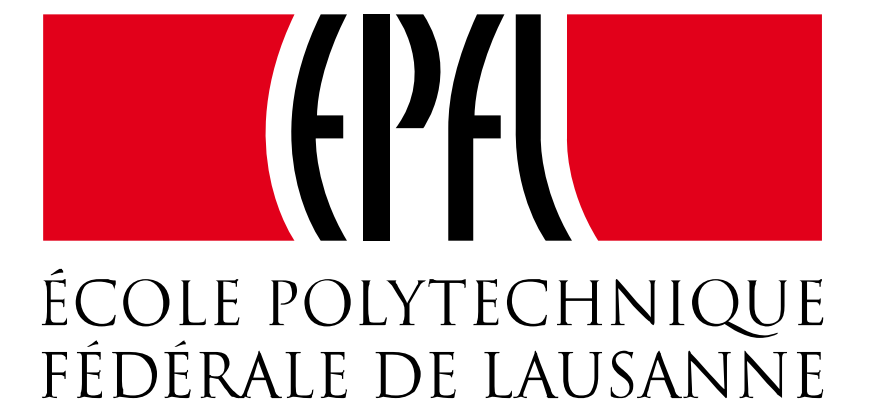


Electrospun Matrices For Paper-like Fluidics

D. Forchelet, P. Renaud

EPFL – LMIS4



Introduction

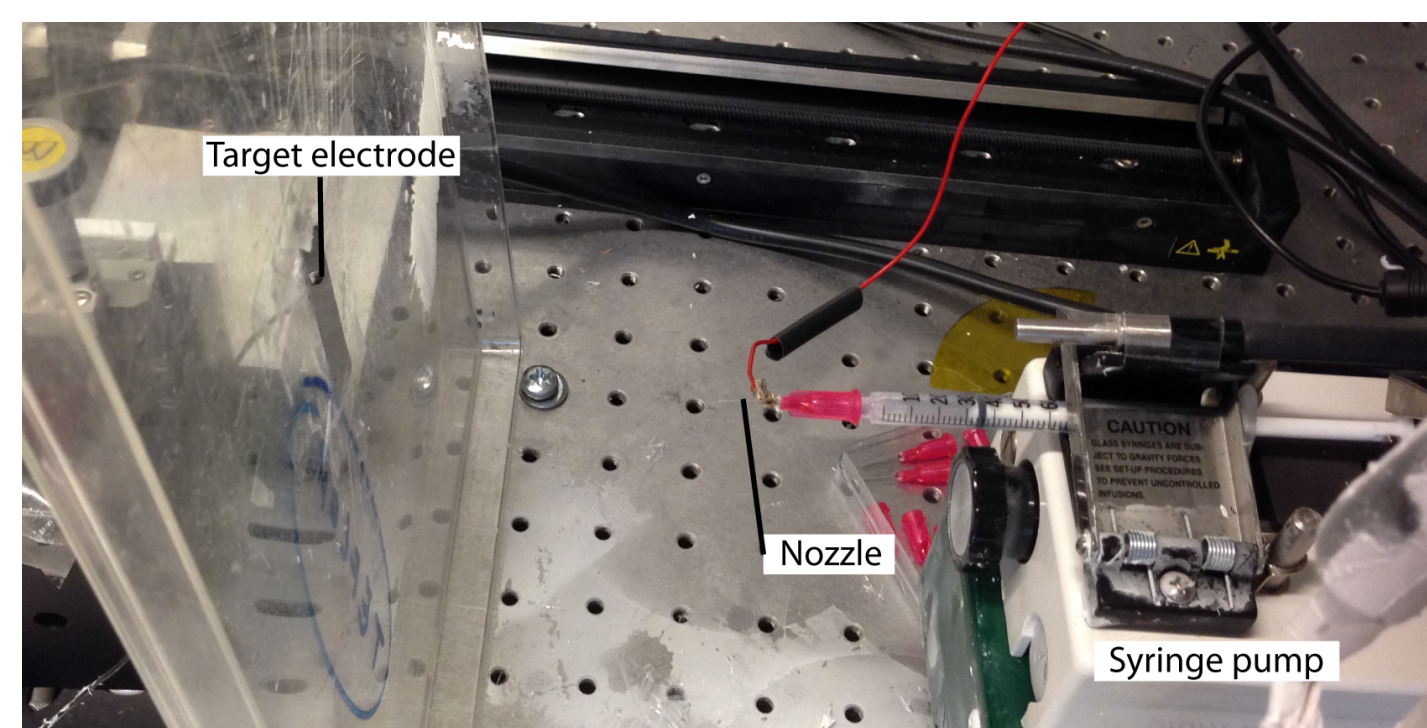
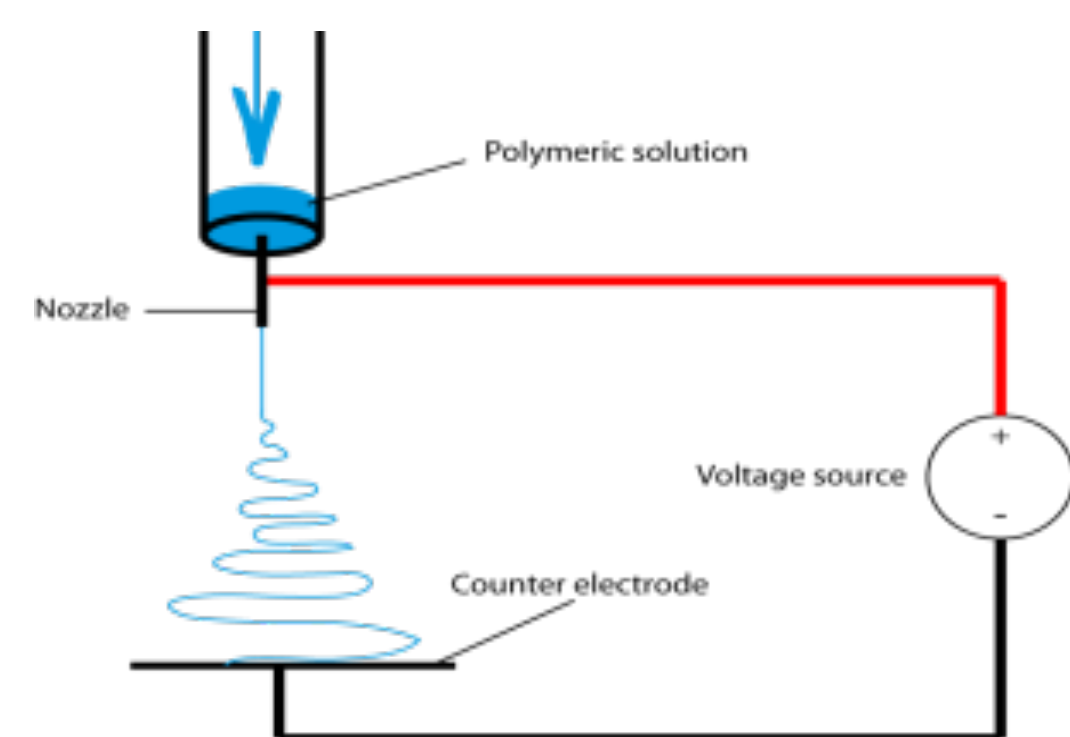
Paper has long been used as a substrate for liquid handling. Its hydrophilicity allows transport through capillary forces and the raw materials for its fabrication are very common and cheap. If paper offers a favorable substrate, its properties are set during manufacturing and not tailored to the proposed application.



