LONGER AND STRONGER

As new legislation forces change for coating manufacturers, Simon Lott looks at two companies hoping to take advantage of the pending ban on chrome-based compounds with alternative technologies.

While the ultimate challenge for aerospace qualified coating developers never really changes – extending the service life of critical components through improved resistance to corrosion, abrasion and damage – every so often the goalposts can move. The REACH directive in particular is proving problematic for developers, with chromium-based compounds being outlawed in the near future, and has given rise to a variety of alternative systems that seek to recreate the desired attributes of the widely-used substance.

A relative newcomer to the market having achieved AS9100 certification last February, Hardide Coatings has recently launched an aerospace-specific product, named Hardide A, which it claims not only effectively replicates the properties of hard chromium, but offers much better corrosion protection thanks to the development of a new proprietary nanostructure, applied by chemical vapour deposition (CVD).

Several factors contribute to these favourable properties, as the company's technical director Dr Yuri Zhuk describes: "The structure consists of a metal tungsten matrix with nanoparticles of tungsten carbide dispersed throughout, combining both hardness and toughness. This helps to prevent the two main mechanisms of wear: abrasion and fatigue microcracking."

In contradistinction to traditional tungsten carbide-based spray coatings, Hardide coatings also don't require a binder material, which is perceived as the weakest link in coating technology. "Spray coatings commonly consist of very hard tungsten carbide grains that are cemented together by a soft metal cobalt binder, which is prone to wearing or leaching away in a corrosive or abrasive environment," explains Dr Zhuk. "Then there is nothing to hold the hard particles together. Our coating has a uniform structure so doesn't suffer from that problem. An additional advantage is its extremely low porosity, so moisture or aggressive fluids, such as those used to de-ice the wings of aircraft, can't penetrate to the substrate and corrode it.

"Hard chrome as well as high velocity oxy-fuel (HVOF) coatings also have issues when they are under high point loads or repeated fatigue load conditions. HVOF in particular is quite a rough coating and needs to be ground to bring out a good finish. Also, when a HVOF binder is worn away, the very hard tungsten carbide grains stick out of the surface and abrade any component material or seal like a cheese grater. Hardide however is uniform when applied and will remain smooth, doesn't require grinding and even reduces wear on seals and bearings."

Crucial to achieving this level of performance is the CVD process used at Hardide's facility in Oxfordshire, whereby coating precursors in gas form are pumped into a vacuum chamber at low pressure. The method not only ensures that the coating crystallises uniformly across the surface, facilitating further finishing, but it can achieve full coverage of difficult to reach areas such as inside long tubes and complex shapes. Once the coating is applied, it has very strong adhesion bonds but if necessary it can be readily stripped and replaced at the end of its life.

The CVD process, which is performed at around 480°C, can also be controlled to vary the thickness and hardness of the coating so the one product covers the majority of applications, with thicknesses from 5μm to up to 100μm on titanium, steel, and their alloys.

All this ultimately means less maintenance for airlines with component lives being extended by a factor of between three and ten depending on application. Hardide is currently undergoing Airbus certification and has already supplied its coating to the Eurofighter Typhoon programme. It is also testing a number of aero-engine components to prove the product out in this particularly demanding environment.

Taking a different approach, with a system of formulation geared towards the development of bespoke products for different customers, Cambridge-based Tecvac's Nitron Flight coatings feature a combination of metal nitride and metallic interlayers which can be specifically tuned in terms of layer composition and thickness to have anything from two or more layers per process, typically going up to 40 for more demanding environments.

Tecvac's business manager for advanced coatings, Ian Haggan explains: "The Nitron Flight brand began as a research project into anti-erosion coatings in partnership with Hull University and later, a global land-based turbine manufacturer. Offering hardness ratings of up to 1,800HV and reducing abrasive wear by 75%, the coatings can be applied to titanium, steel and advanced alloy surfaces at temperatures up to 700°C using physical vapour deposition (PVD)."

As far as Tecvac is concerned, PVD is the most desirable process as it can combine many properties desired by OEMs and MRO companies at a reasonable cost and reproducible quality, such as corrosion resistance, erosion resistance, high adhesion and hardness, a low friction coefficient, excellent surface finish and thermal stability. Specifically, the process used for the Nitron Flight

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