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INNOVATING MINDS FOR EXCELLENCE



9th World Congress on

MATERIALS SCIENCE AND ENGINEERING

November 07-08, 2025 | Park Hotel Hong Kong, Hong Kong

Theme:

“Shaping the future through expertise and innovations in
Materials Science and Engineering”

MAT SCIENCE 2025

<https://materialsscience.mindauthors.com/>

- 14:05 - 14:25** Title: Interactions of Re and Hydrogen At Γ/Γ' Interfaces Enhanced Hydrogen-Embrittlement Resistance of Re-Optimized Ni-Based Superalloy
Tingting Zhao, Northwestern Polytechnical University, China
- 14:25 - 14:45** Title: Empowering oxidation resistance of Cr-coated zirconium alloys via hydrogen-driven interface polymorphic transformation
Junlei Yin, Northwestern Polytechnical University, China
- 14:45 - 15:05** Title: Exploring the Electric Conductivity of Additively Manufactured Multiphase High-Entropy Alloys
David Maximilian Diebel, Tongji University, China

Refreshment & Coffee - 15:05 - 15:25

Oral Presentations

- 15:25 - 15:45** Title: Simultaneously Achieving Advanced and Heat Treatment Insensitive Strength-Ductility Synergy in an A+B Titanium Alloy Via Tailoring Silicide and Heterogeneous A Precipitates
Jinhua Dai, Northwestern Polytechnical University, China
- 15:45 - 16:05** Title: Revealing the Materials Genome for Advanced High-Entropy Materials
Jiaqi Lu, Northwestern Polytechnical University, China

Poster Presentations - 16:05 - 17:05

- 16:05 - 17:05** Title: Evaluation of Nano-mechanical Performance in Hydroxyapatite-selenium-collagen Nanocomposite Coatings on Ti6Al4v via Electrochemical Deposition
Dr. Ali Shanaghi, Malayer University, Iran
- Title: Comb-shaped anion exchange membrane with segmented hydrophilic/hydrophobic side chain
Dr. Tiantian Li, Dalian University of Technology, China
- Title: Multi-layered electrode architectures for use in the next generation of electrochemical lithium-based energy storage devices
Prof. Sangho Lee, Pukyong National University, Korea
- Title: Hydrolase Nanozyme Based On N, O-Tethered Ni In Reduced Graphene Oxide Matrix
Chen Xuanyu, National University of Singapore, Singapore
- Title: Computational Design and Mechanistic Analysis of Smart Antioxidant Nanoparticles for UV-Induced DNA Damage Prevention: A Molecular Dynamics Study
Ms. Chelsey Miguel, King Kekaulike High School, USA

***** End of Day 2 & Conference *****

Enhanced Corrosion Resistance of Titanium Alloys with Electrochemically Deposited Hydroxyapatite-Selenium-Collagen Nanostructured Coating

Ali Shanaghi^{1*}, Yanbin Zhao^{2*}, Hanieh Shahriyari¹, Ali Reza Souri¹, Qingdong Ruan², Paul K Chu^{2*}

¹ *Department of Materials Engineering, Faculty of Engineering, Malayer University, Malayer, Iran*

² *Department of Physics, Department of Materials Science and Engineering, and Department of Biomedical Engineering, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong*

Abstract

Titanium alloys (Ti6Al4V) are extensively used in medical implants due to their biocompatibility and mechanical strength, yet long-term corrosion in physiological environments remains a challenge. This study evaluates the corrosion resistance of nanostructured hydroxyapatite (HA), HA-selenium (HA-Se), and HA-selenium-collagen (HA-Se-Col) coatings on Ti6Al4V via electrochemical deposition. Electrochemical impedance spectroscopy (EIS) in simulated body fluid (SBF) revealed distinct corrosion mechanisms, that the HA coating reduced corrosion resistance by 35–40% compared to uncoated Ti6Al4V after 1-hour immersion due to high porosity (20–25%), enabling rapid electrolyte penetration. HA-Se exhibited comparable corrosion resistance to uncoated alloy, indicating selenium alone minimally enhances protection. In contrast, HA-Se-Col demonstrated a 60–65% improvement in corrosion resistance, attributed to collagen's pore-filling effect (reducing porosity to 8–10%) and formation of a stable protective layer. Nyquist plots showed HA-Se-Col's charge transfer resistance (25–30 kΩ·cm²) surpassed HA (8–10 kΩ·cm²) and HA-Se, while Bode-phase analysis revealed HA's three time constants (linked to solution resistance, coating defects, and charge transfer) simplified to two in HA-Se-Col, reflecting structural homogeneity. These findings demonstrate that collagen synergizes with selenium to optimize HA coatings, offering enhanced corrosion resistance for biomedical implants through microstructural refinement and electrochemical stabilization.