Electrospinning

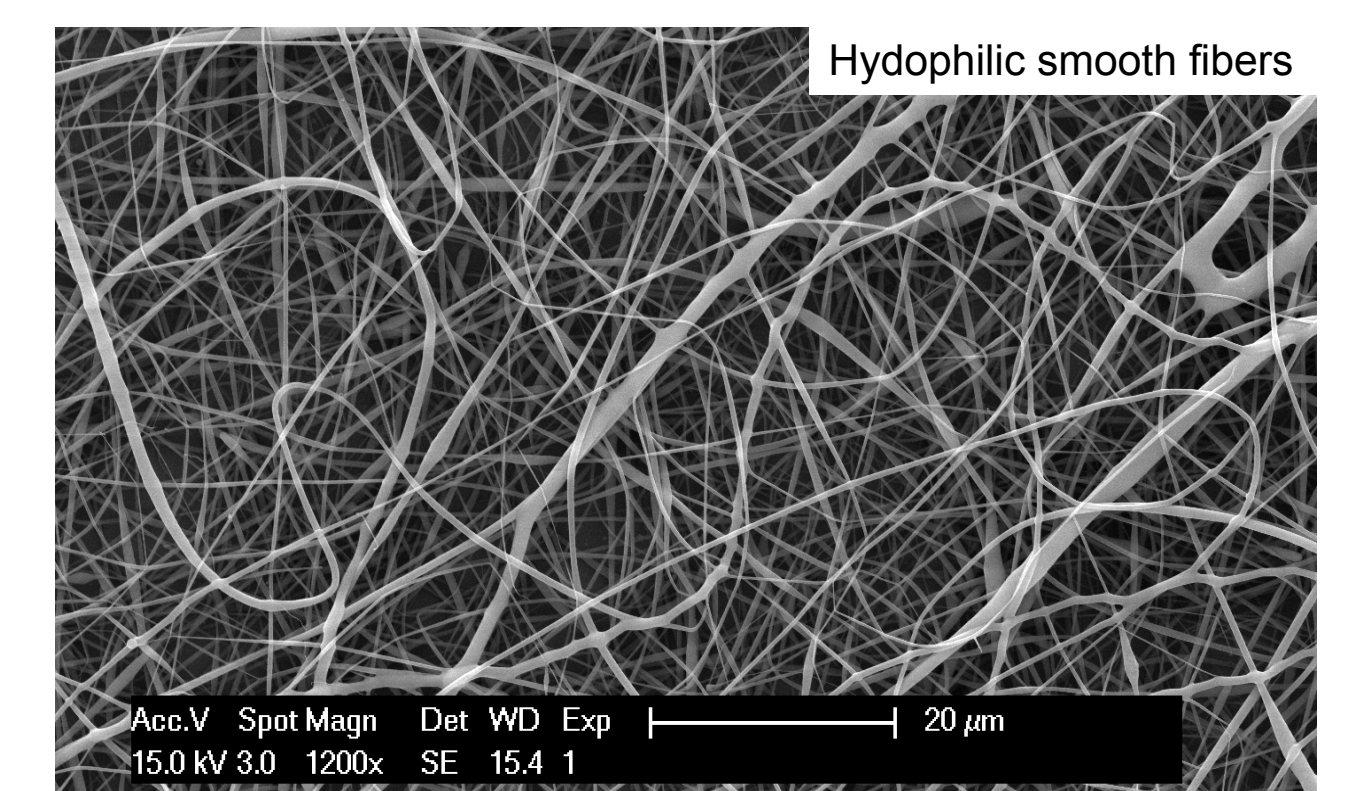
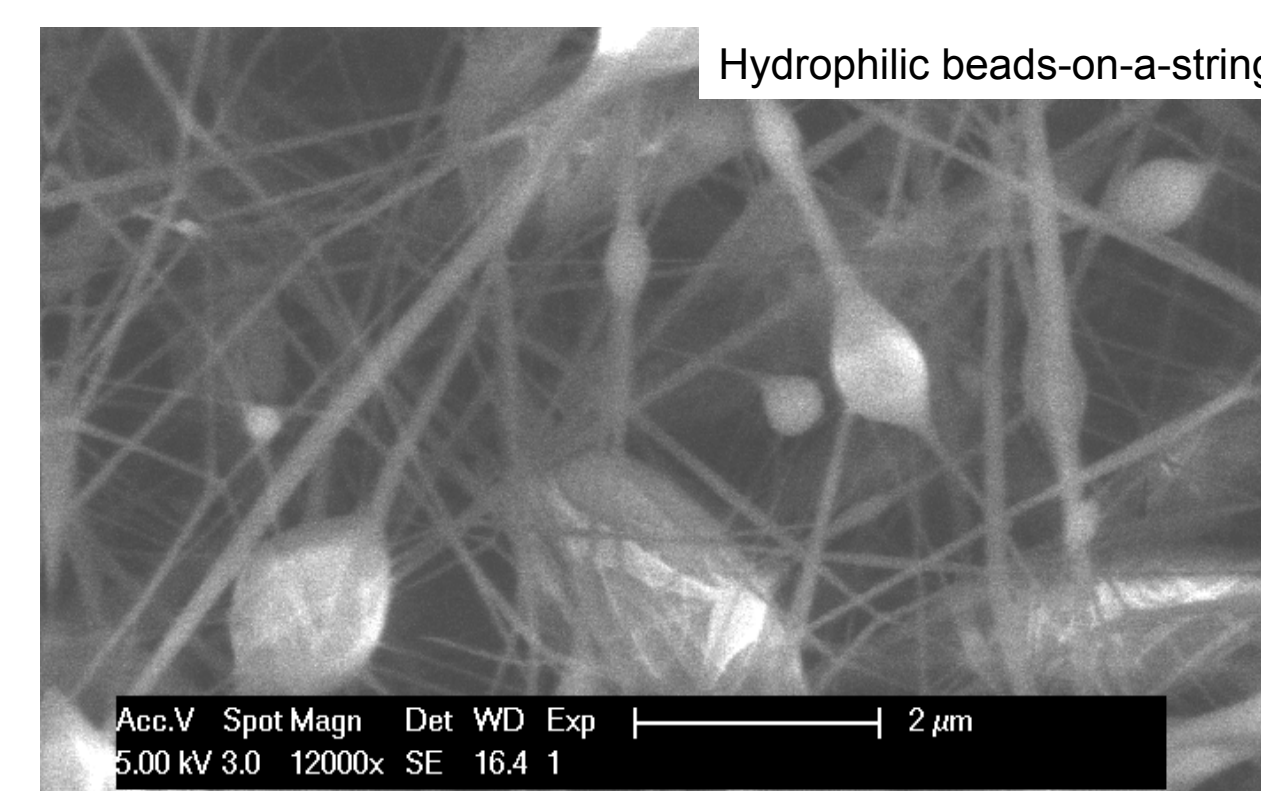
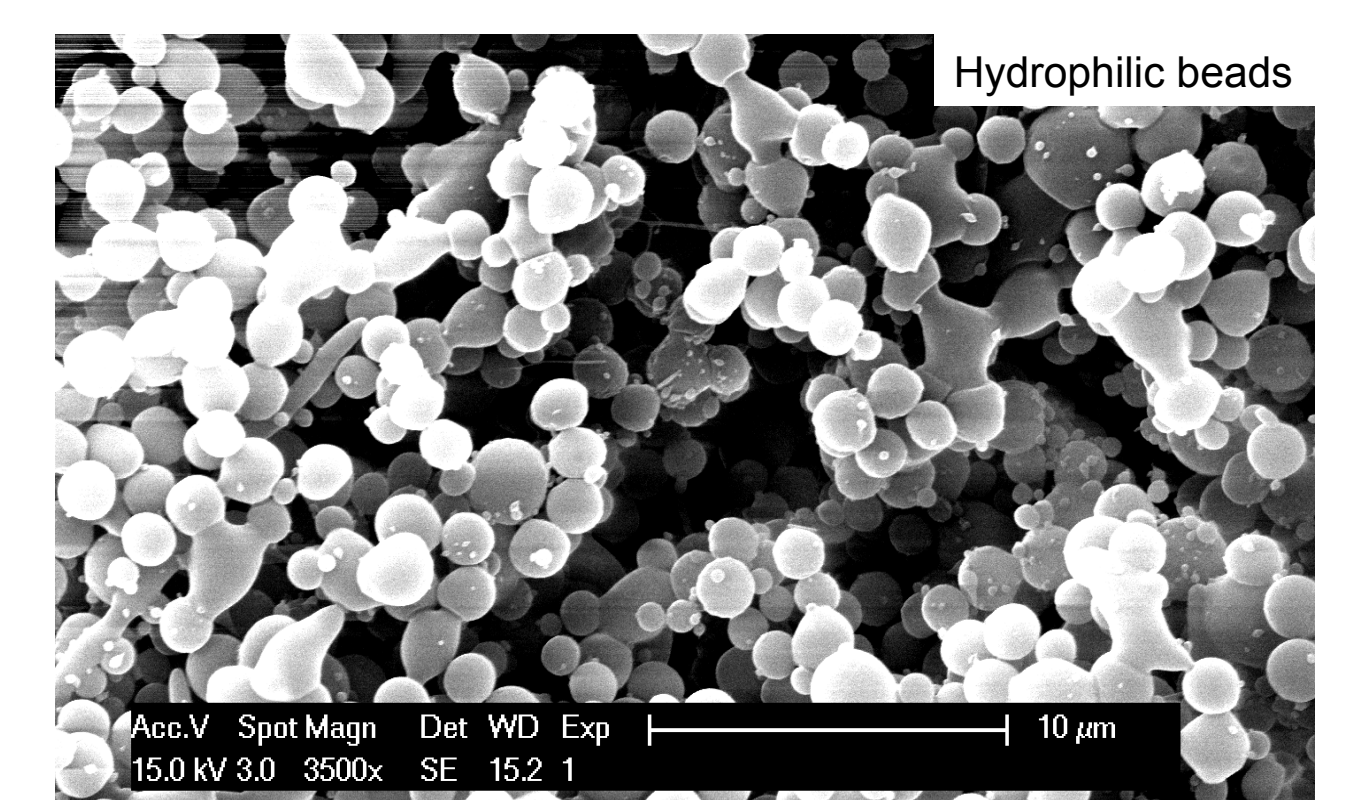
