

Undifferentiated adult human mesenchymal stem cells (*ahMSCs*) response on a novel graphene coated – Nurse’s A phase bioceramic

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Introduction

It is well known that Si-Ca-P bioceramics are promising bioactive materials for bone tissue engineering, particularly for bone repair. Recently, it has been reported that graphene can be used as an additive to improve the properties of composites due to its biocompatibility and it has been proposed for a number of biomedical applications¹.

It has been shown that graphene oxide (GO) and reduced graphene oxide (r-GO) can promote biological interactions due to its many surface functional groups and serve as a carrier for drugs and other biomolecules. In addition, GO regulates the proliferation and differentiation of cultured mesenchymal stem cells².

Here, we report a simple method for the coating of a Si-Ca-P bioceramic (Nurse’s A phase ceramic, **A**) with graphene oxide (**A-Go**) and reduced graphene oxide (**A-Gr**) and a simple test for the biocompatibility of this biomaterials with adult human mesenchymal stem cells (*ahMSCs*).

Material and methods

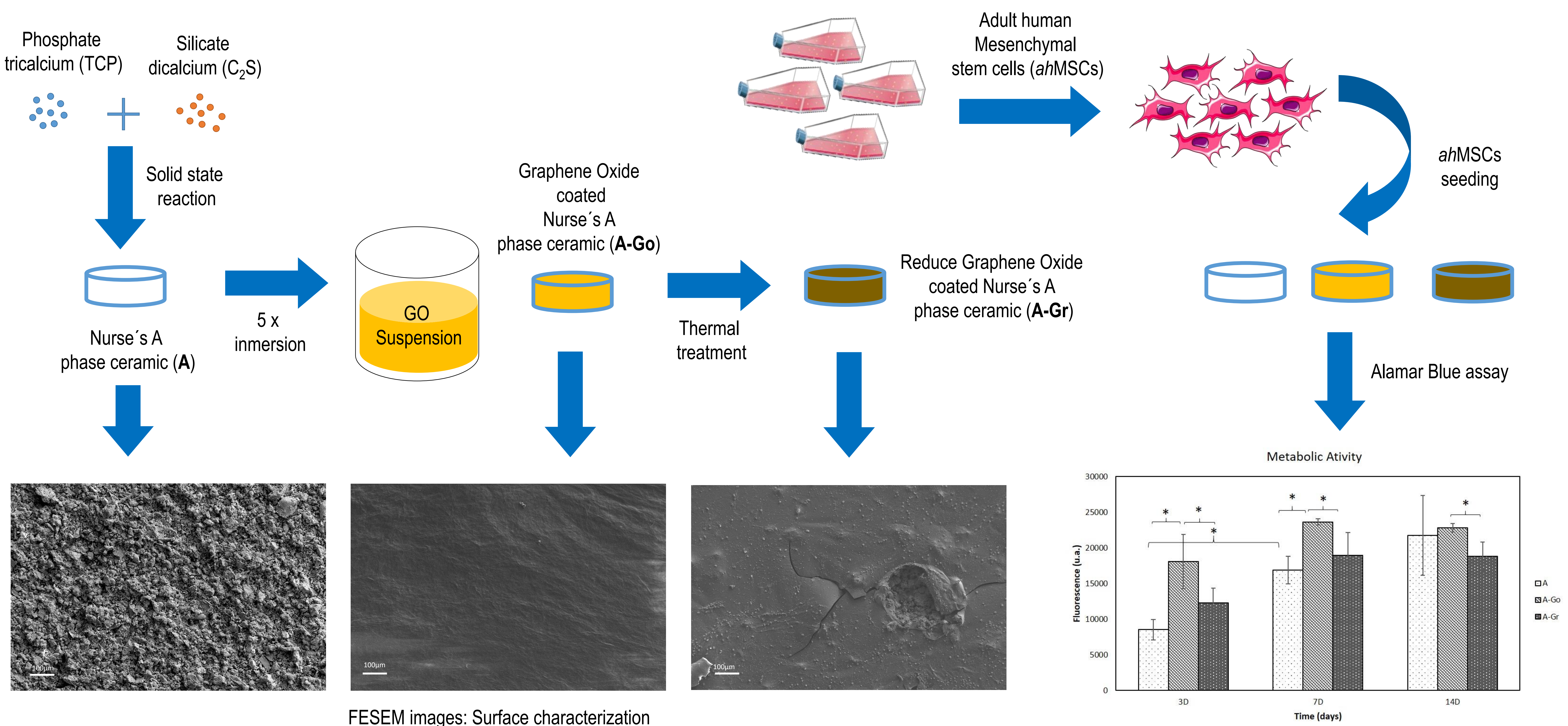
A Si-Ca-P (Nurse’s A phase, **A**) single-phase ceramic material was prepared from tricalcium phosphate and dicalcium silicate ceramics, which were used as starting materials. Nurse’s A phase scaffolds were coated with graphene oxide (GO, **A-Go**) by means of five cycles of 20 minutes of immersion in 50 mL of aqueous suspensions of GO (GRAPHENEA, San Sebastian, Spain), alternating them with drying periods of 24 h. After this, some of the bioceramics were immersed in an aqueous solution of ascorbic acid (20 mM) for 3 h at 70 °C to reduce the GO (**A-Gr**). Bioceramics surface were studied by FESEM in order to verify the covering of the scaffolds.

To assess the biological properties and the biocompatibility of the Nurse’s A phase ceramics, adult human mesenchymal stem cells (*ahMSCs*) were seeded onto the top of A, A-Go and A-Gr. After that, a metabolic activity assay was run (Alamar Blue™ assay, Invitrogen) to test the cellular proliferation.

Results

- A Si-Ca-P (Nurse’s A phase, **A**) single-phase ceramic material coated with graphene oxide (**A-Go**) and reduced graphene oxide (**A-Gr**) were obtained.
- FESEM images of the bioceramics verify that surface scaffolds were well covered by a thin graphene layer. Also, we could observe some small particles on the A-Gr surface, probably due to the precipitation of different ions.
- Alamar Blue assay showed that A, A-Go and A-Gr were biocompatible with *ahMSCs* and stimulate the cellular proliferation.
- Cells seeded on A-Go showed a major metabolic activity after 3 and 7 days after the seeding. After two weeks, cells proliferate at the same level in all materials.

Graphical abstract



FESEM images: Surface characterization

Conclusions

In this work, we have optimized the **graphene coating of a Si-Ca-P bioceramic**, obtaining scaffolds totally covered by a thin layer of graphene oxide and reduced graphene oxide.

In vitro assays with *ahMSCs* showed that **A-Go stimulates cellular proliferation** more than A-Gr the first days of culture. This could support the theory of other researchers that indicates that graphene oxide mainly stimulates cell proliferation, while reduce graphene oxide favors cell differentiation.

After these experiments, we will have to carry out more tests *in vitro* e *in vivo* to verify which coating is better to induce the regeneration of bone tissue.

Acknowledgements

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References

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2. Chen, G. Y. et al. (2012). A graphene-based platform for induced pluripotent stem cells culture and differentiation. *Biomaterials*, 33(2), 418-427.



Vcard
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