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Electroconductive Graphene Oxide-Nanosheets with Pulsed Electromagnetic Fields:
-Potential and New Horizons of Reduced Graphene-based Nanocomposites on Stem Cells-

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I. ***Nanoscale topography of artificial substrates*** can greatly influence the fate of controlled stem cells including adhesion, proliferation, and differentiation.

II. Human mesenchymal stem cells (hMSCs) are critical for numerous groundbreaking therapies in the field of regenerative medicine.

III. Thus the design and manipulation of ***reduced graphene oxide (rGO)-based nanosheets and its electrical properties*** are of great importance to realize graphene-based electronics as a strategy in stem cells and tissue engineering applications.

IV. In this report, we propose that ***electro-conductive graphene oxide nanosheets*** **are an efficient platform for modulating and enhancing structure and function of stem cells.**

Key words: reduced graphene oxide (rGO); chemical vapour deposition (CVD); electrical stimulation; controlled stem cells

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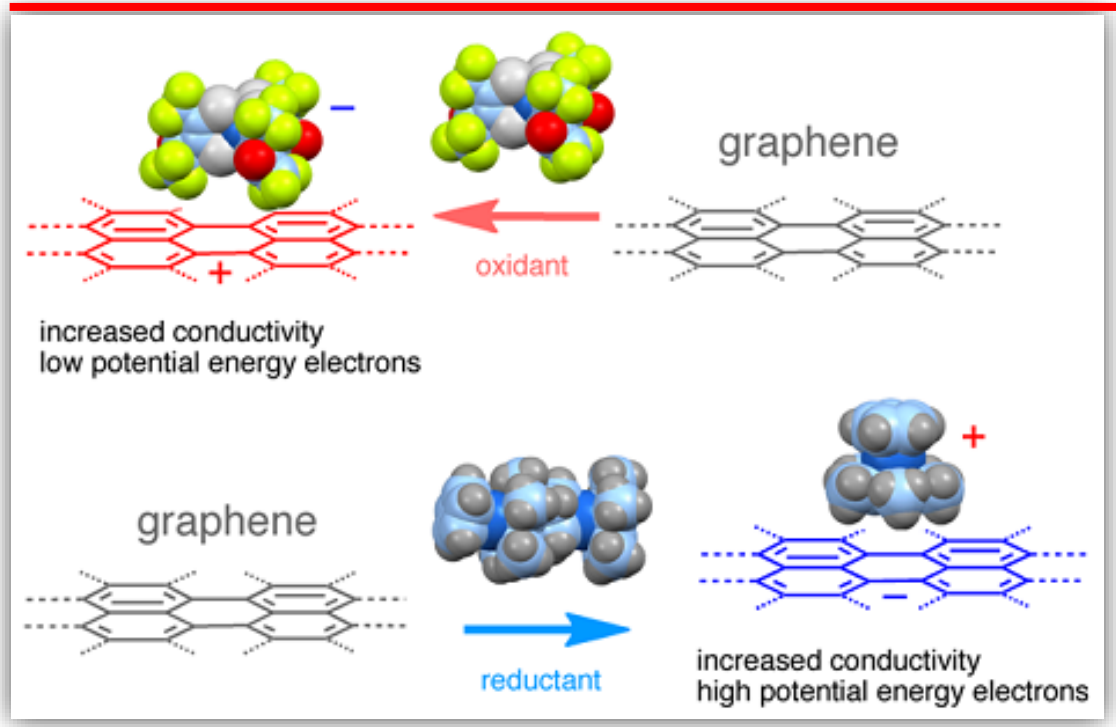

