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From Roughening to Engineered Interfaces: Can Laser Texturing Unlock the Full Potential of Thermal Spraying?

Abstract:

Substrate preparation is a key step in thermal spraying, as surface condition strongly affects coating adhesion, microstructure, and long-term performance. Traditionally, mechanical methods such as grit blasting are used to introduce surface roughness and promote mechanical interlocking. While effective, these approaches provide limited control over surface morphology and can lead to variability at the coating–substrate interface.

This presentation gives an overview on the evolution of substrate preparation routes in thermal spraying, from conventional roughening methods toward more controlled strategies. Particular focus is placed on laser texturing, which has developed over recent decades as a promising technique for tailoring surface topography and modifying near-surface microstructure. In contrast to traditional treatments, laser processing enables precise control of feature geometry, spacing, and depth, allowing interfaces to be engineered rather than simply roughened.

The talk discusses how laser texturing affects substrate microstructure and its functional roles, including improving adhesion, enhancing interface stability, and enabling better control of coating architecture. These aspects are especially relevant for advanced thermal spray processes such as suspension plasma spraying (SPS) and solution precursor plasma spraying (SPPS).

Selected case studies, particularly in thermal barrier coating (TBC) systems, illustrate how engineered surface features can influence coating durability and behavior during thermal cycling. Finally, remaining challenges and open questions are outlined, including texture design optimization, scalability, and the broader application of laser-engineered interfaces in next-generation coating systems.

Biography:

Pawel Sokolowski is an assistant professor at the Faculty of Mechanical Engineering at the Wroclaw University of Science and Technology. His research focuses primarily on thermal spraying technologies, especially plasma spraying and characterization of advanced coating materials such as thermal barrier coatings or wear-resistant coatings. His work covers topics related to process-properties relationships, process diagnostics, microstructure analysis, and the properties of thermally sprayed coatings for various industrial applications. He is also a strong enthusiast of novel manufacturing technologies and powder-based materials.