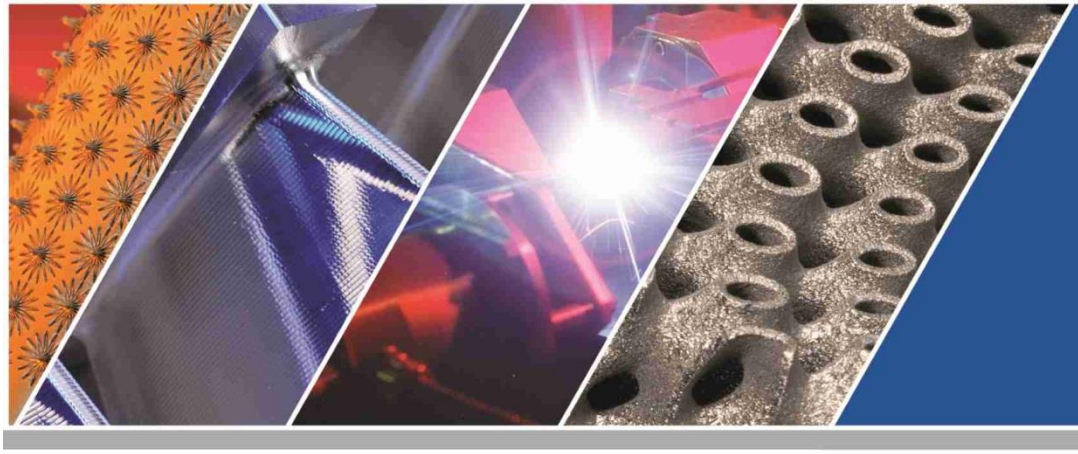
High Speed, Low Cost, Hard Chrome Replacement Coating Technologies for Improved Industrial Performance and REACH Compliance



JOINT INDUSTRY PROJECT OUTLINE

PROP305095 v2

Summary

REACH legislation is becoming increasingly restrictive for coatings based on Cr, Co and Ni alloys. New developments in thermal spraying and ultra high-speed laser cladding processes offer high quality alternatives to hard chrome plating in a wide range of coating applications.

High velocity oxy-fuel (HVOF) spraying has been used as a hard chrome plating alternative for many years. New process developments, including high velocity air-fuel (HVAF) spraying, are aimed primarily at reducing the operating costs of HVOF spraying.

Extreme high-speed laser application (EHLA) process, recently developed from laser cladding techniques, also offers the ability to produce metallic coatings. These coatings are ~20-300µm thick, enabling similar coatings to those traditionally produced using HVOF, with the benefits of being fully fused, with minimal dilution of the substrate compared to traditional laser cladding at >10x coating speed.

Both HVAF and EHLA, and also new coating materials developments, offer new options of depositing high quality protective coatings, for demanding industrial applications requiring combined corrosion and wear mitigation.

The project will conduct a pre-competitive technology review and performance evaluation of new processes and materials to enable TWI's Industrial Members to assess whether the technologies are of benefit to their business prior to undertaking more in-depth, application specific coating development. OEMs, Tier 1 and 2 suppliers and manufacturers will all benefit from joining the project to validate new processes and materials. The majority of work will be conducted using TWI's state of the art, commercial HVOF/HVAF and EHLA coating equipment.

HVAF coating process

EHLA coating process

Applications

Hydraulic rods and cylinders, aircraft landing gear and actuation systems, piston rings and valves, machinery parts, sliding and rotating shafts, automotive drive trains and suspension, tools and dies, internal bores.

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Project Concept

Both HVAF spraying and the EHLA processes claim to offer significant benefits as alternatives to hard chrome plating technologies. The application of thinner/denser EHLA or HVAF 'flash carbides', already in limited use in industry with thicknesses ranging from 10-50µm, opens up cost/performance improvements over coatings produced using conventional HVOF spraying systems which are typically ~300µm thick. For example, WC-CoCr HVAF or EHLA coatings claim to offer comparable performance to electrolytic hard chrome plating. Cost savings are made with HVAF, due to the use of less material and process gases, and the elimination of grit blasting and dimensional grinding post spraying compared to traditional HVOF WC-CoCr and Cr_3C_2-NiCr coatings. For all thermal spray processes, high quality, high adhesion coatings are applied directly to substrates without a heat affected zone. In contrast, the EHLA process offers capability of depositing fully fused metallic coatings, with minimal dilution of the substrate. Both processes therefore offer new options of depositing high quality protective coatings, for demanding industrial applications where combined wear and corrosion resistance is required. Additionally, HVAF ID coating systems potentially offer an alternative to hard chrome plating for internal bores.

Traditional wear resistant coatings, such as tungsten carbide and chromium carbide, are expensive, and are also increasingly subject to REACH legislation relating to the use of alloys containing Co, Cr, Ni and other metals. Thus, there is a drive to reduce the use of these materials. A number of newer commercially available consumables featuring alternative carbides, such as SiC and TiC, in lower cost metallic binders, also offer potential cost savings and performance benefits, particularly when coupled with lower cost processes and will be considered alongside traditional consumables based on WC-CoCr and Cr_3C_2-NiCr coatings.

Approach

The project will include a state of the art technical review of new coating processes and consumables for improved performance and cost benefits. Further work packages will assess the relative performance of HVAF and EHLA coatings of traditional cermet materials and new coating consumables. Where relevant, the application of coatings on internal bores will also be assessed.

Following completion of the technical work packages, additional steps will be identified for industrialisation of new processes and materials to benefit industry, including CapEx requirements and cost comparisons between the new coating processes and materials against current industry benchmark coatings. Recommendations will also be made regarding industrial best practice and standards for the application of new processes and materials.

Deliverables

- Technology review report including an overview of new thermal spraying processes, internal diameter spraying systems and the EHLA process, and new consumables relevant to thermal spraying and EHLA.
- Coating performance data.
- Recommendations on the technology/manufacturing readiness of new coating processes and materials and indication of the relative cost performance benefits compared to current technologies.
- Final report detailing the results of each technical work package, along with recommendations on the technology/manufacturing readiness of new coating processes and materials.

Price and Duration

The above approach is based on a total budget of £400,000 (excluding VAT) over 2 years, which requires £25,000 per company per annum from 8 Sponsors. The scope of work and associated budget requirements will be defined following the project launch.

Further Information

It is a condition of participation in our Joint Industry Projects that the participant organisation be an Industrial Member of TWI. For further information on how a Joint Industry Project (JIP) runs please visit:

https://www.twi-global.com/what-we-do/research-and-technology/current-research-programmes/joint-industry-projects#/

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