

## **Advanced Concepts in Thermal Spray Processing of Materials: An Illustrative Discussion on YSZ Thermal Barrier Coatings**

Prof. Sanjay Sampath  
Director, Center for Thermal Spray Research  
State University of New York at Stony Brook  
Stony Brook, NY 11794-2275

Over the last 11 years through support from the National Science Foundation Materials Research Science and Engineering, Center for Thermal Spray Research at Stony Brook has led a multidisciplinary group of investigators to critically examine the science and technology of thermal spray materials. Major breakthroughs have been made on a number of fronts which has enabled new insights into thermal spray and an exploration of its potential into new territories: These initiatives have had impact at both science and technology with implications for prime reliant coating design and applications.

Key accomplishments include:

- 3D process multi-instrument diagnostics and 3D process modeling
- Process maps: an intelligent approach to process optimization, design and reliability
- Quantitative characterization of porosity using sophisticated instrumentation
- Defect-property correlations and its relevance in design, performance and processing
- Multiscale methods for determining design relevant coating properties
- Methodologies for integration of design, materials and processes

These investigations have led to several important findings of direct relevance to coating design and industrial practice of thermal spray processing. This includes:

- Appropriate utilization of process sensors in industrial environment (e.g for plasma spray YSZ)
- Importance of environmental control in deposit formation dynamics
- Relevance of inelastic mechanisms in metals and non-linear properties of ceramics when applied as thermal spray coatings
- Benchmarking process-property relationships through multiscale and multiphysics characterization.
- Science based understanding and controlling process efficiency, coating reproducibility and reliability.

These accomplishments are now being transitioned to industrial practice through a pre-competitive knowledge transfer mechanism through the *Consortium for Thermal Spray Technology* comprising of some 20 leading companies. The consortium allows application of the new methods to enhance efficiency, improve reliability and implement Center's new methods for industrial practice for rapid translation of knowledge.

The presentation will highlight these developments to develop further interaction/discussion.