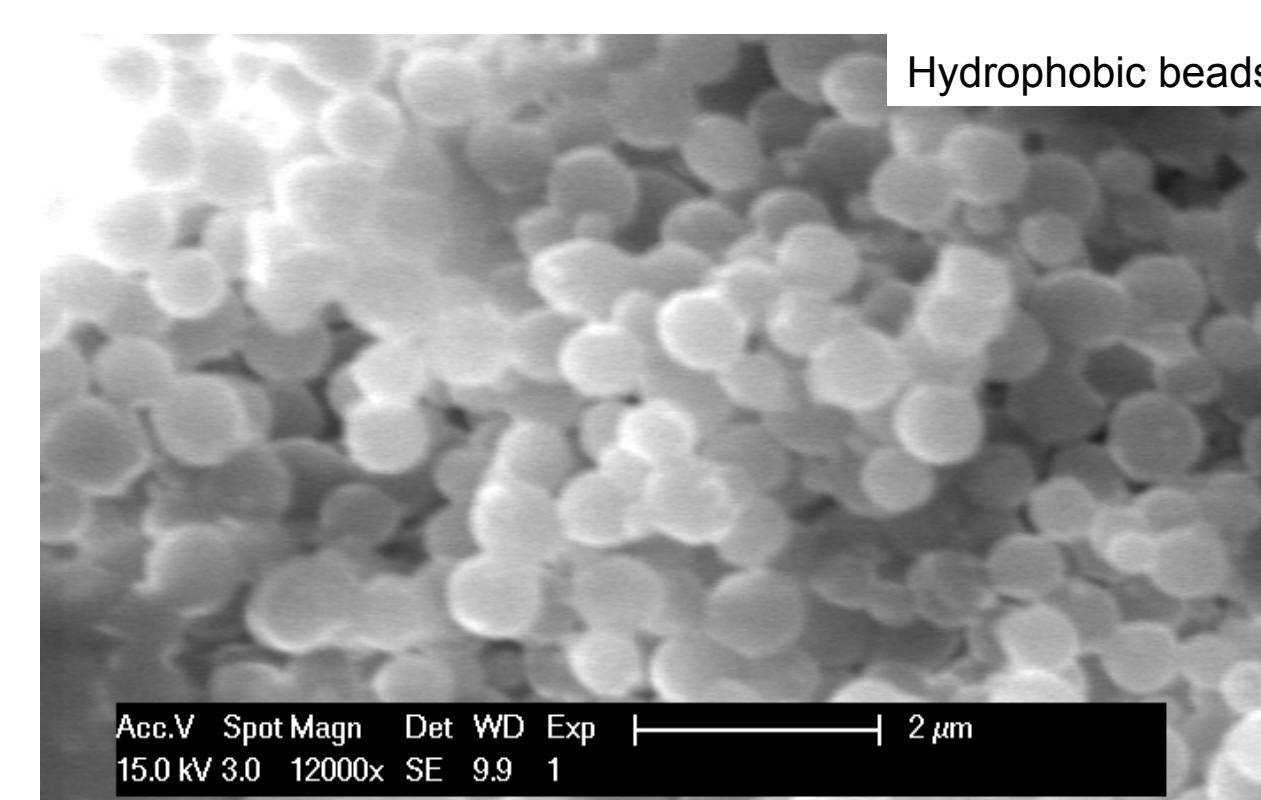
Electrospinning is a method for deposition of porous mats through the application of electric field to a polymeric solution. A high voltage is applied to a drop at the end point of a nozzle, creating a protrusion and eventually a jet of polymer towards the target electrode.

