MP0701 COST Workshop, *Electrospun Nanofibres Composite Materials*
Antalya, Turkey, February 21-22, 2012

- Invited oral communication -

Electrospun nanofibrous mats outstanding materials for biotechnology applications

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Electrospun nanofibrous mats

The great advantages

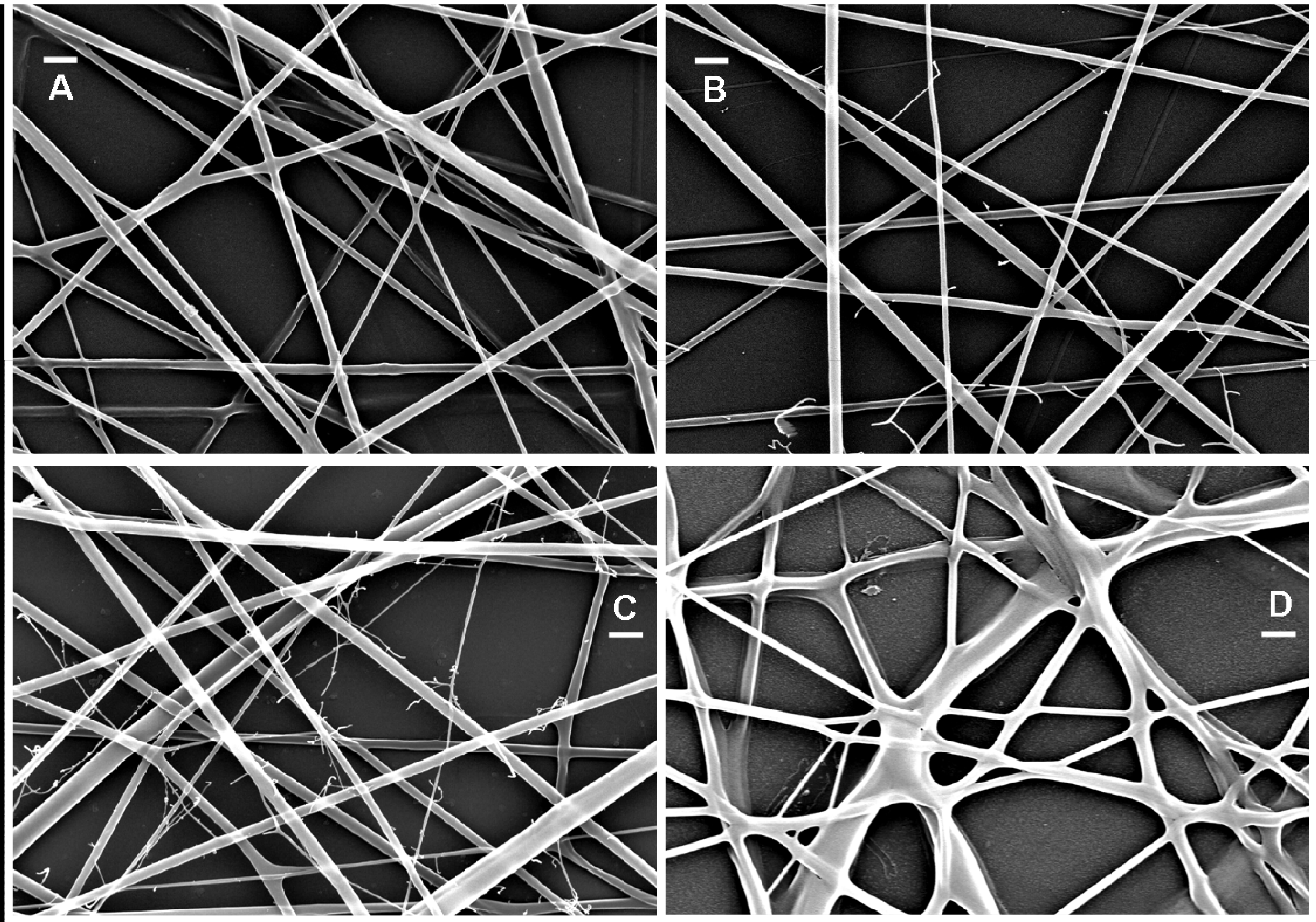
- Nano- and micro-sized fibers
- From random to aligned fiber arrays
- High porosity and interconnected pores
- Prone to manipulation
- Bulk and surface composition versatility

‘Our’ materials

- Focus on cheap and/or renewable materials, such as polyethylene terephthalate (PET), microbial polyesters (PHBV), polyvinyl alcohol (PVA), chitosan, pectins, cellulose …

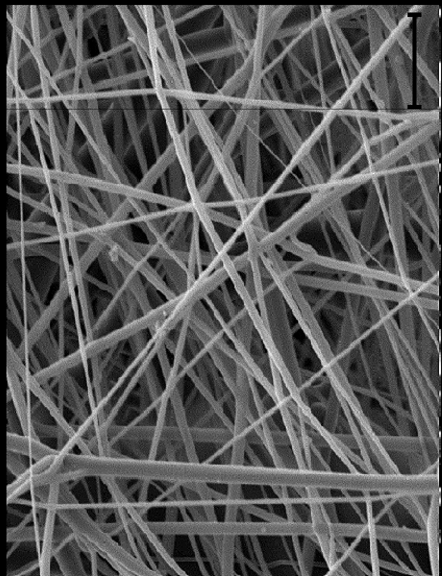
Electrospun poly (3-hydroxybutyrate-co-hydroxyvalerate) / chitosan blend fibers

Veleirinho, B., Ribeiro-do-Valle, R.M., Lopes da Silva, J.A. (2011)
Materials Letters, 65, pp. 2216–2219.

