Validation of the micro-extrusion process for the manufacturing of tubular bio-resorbable porous scaffolds for tissue engineering.

Xabier Mendibil[1], Rocío Ortiz[1], Virginia Sáenz de Viteri[1], Jone M. Ugartemendia[2], Jose-Ramón Sarasua[2], Iban Quintana[1]

[1]Fdn. Tekniker, Spain

[2]Univ. Basque Country UPV EHU, Spain

xabier.mendibil@gmail.com

Abstract

Micro-extrusion is a scalable manufacturing technique that can be applied for processing thermoplastic polymers, blends and composites, to produce tubular geometries with customized properties. Tube extrusion of bio-resorbable porous elastomeric materials is of great interest for scaffold manufacturing and tissue engineering of nerves, tendons, and veins. Current manufacturing techniques to produce these scaffolds are based on limited and hardly scalable manufacturing processes as solvent casting, freeze drying, dip coating, electro spinning, etc. Here, micro-extrusion was applied to produce porous tubes made of poly(L-lactide-co-ε-caprolactone), a bio-resorbable copolymer, using size controlled NaCl particles as leachable agent. The effects of the particle size and proportion on the pore density, dimensional stability, mechanical properties and ageing of the produced scaffolds were analysed. The increase of salt proportion improved the leaching efficiency. Higher porosity samples showed lower dimensional swelling when wet. The mechanical properties were surprisingly not affected by pore proportion but by the pore size, being the samples with smallest pores those which showed the best properties. The produced scaffolds showed strength and stiffness values comparable to human soft tissues, as veins and nerves, making those scaffolds appropriate to mechanically mimic the host tissue. Several meters of a 400 µm wall thickness porous tube were micro-extruded, proving this process as a scalable manufacturing technique to obtain bio-resorbable porous scaffolds with constant section and no limitation in length.

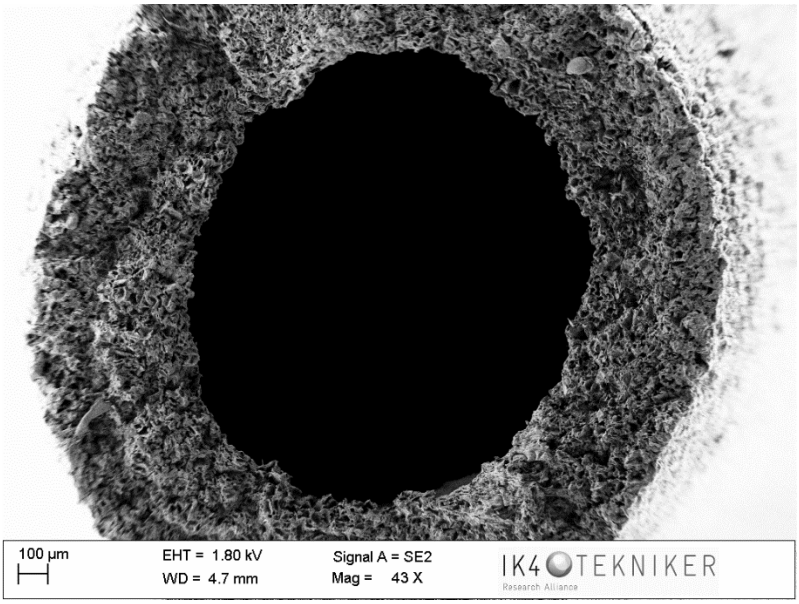

Figure 1: SEM image showing the cross section of an extruded porous tube with 400 µm wall thickness and pores in the 25-50 µm range.