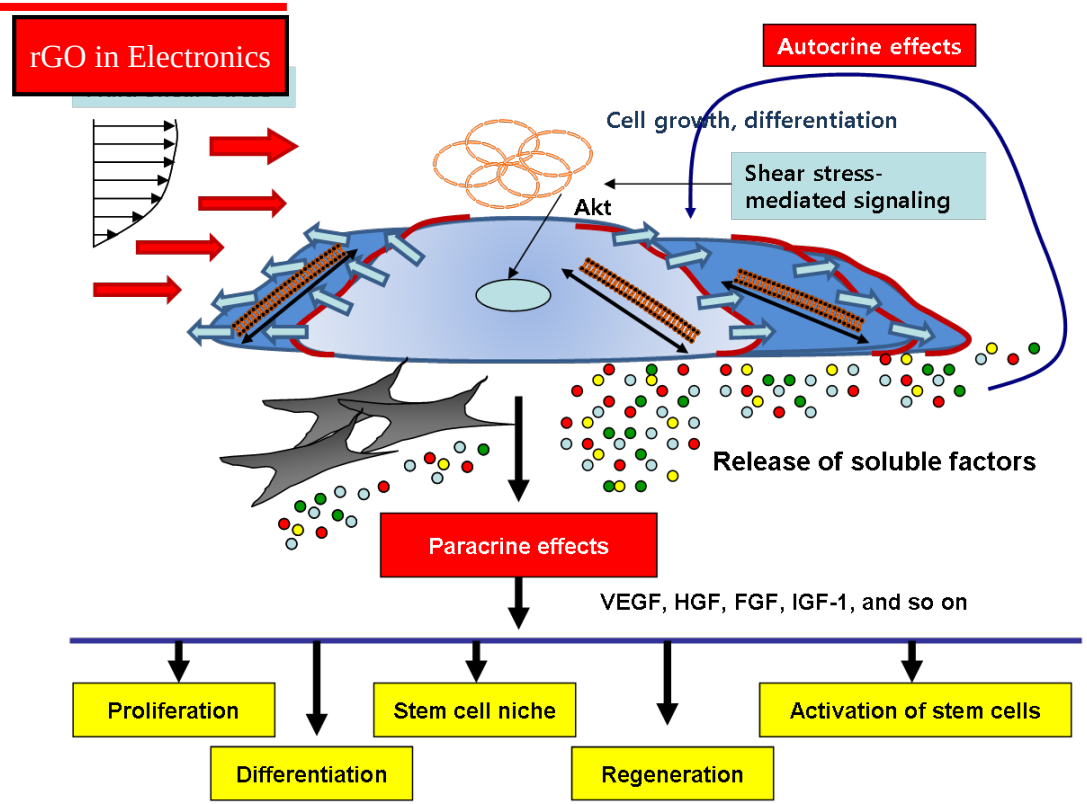

- **Rationale**: rGO can be providing a biocompatible nanocomposite that does not hamper the proliferation and accelerates their specific differentiation into cells

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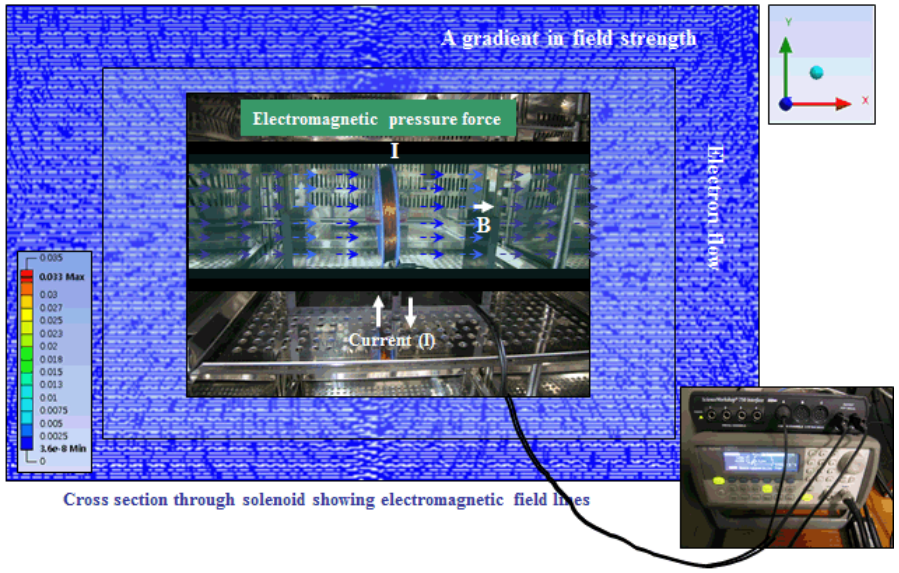
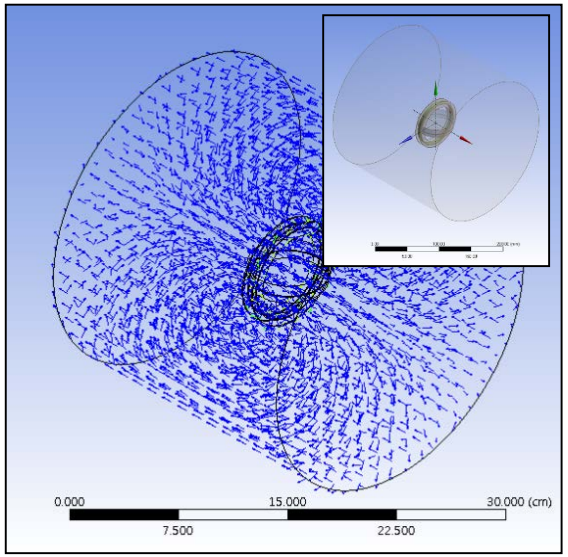
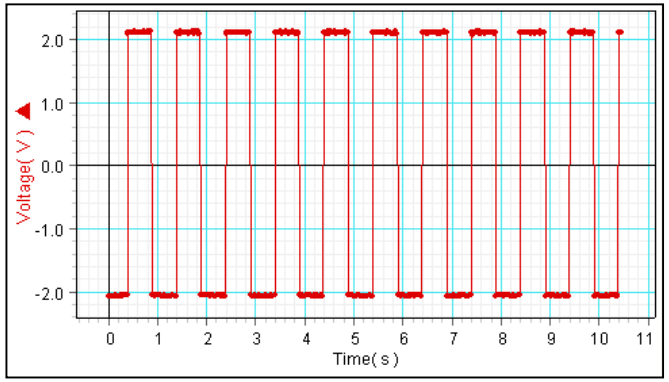
Boundary conditions

