POROUS POLYCAPROLACTONE SCAFFOLD FABRICATION FOR CARTILAGE REGENERATION VIA CRYO-ELECTROSPINNING

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Introduction

Tissue engineering (TE) can overcome limited long-term repair success or unacceptable side effects of surgical treatments currently applied for the treatment of injury or osteoarthritis [1]. Furthermore, TE scaffolds can mimic the structure of the natural ECM, providing great potential in bone and cartilage regeneration. An ideal scaffold should have an interconnected porous structure that allows the diffusion of nutrients and cell penetration, serving as a substrate for tissue growth [2]. Due to their high porosity and tunable morphology, electrospun scaffolds can be used for cartilage tissue applications.

Materials and methods

A blend of a biodegradable synthetic polymer poly(ε)caprolactone (PCL) and regenerated cellulose (CEL) was used to fabricate a fibrous and porous scaffold by the solution cryoelectrospinning technique. The effects of relative humidity within the electrospinning chamber on fibre morphology has been researched, as characterized by SEM and μCT techniques. The fiber and pore diameters were calculated using ImageJ software by dividing the SEM image into four equal quartiles and selecting all points in one quartile. The differences between samples were assessed using two sample T-tests implemented in the OriginPro software data analysis package.

Results and conclusion

The average pore size of 112 ± 26 μm, fiber size of 9.7 ± 2.5 μm and 90 % porosity were achieved, at the same time, RH did not seem to significantly affect the morphology of the fibrous scaffolds. However, as described elsewhere, the most beneficial optimal range of pore diameter is between 100 and 250 μm and porosities greater than 90%, which means that our scaffold could be successfully applied for cartilage tissue engineering [3].

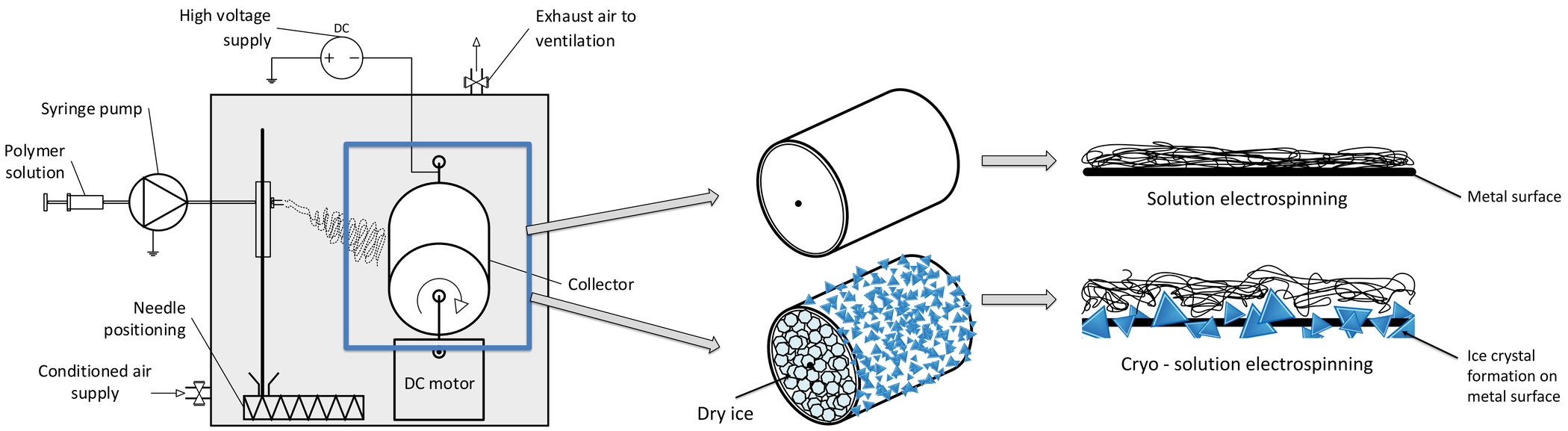

Fig. 1. Electrospinning setup [4]

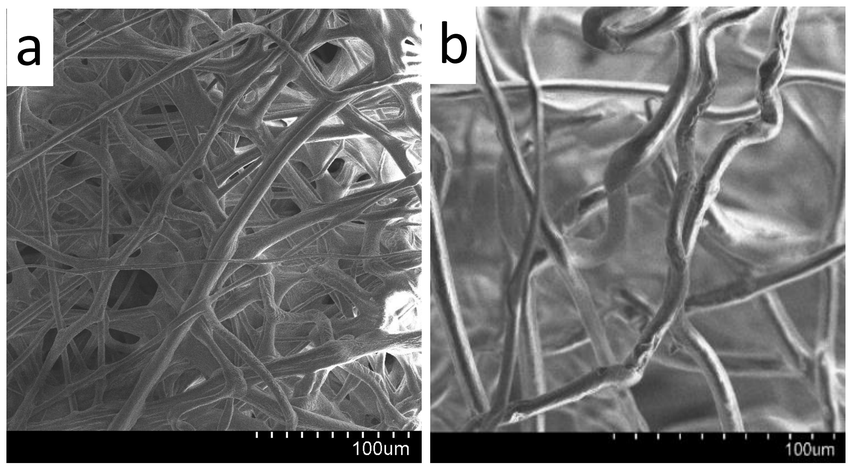

Fig. 2. SEM images of solution electrospun (a) and cryo-electrospun (b) PCL-CEL scaffolds

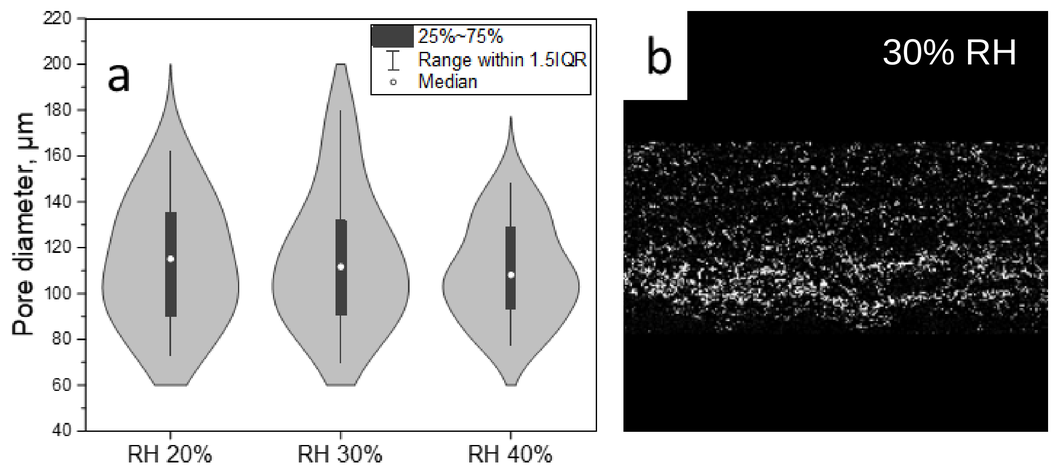

Fig. 3. Fiber and pore size analysis using different related humidity (a), 2D μCT (b), images of the PCL-CEL scaffold

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