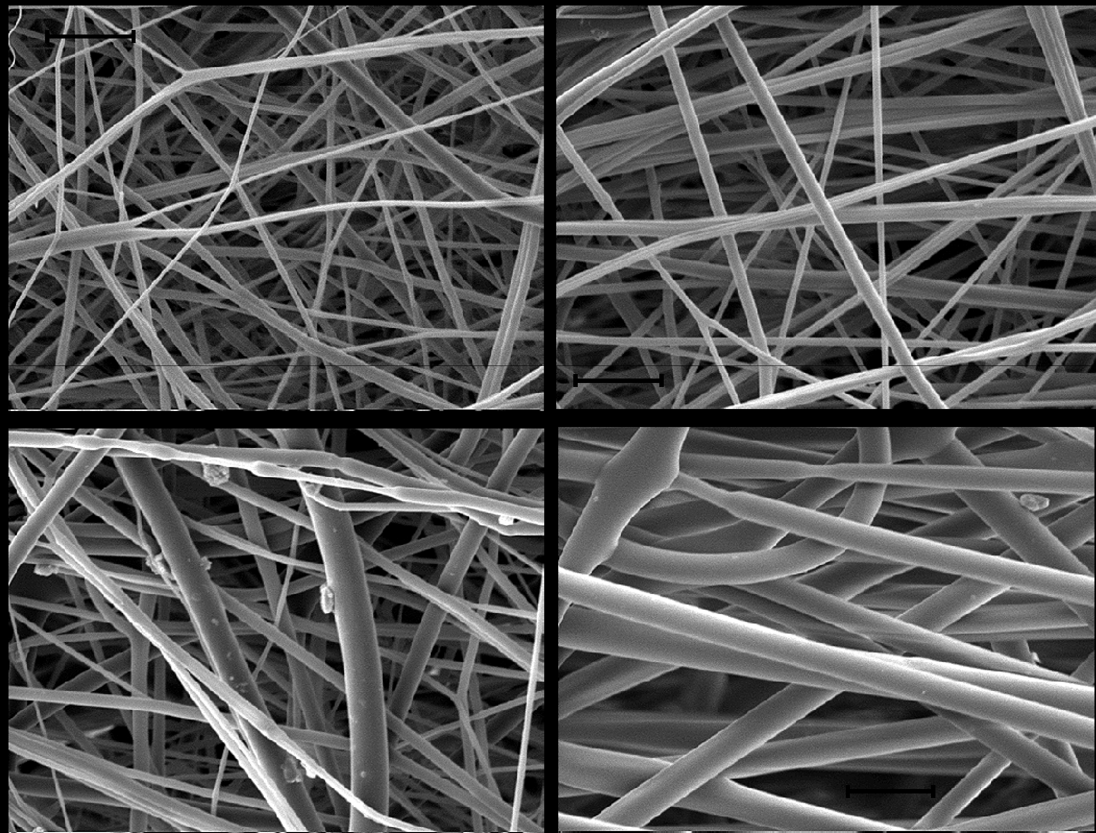


Electrospun PET and PET/chitosan blend fibers

Lopes da Silva, J.A., Veleirinho, B., Delgadillo I. (2009)
Journal of Nanoscience and Nanotechnology, 9, pp. 3798-3804.