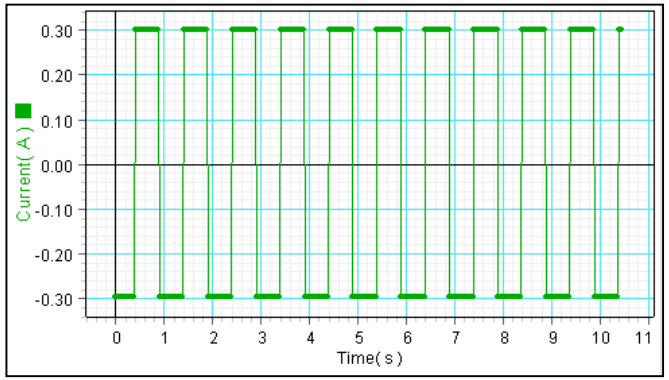


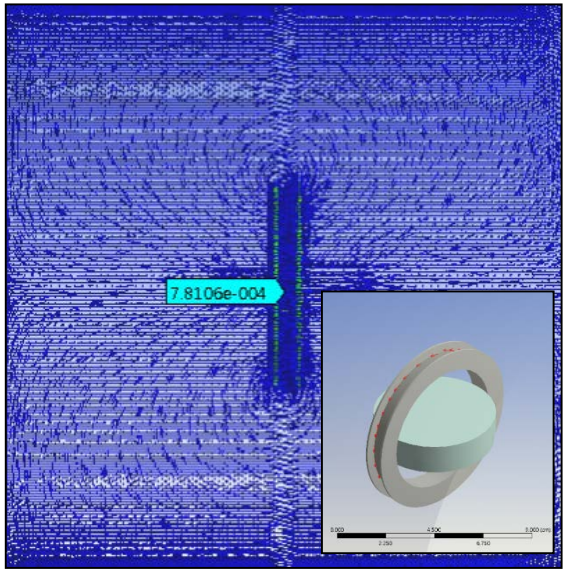
Cross section through solenoid showing electromagnetic field lines

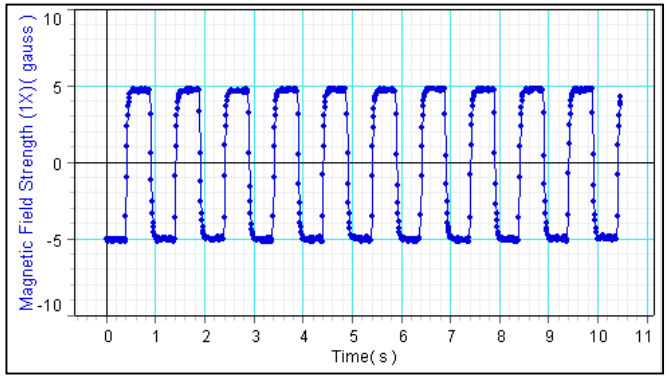
Electromagnetic fields and modeling by CFD











