Effect of surface chemistry and morphology of passivated ZnNi on the epoxy paint adherence

Thomas SANCHEZ[1], Jolanta SWIATOWSKA[1], Jacques ECHOUARD[2], Sandrine ZANNA[1], Antoine SEYEUX[1], Michel LAHAYE[3], Polina VOLOVITCH[1]

[1] *Chimie ParisTech, PSL Research University, CNRS, Institut de Recherche de Chimie Paris (IRCP), France*

[2] *Safran Landing Systems, France*

[3] *Placamat, University of Bordeaux, France*

Due to the European REACH (Registration, Authorization and Restriction of Chemicals) and RoSH (Restriction of Hazardous Materials) regulation, ZnNi coatings with Cr(III) based passivation (conversion treatment) are regarded as new anti-corrosion system for steel protection. ZnNi coatings offer lower corrosion rates, smaller quantity of voluminous zinc-based corrosion products and higher hardness compared to Zn coatings[i]. The polymer-metal interface is one of the key points for the full protection scheme. Its optimization requires a fine study is interesting to understand microscopic phenomena.

In this work, we compare two pre-painted systems with Cr(III)-based conversion coatings on 20 µm electroplated ZnNi coating on 4130 steel. The morphology and chemistry were studied using 3D optical microscopy, scanning electron microscopy (SEM), energy dispersive X-ray spectrometry (EDX), X-ray photoelectron spectroscopy (XPS), glow discharge optical emission spectroscopy (GD-OES), time of flight secondary ions mass spectrometer (ToF-SIMS) and nano-Auger electron spectroscopy. In parallel, the electrochemical reactivity of the two surfaces w/o 10 (+/- 1) µm DGEBA-TETA epoxy model paint was studied by global and local electrochemical impedance spectroscopy (EIS/LEIS) and time-lapse-microscopy (TLM).

GD-OES, XPS and ToF-SIMS showed a difference in conversion layer's thickness and heterogeneities in the Cr to Zn ratio. SEM and 3D optical microscopy analysis revealed that the surface is more homogeneous and has a finer morphology at the micrometric scale after the treatment giving a thicker conversion coating, although the passivation being at the nanometric scale. Besides, nano-Auger showed a non-negligible heterogeneity in both thickness and chemical composition of the passivation layer depending on the morphology of the surface. According to EIS/LEIS and TLM under model organic coating, this system with thick conversion coating was less sensitive to cathodic polarization: it exhibited only localized disbondment areas while the second system demonstrated homogeneous underpaint reactivity.

Acknowledgements:

Financial support of SAFRAN GROUP (Safran Landing Systems)

References:

[i] *Characterization of electrodeposited Zn-Ni alloy coatings as a replacement for electrodeposited Zn and Cd coatings*, Sriraman Kankoduthavanitham Rajagopalan, PhD-Thesis (2012)