PLASMA ASSISTED PULSED LASER DEPOSITION OF HYDROXYLAPATITE THIN FILMS

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Aim
The investigation of the effect of different reactive gas atmospheres and the incorporation of a RF plasma source in the pulsed laser deposition of hydroxyapatite coatings

Material: Hydroxyapatite
- Calcium phosphate compound with formula: \([\text{Ca}_n(\text{PO}_4)_m(\text{OH})_3]\).
- Main bone constituent.
- Coatings of HA are used in implant technology to improve the bonding of prostheses to the bone.
- Its most important property is the ability of bond formation with living tissue.

Method: Radiofrequency Plasma Assisted Pulsed Laser Deposition

Conclusions
Pulsed Laser Deposition in a reactive atmosphere allows a fine control of the HA coatings properties.

The atmosphere plays an important role in the growth, bonding configuration and local structure of the PLD HA coatings.

The \(\text{H}_2\text{O}\) vapour atmosphere is the most appropriate one in order to obtain a crystalline coating.

RF plasma increases the deposition rate and improves the crystallinity of the HA coatings by diminution of the \(\text{CO}_2\) groups.

Acknowledgements

Results

Influence of the atmosphere
FTIR Analysis

Compared to \(\text{Ar}\) and vacuum, water vapour atmosphere induces:
- Increase of the crystallinity grade, indicated by the sharpness of the FTIR peaks.
- Structural changes in the lattice, indicated by the \(\text{PO}_4^{3-}\) \(\nu_3\) shifting.
- Higher deposition rate, indicated by the intensity of the peaks.

Influence of the RF plasma
FTIR Analysis

- The increase of the intensity of the \(\text{PO}_4^{3-}\) \(\nu_3\) band indicates an increase of the film growth rate.
- The increase of the \(\text{PO}_4^{3-}/\text{CO}_2\) ratio indicates a diminution of the \(\text{CO}_2\) groups which improves the crystallinity grade of the films.

EDS Analysis

Ca/P ratio measured with standards

- The Ca/P ratio was calculated with the calibration plot using three standards of Calcium Phosphate.
- The Ca/P ratio is an important parameter to assess the quality of the HA films.
- The RF plasma does not seem to affect the ratio of Ca and P present in the films.

XRD Analysis

- The (002) and (200) reflections present in the film deposited without RF plasma are clearly attenuated.
- The (211) and (112) reflections tend to be more well defined, which indicates less content of \(\text{CO}_2\) groups.
- The diminution of \(\text{CO}_2\) indicates an improvement of the crystallinity grade of the films. This result is in agreement with the FTIR analysis.