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Effect of graphene coated titanium via wet and dry transfer technique on collagen synthesis by pre-osteoblast

Introduction: Graphene is an attractive coating material for biomedical implants to enhance the biomineralization of osteoblast due to its tuneable physicochemical properties, flexible design, and biomolecule storage capacity[1-3]. Despite numerous study on biomineralization capacity of graphene, there is yet no systematic characterization of the mineral phase produced by osteoblast cultured on graphene. Here we have isolated and characterised an osteoblast- derived matrix (MX) from MG-63 cultured on commercially pure titanium (CpTi) and on graphene transferred by wet and dry transfer technique on CpTi.
Method: CpTi disks (12 mm in diameter x 1 mm thick) were obtained by cutting a rod and polished up to P2500. Chemical vapor deposition was used to synthesize graphene on 35 µm thick copper substrate using methane and hydrogen as precursors. Graphene was transferred on commercially pure titanium using wet transfer (WGp) and dry transfer (DGp) technique. The substrates (CpTi, WGp and DGp) were characterized using Raman spectroscopy, Atomic force microscopy (AFM). The osteoblast matrix was isolated using 0.02 M NH_4OH in ddH2O for 5 min at 25˚C and the types of collagen secreted were evaluated by quantitative RT-PCR. Statistical analyses were performed using the One-way ANOVA (α =0.05).
Results: Raman spectra showed that graphene was successfully transferred to CpTi as the 2D (∼2500-2800 cm^{-1}) and G (∼1587 cm^{-1}) peaks were detected on CpTi (Figure 1A and 1B). AFM analysis showed that the graphene film deposited by both techniques presented surface characteristics comparable to those of CpTi (Figure 1C to 1e). Furthermore, RT-PCR (Figure 2) showed upregulated collagen marker expression during osteogenesis of MG-63 for samples coated with graphene.
Conclusion: Graphene can be transferred to CpTi using both wet and dry techniques. Treatment with 0.02 M NH_4OH showed the successful removal of cellular components and retention of the extracellular matrix. Furthermore, RT-PCR demonstrate that substrate coated with graphene showed enhance collagen production.

References

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[3] Morin, J.; Dubey, N.; Decroix, F.; Luong-Van, E.; Neto, A.C.; Rosa, V,2D Materials 2017, 4, 025060.

Figures

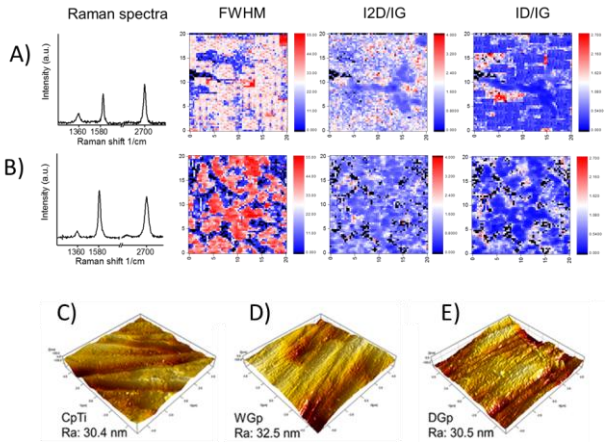

Figure 1: Raman characterization of graphene films on titanium by wet (WGp) and dry (DGp) techniques. The Raman spectra confirm that the films were successfully transferred onto titanium via both techniques. AFM characterization of graphene on titanium by dry transfer (C), wet transfer technique (D) and CpTi (E).

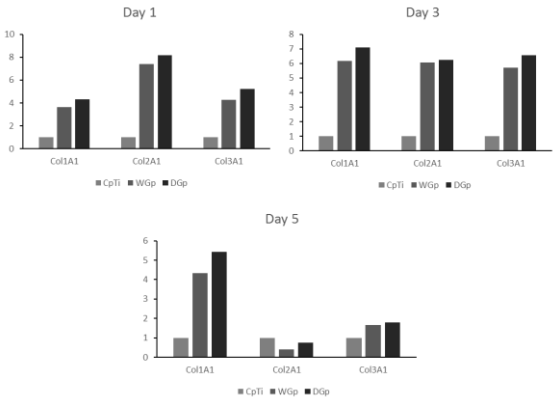

Figure 2: Transcriptional level of type of collagen synthesis of MG63 cells cultured on CpTi, WGp and DGp.