Functional coatings to enhance corrosion protection of aluminium and its alloys

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Aluminium and its alloys are important lightweight materials for various construction and transportation applications. The use is often limited due to low corrosion resistance, which can be enhanced by protecting the metal surface with additional corrosion protection. Over the last decade, research has been focused on developing several methods that will effectively protect aluminium and its alloys against corrosion and will be in line with the strict European Union's REACH regulation, such as using hexavalent chromium compounds.

In the last decade, cerium- (CeCC) or zirconium-chromium(III)) based conversion coatings (ZrCrCCs) have emerged as a substitute for (active) surface pre-treatment based on conversion coatings. Several aspects will be presented such as (i) the addition of various cerium salts (i.e., cerium chloride, cerium nitrate and cerium acetate) into a corrosive medium [1] and (ii) the synergistic effect with other salts such as Na_2SO_4.[2,3]

Additional corrosion (barrier) protection of Al alloys can be achieved by depositing a hybrid sol-gel coating that reflects the properties of inorganic and organic substances in one functional material.[4] Several polyacrylic/siloxanes silica coatings will be described consisting of various lengths of alkyl or perfluoroalkyl acrylate monomer and organically modified silane 3-(trimethoxysilyl)propyl methacrylate as well as an inorganic silane, tetraethyl orthosilicate.[5,6]

Combining both types of coatings (active and barrier) can also be used for developing functional coatings, Figure 1. Such coatings also have the ability to prevent the damaged area on metal surfaces.[7,8]

In the last part, the developments made in superhydrophobic corrosion protective coatings will also be presented. The definition of superhydrophobicity is based on the water contact angle of the droplet on the surface, which has to be larger than 150°, and a sliding angle smaller than 10°.[9,10] Such surface prevents the aggressive ions from reaching the surface, consequently offering an efficient mechanism for corrosion protection.[10,11] These coatings also offer additional functional abilities of the surface once exposed to the natural or industrial environments, including preventing the adsorption of pollutants and ice formation; therefore, there is a high potential for applications in different fields.

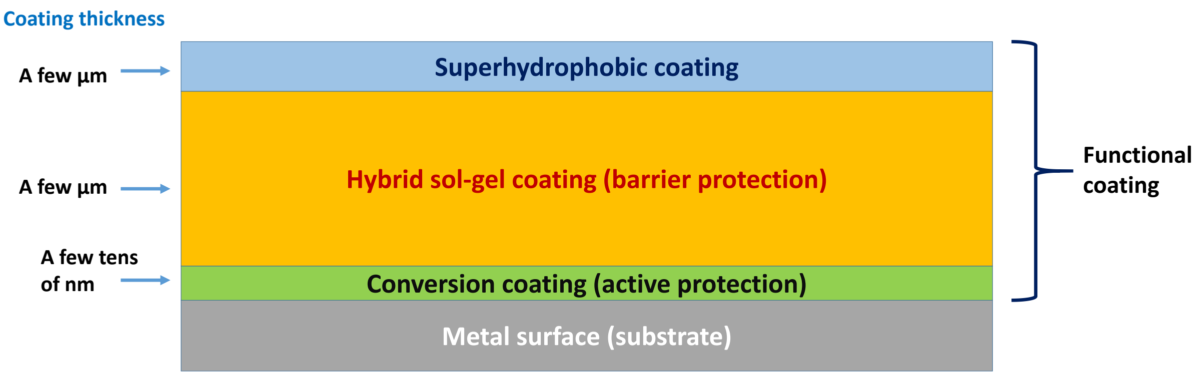

Figure 1. A schematic presentation of the example of functional coating consists of conversion, hybrid sol-gel and superhydrophobic coatings.

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