Electromagnetic fields in a solenoid

$B = \mu_0 n I$ where,

$\mu_0 = 4\pi \times 10E\text{-}7\ N/A^2$

$n = N/l$

$= (4\pi \times 10E\text{-}7\ N/A^2) \times 100 / 0.1\ m - 0.5A$

$= 0.00063\ N/A^2\ m$

$= 0.00063\ T$

$= 6.3$ Gauss ($1T = 10000G$; $1mT = 10G$)

Magnetic pressure P_B:

$P_B = B^2/2\mu_0$ where,

P: Pa
B: T
μ_0: $4\pi \times 10^{-7}\ N/A^2$

Electromagnetic pressure P_B:

$= 1.56 \times 10E\text{-}8$ Pa

$= 1.56 \times 10E\text{-}7\ dyn/cm^2$

The magnetic field is concentrated into a nearly uniform field in the center of a long solenoid. The field outside is weak and divergent

The electromagnetic pressure force is an energy density associated with the magnetic field strength by electric fields

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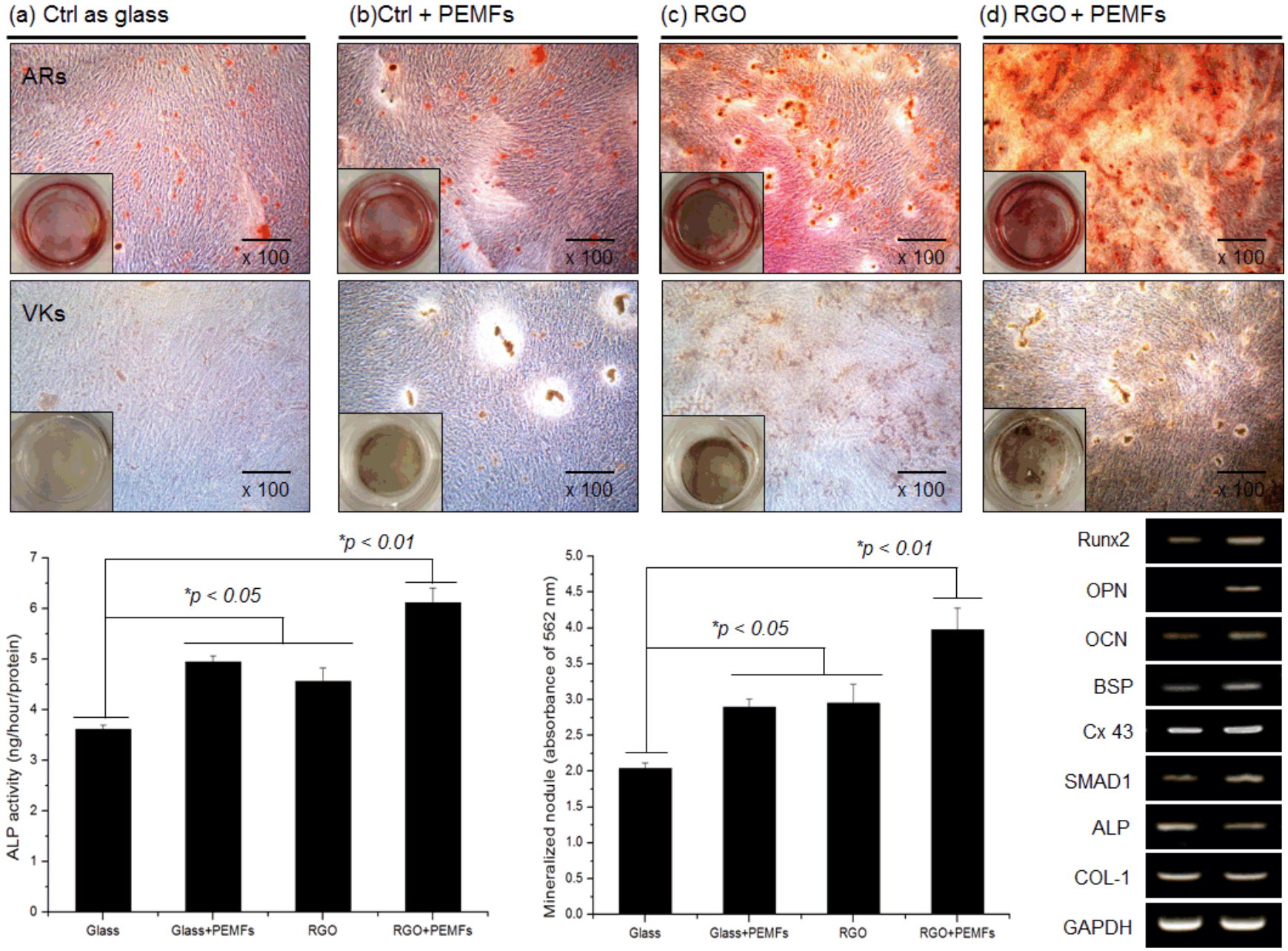