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¹ Department of Materials Engineering, Faculty of Engineering, Malaver University, Malaver, Iran

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CityU 香港城市大學
City University of Hong Kong



Malayer University

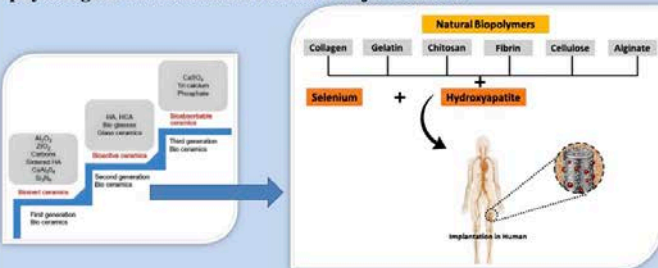
alishanaghi@gmail.com, yanbzha@cityu.edu.hk, paul.chu@cityu.edu.hk

MAT SCIENCE 2025

9TH WORLD CONGRESS ON MATERIALS SCIENCE AND ENGINEERING

Abstract

Titanium alloy (Ti6Al4V) is widely used for biomedical implants due to its superior biocompatibility and strength; however, its long-term corrosion in physiological environments remains a major concern.

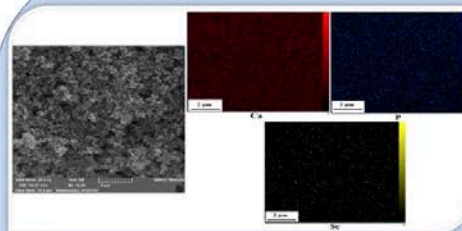


This work investigates nanostructured hydroxyapatite (HA), HA-selenium (HA-Se), and HA-selenium-collagen (HA-Se-Col) coatings fabricated via electrochemical deposition to improve corrosion resistance. Results reveal that the synergistic incorporation of collagen and selenium refines the coating microstructure and enhances electrochemical stability, providing significantly improved corrosion protection for Ti6Al4V implants.

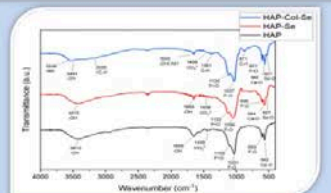
Methods

Nanostructured hydroxyapatite (HA), HA-selenium (HA-Se), and HA-selenium-collagen (HA-Se-Col) coatings were fabricated on Ti6Al4V substrates using an electrochemical deposition method. Titanium plates (10 × 20 × 1 mm) were mechanically polished, ultrasonically cleaned in acetone and ethanol, and surface-activated by alkaline, oxalic, and hydrofluoric treatments. The coating solution contained calcium nitrate tetrahydrate, diammonium hydrogen phosphate, and sodium nitrate, adjusted to pH 4.5 at 37 °C. Selenium incorporation was achieved by adding sodium selenite (0.04 g), while collagen modification was performed by immersing dried HA-Se coatings in a collagen solution. The coatings were characterized by XRD, FTIR, SEM/EDX, and electrochemical impedance spectroscopy (EIS) in simulated body fluid (SBF) at 37 °C to evaluate their structure and corrosion resistance.

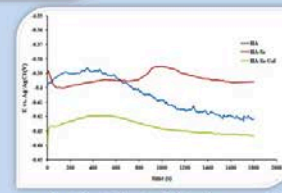
Results



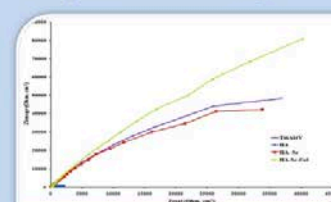
FESEM image and Elemental mapping images of the nanostructured coatings of hydroxyapatite-selenium-collagen (Ca, P, Se).



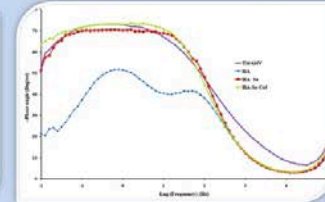
FTIR plot of coated titanium samples.



E-t plot of coated titanium samples.



Nyquist plot of nanostructured hydroxyapatite (HA), hydroxyapatite-selenium (HA-Se), and hydroxyapatite-selenium-collagen (HA-Se-Col) coatings deposited on Ti6Al4V alloy in simulated body fluid (SBF) after 1 hour of immersion at 37 °C.



Bode-phase plot of nanostructured hydroxyapatite (HA), hydroxyapatite-selenium (HA-Se), and hydroxyapatite-selenium-collagen (HA-Se-Col) coatings deposited on Ti6Al4V alloy in simulated body fluid (SBF) after 1 hour of immersion at 37 °C.

Conclusion

The corrosion potential variations revealed that the HA coating exhibited the most negative shift after 72 hours, indicating higher susceptibility to the corrosive environment. The HA-Se coating showed improved electrochemical stability, attributed to selenium's inhibitory effect on corrosion reactions. Interestingly, the HA-Se-Col coating displayed initial activation followed by long-term stabilization, suggesting that collagen introduces a dual effect—enhancing interfacial integrity while moderating corrosion kinetics over time.

References

- [1] Huang, Chi-Huang, and Masahiro Yoshimura. "Biocompatible hydroxyapatite ceramic coating on titanium alloys by electrochemical methods via Growing Integration Layers [GIL] strategy: A review." *Ceramics International* 49.14 (2023): 24532-24540.
- [2] Yilmaz, Eren, et al. "Novel hydroxyapatite/graphene oxide/collagen bioactive composite coating on Ti16Nb alloys by electrodeposition." *Materials Science and Engineering: C* 101 (2019): 292-305.
- [3] Korowash, Sara I., et al. "Selenium-and/or copper-substituted hydroxyapatite: A bioceramic substrate for biomedical applications." *Journal of Biomaterials Applications* 38.3 (2023): 351-360.