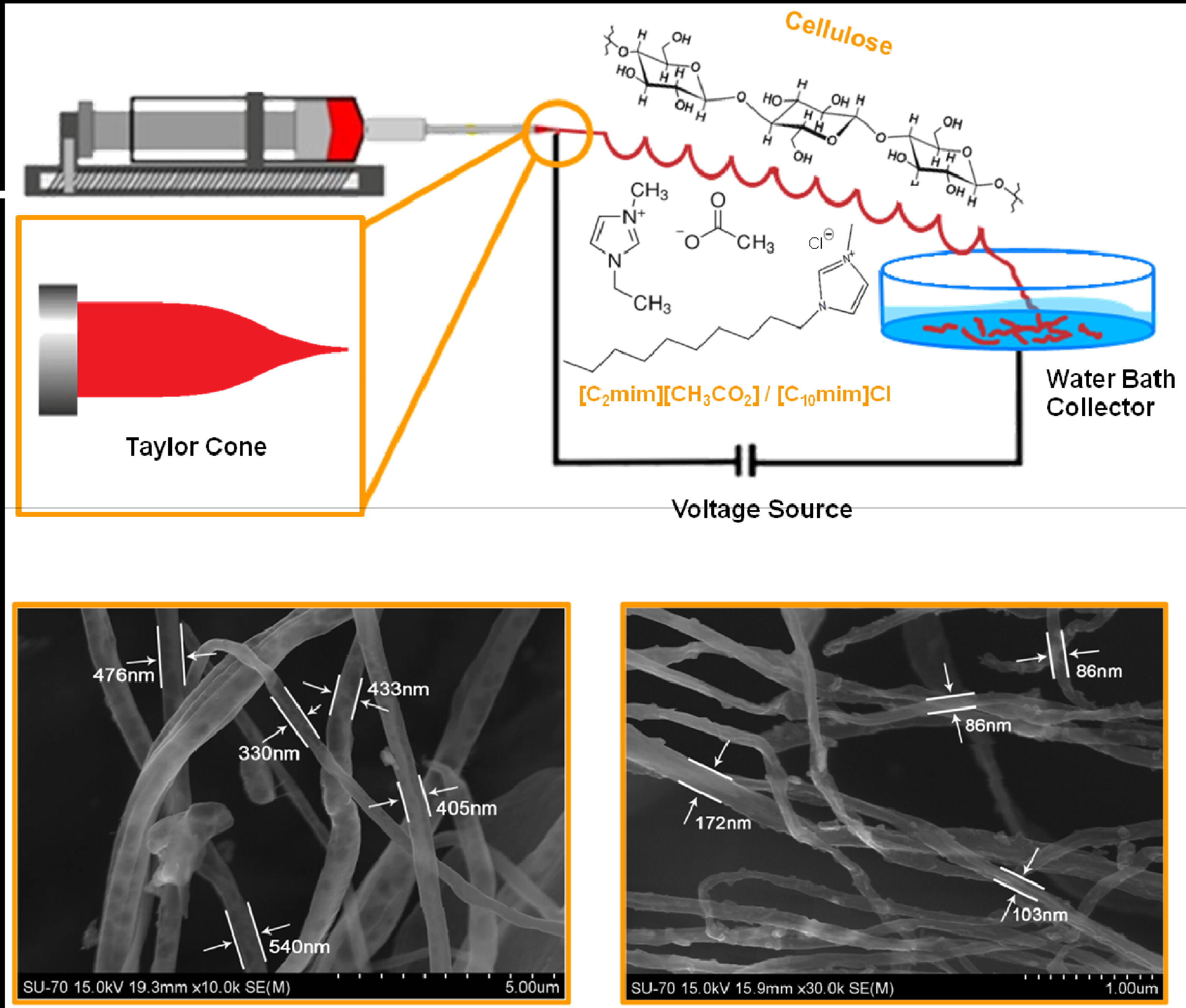


PET



PET/chitosan blend fibers

(different chitosan concentration and molecular weight)



Freire *et al.*, Electrospun nanosized cellulose fibers using ionic liquids at room temperature. ***Green Chem.***, 2011, 13, 3173.

Electrospun nanobibrous mats

'Our' applications

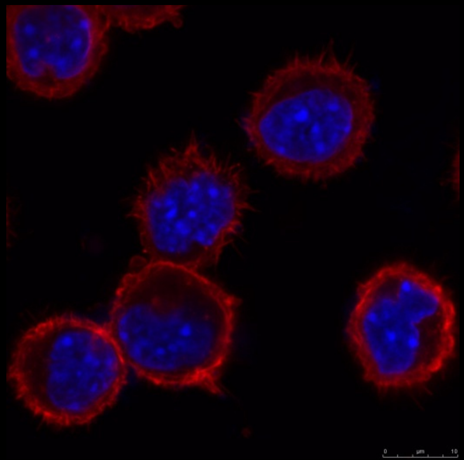
- Cell-scaffold interactions
  Potential membranes for wound dressing
  Potential for hernia meshes

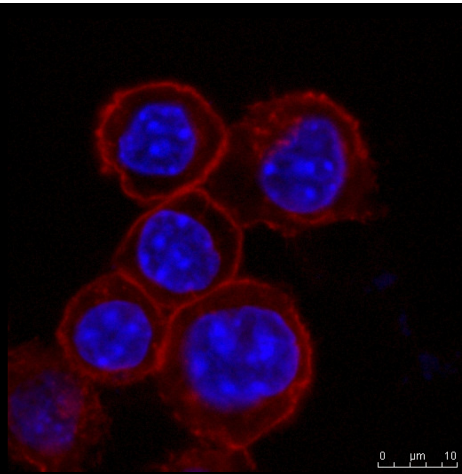
- Separation/filtration applications
  Potential membranes for juice clarification

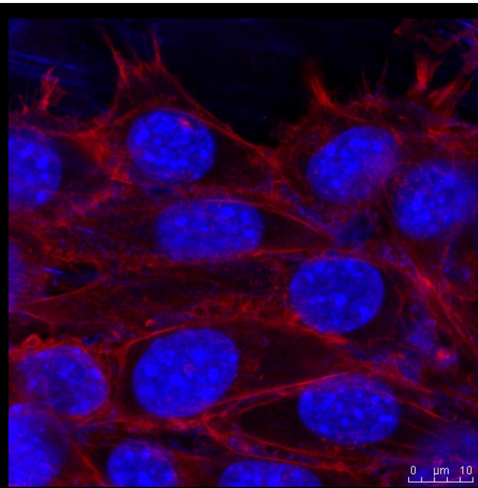
- Fibrous mats as supports for bioactive compounds immobilization/encapsulation
  Potential supports for enzyme immobilization

