

Deposition of thick tungsten and high melting point materials coatings

Plasma Spray is the most versatile of all the thermal spray processes and can be used to deposit very different materials, from metals to ceramics. RINA Consulting – CSM has a special equipment installed in Rome and is able to work in different modalities (APS, VPS, IPS, and HPPS) with a chamber volume of about seven cubic meters and the possibility to deposit thick coatings from 50 micron to some millimetres of thickness. The technology has been used in several nuclear activities focused on the study of the plasma-wall interaction in the presence of high thermal loads and received funding's within EFDA and its main advantage is the possibility to deposit materials with very high melting point so it is the best solution for ceramics and refractory metals.

■ Description of the technology

Thermal spray is a generic term for a group of processes which involve the deposition of coatings from a stream of molten or semi-molten material impinging onto the substrate. High performing thermal spray coatings can provide different functions such as wear and corrosion protection, thermal barrier, clearance control.

The utilization of plasma spray coating technology allows the spraying of almost any metallic or ceramic on to a large range of materials with exceptional bond strength, while minimizing distortion of the substrate. In order to ensure the achievement of the required quality of the coatings, as well as the reproducibility of the production process, automated robot assisted manufacturing and control systems are widely used in the field of thermal spray. The trajectory of the torch has a significant influence on the heat and mass transfer during the coating process. The structure and final properties of the coating can be improved by using appropriate trajectories and speed profiles of the torch. Furthermore, a proper design of the torch trajectory can avoid undesirable wastefulness of coating powder. RINA know how consists in development of tailored coatings solutions by using either innovative compositions or innovative methodologies.



Fig. 1: Controlled atmosphere Plasma Spray equipment



Fig. 2: Example of thick tungsten coating

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■ Innovation and advantages of the offer

Plasma spray is a well known technology and it is used to deposit many materials. Anyway the methodology to deposit thick coatings is not typical for standard applications neither its use on complex geometries. In particular the deposition of refractory metals (such as tungsten) can be easily performed because of the possibility to work in a controlled atmosphere avoiding any oxidation or other chemical modification of the material. Another important aspect to be considered is the possibility to manufacture thick coatings and Functional Graded Materials (FGM) Coatings. The FGM can be obtained by continuously changing the percent composition of a binary mixture during deposition. The resulting coating has interesting properties particularly related to thermal and chemical compatibility of the coating with the substrate. FGM coating is extremely difficult to be realized with other deposition techniques.

■ Non-fusion Applications

The technology has been used in several nuclear activities focused on the study of the plasma-wall interaction in the presence of high thermal loads. Nonetheless, plasma spray is a well-known technology and it is used to deposit many materials in different sectors. As an example, RINA has a patented methodology to deposit UHTC (Ultra high temperature ceramics) by plasma spray for aerospace applications.

■ EUROfusion Heritage

The technology has been used in several nuclear activities focused on the study of the plasma-wall interaction in the presence of high thermal loads (possible application in ITER and DEMO). The first project of this kind in EFDA framework dates back to 2005. The project titled «Manufacture and characterization of Tungsten Plasma Spray Coatings on carbon substrates». In this framework, pure W coatings have been applied on components (demonstrators) of first wall configuration. The deposition onto selected substrates has been done directly or with the interposition of an interlayer made by Plasma spray or PVD coating.

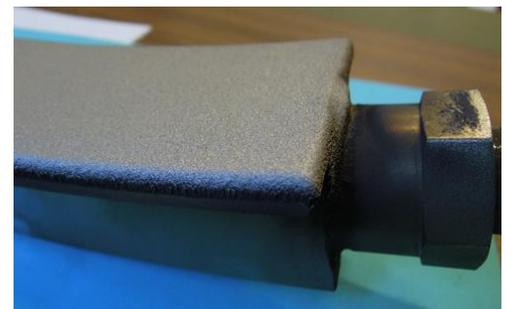


Fig. 3 : Tungsten thick coating on complex geometry