0006 Magnetically responsive tropoelastin hydrogel as a platform for soft tissue regeneration applications

Tamagno Pesqueira[1,2], Raquel Costa-Almeida[1,2], Suzanne M. Mithieux[3,5], Rui L. Reis[1,2], Manuela E. Gomes[1,2], Anthony S. Weiss[3,5]

[1]3B's Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho Guimarães, Guimarães, Portugal, [2]ICVS/3B's - PT Government Associate Laboratory, University of Minho Braga/Guimarães, Braga, Portugal, [3]School of Molecular Bioscience, The University of Sydney, Australia, New South Wales, Australia, [4]Bosch Institute, The University of Sydney, Australia, New South Wales, Australia, [5]Charles Perkins Centre Node in Tissue Engineering and Regenerative Medicine Life and Environmental Sciences, New South Wales, Australia

The natural polymer tropoelastin is a structural protein of ECM of tissues requiring elasticity as part of their function, including ligaments and tendons. Tropoelastin has an innate capacity of self-assembly into high-order structures, and together with elastic resilience, structural stability and bioactivity bring forth pleasant singularities in adopting it as a building block to fabricate hydrogels. Moreover, easy tailoring of properties can be attained via incorporation of specific components into the polymeric network, including magnetic nanoparticles (MNPs), which are beneficial for on-demand therapies. Thus, the main goal of this work consisted in developing a magnetically responsive tropoelastin (MagTro) hydrogel as a platform to study the response of tendon cells to a mechanical stimulus induced by application of an external magnetic field (EMF). For this purpose, to first produce hydrogels, a solution of recombinant human tropoelastin was first freeze-dried overnight inside a mould and then chemically cross-linked inside an open desiccator via vapour glutaraldehyde. Thereafter, MagTro hydrogels were obtained through *in situ* precipitation of MNPs by immersing tropoelastin hydrogels in $FeCl_2$ and $FeCl_3$ solution overnight and secondly by soaking them in NaOH. Hydrogels were then analysed morphologically by Scanning Electron Microscopy (SEM and Cryo-SEM). Enzyme-triggered degradation was studied after 72h at 37ºC in a human neutrophil elastase solution. Hydrogels exhibited a quick magnetic responsiveness to an EMF (Fig.1). Interestingly, MagTro hydrogels exhibited smaller pores as observed by Cryo-SEM. This feature can be tuned according to different soft tissue requirements by controlling different parameters of the fabrication process. Additionally, the release of tropoelastin into solution decreased, which suggests the formation of a surface coating of MNPs on tropoelastin network, protecting the hydrogel from a faster degradation. Preliminary results also indicate that cultured cells are viable and spread at the surface of the hydrogel. The application of an EMF to cell-laden MagTro hydrogels will be further investigated.

Overall, the streamlined fabrication of MagTro hydrogels was successfully attained and the hydrogel formulation represents a promising potential platform for soft tissue regeneration.

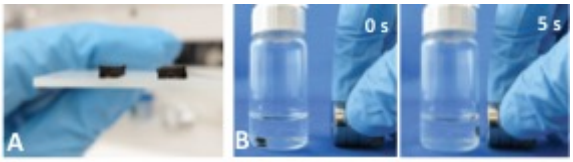

Figure 1. (A) MagTro hydrogels and (B) magnetic responsiveness to an EMF.

Acknowledgments: The authors acknowledge to BEAM-Master Joint Mobility Project an EU Australian cooperation in Biomedical Engineering Grant Agreement, 2014-1843/001 001-CPT EU-ICI-ECP and to FCT–Fundação para a Ciência e a Tecnologia in the framework of FCT-POPH-FSE, RC-A PhD grant SFRH/BD/96593/2013 and MEG grant IF/00685/2012.