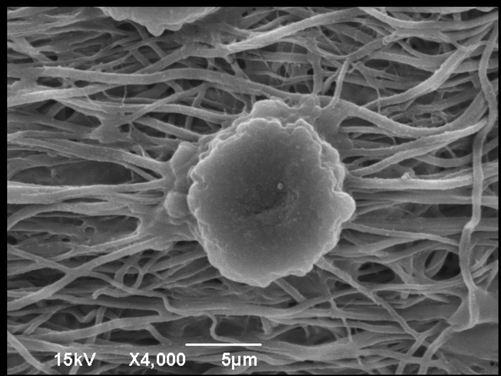
Electrospun fibrous mats as wound dressing membranes

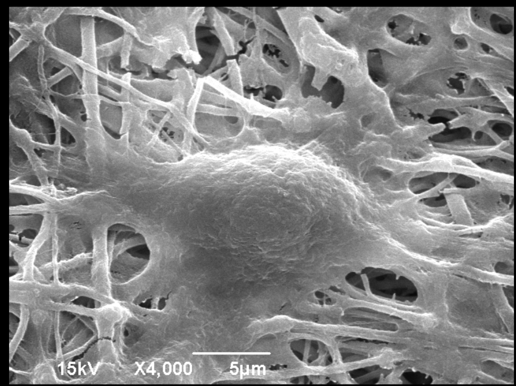
- *In vitro* growth of fibroblasts on PHBV/chitosan scaffolds

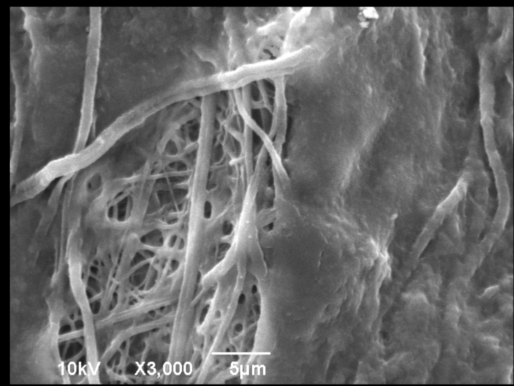




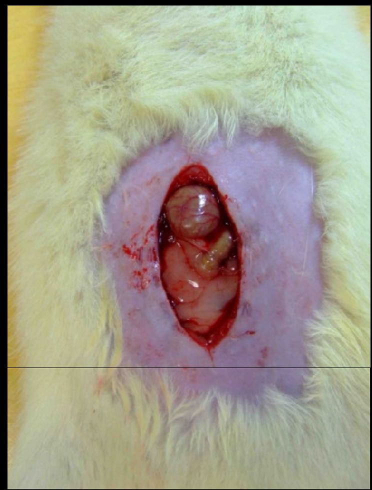
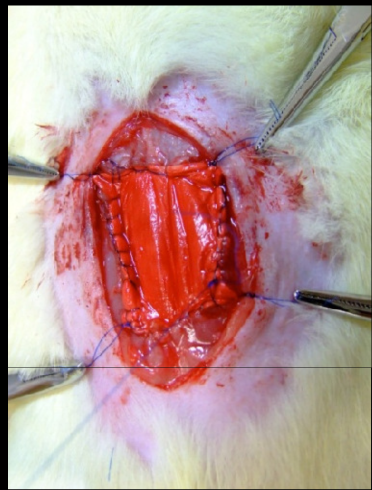








Polymer meshes for hernia repair


In vivo tests using inlay implantation in rodent animal models

Materials

Commercial meshes: Marlex© (polypropylene), Dracon© (polyethylene terephthalate)

PET mesh – *average fiber diameter* = 340 μm

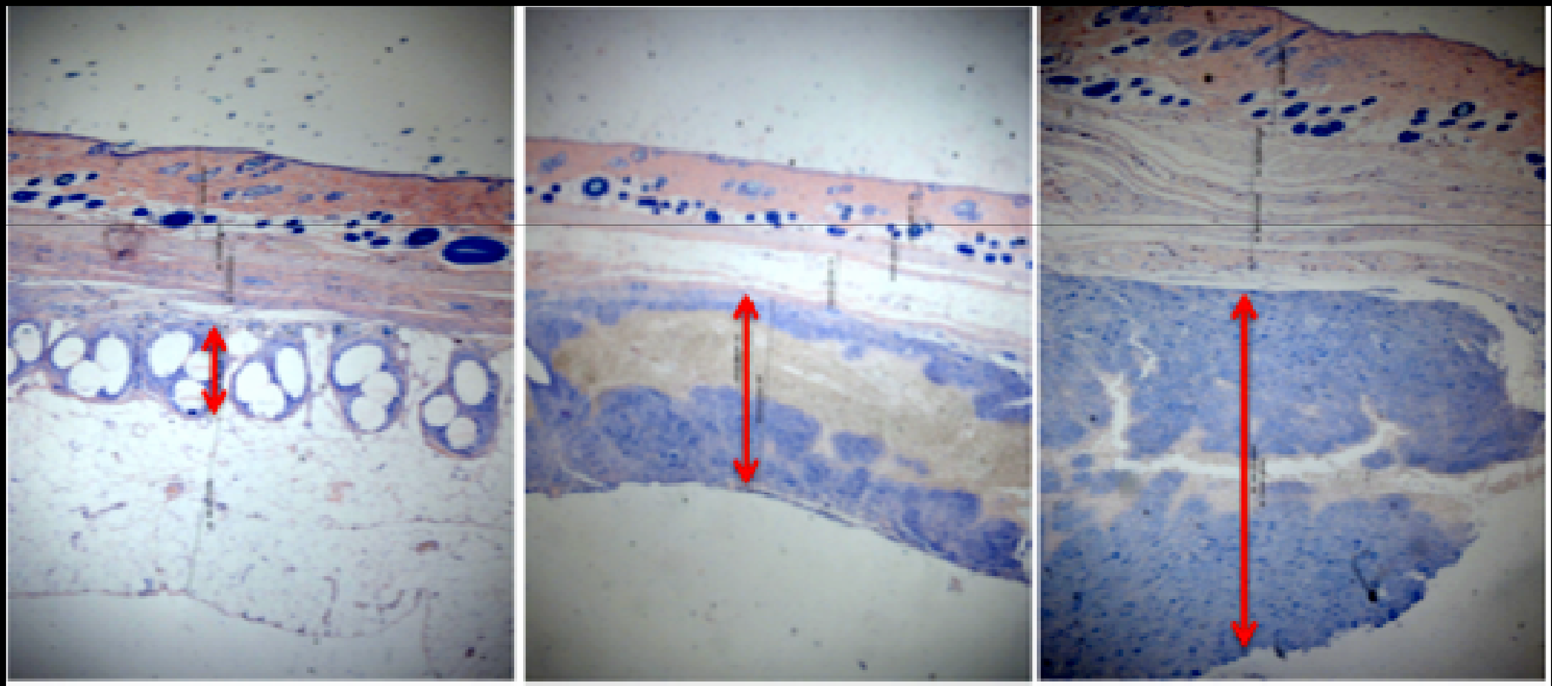
PP mesh – *average fiber diameter* = 208 μm

