Nb-C nanocomposite coatings for biomedical applications

Luis Yate[1], **L. Emerson Coy**[2], Danijela Gregurec[3], Willian Aperador[4] , Sergio E. Moya [3], Guocheng Wang [3]*

[1] Surface Analysis and Fabrication Platform, CIC biomaGUNE, Paseo Miramón 182, 20009 Donostia-San Sebastian, Spain
[2] NanoBioMedical Center, Adam Mickiewicz University, Umultowska 85, 61-614 Poznan, Poland
[3] Soft Matter Nanotechnology Laboratory CIC biomaGUNE, Paseo Miramón 182, 20009 Donostia-San Sebastian, Spain
[4] School of Engineering, Universidad Militar Nueva Granada, Carrera 11 #101-80, 49300 Bogotá, Colombia
Corresponding author: gwang@cicbiomagune.es *
Presenting author: coyeme@amu.edu.pl

Abstract Hard-elastic coatings with bioactive properties are very promising for many biomedical applications, specifically in the field of implantology. Carbon, especially amorphous (a-C) and diamond-like carbon films (DLC) films have attracted much attention in biomedical fields due to their biocompatibility and low coefficient of friction. However, they are unsuitable for uses as a "bioactivity enhancer" of orthopedic implants due to their bioinertness. In this work, we use the non-reactive magnetron sputtering technique to produce a-C films including the biocompatible niobium (Nb) element to alter the surface chemistry and nanotopography of the aC films with the purpose of bioactivating the a-C film coated implants. Results show that the nanocomposite films/coating (Nb-C) formed by the addition of Nb into the a-C films not only have improved corrosion resistance, but also possess enhanced mechanical properties (nanohardness, Young´s modulus and super-elastic recovery). Preosteoblasts (MC3T3-E1) cultured on the Nb-C films have enhanced adhesion and upregulated alkaline phosphatase (ALP) activity, compared to those cultured on the a-C film and TiO2 films used as a control, which are thought to be ascribed to the combined effects of the changes in surface chemistry and the refinement of the nanotopography caused by the addition of Nb. Results are very promising and encouraging due to their potential impact in both protective coatings and biomedical fields.

References

[1] Yate, L.; Coy, L. E.; Wang, G.; Beltrán, M.; Díaz-Barriga, E.; Saucedo, E. M.; Ceniceros, M. A.; Zaleski, K.; Llarena, I.; Möller, M.; et al. Tailoring Mechanical Properties and Electrical Conductivity of Flexible Niobium Carbide Nanocomposite Thin Film. **RSC Adv.** 2014, **4**, 61355–61362.
[2] Luis Yate, L. Emerson Coy, Danijela Gregurec, Willian Aperador, Sergio E. Moya, Guocheng Wang. Nb-C nanocomposite films with enhanced biocompatibility and mechanical properties for hard-tissue implant applications ***submitted jan -2015***

Figures

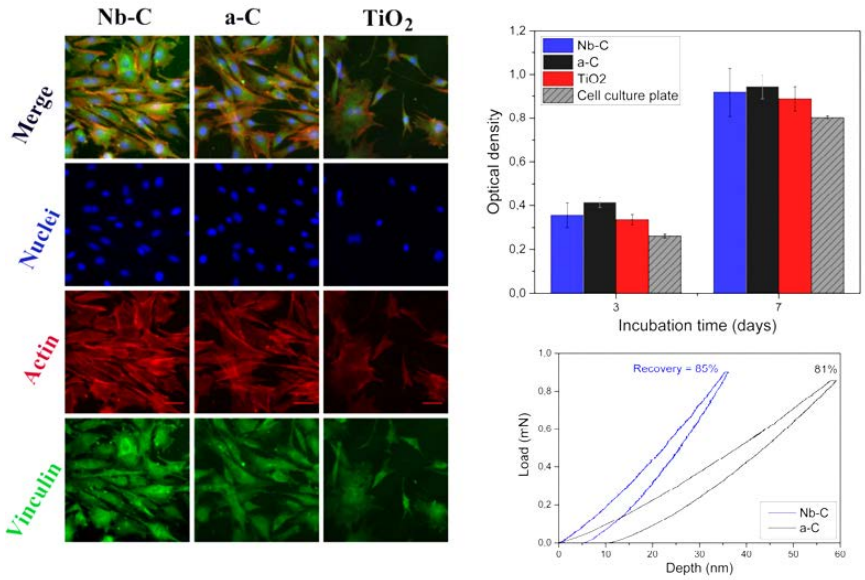

Figure shows, proliferation studies (left & right top) and mechanical properties (bottom right)