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Two-dimensional protective organic film formed on 11-mercapto-1-undecanol self-assembled on electrodeposited zinc surfaces

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Abstract – The high toxicity of chromate conversion treatments has induced a great interest to search alternative coatings for corrosion protection of oxidisable metals. Today, the formation of self-assembled monolayers seems to have a great future in anticorrosion applications. In this aim, a protective film consisting of a bidimensional organic coating is elaborated by self-assembly of 11-mercapto-1-undecanol on acidic zinc electrodeposited on steel. This first step is following with the formation of a second layer by self-assembly of 3-(heptafluoroisopropoxy)propyltrimethoxysilane (HIPS).

The high toxicity of chromate conversion coatings (CCC) has induced researches for alternatives to chromated galvanized steel. Among the different approaches to protect zinc, coatings based on molybdenum, tungsten, vanadium or rare-earth elements have been considered, but so far none has led to a level of protection comparable to CCC.

Another direction concerns organic coatings based on organosilane polymers and epoxy resin. These films show a decrease of one decade of current density. However, the porosity and defects in these organic layers do not lead to the same protection as chromate conversion coatings and, in some cases, delamination takes place. We have shown that it is possible to form good quality alkanethiol films on electrodeposited Zn and ZnNi [1-5].

The objectives in this work are the formation of a bilayer film on acidic zinc electrodeposited on steel. This system is elaborated by the self-assembly of 11-mercapto-1-undecanol on Zn, followed by its reaction with 3-(heptafluoroisopropoxy)propyltrimethoxysilane (HIPS).

The formation of the two-dimensional organic film is confirmed by XPS analysis (Fig. 1.). Indeed, atomic (F, O, Si, C) characteristic signals of the organic compounds but also the peaks of the substrate (Zn and Zn Auger) are present. For the corrosion protection, the electrochemical evaluation is realized by CV, LSV, SVET. For example, the CV curves show the increase of the surface blocking rate when the different treatments are performed (Fig. 2.). A blocking rate close to 100 % is obtained with the creation of the double organic coating.

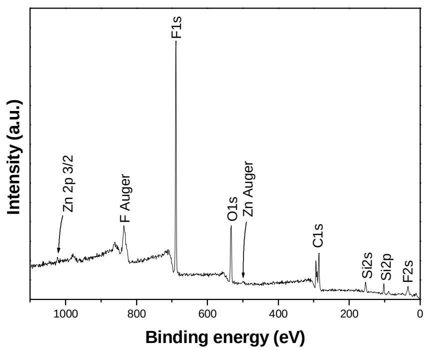

Fig. 1. XPS spectrum of a bidimensional system

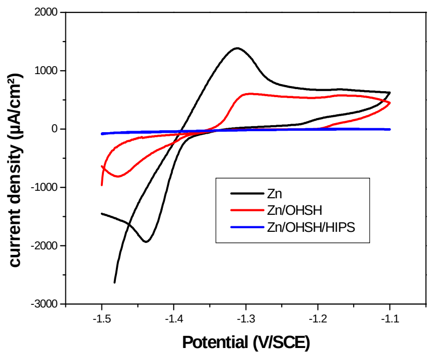

Fig. 2. CV curves of created double system

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