Ion doped apatite coatings by laser ablation

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The mineral family of apatites presents the property of being able to incorporate a variety of ions and compounds into its structure [2]. Hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$ (HA), is a member of the apatites group which has been investigated extensively as a biomaterial due to its resemblance to the inorganic phase of bone. The growing evidence of the beneficial role of different ions (Si, Se, Mg^{2+}, K^+, Na^+, F^-, Sr^{2+}, …) in bone tissue has increased the interest of developing ion doped apatites for medical applications, and specifically biocompatible coatings that can be deposited on metallic implants to benefit from their loadbearing capabilities, protection against the release of metal ions into the body and improvement of the implant fixation to hard tissues.

Pulsed laser deposition (PLD) is a technique that has proven effective in the fabrication of calcium phosphate films on metallic substrates with excellent final coating attachment. It makes use of laser pulses to expel target material from a rotating disk placed inside a vacuum reaction chamber and project it on the surface of a metallic substrate. The PLD method outperforms other techniques in versatility, since the choice of its ablation and deposition parameters control of the stoichiometry and crystallinity of the deposited material.

Ion doped hydroxyapatite (*i*HA:Si,Sr,Se) coatings have been fabricated by pulsed laser deposition (PLD) from initial targets obtained after mixing and compacting commercial HA and different proportions of precursors powders. The macroscopic morphology of the films presented in all cases equivalent spherical shaped aggregates of typical calcium phosphate coatings (see an example in Fig. 1). The incorporation of different ions (silicon, selenium, and strontium) into the HA compounds follows a linear behavior with the composition of the precursor compound in the original ablation target (Figs. 2 and 3).

Additionally, the coatings thus fabricated were structurally, morphologically and chemically characterized using scanning electron microscopy, optical profilometry, X-ray diffraction, Fourier-transform infrared spectroscopy, X-ray photoelectron spectroscopy and energy dispersive X-ray spectroscopy. The role of the ion doped in the modification of the HA structure and possible substitutional mechanisms are discussed.

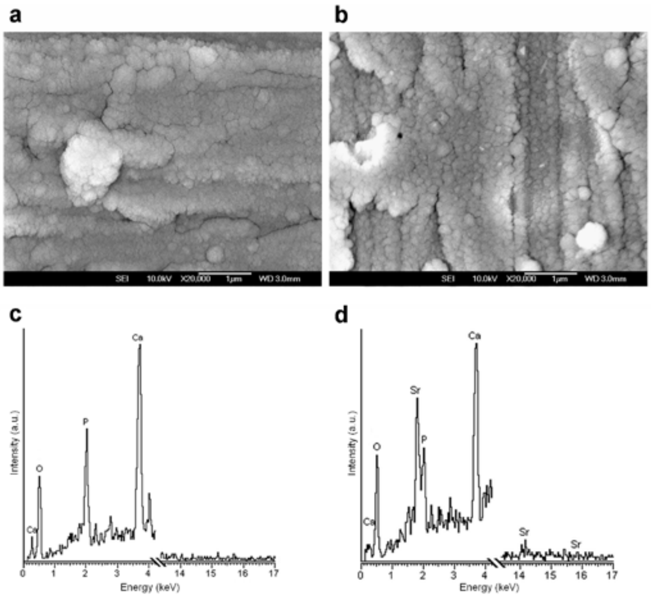

Fig. 1 SEM micrographs and EDS analysis of two representative coatings deposited on titanium: pure HA (a,c) and *i*HA:Sr produced from an ablation target of 10% Sr (b,d).

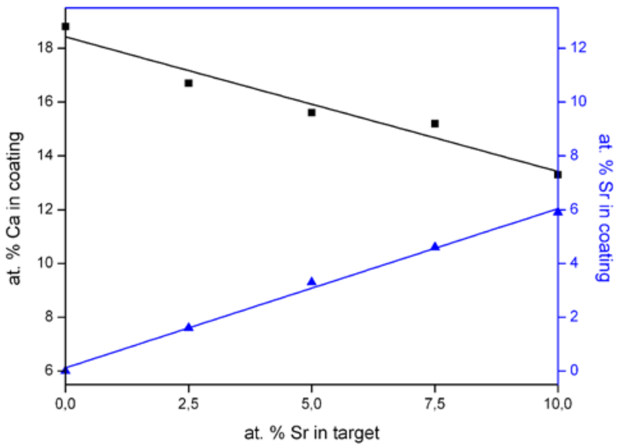

Fig. 2 Incorporation of Sr (▲) in the coating measured by XPS as a function of the at. % of Sr in the target, and consequent decremental effect of the Ca (■) content in the coatings.

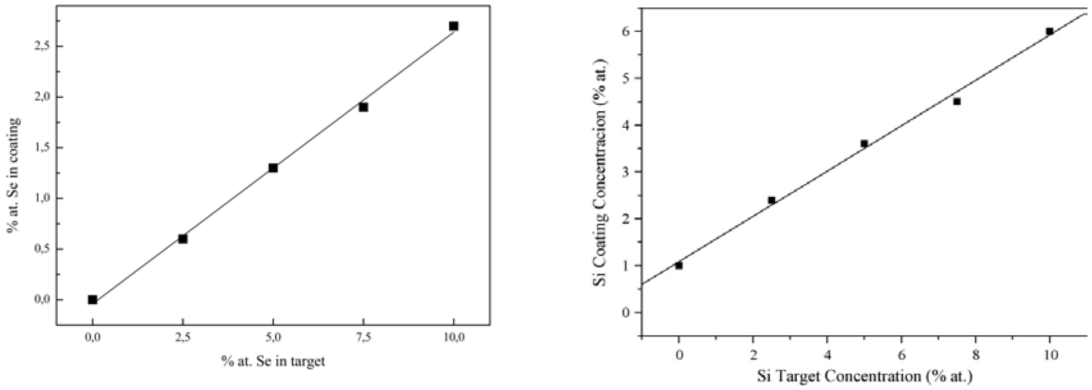

Fig. 3 Similar behaviors were found for *i*HA:Si and *i*HA:Se coatings obtained by laser ablation.