Electrospun PET mat – *average fiber diameter* = 0.7 μm

Electrospun PET+chitosan mat – *average fiber diameter* = 1.2 μm

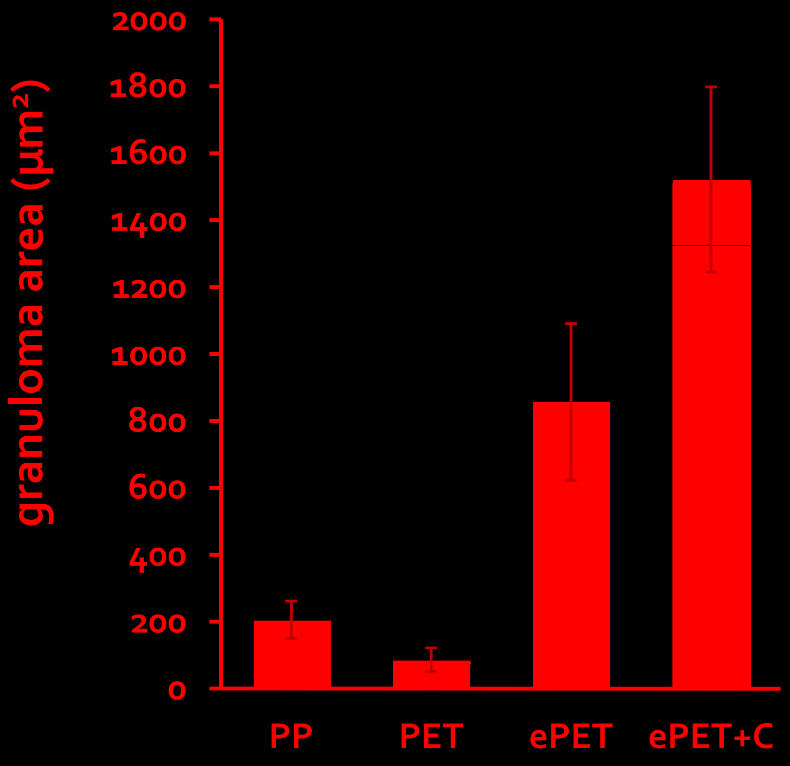
Histological evaluation **Day 30**

Changes on foreign body granuloma

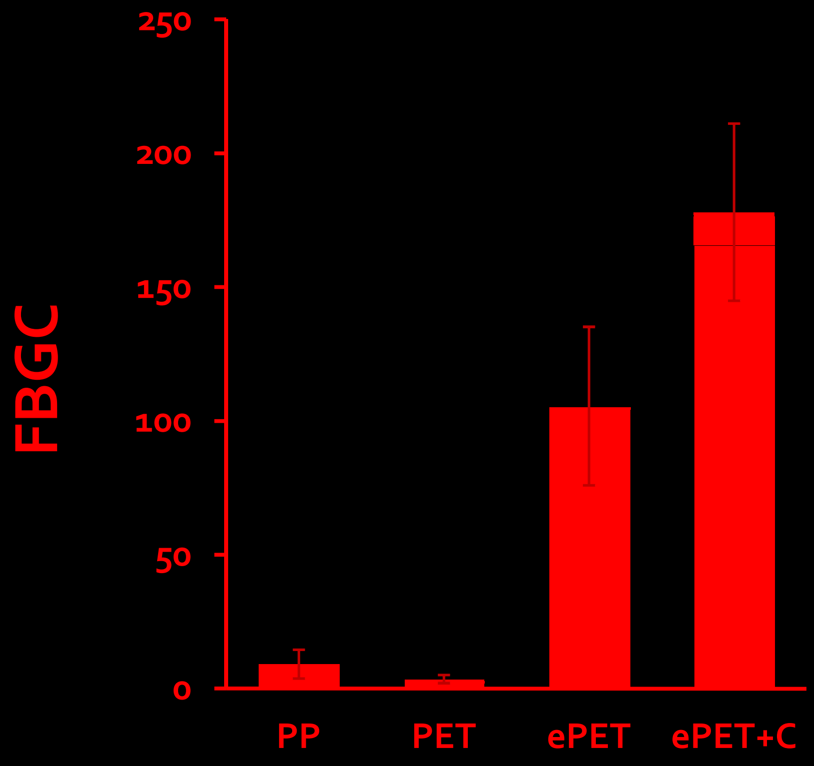


