Magnetically Actuated Smart Textured Fibrous System as a Cell Carrier

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INTRODUCTION

- Disease
- Trauma

DAMAGED TISSUES

• Surgery

REPLACEMENT

TISSUE ENGINEERING

• Regenerate

➢ Develop a carrier scaffold for tissue engineering.
➢ Overcome the existing limitations constraining classical approaches used in plastic and reconstructive surgery.
OBJECTIVE

We aim to create a biocompatible scaffold which promotes cell growth and can be implanted with minimum surgical techniques.
SCAFFOLDING

Mitra et al. RSC Adv., 2013, 3, 11073

Bioactive glass  Electrospun nanofibers

Hydrogel  Polymer/ceramic composite

Self-assembled peptide  Nanofibrous hollow microspheres

MAST FIBERS

BIOCOMPATIBLE

SIMILAR TO 3D ECM

APPLICATION SPECIFIC TEXTURE
ELECTROSPINNING
CONSTITUENTS OF THE POLYMER

- Biodegradable polyester
- Ability to promote cell attachment and proliferation

PolyCaprolactone

- Fluorescence Imaging
- Navigable in magnetic field

Carbon quantum dots (CQDs)

SOLVENTS

- Tetrafluoroethylene
- Tetrahydrofuran
- Dimethylsulfoxide

THF
## CHARACTERIZATION

![Images of smooth, rough, and porous fibers](a-b-c)

<table>
<thead>
<tr>
<th>TOTAL PARTICLE CONCENTRATION</th>
<th>SOLVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCL</td>
<td>QDs</td>
</tr>
<tr>
<td>SMOOTH</td>
<td>0.144g</td>
</tr>
<tr>
<td>ROUGH</td>
<td>_</td>
</tr>
<tr>
<td>POROUS</td>
<td>_</td>
</tr>
</tbody>
</table>

**Table 1.** Table showing the different concentrations of solvents used to make 1 ml solution for the fabrication of smooth, rough and porous fibres.
CHECK FOR HYDROPHOBICITY

Water contact angle made with the fibrous mats.

(a) Porous  
(b) Rough  
(c) Smooth

At 0 seconds  
124°  
125.8°  
112.8°

At 15 seconds  
124.8°  
125.6°  
72°
MOVEMENT IN MAGNETIC FIELD

Electromagnet setup.

Size: 0.5 cm
Speed: 0.416 mm/s
Mag Field Gradient: 21 G/mm
# Speed of the Fibers in Different Mediums

<table>
<thead>
<tr>
<th>Medium</th>
<th>Field Gradient</th>
<th>Smooth (mm/s)</th>
<th>Rough (mm/s)</th>
<th>Porous (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 X PBS</td>
<td>25 G/mm</td>
<td>0.324</td>
<td>0.217</td>
<td>0.390</td>
</tr>
<tr>
<td>50% FBS</td>
<td>20 G/mm</td>
<td>0.185</td>
<td>0.159</td>
<td>0.21</td>
</tr>
<tr>
<td>FBS</td>
<td>22 G/mm</td>
<td>0.11</td>
<td>0.078</td>
<td>0.064</td>
</tr>
<tr>
<td>MEDIA</td>
<td>21 G/mm</td>
<td>0.416</td>
<td>0.104</td>
<td>0.153</td>
</tr>
</tbody>
</table>

**PBS**: Phosphate-buffered saline  
**FBS**: Fetal Bovine Serum  
**MEDIA**: DMEM – 10% FBS and 1% antibiotic  
**SIZE**: 0.5 cm
MOVEMENT IN MAGNETIC FIELD

Size if the fibrous mat used: 0.5 cm
HeLa CELLS WERE EXPOSED FOR 30 MINUTES IN MAGNETIC FIELD.
CELL VIABILITY ON FIBERS

MTT ASSAY

Cell Viability (% Control)

Magnetic Field Intensity (Gauss)

Smooth
Porous
Rough
SUMMARY AND FUTURE SCOPE

- Biocompatible
- Supports cell growth
- Navigable with external magnetic field
- Stem Cell delivery
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