PUBLISHABLE SUMMARY

Biofunctionalization of materials for application in regenerative medicine constitutes a constantly expanding field that is likely to introduce revolutionary changes in classical healthcare and drastically improve the quality of life of patients. In recent years, extensive research has focused on the development of new biomaterials with the ability to restore damaged parts of the body or enhance tissue regeneration. However, much of this challenging area of research remains to be explored and some serious concerns need to be addressed. One of the major issues has proven to be an inadequate interaction between the materials and the surrounding tissue, leading to unwanted adverse reactions such as inflammation, infections, aseptic loosening, implant encapsulation, thrombosis and embolism. A poor biointegration of an implant material is therefore associated with limited long-term medical outcomes. To overcome this issue, **strong and stable biochemical and mechanical interactions between the implant surface and the surrounding bone tissue are required after the implant surgery**.

Thus, the aim of this project was to **develop novel metallic biomaterials functionalized with cell adhesive and antibacterial biomolecules** with the capacity to **selectively improve cell adhesion and biointegration**, and to **reduce the risk of bacterial infections**. Such materials could be used as **orthopedic and dental implants for regenerative medicine.**

To this end, in this project a novel set of metallic materials based on titanium and tantalum were produced and biofunctionalized with cell adhesive and antibacterial biomolecules. These coating molecules included linear and cyclic peptides, peptide-based dimeric platforms, peptidomimetics and polymeric nanocapsules. The resulting biomaterials were carefully characterized by physicochemical and biological methods. In summary, the biomaterials **enhanced the adhesion of osteoblasts and the osteogenic differentiation of mesenchymal stem cells in vitro, and improved bone formation in vivo**.

Hence, the biofunctionalization strategy proposed in this project **successfully supported and promoted the biological processes required to ensure an optimal osseointegration of the implant material**. Furthermore, the experimental data demonstrate the **osteoinductive properties** of the coating molecules and **validated the approach of this research project in an animal model**.

The biomaterials produced in this project offer the following advantages in regards to currently available materials:

1) The biomaterials produced are **Ni-free, highly bioactive and biomechanically compatible**
2) The biomolecules used display **higher receptor/cell specificity, biological activity and stability** than other classical strategies (e.g. linear peptides or proteins). Moreover they have capacity to **install multifunctionality on biomaterials**.
3) Furthermore, the surfaces show **strong antibacterial properties** and, therefore, have the capacity to reduce infections associated to the use of medical devices.

During the Marie Curie Career Integration Grant (CIG) the fellow has **established his own research lines, which he has led in an independent manner** within the host research group. He has been **co-director of 2 PhD students,** has hosted 2 PhD exchange students, and directed 7 Master and/or End of Course projects. He has has been very active in the publication of research during the CIG (Nov 2012 – October 2015) with **13 articles** (4 more submitted, 1 under preparation), **2 reviews** and **2 book chapters**. Noteworthy, he has signed **7 publications**

as last and/or corresponding author. Moreover, the fellow has been very active in other research activities including: oral communications (**11**) and posters (**9**) in international conferences (3 of them awarded), **3 invited talks**, organization of **1 course and 3 conferences**, preparation of grant proposals, and reviewing of grants and manuscripts. The fellow has also been involved in **teaching activities** at the host institution.

The Marie Curie CIG has thus very positively supported and contributed to the fellow integration and career development.