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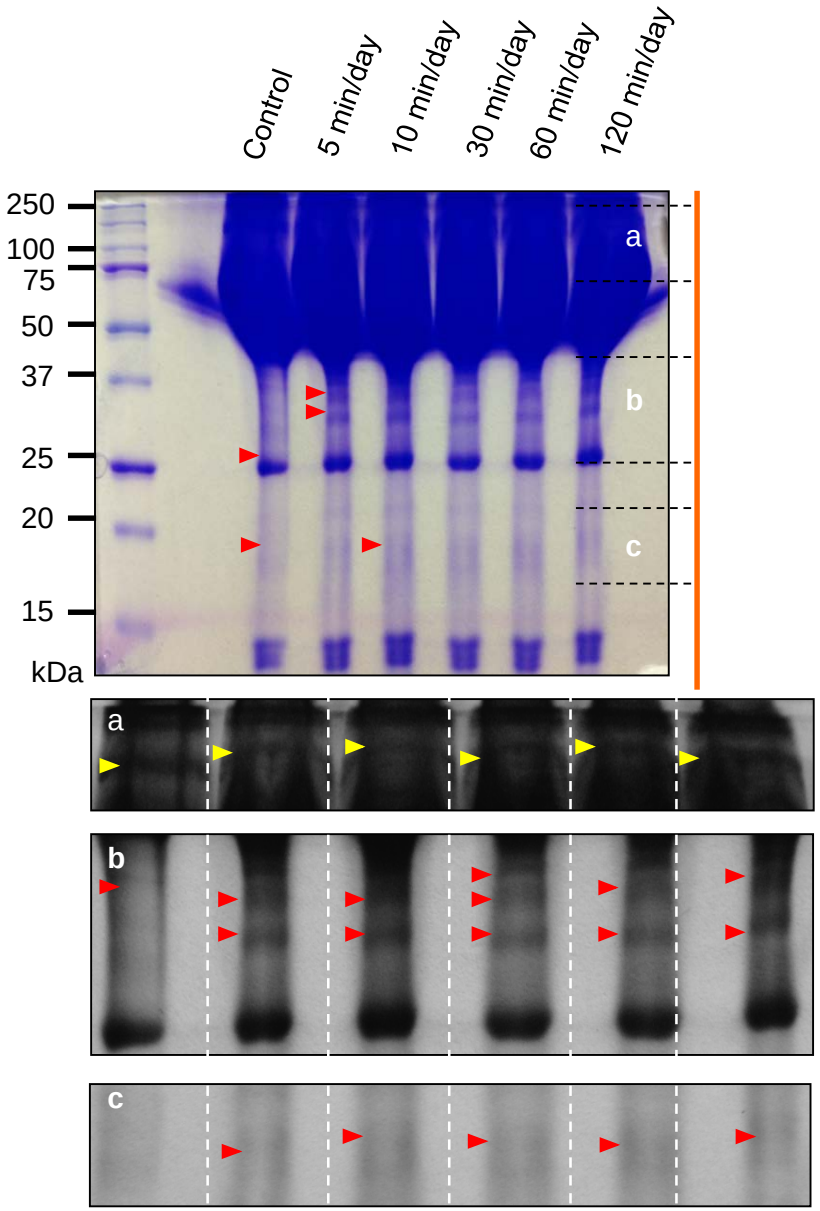