During flight, the jet is subject to the Rayleigh and electrostatic instabilities and might breakup into beads: the process becomes electrospraying. A very common result of the electrostatic instabilities is a fiber morphology called “beads on a string” or “pearls on a string”.

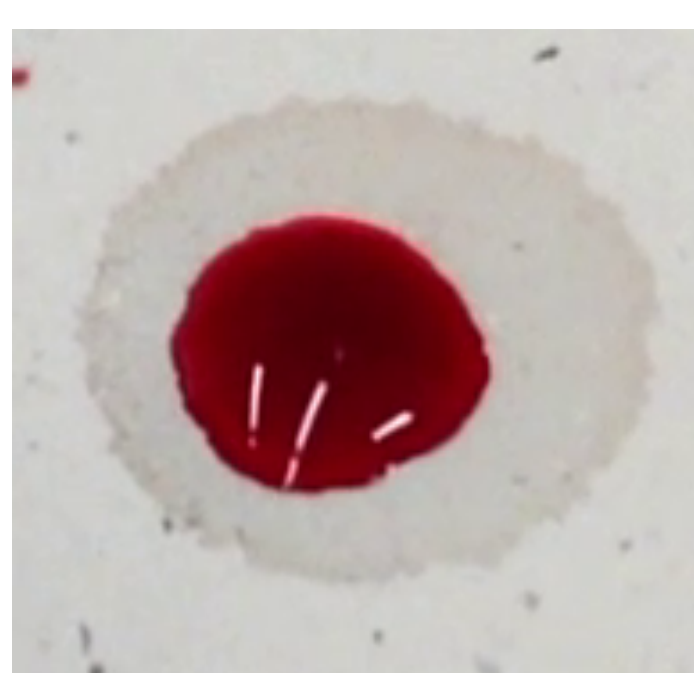
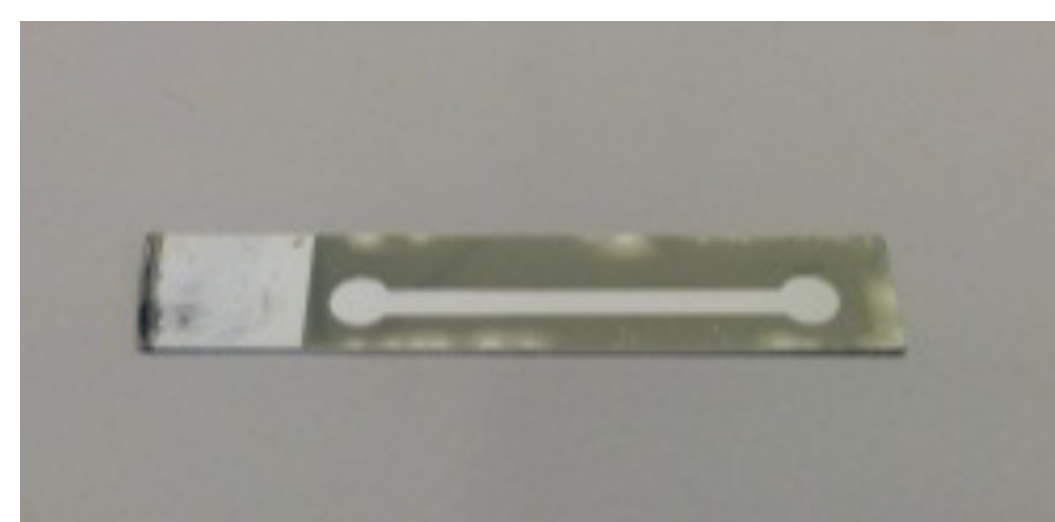


Resulting media

Adjusting the electrospinning parameters (electrical or chemical), different morphologies have been achieved such as bead mats or fiber mats. Hydrophobic and hydrophilic absorbent structures have been created.

