ELECTROCHEMICAL EVALUATION OF THE CORROSION PROTECTION PROPERTIES OF A BI-DIMENSIONAL ORGANIC FILM SELF-ASSEMBLED ONTO POLYCRISTALLINE BRASS SUBSTRATES

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Brass is an alloy (Cu/Zn) commonly used in the manufacture of various types of products which applications are ranging from decoration to enhancement of adhesion properties between rubber compounds and steel cords in tire belts [1]. The final use of this material is determined by its chemical and mass composition because these greatly influence quality and properties of the alloy. In this contribution, experiments have been performed on brass with zinc content of 37%. This most commonly used alloy is hard and rather brittle and presents a fairly good resistance to oxidation.

To further enhance corrosion resistance (in atmospheric and other environments) of brass and to promote adhesion of organic coating or adhesives, we had recourse to the chemistry of self-assembly. In this context, the grafting of an alkanethiol molecule has been firstly considered. Prior modification, it is of major importance to activate electrochemically the bare substrate in order to obtain reduced surfaces predisposed to form strong thiolate bonds.

The (3-mercaptopropyl)trimethoxysilane (MPST), (MeO)3Si-(CH2)3-SH, is the organothiol molecule which has been chosen. Once this bifunctionnal molecule chemisorbs onto brass by the thiol function forming a self-assembled monolayer, it presents a trimethoxysilane terminal group (-Si(OMe)3) pointing out at the surface. The next challenge has been the determination of hydrolysis conditions able to bring those groups trough a siloxane framework containing silanol functions. This has to be done without any alteration of the modified substrate. To increase the organization of the molecular assembly and to further prevent oxidation of the brass modified by the hydrolyzed monolayer, the grafting of a second organic molecule has been optimized. The (3-heptafluoroisoproposy)propyltrichlorosilane, SiCl3-(CH2)3-O-CF(CF3)2, has been chosen for that purpose. This molecule reacts by condensation of its terminal -SiCl3 group on silanol functions still present in the network. An intense fluorine signal on the XPS spectra confirm the grafting of the second layer while analysis of the doubly modified surfaces have evidenced hydrophobic properties by contact angle measurements.

Techniques used to characterize the bidimensional films formed on brass substrates are X-ray Photoelectron Spectroscopy (XPS) and contact angle measurements. The electrochemical cyclic voltammetry technique has been performed in proper conditions to evaluate the blocking of the substrate at each step of its modification while the polarization curves have furnished essential information on the dissolution rate of the alloy along with the chemical modifications of the substrate.

Reference

[1] Article: G. Cepria, C. Aranda, J. Perez-Arantegui, F. Lacueva, J.R. Castillo, Journal of Electroanalytical Chemistry, 513, 2001, 52-58.

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