Stony Brook University
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Doctoral Defense Announcement

Abstract

A Critical Assessment of the In-Flight Particle State During Plasma Spraying of YSZ and Its Implications on Coating Properties and Process Reliability

By

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Plasma spray process belongs to the thermal spray family of processes, where the feedstock – usually in the form of micron sized particles – is rapidly melted and propelled towards the target to obtain a deposit upon impact and rapid solidification of the molten droplets. With respect to each particle the entire sequence of events takes place in a fraction of a second, while the whole deposition process takes anywhere from a few minutes to hours depending on the dimensions of the component being coated. Due to the non-equilibrium 3D nature of the process and the multitude of parameters and variables involved, this process is not yet completely understood.

This study is aimed at understanding the in-flight state of the plasma spray process towards designing reliable coating and achieving reproducible process states with the aid of non-contact particle and spray stream sensors. Yttria Stabilized Zirconia (YSZ) has been chosen for its physical properties that enable efficient in-flight detection and its widespread commercial application as thermal barrier coatings (TBCs) in turbines.

This dissertation outlines the methodology to obtain process-structure-property relations and provides an approach to tailor the microstructure and properties of coatings. Key issues such as particle injection and process variability are addressed. Focus has been given to understanding the variability resulting from the 3D nature of the process. Efforts have been made to understand the dynamic and complex spray stream towards science-based true in-flight monitoring and control of the process. New approach to interpretation of sensor data towards better understanding of the spray stream has been provided.

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