Electrospinning of Polyesters

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INTRODUCTION: Electrospinning is a unique procedure using electrostatic forces to make fine fibers with diameters in the range of nanometers to a few microns from solutions or melts. These fibers may act as highly porous scaffolds for tissue engineering, among others. So far, we have spun some poly(ε-caprolactone) (PCL)- fibers by variation of several parameters using a self constructed apparatus. Subsequently we want to spin PCL and other polyesters as scaffolds for Calcium Phosphate mineralization.

METHODS: The apparatus used for electro-spinning consists of a high voltage electric source with positive or negative polarity, a syringe pump with capillaries or tubes to carry the solution from the syringe to the capillary, and a conducting collector like aluminium (Figure 1).The final fibrous structure can be tailored by altering the concentration of the polymer solution, the molecular weight and molecular-weight distribution, the applied voltage, the solution flow rate and the distance between the capillary and collector. The effects of the preparation conditions on the fiber diameter were observed by optical microscopy and scanning electron microscopy (SEM).

Fig. 1: Configuration of our Electrospinning apparatus.

RESULTS: Most effective parameter variations are polymer concentration and flow rates of the polymer solutions. If the flow rate is low, the capillary may plug. On the other hand, no continuous jet will form when the flow rate is too high. Spinning with different polymer concentrations leads to different fiber diameters, nonfibrous structure, and bead-rich scaffolds. Another very important parameter is the distance between needle and collector plate. For fine and uniform fibers, the interspace has to be as wide as possible. But for a constant flow and formation of fibers, one needs a minimal distance.

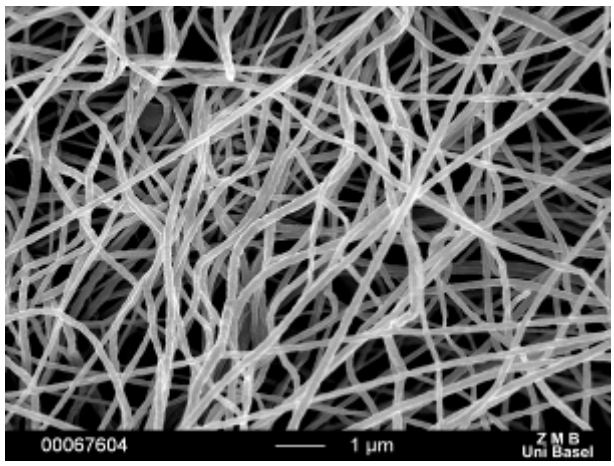

Fig. 2: Scanning Electron Microscope Image from 7 % wt PCL (80kDa) in Dichloromethane at 20 kV with 0.7 ml/h solution flow and a needle to collector distance of 9 cm.