Bone Healing Characterization by Synchrotron Diffraction at HA Coated and Uncoated Implant Interfaces.

Pr Pierre Millet
LACM EA 3304 LRC CEA DSM0534

The oral environment provides an extraordinary opportunity for the fundamental researcher associated to the oral health care provider, the dentist, because it presents a heterogeneous, evolutive, aggressive and uncontrolled environment. Materials must be biocompatible, functional, esthetic, durable and in a cost-effective manner.

If understanding the basic principles behind human tissue response to artificial surface implantation may be developed under its biological aspect, it is necessary for a medical use to study the mechanical limits of every biomaterials to predict the tissue and the body's response according to the composition, the structure and the design of a biomedical material. To promote a stable and functional direct connection between bone and implant, titanium implants can be coated with materials based on calcium phosphate ceramics such as hydroxyapatite (HA)($Ca_{10}(P0_4)_6(OH)_2$). The longevity of the HA coated implants are conditioned by the quality of the bonding to natural bone and by the unavoidable rate of bioresorption in the host organism. As clinical reports present HA coated implants failures, manufacturers improved their process and post-treatment of hydroxyapatite in order to increase the crystallinity ratio and to limit the resorbability of the coating. The *in vivo* bone integrations are usually investigated by mechanical testing measurements and histological analysis. We present different original methods, based on diffraction techniques using synchrotron radiation to characterize coatings, bone-implant interfaces and bone regeneration. We compare the experimental results to simulation of the plasma spraying technique. These original and non-destructive experimental methods give mechanical data about a complicated biological interface. This information, which cannot be reached by other usual methods, has a real clinical significance for orthopedic and dental surgery.