

Solubility Behaviour of Bioceramic Coatings

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Introduction

Bioceramics using as coatings show different mechanical and chemical properties in relation to bulk materials. In particular the solubility behaviour alters by various chemical composition and porosity of samples. In this work the aptitude of two bioceramic materials for plasma spraying process and changes in solubility behavior were examined.

Materials and Methods

The material powder M1 was prepared by mixing stoichiometrical quantities of CaHPO_4 , ZrO_2 , CaF_2 and H_3PO_4 . By a particular temperature treatment the material will melt and after a special cooling process the product contains about 25weight% $\text{Ca}_5(\text{PO}_4)_3\text{F}$, 54 % $\text{CaZr}_4(\text{PO}_4)_6$ and 21 % $\text{Ca}_3(\text{PO}_4)_2$. M2 was also prepared by mixing CaCO_3 , MgO , Na_2CO_3 , K_2CO_3 and H_3PO_4 and a special heat treatment. M2 contains the crystalline phases $\text{Ca}_3(\text{PO}_4)_2$ and $\text{Ca}_2\text{KNa}(\text{PO}_4)_2$. TiAl6V_4 targets were coated with this materials by using plasma spray process. Discs of 1,5 cm diameters were also manufactured for solubility tests.

For solubility investigation coated targets as well as pure ceramic discs were stored in 40 ml simulated body fluid after KOKUBO (SBF) and in a 1M TRIS-buffer solution. The treatment took place over a period of 24 weeks. The solutions were renewed weekly and the targets and discs were dried and weighed at the same time. After 24 weeks the surfaces of the layers were examined by X-ray diffraction as well as by Scanning Electron Microscopy (SEM).

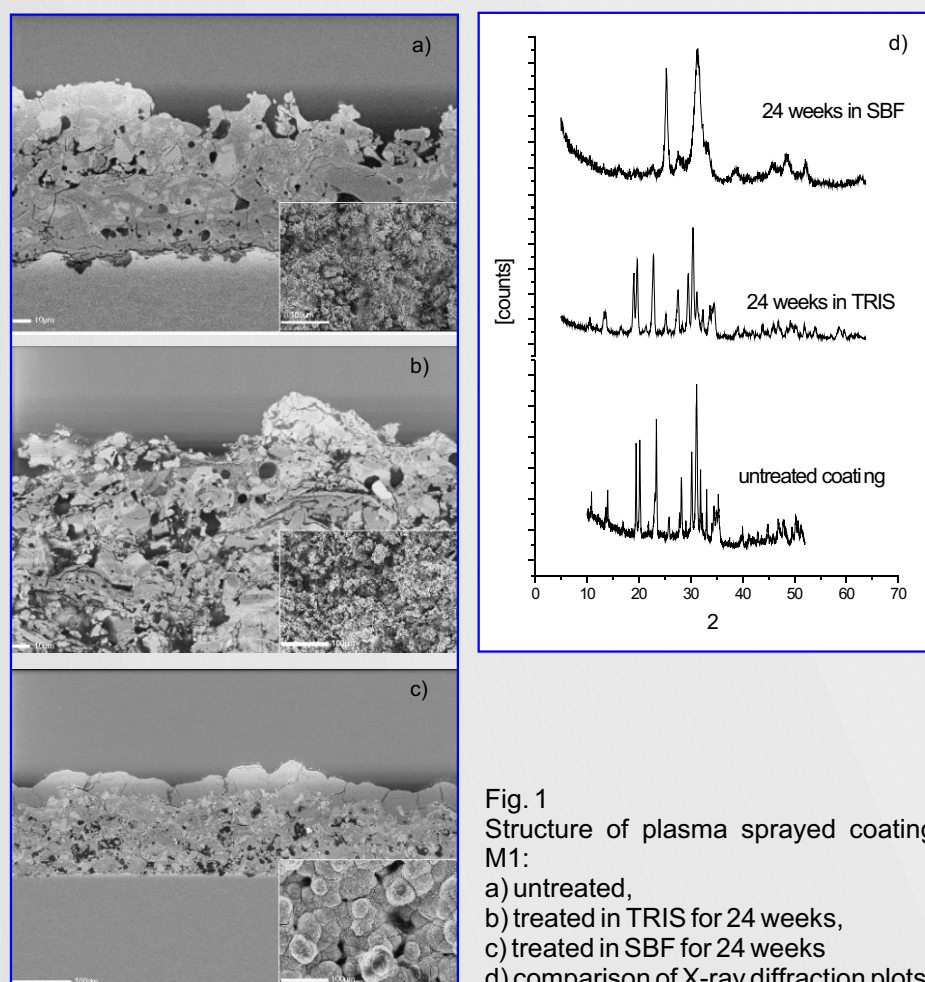


Fig. 1
Structure of plasma sprayed coating M1:
a) untreated,
b) treated in TRIS for 24 weeks,
c) treated in SBF for 24 weeks
d) comparison of X-ray diffraction plots

