**Recent developments in triode-plasma processing of austenitic and non-ferrous alloys**

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For industrial applications of metallic components, the tribology of 'traditional' materials (ie. primarily ferritic steels under oil-lubricated contacts) is well known and generally well understood. Thus 'Tribology' - as a scientific discipline to study the friction, wear and corrosion behaviour of moving parts in loaded contact - has become firmly established over the last 50 years; ie. since the introduction of this terminology to the wider research community by the 1966 Jost Report to UK government (stating the potential savings to UK industry if wear/corrosion could be reduced/eliminated) - and the subsequent establishment of a UK National Tribology Centre (NCT) in 1968. As demands on engineering components for tribology applications increased, Surface Engineering (as a distinct subset of Tribology) emerged in the early-mid 1980's, largely due to the commercial availability of plasma-assisted PVD processing - and of Titanium Nitride coatings (and their many subsequent variants) that could be deposited at temperatures low enough to satisfy the bulk requirements of metallic (again, primarily ferritic steel) substrate materials.

Over the last ~30 years, PVD coatings technology has developed at a tremendous pace - and (as we push our available engineering materials to their limits) has become an 'enabling' technology, allowing us to extract properties and performance from components that would have been unthinkable at the time that Peter Jost wrote his report. In parallel to these developments, plasma-thermochemical diffusion treatments (such as plasma nitriding) have also developed rapidly - and 'duplex' plasma-nitriding/PVD-coating surface treatment techniques have also found their way into commercial applications. More recent reports to UK government on "Surface Engineering and Advanced Coatings" identify that (together with traditional engineering coating techniques, such as electroplating, anodising, etc.) around 70% of manufactured products rely on a surface coating or treatment to perform their function - representing hundreds of billions of dollars in value, to the UK alone.

However, the technical, societal and environmental demands on our manufactured goods continue to increase (and the 'Surface Engineering' of them, to improve performance and reliability, becomes ever more important). The trend over the last 20 years or so has been to adapt plasma-assisted PVD processing away from the cutting tool arena where it originally found widespread acceptance, to the functionalisation of engineering components for improved tribological performance in other application sectors of industry, such as automotive, aerospace and biomedical. With this trend comes an increasing need to satisfy combined wear and corrosion requirements, and to coat/treat a wider range of metallic alloys, such as austenitic stainless steels and titanium alloys, whose load-bearing capacity and tribological behaviour are poor - and which currently limits their use in moving parts.

This talk examines some of the Surface Engineering issues and challenges in improving the tribological performance of such materials, showing how appropriate selection of plasma-assisted coating and/or thermochemical diffusion treatments might better satisfy complex (and often conflicting) performance requirements. In the case of austenitic alloys based on iron and/or nickel, there is an argument that modified, 'nitridable' alloys need to be developed (as has already been the case for ferritic steels for many years); for titanium alloys, it seems that PVD coating before (rather than after) thermochemical diffusion treatment may be a key factor in developing 'bespoke' solutions for particular classes of Ti-alloy. In general, the over-arching challenge is to cost-effectively optimise the tribological performance, without damaging the inherent desirable attributes - such as corrosion- or fatigue-resistance - that these (relatively expensive) materials possess.