

Advanced hybrid Sol-Gel coatings for aeronautical applications: industrial needs and new developments

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Innovation in the aeronautics drives the development of new coating materials for surface treatment and finishing. For decades, the aeronautical industry has been using organic coatings to functionalize aircraft surfaces (figure 1).

New aircraft design concepts call for the development of new solutions such as transparent anti-erosion and anti-scratch coatings for leading edge, thermal resistant coatings in high temperature areas, adhesion primers for multi-assembling materials or easy-to-clean surfaces for displays.

In the meantime, regulatory evolutions such as REACH stimulate the development, implementation and qualification of safer alternatives for human health and the environment, notably to chromated epoxy primers which are used to protect metals against corrosion, but contain hexavalent chromium which is classified as a CMR substance.

Hybrid organic inorganic systems offer great versatility in terms of properties. By taking into account metal alcoxide & organosilane precursors, synthesis parameters, processing and curing, hybrid networks can be properly controlled and coatings properties can be tailored to the targeted field of application. Moreover, the materials obtained by Sol-Gel processing present the inherent advantage to be synthesized in aqueous media which is compliant with industrial requirements and HES regulations.

In this contribution, we present 4 coatings that were developed in the frame of French and European research collaborative projects. These coatings comply with a variety of functional criteria and meet a multitude of industry specifications, as for instance:

The substitution of chromate-based coatings is one of the challenges for coating industry, Sol-Gel synthesised hybrid coatings have already proven their potential for Cr(VI) replacement. But one of their drawbacks is that they do not prevent filiform corrosion, and do not fulfil processing specifications. The hybrid SAFE coating is a 2 component coating processed at low temperature (<120°C) that offers protection against corrosion up to 3,000h in neutral salt spray test and satisfies filiform corrosion requirements.

The number of touch screens is increasing in aircraft cabins for passengers' entertainment, but touch screens interfaces are likely to be brought into the cockpit as well by 2030. One of the main concerns about this technology is related to smudges that can dramatically affect touch screen performances and decrease readability. The Anti-Smudge coating protects glass and other material surfaces from smudges effect thanks to enhanced hydro- and oleo-phobic properties, while offering high resistance to abrasion and wiping.

Because customers are always requiring aesthetic even in harsh environments, there is a need for coatings that keep their colour and brightness even at high temperature. The thermal resistant coating presents minimal colour change after high temperature exposure and satisfies aeronautical coatings specifications.

Erosion is a major issue because it impacts aircraft aerodynamics. In order to prevent this phenomenon, polished 2024 clad aluminium must be protected. The coating that have been developed is an abrasion resistant, Sol-Gel finish with high resistance to wear and scratch that could be an alternative to traditional polyurethane coatings.

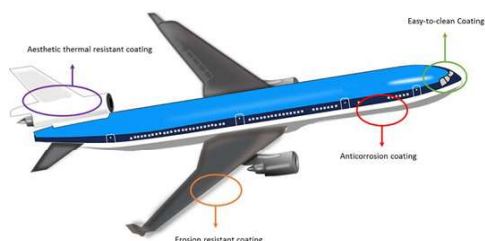


Figure 1 : Functional coating needs in the aeronautics.

KEYWORDS

functional coating-protection-hybrid materials-industrial needs