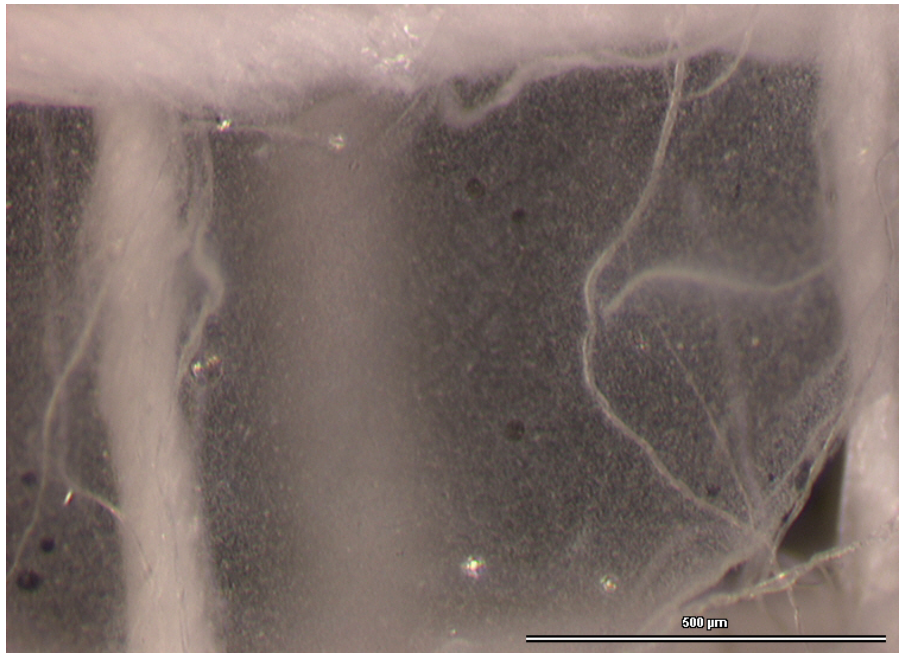
Deposition on fabrics: higher voltage





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Conclusions

Electrospinning for nanoweb feasible

Many polymers can be spun by electrospinning

Conditions of production critical

Nanofibres can be deposited on fabric

Process conditions need to be adapted