MULTIFUNCTIONAL NANO-COATINGS BY MAPLE DEPOSITION ON TITANIUM ALLOY FOR BIO-APPLICATIONS

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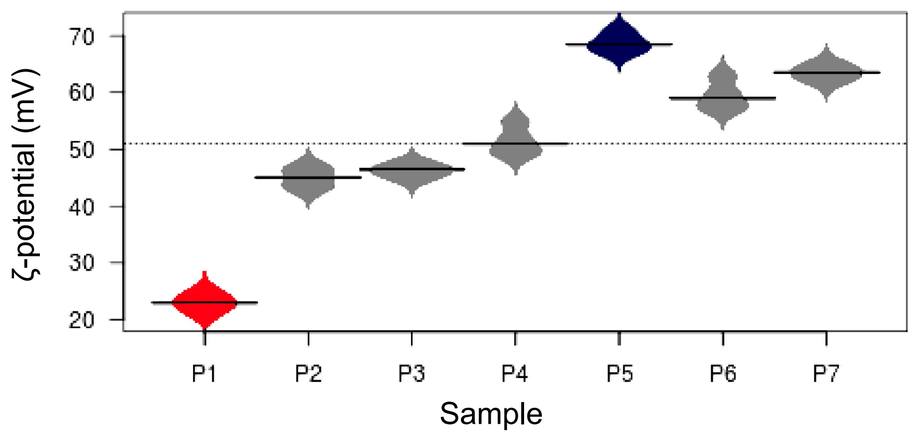
INTRODUCTION

- The MAPLE deposition technique can produce uniform films, composed of species with different molecular weights, with unique morphologies using the advantages of vacuum deposition.
- The purpose of this work was to obtain new multifunctional coatings based on chitosan, bioglass, ZnO and graphene oxide.
- In this study, the deposition was carried out on 73Ti-20Zr-5Ta-2Ag.
- The suspensions used for deposition were studied in detail, determining the stability of the particles in suspension.
- The best combination of deposition parameters will be presented.

SAMPLE COMPOSITIONS

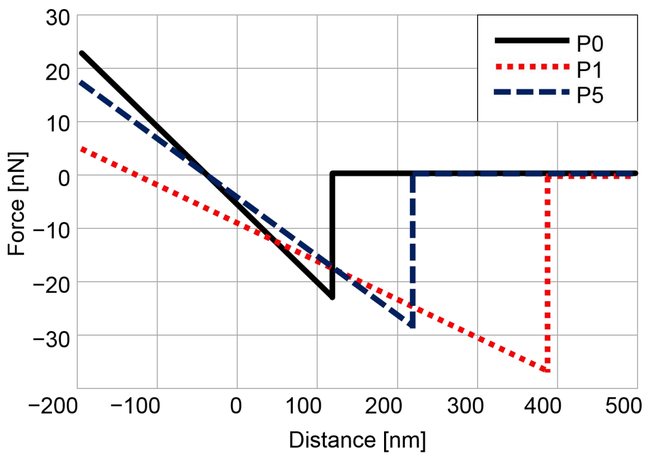
Sample	Components	Chi:(BG:ZnO:GO) ratio (wt./wt./wt.)	BG:ZnO:GO ratio (wt./wt./wt.)
P0	Ti-Zr-Ta-Ag	-	-
P1	Ti-Zr-Ta-Ag/Chi	-	-
P2	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	1:1	5:1:1
P3	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	1:1	1:1:1
P4	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	1:1	1:5:1
P5	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	2:1	1:5:1
P6	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	2:1	1:1:1
P7	Ti-Zr-Ta-Ag/Chi/(BG/ZnO/GO)	2:1	5:1:1

