

ROMANA

A treia etapa a proiectului PED 605/2022- Depunerea MAPLE a unor nano-acoperiri active pentru aplicatii multifunctionale ale aliajului TiTaZrAg a cuprins *Evaluari biologice si multifunctionale ale depunerilor* prin mai multe pachete de activitati si anume: Act 3.1 - Evaluarea bioactivitatii probelor prin teste in vitro, Act 3.2 - Teste de viabilitate celulara cu osteosarcoma MG-63 atasata pe depuneri, Act 3.3 - Compararea performantei probelor bio-activate cu aliajul neacoperit, Act 3.4 - Studii de encapsulare si eliberare a cephalosporinei pentru dezvoltarea activitatilor antibacteriene si osteoinductive, Act 3.5 - Propunere de legi de cinetica pentru probele obtinute bazate pe investigarea amanuntita a proceselor de adsorbție si eliberare de ioni, Act 3.6 - Evaluarea eficientei antibacteriene pentru probele obtinute, Act 3.7 - Teste de conductivitate termica in prezenta si absenta de oxid de grafena, Act 3.8 - Evaluare electrochimica in NaCl 3.5% pe diferite perioade de timp in autoclave, Act 3.9 - Evaluarea rezistentei acoperirilor la temperaturi inalte, Act 3.10 - Teste de anduranta efectuate in conditii ambientale extreme (temperatura inalta, umiditate ridicata, salinitate crescuta) pe perioade lungi de timp pentru evaluarea coroziunii probelor, Act 3.11 - Diseminare rezultate. Webinar. Workshop.

Astfel au fost depuse noi acoperiri prin MAPLE care au fost caracterizate prin FTIR, SEM & EDX, AFM & nanoindentare si UV-Vis.

Depunerile au fost caracterizate din punct de vedere biologic si electrochimic la temperaturi inalte, cuprinse intre 600 si 800 °C.

Doi agenti patogeni comuni implicați în infecțiile legate de implant, *Escherichia coli* (bacterie Gram-negativă) și *Staphylococcus aureus* (un coc Gram-pozitiv), au fost utilizați pentru a testa efectul antibacterian al probelor. Au fost utilizate două tulpini standardizate, și anume *S. aureus* ATCC 25923 și *E. coli* ATCC 25922 (American Type Culture Collection).

Pentru fiecare probă, s-a constatat că OD600 scade constant în primele 24 până la 48 de ore înainte de a crește treptat în următoarele 24 de ore. Toate materialele au avut activitate antibacteriană, dar cea mai mare a fost prezentată de proba care conține GO. După 48 de ore de incubare, activitatea antibacteriană a tuturor materialelor a atins apogeul. La 48 de ore, acoperirea cu ZnO și biosticlă a oprit în mod eficient creșterea bacteriilor *S. aureus* și *E. coli* cu 79%, respectiv 66%. Proba care conține particule de biosticlă și GO a prezentat cel mai înalt nivel de activitate antibacteriană dintre toate materialele, și anume 83% împotriva *S. aureus* și 71% împotriva *E. coli*.

Cantitatea de ioni eliberata din aliajul de titan scade odata cu cresterea timpului de imersie in solutia de NaCl, ramanand in domeniul catorva zeci de ppm.

Din punct de vedere electrochimic, toate probele manifesta o rezistenta buna la coroziune care creste odata cu cresterea temperaturii de calcinare. Masuratorile FTIR si EDS au pus in vedere inglobarea cu succes a cefuroximei. In urma testului MTT putem spune că aliajul de TiTaZr acoperit prin MAPLE, continand o concentrație mai mare de ZnO prezintă cea mai mare valoare a viabilității si a diferentierii celulare.

ENGLISH

The third stage of the PED 605/2022 project - MAPLE deposition of some active nano-coatings for multifunctional applications of the TiTaZrAg alloy included biological and multifunctional evaluations of the depositions through several activity packages, namely: Act 3.1 - Evaluation of the bioactivity of the samples through tests in vitro, Act 3.2 - Cell viability tests with osteosarcoma MG-63 attached to deposits, Act 3.3 - Comparison of the performance of bio-activated samples with the uncoated alloy, Act 3.4 - Encapsulation and release studies of cephalosporin for the development of antibacterial and osteoinductive activities, Act 3.5 - Proposal of kinetic laws for the samples obtained based on the detailed investigation of the processes of adsorption and release of ions, Act 3.6 - Evaluation of the antibacterial efficiency for the samples obtained, Act 3.7 - Thermal conductivity tests in the presence and absence of graphene oxide, Act 3.8 - Electrochemical evaluation in NaCl 3.5% over different periods of time in autoclaves, Act 3.9 - Evaluation of the resistance of coatings at high temperatures, Act 3.10 - Endurance tests performed in extreme environmental conditions (high temperature, high humidity, increased salinity) over long periods of time for corrosion assessment of samples, Act 3.11 - Dissemination of results. Webinar. Workshop. Thus new coatings were deposited by MAPLE which were characterized by FTIR, SEM & EDX, AFM & nanoindentation and UV-Vis. The deposits were characterized biologically and electrochemically at high temperatures, between 600 and 800 °C. Two common pathogens involved in implant-related infections, *Escherichia coli* (a Gram-negative bacterium) and *Staphylococcus aureus* (a Gram-positive coccus), were used to test the antibacterial effect of the samples. Two standardized strains were used, namely *S. aureus* ATCC 25923 and *E. coli* ATCC 25922 (American Type Culture Collection). For each sample, the OD600 was found to decrease steadily over the first 24 to 48 hours before gradually increasing over the next 24 hours. All materials had antibacterial activity, but the highest was shown by the sample containing GO. After 48 hours of incubation, the antibacterial activity of all materials peaked. At 48 hours, ZnO and bioglass coating effectively stopped the growth of *S. aureus* and *E. coli* bacteria by 79% and 66%, respectively. The sample containing bioglass particles and GO showed the highest level of antibacterial activity among all materials, namely 83% against *S. aureus* and 71% against *E. coli*. The amount of ions released from the titanium alloy decreases with the increase of the immersion time in the NaCl solution, remaining in the range of several tens of ppm. From an electrochemical point of view, all the samples show a good corrosion resistance that increases with the increase of the calcination temperature. FTIR and EDS measurements showed the successful incorporation of cefuroxime. Following the MTT test, we can say that the TiTaZr alloy covered by MAPLE, containing a higher concentration of ZnO, presents the highest value of cell viability and differentiation.