Expedited ORP-EIS evaluation of the effect of Cu(II) at the interface of epoxy coatings with converted galvanized steel

The corrosion protection of hot dip galvanized (HDG) steel is of great importance in the automotive industry. To this purpose, Zr-based conversion of the metal substrate (for passivation and improved adhesion), in combination with the application of a polymeric primer coating (which acts as a physical barrier to the environmental moisture and oxygen) is performed. Typically, Cu(II) additive is used as an accelerator in the Zr-based conversion. In this work, we want to investigate the effect of copper on the failure of the barrier properties of an epoxy-amine coating on the converted HDG steel substrate by odd random phase multisine electrochemical impedance spectroscopy (ORP-EIS), a singular method developed in our laboratory. High temperature and application of cathodic polarization will be applied in order to accelerate the breakdown of the polymer coating.

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Understanding the performance of novel catalytic materials for integrated photo- and electrochemical CO2 conversion processes: mechanistic insights by nanoscaled molecular surface characterization.

Design of complex photo-electrocatalyst material systems for CO2 conversion into methanol requires knowledge of the basic properties of each component's band structure in order to achieve efficient charge transport thus maximizing catalyst activity and selectivity towards methanol.

As the top surface of the catalyst is key in the efficiency of the conversion processes, X-ray Photo-electron Spectroscopy (XPS) in combination with Ultraviolet Photo-electron Spectroscopy (UPS) will be employed. XPS allows to identify with a 10 μm lateral resolution, the chemical configuration present at the first few nm's of the electrode material. UPS is even more surface sensitive and provides a complete characterization of the valence bands as well as useful electronic parameters of the catalysts such as work function, ionization energy and fermi level position. Knowledge of these parameters provides a level reference relative to the vacuum energy, which is important for applications where the discontinuities of energy levels between different materials have a large effect on the materials properties and performance.

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Finite element modelling of corrosion protection using inhibitor particles in an organic coating

Metal corrosion has been a main factor in the high maintenance cost and the reduced lifetime of many structural projects. This has motivated many research efforts towards corrosion protection. Organic coatings are commonly used for that purpose. However, a coating defect would create a vulnerable location for severe pitting corrosion causing considerable damage to the metal. A favorable solution is the usage of inhibitor particles dispersed in the coating. In the case of metal surface exposure, the particles would diffuse to the defect to provide additional protection from the environment and prevent oxygen from reaching the surface.

The aim of the project is to model the protection provided by an organic coating with dispersed inhibitor particles in a scribe exposing the metal surface to the environment. Different inhibitors and modes of inhibition are considered. The model will take into account the reactions occurring at the surface for metal corrosion and inhibitor protection, as well as the transport of ions and the inhibitor particles through the coating and the exposed surface. This would be done using a finite element software tool. Some experiments could be conducted to obtain some of the model inputs or to verify the results.

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