PP (Marlex©) | electrospun PET | electrospun PET+Chitosan

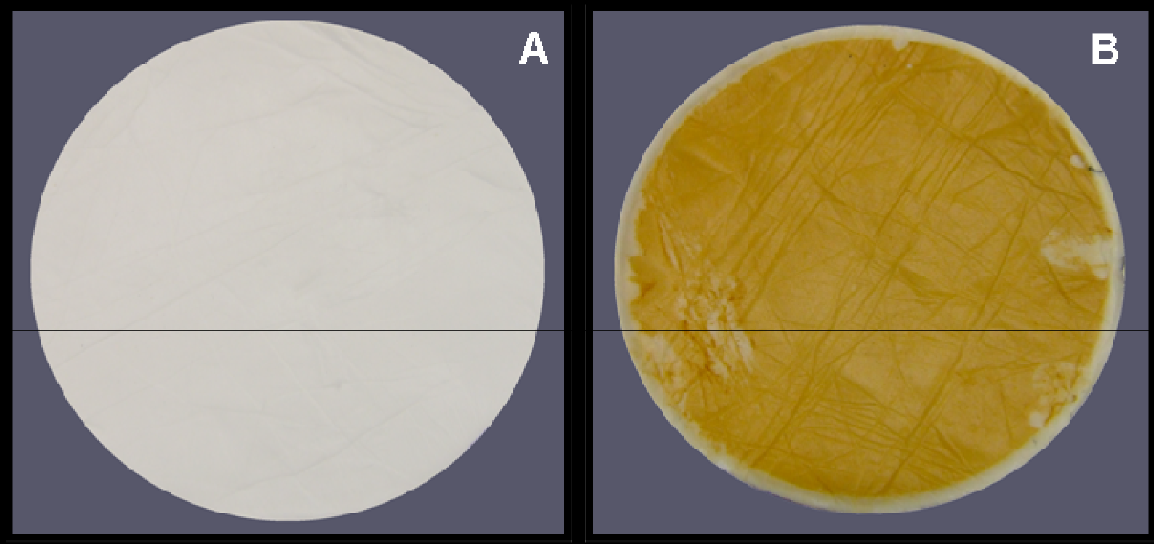
Histological evaluation **Day 30**



Foreign body giant cells



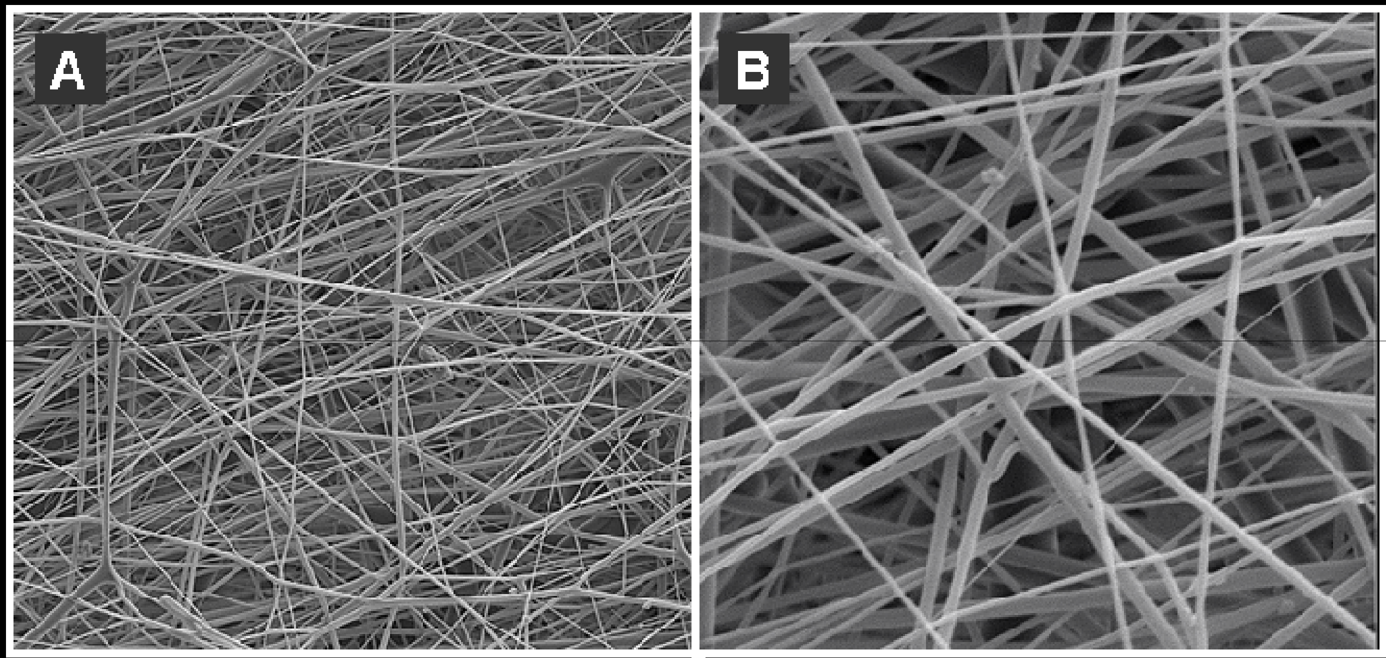
Electrospun fibrous mats in food-related separation applications



