Corrosion protection of aluminium using hydrophobic sol-gel coatings based on alkyl or fluoroalkyl silane

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The aim of this study was to synthesize a highly effective hydrophobic surfaces based on alkyl or fluoroalkyl silane used as corrosion protection of aluminium substrates.

Nature has provided many examples of superhydrophobic surfaces, such as lotus leaves, to show water repellent and self-cleaning functions. The hydrophobicity mainly depends on surface chemistry (the presence of non-polar molecules) and surface topography.[1] Surface chemistry can be modified by incorporation of long alkyl or fluoro chain which enables us to simultaneously incorporate hydrophobic and oleophobic properties.[1,2] Superhydrophobic materials have many applications in areas including protection of electronic devices, oil-water separation, anti-icing and also corrosion protection.[1]

Synthesis an organic-inorganic hybrid sol-gel materials is one of the options to obtain hydrophobic surface. Hybrid materials have received considerable attention as a new class of composite materials with improved properties arising from the synergy between the properties of organic polymer and inorganic material.[2] Usually a sol is prepared by hydrolysis and polycondensation. The inorganic phase is mainly obtained from metal alkoxides in the sol-gel process; organic phase is formed from silanes with organic substituents through Si-C bond. The non-hydrolyzable functional groups in the organic silanes have a considerable influence on the surface wettability.[3,4]

The hybrid sol-gel coatings were synthesized using alkoxysilane, organically modified silane and zirconium precursor.[3,4] The coatings are very stable and corrosion resistant due to barrier protection in different corrosion environments.[4] The hydrophobicity was increased due to the addition of long alkyl or perfluoroalkyl chain covalently bonded on silane group in order to promote corrosion protection and to elucidate the difference between the effect of chain on the coating properties. The characterization was carried out using electrochemical potenciodynamic measurements and surface analytical techniques: contact profilometer, scanning electron microscopy, IR spectroscopy and water contact angle. The stability tests were performed according to standard protocol for assessing durability of superhydrophobic surfaces, which also confirmed improvement in self-cleaning and anti-icing properties.[5]

Key words: aluminium, superhydrophobic coatings, corrosion inhibition, self-cleaning, anti-icing.

References:

[1] J. Shirtcliffe, G. McHale, S. Atherton, M. I. Newton, (2010), An introduction to superhydrophobicity, Adv. Colloid Interface, 2010, 161, 124–138.

[2] S. Latthe, A. B. Gurav, C. S Maruti, R. S. Vhatkar, J. Sur. Eng. Mater. Adv. Tech, 2012, 2, 76-94.

[3] Rodič, J. Iskra, I. Milošev, J. Non-Crystal. Solid. 2014, 396–397, 25–35.

[4] Rodič, J. Iskra, I. Milošev, J. Sol-Gel Sci. Technol. 2014, 70, 90–103.

[5] Malavasi, I. Bernagozzi, C. Antonini, M. Marengo, Surface Innovations, 2015, 3, 49–60.