Electrospinning Poly(e-caprolactone) Dissolved in Acetic Acid
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Introduction
Polycaprolactone (PCL) is a linear aliphatic polyester, whose biocompatibility, low melting point and elastomeric properties make it appealing for the production of scaffolds for Tissue Engineering. Being hydrophobic, PCL is insoluble in aqueous solvents. Typical solvents include acetone, chloroform, dimethylacetamide, methylene chloride and dimethylformamide [1]. The present study investigated the feasibility of producing PCL nanofibres by electrospinning precursor solutions of PCL dissolved in glacial acetic acid. So far, no-one has reported the successful electrospinning of such solutions.

Materials and Methods
PCL (Mn = 80 kg/mol) from Aldrich and acetic acid from Pronolab were used in this study. The properties of the solutions were measured as follows: surface tension, \( \gamma \), using the pendant drop method in a CAM101 tensiometer from KSV; electrical conductivity, \( \sigma \), using a conductivity meter HI 4521 from Hanna Instruments; zero shear viscosity, \( \eta \), using a rotational rheometer from Malvern Instruments. Electrospinning was performed using a 30 kV power supply (Iseg High Voltage) and the polymer solution feeding was controlled using a KDS 100 (KD Scientific) syringe pump. Experimental results are presented as (mean±experimental standard deviation).

Results
PCL was dissolved in glacial acetic acid in concentrations ranging from 14% to 26%. The properties of these solutions are summarized in the table.

<table>
<thead>
<tr>
<th>PCL / %</th>
<th>( \gamma ) / (mN/m)</th>
<th>( \sigma ) / (µS/cm)</th>
<th>( \eta ) / (Pa.s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>28.5</td>
<td>0.028</td>
<td>1.63</td>
</tr>
<tr>
<td>17</td>
<td>28.6</td>
<td>0.014</td>
<td>3.39</td>
</tr>
<tr>
<td>20</td>
<td>30.9</td>
<td>0.017</td>
<td>7.66</td>
</tr>
<tr>
<td>23</td>
<td>29.7</td>
<td>0.016</td>
<td>9.61</td>
</tr>
<tr>
<td>26</td>
<td>32.8</td>
<td>0.012</td>
<td>22.7</td>
</tr>
</tbody>
</table>

Table. 1. Solutions properties.

Good quality fibres were obtained from the 20% and 23% solutions. The 14% and 17% solutions yielded fibres with beads and the 26% solution originated fused fibres.

The diameter of the fibres obtained with the 20% solution was \((1.13±0.25)\) µm. Using the 20% solution, fibres without defects were obtained for the following ranges of processing parameters: distance from 8 cm to 14 cm; flow rate from 0.1 ml/h to 1.0 ml/h; high voltage from 5.0 to 6.0 kV. Tensile tests of the fibres produced from the 20% solution revealed fibre mats with a Young’s modulus of \((13.9±1.8)\) MPa.

Discussion and Conclusions
We demonstrated for the first time the feasibility of producing nanofibres by electrospinning PCL dissolved in glacial acetic acid, a solvent that can be neutralized and washed away from the fibres without leaving potentially harmful residues.

References

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Disclosures
Authors have nothing to disclose.