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Short biography

Thierry Gloriant is Professor at the National Institute of Applied Sciences of Rennes (INSA Rennes), France. He is head of the Metallurgical-Chemistry Laboratory of the ISCR CNRS 6226 Unit. After a Ph.D Thesis in Materials Science at the University of Lille, France, he was post-doctoral researcher at the University of Cambridge, UK, in the Department of Materials Science & Metallurgy. During his career, he was visiting scientist at the University of Barcelona, Spain, and at the National Institute for Materials Science at Tsukuba in Japan. T. Gloriant research interests concern the structural metallurgy of different class of alloys with a predilection for those elaborated far from equilibrium (metallic glasses, nanostructured alloys, metastable states…). One of the main research activities carried out by Prof. Gloriant concerns the development of new functional alloys for biomedical applications. In this research field, many collaborative research projects have been set-up under his supervision in association with biologists, clinicians and industrial partners developing metallic biomedical devices such as orthopedic prosthesis, cardiovascular stents, orthopedic staples, dental implants… At the national level, Prof. Gloriant is president of the "Materials for Health" commission endorsed by the French Society of Materials and Metallurgy (SF2M) and by the French Association of Ceramics (GFC).

Title of the communication

Titanium alloys in the human body: from those implanted today towards the design of the new functional alloys of tomorrow

Abstract

Titanium and titanium alloys are widely used for biomedical applications due to their numerous advantageous properties: low density, high mechanical properties, good biocompatibility… Thus, many standardized biomedical grades are available for the manufacture of medical devices such as commercially pure CP Ti or Ti-4Al-6V ELI alloy for example. Consequently the mumerous grades can be a source of confusion, particularly for the practitioners and the clinicians. In this communication, an overview of the titanium alloys used in medicine will be proposed with the description of their advantages and disadvantages. On the other hand, metastable titanium alloys containing biocompatible elements (such as niobium, tantalum, zirconium, hafnium…) show interesting mechanical properties for biomedical applications. Indeed, it was observed for some compositions a stress-induced martensite transformation leading to a superelastic effect. These non-allergenic Ni-free alloys can then be envisaged to replace the TiNi shape memory alloy for the fabrication of biomedical smart devices such as coronary stents, orthopedic staples or orthodontic wires. On the other hand, this superelastic effect is accompanied by a very significant reduction of the elastic modulus, which is very beneficial for the medical devices in osseous site such as hip prostheses or dental implants. Thus, the challenge consists here to optimize the chemical composition, the microstructure and the mechanical properties in order to propose new highly biocompatible titanium alloys possessing the mechanical properties adapted to dedicated medical devices.