Graphene as a substrate to enhance neurogenic differentiation of dental pulp stem cells

V. Rosa[1,2], T.T. Madanagopal[1], N. Dubey[2], JC Viana Gomes[2]

[1] Faculty of Dentistry, [2] Centre for Advanced 2D Materials and Graphene Research Centre

Introduction

Graphene is a single atomic sheet of conjugated sp^2 carbon atoms.

Graphene has remarkable properties (Fig. 1). Its electrical conductivity and charge carrier mobility surpass the most conductive polymers by several orders making graphene an interesting material for neural applications.

(i) Thinnest, strongest, and stiffest imaginable material

(ii) Almost transparent
(iii) Most stretchable crystal (20% elasticity)
(iv) Recording thermal conductivity
(v) Highest current density at room temperature
(vi) Completely impermeable
(vii) Highest intrinsic mobility (100 times more than in Si)

(viii) Conducting electricity in the limit of no electrons

(ix) Large surface area (~2600 $m^2 g^{-1}$)
(x) Longest mean free path at room temperature (micron range)

Fig.1: Characteristics of graphene

Objective

To explore the potential of graphene on neuron differentiation of dental pulp stem cells (DPSC).

Methods

Graphene (2DG) was produced by chemical vapour deposition (Fig. 1) and tranfered to coverslips.

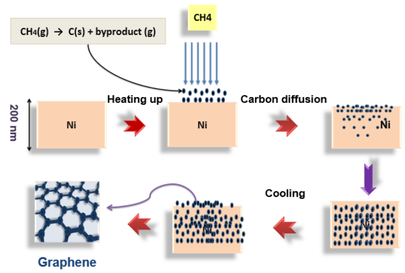

Fig. 2: CVD-growth process

DPSC were seeded on 2DG and glass (Gl, control) and treated with Neurobasal-A medium, 1X B-27 supplements, 1% pen/strep, 20ng/ml EGF and 40ng/ml bFGF.

Results

The characteristic Raman peaks for G and 2D bands at 1587 and 2689 cm^{-1} shows that 2DG was successfully generated (Fig. 3).

MTS assay showed that the cell proliferation (Fig. 4) was similar for both Gl (blue) and 2DG (black)

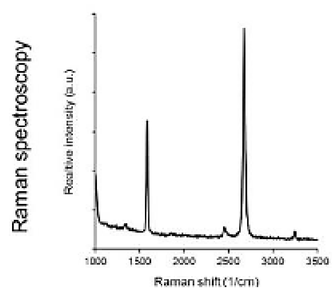

Fig. 3: Raman characterization of CVD-grown graphene (2DG)

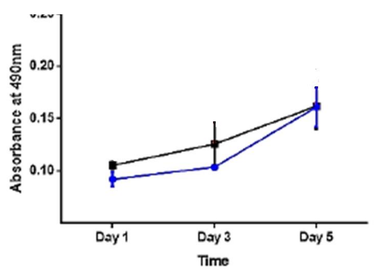

Fig. 4: Cell proliferation was similar for 2DG (black) and Gl (blue, p>0.05 for all time poinst))

DPSC on 2DG presented significant increase in gene expression of neurongenic-related genes (Fig. 5).

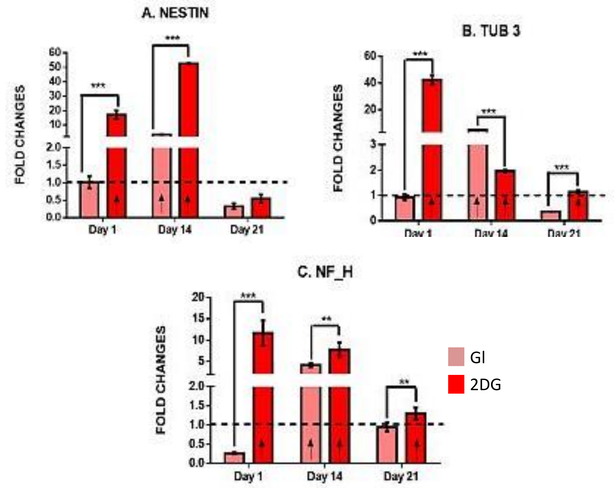

Fig. 5: DPSC on 2DG presented increased expression of neurogenic-related genes (*= p<0.05, **=p<0.01, ***=p<0.001)

2DG also increased the expression of neurogenic-related proteins as observed by FACS (Fig. 6).

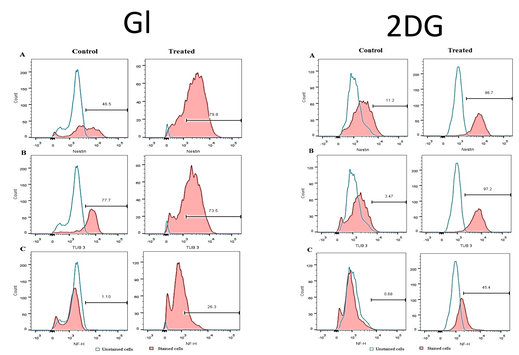

Fig. 6: Expression of neuron-related proteins

Conclusion

2DG is promising platform to increase neurogenic differentiation of DPSC

Acknowledgement

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