ZETA POTENTIAL



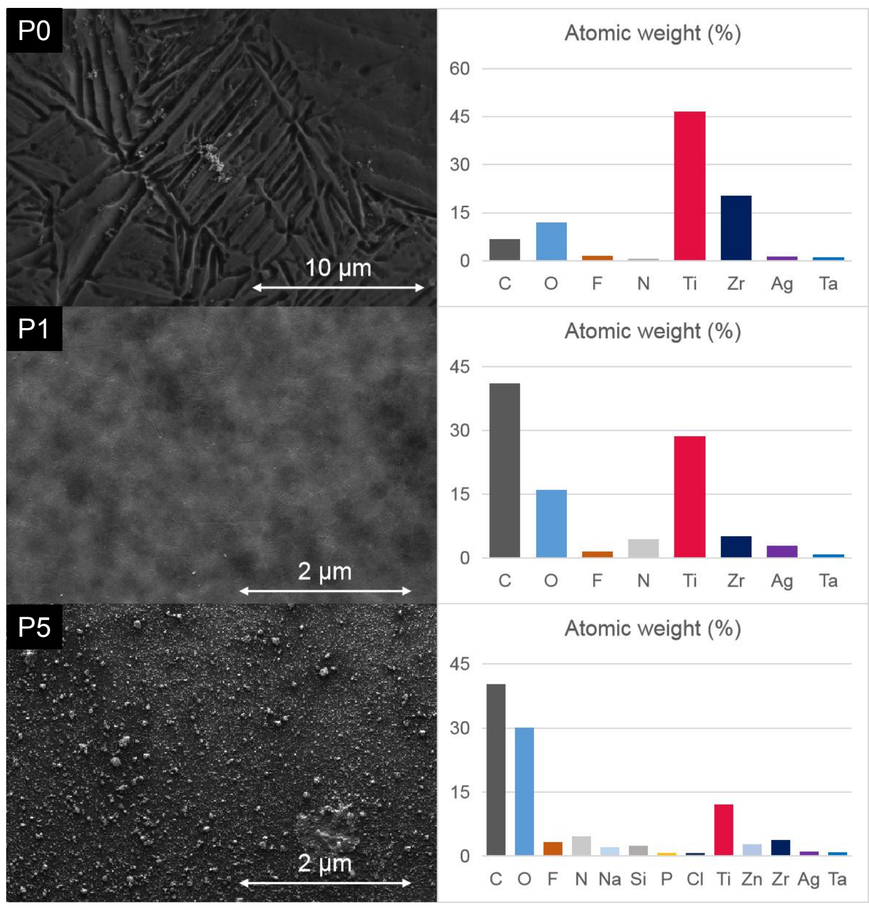
- Particles with ζ-potentials higher than +30 mV or lower than -30 mV are considered to have moderate stability, while high stability is generally ensured by ζ-potential values >50 mV.
- These values can ensure a sufficient electrostatic repulsion to generate stability over a longer period of time.
- All the mixtures had a good stability, however a slight decrease in stability was observed with the increase of the ceramic component, this behavior being due to the large dimensions of the BG.
- The addition of ZnO led to an increase in stability.

SURFACE ADHESION FORCES



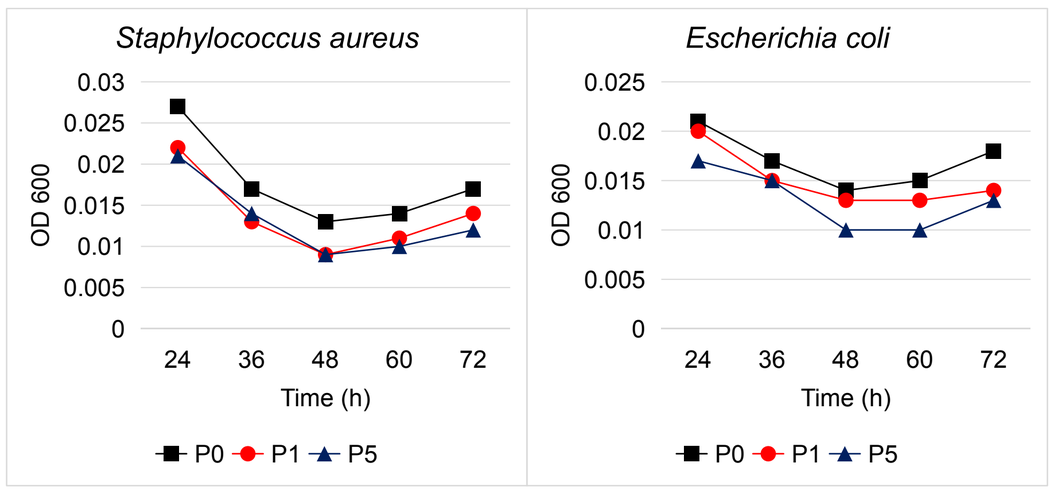
- Sample P0 had the highest adhesion force of 24 ± 3 nm and a short activity range, which can be attributed to the relatively smooth and tough oxide surface.
- Sample P1 had the lowest adhesion force of 6 ± 2 nm, but it had the longest range of activity, probably given by the semi-elastic properties of the chitosan film deposited on the surface.
- Sample P5 gave mixed results depending on the material that the AFM tip touched during the experiments, with a median value of 16 ± 4 nm being between the values of samples P1 and P2.

SURFACE MORPHOLOGY



- Sample P0 surface is covered with complex oxides resulting from the etching process. 0.7–1 µm silver formations are present, scattered on the surface.
- Sample P1 had a surface uniformly covered with the chitosan film. No oxide formations were found to protrude from the film.
- On Sample P5, the ceramic particles are well dispersed in the polymeric matrix, with sizes between 0.1 and 0.5 µm.
- The EDX spectra revealed that the surface of sample P0 is mainly composed of metallic oxides produced after the etching process.
- Sample P1 shows the increase in carbon percentage from the coating with the chitosan solution.
- On sample P5 all the components from the mixture are present on the surface.

ANTIBACTERIAL ACTIVITY



- The first reading of OD600 was made after 24 h, followed by subsequent readings at the specified time intervals.
- It was observed that the OD600 starts to decrease continuously for all samples in the interval of 24–48 h, and then it begins to slowly rise again for the next 24 h.
- The most effective antibacterial activity for all materials was observed after 48 h of incubation.
- As the OD600 is lower, the bacterial growth is also low.
- The slow rise in OD600 after 60 and 72 h means that the materials' antibacterial activity starts to decrease as time passes, the maximum activity being at 48 h.

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