Graphene-augmented nanofibre scaffolds – GAIN

A new generation of inorganic, bioinert yet biocompatible scaffolds with ultra-high anisotropy

Main characteristics:

- **self-aligned**, self-oriented nanofibers of controlled diameter and tailored lengths
- **controlled porosity** of total 90-95%
- customized with additional proprietary surface **modification** technology, variation from super-hydrophilic to super-hydrophobic, from electrically insulating to electrically conductive
- cut to **standard sizes** to fit most common multi-well plates; other custom sizes can be made
- sufficient **mechanical strength** (over 1-2 MPa in non-modified state).

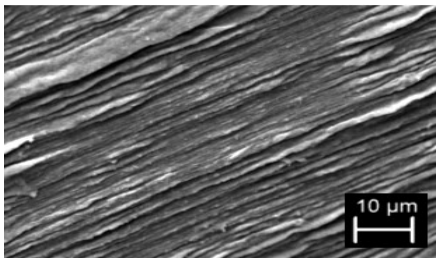
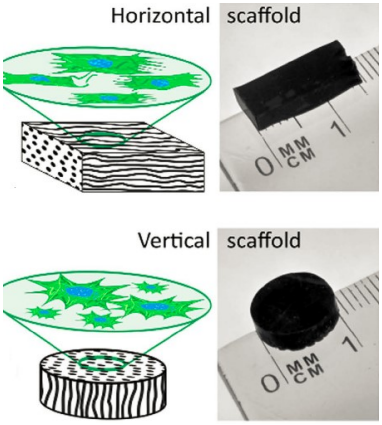


Fig. 1. SEM image of scaffold (40 nm size).

Fig. 2. Scaffolds of 15 x 1 mm size.

Two options are available: **horizontal scaffold** and **vertical scaffold**



The GAIN with horizontally oriented fibres allows

- directional orientation of cells,
- altering morphology of different types of cells.

The GAIN with vertically oriented fibres allows

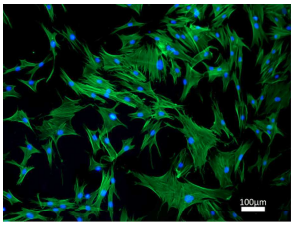
- development of mixed tumour *in vitro* models of 2D/3D configurations for inductive and conductive features,
- to accomplish the selective propagation of tumour cells.

These novel anisotropic scaffold types can be used also for

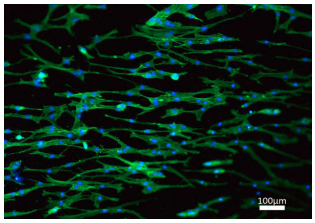
✓ new 2.5D technology, combining the 3D and 2D features like co-cultures,
✓ ALICE assays,
✓ bipolar assays with selective media separation

Horizontally oriented GAIN scaffold

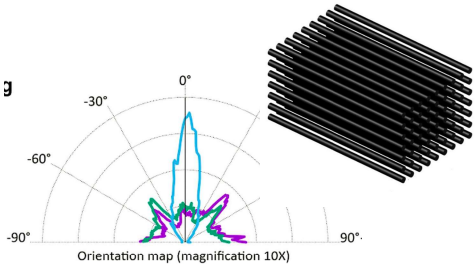
Fluorescence microscopy images



hMSC on control



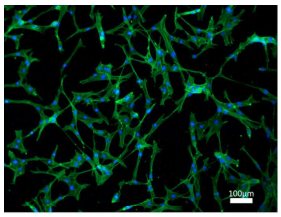
hMSC on GAIN horizontal scaffolds



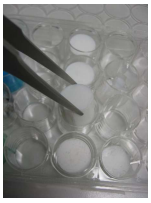
- Guiding cells to line up along the fibres with a spindle-like shape;
- Elongated cytoplasmic lamellipodia extensions;

Elongated morphology of hMSC and its high polarization create pre-requisites for **preferential specific** (e. g. neuronal or myogenic) **lineage differentiation**.

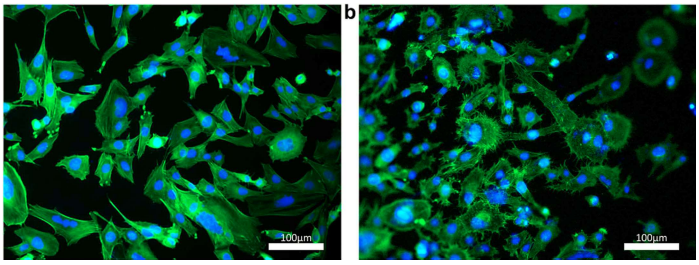
Vertically oriented GAIN scaffold



hMSC on GAIN horizontal scaffolds



Breast cancer cell line MDA-MB 231



- extended microspikes;
- actin-rich filopodia protrusions

- high level of membrane activity;
- local immobilization of the cells

Advantages of GAIN scaffolds:

- new perspectives for ***in vitro* experiments** especially for dermal, neural, cochlear, nephrology, hepatic and other applications;
- for **pharma areas** such as Alzheimer, Parkinson and similar drug developments, possibly BBB-penetration R&D;
- for ***in vitro* toxicology**, true 1R (total replacement) methods beyond the 3R-directive (2010/63/EC), high-throughput ATMP experiments (2001/83/EC, 2007/47/EC),
- for **lab-on-chip devices** including those for PoC applications;
- for more advanced cases like planktonic cancer cells capturers;
- an opportunity for evaluation of primary **cells fate** in different conditions as they could mimic controlled conditions to assess affecting factors with greater precision by varying parameters to extents not possible earlier.

The scaffolds are being now manufactured on laboratory scale, but the scaling up the production and surface modification is foreseen upon commercialization of the technology.

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