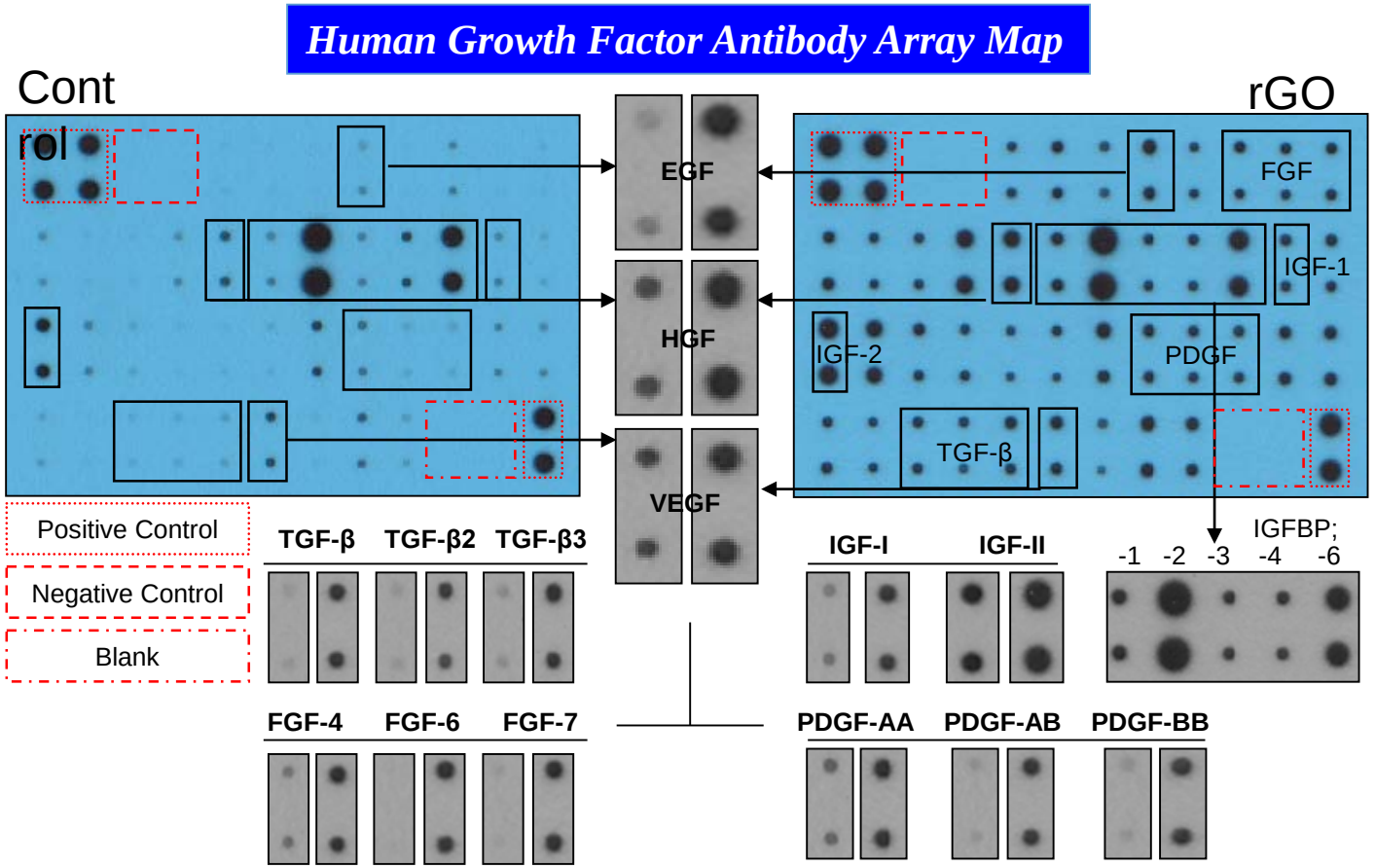

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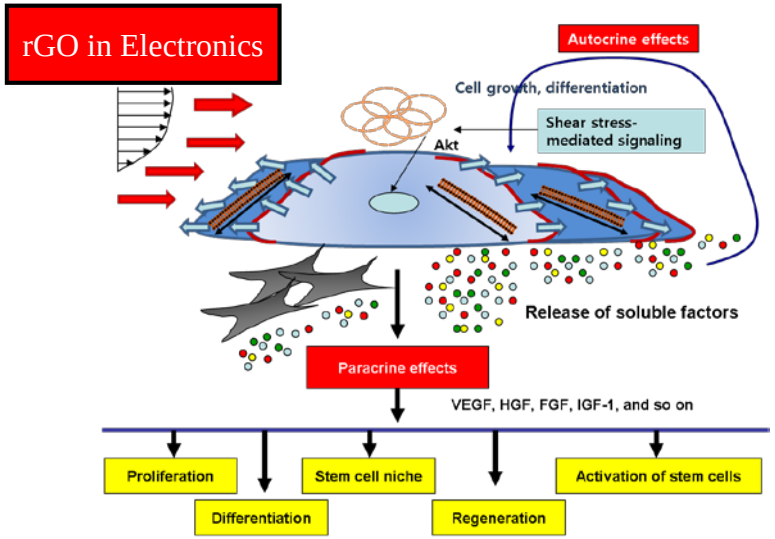
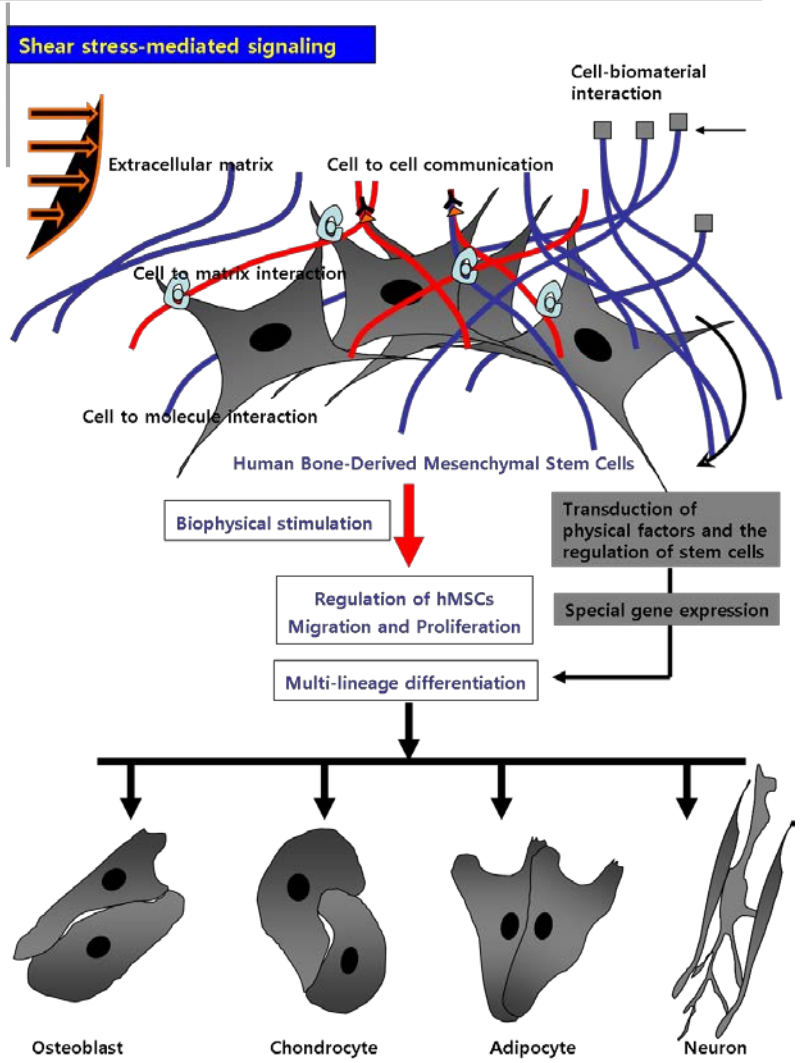
Conclusions

- Here we show that rGO with PEMFs as a graphene-based cell stimulator provides **a promising biocompatible nanocomposite as good substrates**

- Our bottom-up biomechatronic approach of tuning the rGO-sheet properties provides **a path to a broad new class of graphene-materials and their use in a variety of applications**.



rGO in electronics



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