Veleirinho, B. and Lopes-da-Silva, J.A. (2009)
Process Biochemistry, 44, pp. 353-356.

- fibrous mats composed of randomly oriented submicron-size fibers can be prepared by electrospinning and successful used as nonwoven filters in fruit juice clarification

Electrospun fibrous mats in food-related separation applications



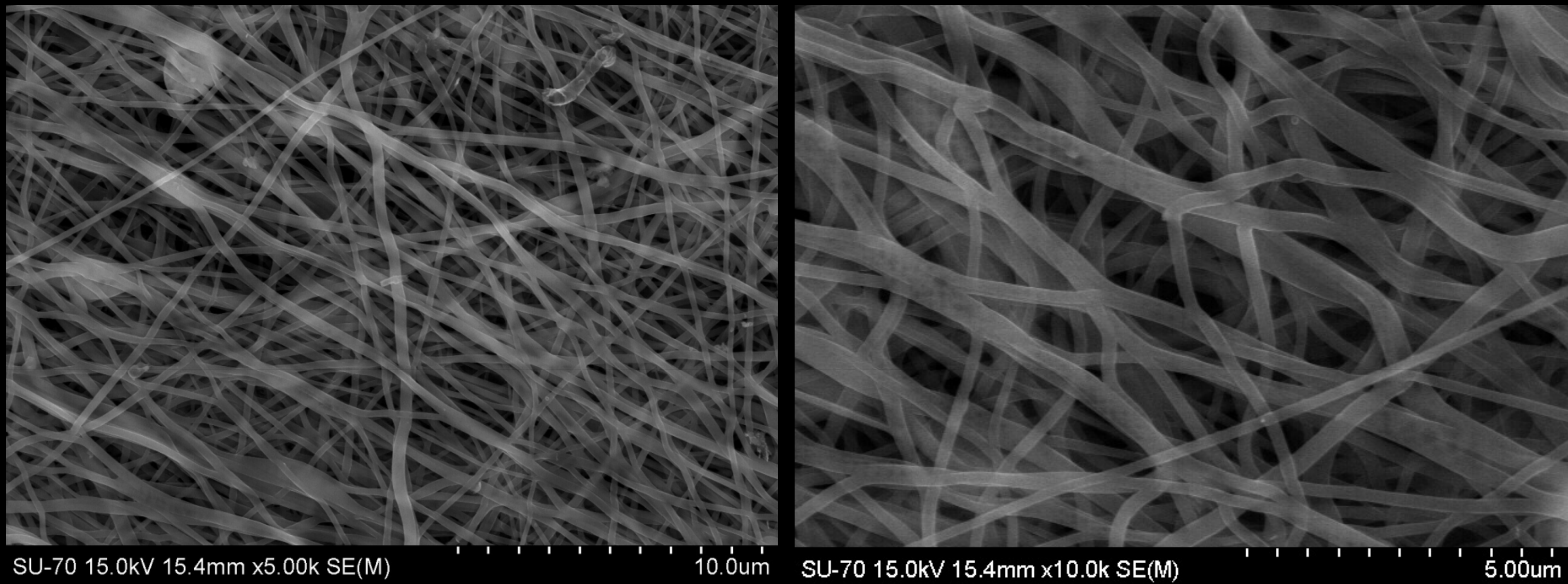
- SEM images showing the morphology of the PET electrospun membrane (A) x 500; (B) x 1500.

Electrospun fibrous mats in food-related separation applications

Open area for further developments:

- multifunctional electrospun fiber membranes able to operate not only on separation mechanisms, but also showing additional functionalities.
  - Antimicrobial nanofibrous membranes to improve the microbial safety of beverages;
  - Development of nanofibrous electrospun mats to be used as separation membranes and improved carriers for enzymes enabling concomitant filtration and catalytic functionalities.

