

Duplex coatings: PEO layers sealed by optimized / modified hybrid sol-gel for corrosion protection of light alloys

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In the key economic sector of transport, a major lever for limiting greenhouse gas emissions while reducing the consumption of fossil fuels is to promote the use of lightweight, recyclable and high-performance materials. Aluminium and magnesium alloys meet these requirements, thanks to their low density and satisfactory compromise between mechanical strength and formability. Nevertheless, the alloys, whether cast or not, remain unusable for the severe applications for which they are intended, because they have low resistance to corrosion and wear. Although, the use of copper results in notable improvements in mechanical properties of aluminum alloys used in aerospace industry, it presents some challenges, due to the galvanic corrosion with Al matrix in an aggressive electrolyte, resulting in the localized corrosion phenomenon. Magnesium alloys can be used as resorbable implants for biomedical applications but their high susceptibility to corrosion in body fluids must be compensated by active and protective coatings. During recent decades, various surface treatments, such as conversion coatings, anodization, and PEO, have been employed to enhance the corrosion resistance properties of the light alloys. Among these techniques, PEO plays a crucial role thanks to its eco-friendly properties along with producing dense, hard, and thick ceramic coatings on light alloys. During the process, a ceramic coating with improved corrosion resistance, hardness, and wear properties is obtained. Since the porous structure provides diffusion pathways for any aggressive electrolytes to access the substrate, the idea of pore-filling by a sol-gel coating is a promising strategy to enhance the life service of a PEO coatings. This idea originated from the fact that the porous structure of the PEO coating can be considered bricks of a wall that is going to be strengthened with a cement-like material like a sol-gel. Sol-gel process is a facile and inexpensive method that is environmentally safe and can produce a reliable protective layer. The performance of a sol-gel coating can be adjusted by solution pH, aging, additives, type of solvent, and particularly the type of sol-gel precursors that play a leading role in its performance. In this talk, duplex coatings: PEO layers sealed by optimized / modified hybrid sol-gel for corrosion protection of light alloys for biomedical and transport applications will be discussed with a special focus on the effect of the PEO electrical parameters, the nature of the substrate and the electrolyte, the sol-gel formulation and the active properties.