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Hybrid plasma spraying: lessons learned and future prospects

Abstract:

Hybrid plasma spraying combines conventional powder routes with liquid feedstocks to enable novel coating architectures for demanding applications. In this process, powder and suspension or solution are injected either into, or alongside, a high enthalpy plasma jet so that coarse particles form the structural backbone of the coating while fine liquid originated features introduce tailored phases, porosity and interfaces.

This talk will introduce the main hybrid concepts and compare them with established processes in terms of achievable microstructures, throughput and process flexibility. Particular emphasis will be placed on the processing window that must be negotiated to simultaneously process coarse powder particles and fine liquid borne droplets, as well as on the torch requirements for sufficient enthalpy and controllable feedstock treatment.

In the second part, the potential of hybrid spraying will be illustrated using ceramic coatings where alumina and related oxides form a powder sprayed matrix and liquid derived additional materials provide functionality such as phase stabilization, wear resistance or solid lubrication. The recently developed external feeding concept, in which heat sensitive suspensions are atomized directly onto the hot substrate and subsequently over sprayed by molten powder, will be highlighted as a route to integrate materials that cannot tolerate direct plasma exposure.

Finally, the talk will outline how hybrid spraying can be exploited to design multifunctional coatings and will discuss current limitations regarding coating failure modes and process robustness that must be addressed for industrial adoption.

Biography:

Tomas Tesar is a researcher at the Institute of Plasma Physics of the Czech Academy of Sciences in Prague, Czechia, where he has worked for over a decade on ceramic coatings deposited by high-enthalpy WSP-H plasma torches. His expertise most recently focuses on hybrid spraying concepts that combine powder and liquid feedstocks, including external feeding routes, to tailor microstructure and functionality of alumina-based and thermal-barrier-relevant coatings for demanding energy and industrial applications.