Encapsulation of β-galactosidase in PVA nanofibrous membranes



SEM images of electrospun PVA/β-Galactosidase nanofibers

Encapsulation of β-galactosidase in PVA nanofibrous membranes

Enzyme loading efficiency

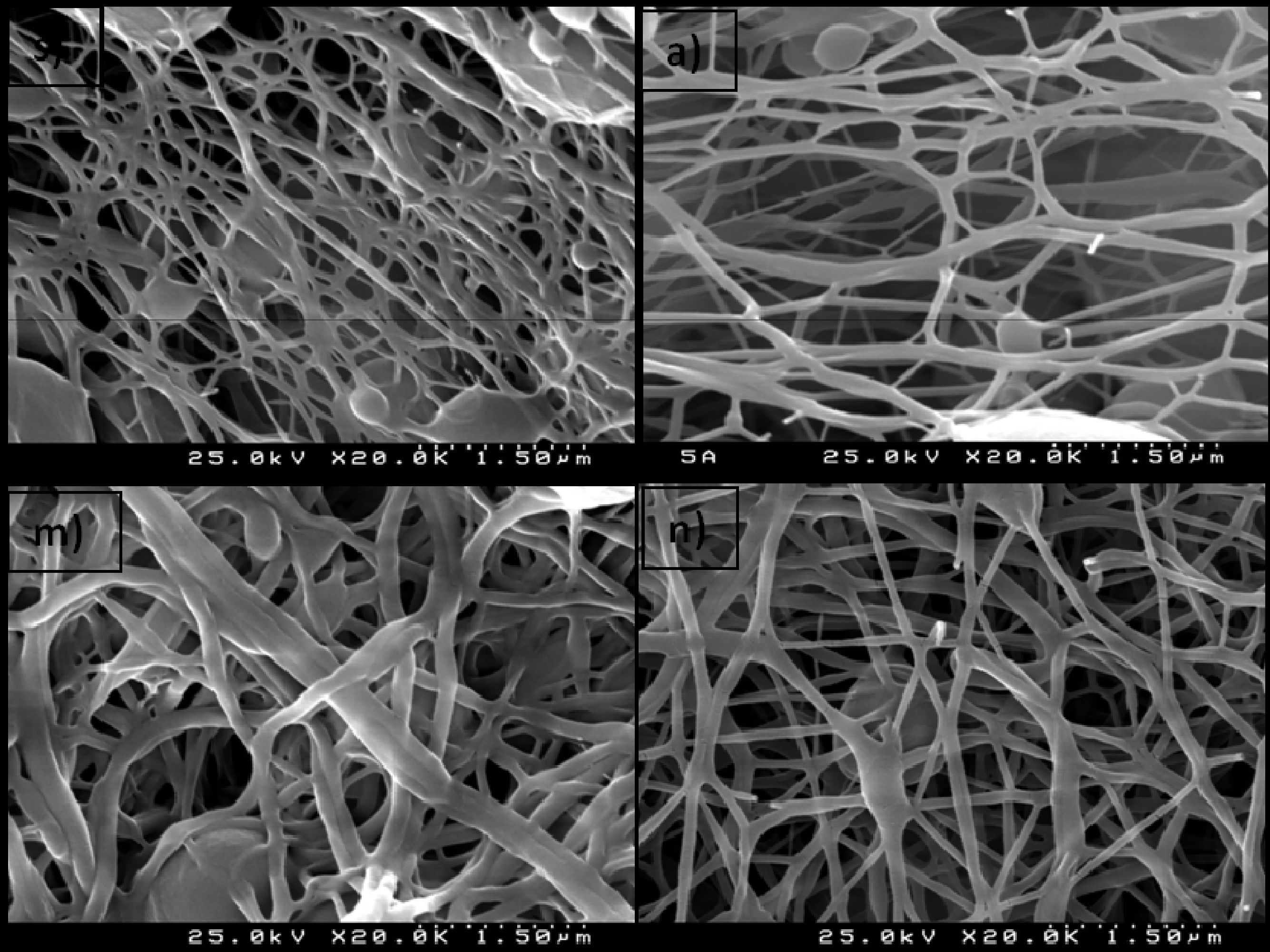
Time of immersion (min)	[Protein] (mg/mL)	Protein in Solution (mg)	% immobilization
30	0,08	0,412	83,5
60	0,08	0,417	83,3
220	0,084	0,421	83,1
280	0,08	0,415	83,4

Encapsulation of β-galactosidase in PVA nanofibrous membranes

Activity of free and immobilized 8-Galactosidase

	Free β-Gal			Immobilized β-Gal		
Days	Activity (mmol min^{-1})	Specific Activity (mmol min^{-1} mg^{-1})	Retained activity (%)	Activity (mmol min^{-1})	Specific Activity (mmol min^{-1} mg^{-1})	Retained activity (%)
0	$7.36x10^{-5}$	$9.81x10^{-4}$	N.A.	N.A.	N.A.	N.A.
5	$6.24x10^{-5}$	$8.33x10^{-4}$	84.9	$7.84x10^{-6}$	$3.19x10^{-5}$	3.25
7	6.94x10-5	9.26x10-4	94.3	6.31x10-6	2.51x10-5	2.55
11	6.49x10-5	8.65x10-4	88.2	4.32x10-6	1.78x10-5	1.81

Encapsulation of trypsin in PCL nanofibers by emulsion electrospinning



Acknowledgements

- My students,
  Bia Veleirinho, Pedro Ferreira, A. Rita Teles,
  Diogo Silva, Nuno Almeida and Susana Pinto

- Financial support made possible our work
  - FEDER, through “Programa Operacional Factores de Competitividade” – COMPETE, and FCT – Fundação para a Ciência e a Tecnologia - project NanoBioCats (PTDC/CTM-POL/112289/2009)
  - QOPNA research unit (project PEst-C/QUI/UI0062/2011)

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