Chemical-physical characterization of porcine bone derived granules enriched with graphene oxide

V.Ettorre[1*], *A. Di Crescenzo*[1], *P. De Marco*[1], *V. Perrotti*[2], *A. Scarano*[2], *M. Petrini*[2], *C. Hadad*[3], *D. Bosco*[4], *G. Iezzi*[2], *A. Piattelli*[2] *and A. Fontana*[1]

[1]Department of Pharmacy, University "G. d'Annunzio", Via dei Vestini 31, 66100 Chieti, Italy; [*]e.mail: valeria.ettorre@unich.it
[2] Department of Medical, Oral and Biotechnological Sciences, University "G. d'Annunzio", Via dei Vestini 31, 66100 Chieti, Italy
[3] Center of Excellence for Nanostructured Materials (CENMAT), INSTM, University of Trieste, Piazzale Europa 1, 34127 Trieste, Italy
[4] Molecular Genetics Institute, CNR Unit of Chieti, 66100, Italy

In recent years hydroxyapatite is playing a major role in the field of biomaterials. It is primarily used for bone regeneration as bioactive and osteoconductive material capable of promoting the adhesion and proliferation of osteoblasts. This material, however, has a poor resistance to fracture. The aim of this study was to overcome the limitations of this material (APATOS CORTICAL OSTEOBIOL®), already used in the biomedical field, by depositing a thin layer of graphene oxide (GO) on the surface of the granules in order to increase the resistance and evaluate the behavior of this new material in contact with the tissues. After the synthesis of GO by the modified Hummers method[1] and the deposition on the granules, they were subjected to chemical-physical characterization (FT-IR, Raman spectroscopy, SEM, TEM and TGA analysis) to assess the homogeneity and the quality of the coating.

FTIR spectrum shows characteristic bands of hydroxyapatite[2] but due to low percentage of GO on the surface of the sample is not possible to find it in the spectrum. The recorded Raman spectra of the GO enriched porcine bone granules (Figure 1) show the tipical peaks of GO and bone tissue attributable to mineral and organic phases.[3] TEM image of a coated granule shows that GO coats the granules of HA although GO is not deposited as monolayer. SEM micrographs show a relatively smooth surface of GO-enriched hydroxyapatite. (Figure 2)

Mechanical investigations showed that GO significantly increased sample fracture resistance of the pre-formed granules.

To quantify the amount of GO deposited on the surface of the granules thermogravimetric analysis was performed.[4] This analysis assesses the loss in weight percentage of the sample subjected to heating. The results show that the GO that is deposited on the granules is about 1.6%.

In conclusion, this study presents a novel and low cost approach to the development of GO-enriched functionalized biomimetic hybrid materials which can be applied to other bone substitute materials in order to improve their performances such as resistance to mechanical stress.

References

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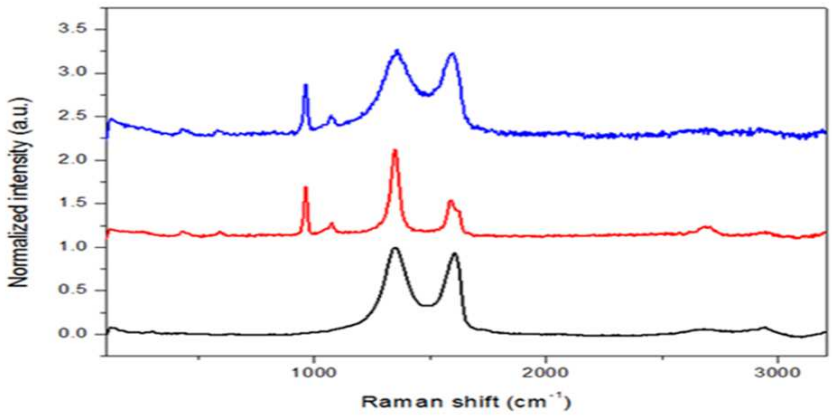

Figure 1: Raman spectra of porcine bone granules and GO. Blue curve rapresents the enriched GO porcine bone granules, the red curve porcine bon granules and the black curve GO.

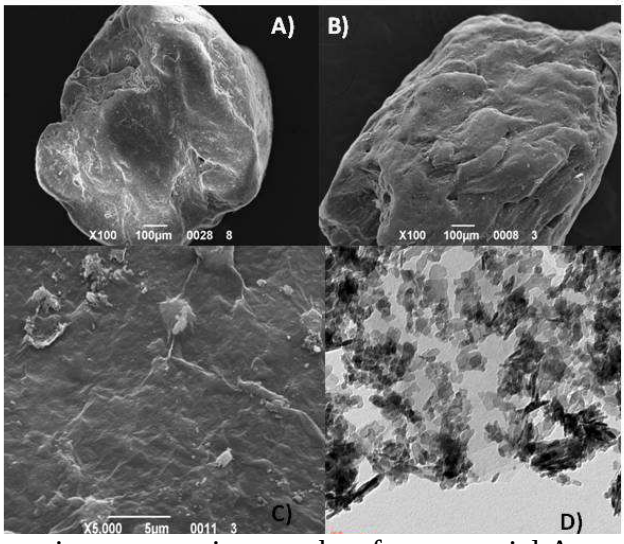

Figure 2: Scanning electron microscopy micrographs of commercial Apatos cortical OSTEOBIOL® (A) and of the GO-coated granules (B and C); TEM micrograph of GO-coated granules (D)