Coatings for Biomedical and Healthcare Applications
Room Golden State Ballroom - Session MD-ThP

Coatings for Biomedical and Healthcare Applications (Symposium MD) Poster Session

MD-ThP-1 Investigation of Silver/Copper Diffusions in the Matrix of Amorphous Carbon Thin Films Produced by Magnetron Sputtering, ***Hailin Sun (hailin.sun@teercoatings.co.uk)***, Teer Coatings Ltd, UK

The environment inside a spacecraft is ideal not only for the members of the crew onboard, but also for bacteria and fungi to grow. The proliferation of harmful microorganisms can become a hazard for the human crew as well as for the safe running of equipment. In our previous work, we used magnetron sputtering to develop amorphous carbon coatings doped with silver and copper for antimicrobial application in space stations, and the benefits of the bactericidal properties added by silver- and copper-doping were shown under both terrestrial gravity and micro-gravity conditions [1]. In addition, these thin films are scratch-resistant and wear-resistant with high hardness, providing a long lifetime which is critical for the applications in a space station.

The prepared Ag- and Cu-doped amorphous carbon coatings showed a slow diffusion of Ag from the carbon matrix to the surface, eventually replenishing the Ag at the surface lost due to daily wear and tear. Such diffusion process is a key factor in the coating performance: if too fast, the antimicrobial lifetime of the coating would be shorter, if too slow the bactericidal efficiency of the coating would be affected. Therefore, it becomes apparent and critical to identify the key factors that influence the Ag diffusion rate in a carbon matrix, and also to understand how they influence it.

In this work we report the latest study on Ag and Cu diffusion in Ag- and Ag/Cu-doped amorphous carbon coatings. Samples with the same concentration of Ag and different concentrations of Cu have been prepared and annealed in oven at 100 ^{o}C, 150 ^{o}C and 200 ^{o}C to speed up the diffusion process of the metals. With the combination of RBS (Rutherford Backscattering Spectrometry) and ToF-ERD (time of flight elastic recoil detection) the elemental depth profile is accurately measured, which is supported by XPS data to investigate the chemical state of the species at the surface. Preliminary results have shown that higher temperature causes a higher diffusion rate, and the addition of copper has slowed down the diffusion rate of silver, which is confirmed also by cross-section SEM images. Interestingly, XPS data show how Ag retains always its metal state and does not oxidize, while Cu bonds with carbon, oxygen and hydrogen to form more complex molecules such as Cu(II) carbonate dihydroxide.

References

[1] G. Sanzone et al.," Antimicrobial and aging properties of Ag-, Ag/Cu- and Ag cluster-doped amorphous carbon coatings produced by magnetron sputtering for space applications", *ACS Appl. Mater. Interfaces* 14 (2022) 10154−10166 (doi.org/10.1021/acsami.2c00263)

MD-ThP-5 Catastrophic Corrosion in Metal Guitar Strings with or Without DLC Films Using Artificial Sweat, *C. Andrés Velásquez Andrade,* Universidade do Vale do Paraiba, Brazil*; N. Pereira Alves Granado,* IGTPAN, Brazil*;* ***Lucia Vieira (lvs.lucia@gmail.com)***, Universidade do Vale do Paraíba - Univap, Brazil

Diamond-like carbon (DLC) film was deposited on electric guitar strings to evaluate corrosion under the impact of artificial sweat at a constant temperature of 37 degrees Celsius. The objective was to assess the effect of corrosion on the change in string mass over time and the string tonality variation. The process involves the application of a DLC by plasma-enhanced chemical vapor deposition (PECVD), recognized for its corrosion-resistant film. The strings' mass changes due to exposure to artificial sweat were measured over 240 hours, focusing on mass variation to obtain information on the strings' durability and corrosion resistance. The results show that all strings suffered corrosion, and the tonality (frequency variation of the notes) varied due to the film of the strings. The results can help design electric guitar strings with better tonal qualities and corrosion resistance. Understanding how external elements such as sweat affect the integrity of the DLC film contributes to the sound quality and longevity of the strings.

Keywords: (mass variation; Corrosion; artificial sweat; nickel plated steel; Raman; guitar strings; DLC; PECVD)

Author Index

Bold page numbers indicate presenter