

# Sustainable materials for corrosion protection on aircraft structures



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In recent years, chromates, widely used as anti-corrosion pigments in primers and wash primers, have completely disappeared in most industries due to the detrimental effects of hexavalent chromium on the human health and the environment. However, many hexavalent chromium coatings are still used in the aircraft industry since the use of these coatings provides exceptional corrosion protection at relatively low cost.

Preserving metal structures in aircraft is a major problem because both the safety of people and operating costs depend on it.

In line with European directives, to minimise the environmental impact and health damage of such systems, there has been growing interest in the development of alternative technologies and/or eco-friendly materials that are not only cost-effective but characterised by corrosion resistance and adhesion performance comparable to Cr(VI)-based coatings.

Meeting all these criteria simultaneously represents a difficult and demanding challenge. In fact, there are only a limited number of valid and ecologically sustainable alternatives that have so far been applied in the field of aviation.

Therefore, one of the most interesting academic and industrial challenge is the investigation of eco-friendly substitutes equally high performing to develop alternative pre-treatments to chromate conversion coatings and chromic acid anodising.

Leonardo S.p.A. - Aircraft Division, a leading manufacturer of components for aeronautical applications, has decided to embark on a phase of transformation for its production process, adhering to the EU's climate action campaign, which foresees the greenhouse gas emissions reduction promoting more environmentally sustainable technologies. The company aims to develop new anti-corrosive coating systems consisting of non-polluting compounds with good adhesion, barrier and rheological properties, also combining protection of exposed surfaces.

For the design, development and characterisation of new coating systems, Leonardo S.p.A. has established a synergetic collaboration with the Applied Chemistry Group of the Chemical Engineering, Materials and Industrial Production Department (University of Naples "FEDERICO II") and the Institute of Polymers, Composites and Biomaterials (IPCB-CNR).

The doctoral research will focus on the evaluation of alternative anti-corrosion systems, starting from those already known in the literature, such as: trivalent chromium (less toxic than hexavalent Cr); transition metal oxyanions (of which the most promising are permanganates and molybdates); coatings with titanium or zirconium additives; micro/nanocapsules based on silica or titania.

As part of this work, the planned PhD activity will also look at the main advantages, in terms of thermal resistance, adhesion capability or capacity and mechanical performance of the *in-situ* crystallisation process of certain systems such as zeolites. The chemical-physical characterisation of the developed materials will allow the likely optimization of the chemical formulation for the innovative systems, but also the study of relationship which links the performance of the material with its structure.

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