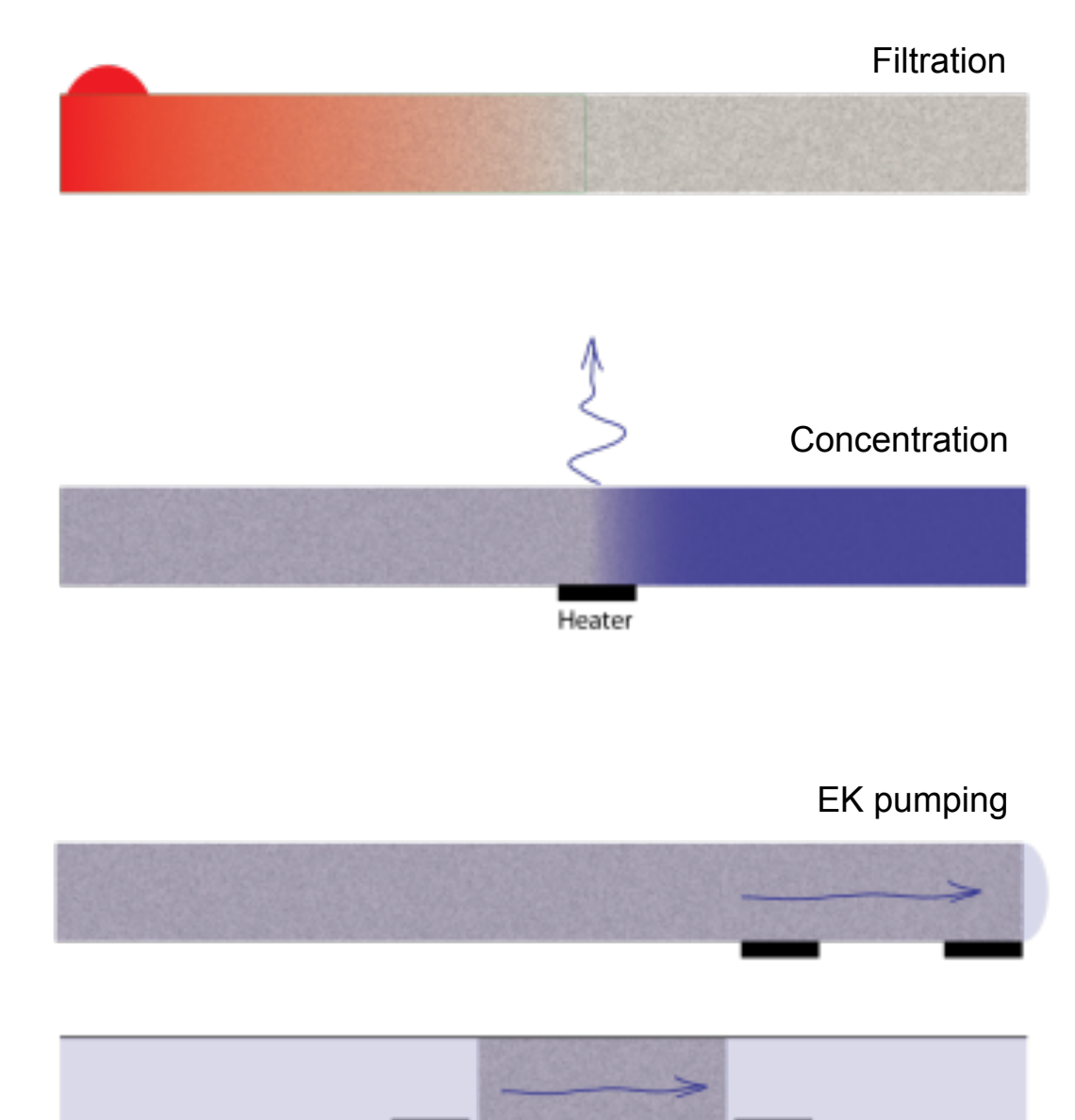


Applications and results



Common paper chips are limited in both morphology and chemistry. Electrospinning allows for controlling such parameters and deposit porous layers on conductors, thin polymer backing layers or glass. Different shapes on insulators can be pattern through electrofocusing. Three functions, previously impossible, are proposed to be implemented on such custom made matrices: blood filtration, concentration and pumping.

Porosity tuning allows for adjusting filtration parameters for cells or particles suspensions. Adding heaters or electrodes to a backing layer and customizing locally the porous media, electrokinetic pumping or preconcentration are possible.



Conclusion

To overcome the limitation of standard paper devices, custom electrospun mats are fabricated. Electrostatic patterning of such devices can be performed to allow for creating filled channels or porous patches. The creation of controlled porous media allows for creating new fluidic applications or optimization of current devices: control of flow and filtration are amongst the possible functions. We propose to use such a method for fabrication of blood filters, preconcentration devices and electrokinetic pumps in an electrospun paper-like microfluidic device.