Biomimetic nanofibrous scaffolds for tissue engineering applications

M. Moffa,[ab] A. Polini,[c†] A.G. Sciancalepore,[a] L. Persano,[ac] and Dario Pisignano[abc]

Contact@E-mail maria.moffa@iit.it

[a]*Center for Biomolecular Nanotechnologies @UNILE, Istituto Italiano di Tecnologia,via Barsanti, I-73010 Arnesano, LE, Italy.*
[b]*Dipartimento di Matematica e Fisica "Ennio De Giorgi", Universit`a del Salento, via Arnesano, I-73100 Lecce, Italy*
[c]*National Nanotechnology Laboratory of Consiglio Nazionale delle Ricerche-Istituto Nanoscienze, via Arnesano, I-73100 Lecce,Italy*
[†] *Present address: Lawrence Berkeley National Laboratory, Materials Sciences Division, 1 Cyclotron Road, 94720, Berkeley, CA, USA.*

The multidisciplinary field of tissue engineering has the ultimate aim of repairing and/or replacing damaged tissues or organs by means of a properly designed combination of scaffolding biomaterials and functional cells. Nanomaterials play a pivotal role in stimulating cell growth and guiding tissue regeneration, since they are able to properly mimic the biomimetic features and physio-chemical properties of natural tissues and organs. In particular, electrospinning has emerged as one of the most successful techniques owning to its ability to generate fibers similar to the intricate fibrillar architecture of natural extracellular matrix [1].

Here we review our recent work about the realization of nanofibers with different naturally occurring matrix proteins and synthetic polymers and demonstrate the growth, proliferation and differentiation of different cell lines with the ultimate aim of designing optimized biomimetic scaffolds to support the formation of functional tissues. We explored the various possibilities to articulate the composition and the others proprieties of nanofibers to meet the specific scaffolds demand of the different tissues and /or organs. In particular, we investigate the possibility to improve cellular proliferation, infiltration and functionality using electrospun polymer nanofibers with improved wettability behavior [2]. We also investigate the possibility to engineer electrospun fibrous scaffolds presenting the anisotropy of the specific native tissues. The possibility to improve cell specific adhesion on synthetic nanofibrous mats is also a topic of our works, through the insertion of specific bioactive molecules on electrospun synthetic scaffolds to promote cell adhesion and proliferation. The immobilization of cell recognition motifs leads to controlled interaction between cells and synthetic substrates.

Among other biomedical materials, by virtue of these peculiar advantages polymer nanofibers are rapidly emerging as one of the most promising for an actual industrial application in the field [3].

We acknowledge the support of the Italian Ministry of University and Research through the FIRB Contract RBNE08BNL7 (MERIT Program).

References

[1] A. Polini, et al., D. Pisignano, Soft Matter, **6**, (2010)1668-1674.
[2] M. Moffa et al., D. Pisignano, Soft Matter, **9** (2013) 5529-5539
[3] L. Persano, A. Camposeo, C. Tekmen, and D. Pisignano, Macromolecular Materials & Engineering, **298** (2013) 504-520.