Results and discussions

On both plasma sprayed samples a significant change in surface composition could be observed during storing in SBF and TRIS. After treatment in TRIS sample M1 show no change on surface but in SBF hydroxyapatite of low crystallinity can be examined by X-ray diffraction patterns as shown in Fig. 1a-d. A significant mass accu-

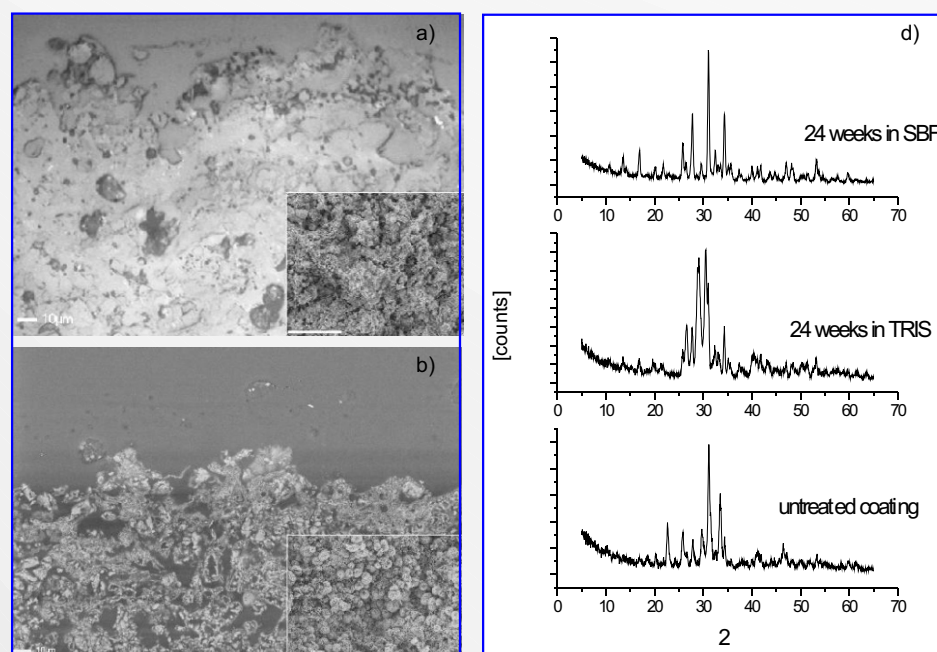


Fig. 3
Structure of plasma sprayed coating M2:
a) untreated,
b) treated in TRIS for 24 weeks,
c) treated in SBF for 24 weeks
d) comparison of X-ray diffraction plots

mulation was found after sample treated in SBF whereas by treatment in TRIS a mass loss was observed (Fig. 2). In contrast to that the sample M2 shows a very different behaviour. After treatment in SBF no change on surface is noticeably but after treatment in TRIS the formation of $\text{Ca}_2\text{P}_2\text{O}_7$ could be observed (Fig. 3a-d).

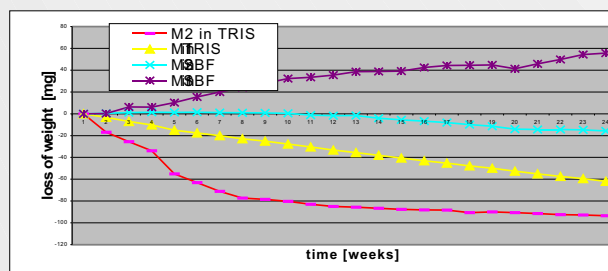


Fig. 2
Loss of weight by treatment in TRIS and SBF

Conclusions

The plasma sprayed samples showed surface changes after medium influence which could not be found on discs after the same treatment. This behaviour could be caused by differences of the amorphous part and porosity between the disc materials and the plasma sprayed coatings. The amorphous part as well as the porosity may increase the solubility and also may influence the chemical reactions.

Acknowledgements

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