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***Deposition and Assessment of Suspension-Sprayed TBCs on Different Bondcoats under Thermal Exposure in Dry and Vapor-Rich Environments***

**Abstract:**

The transition to hydrogen fuel is a key strategy for reducing the carbon footprint of gas turbines. Since the combustion of H<sub>2</sub> introduces an intense flow of water vapor, the durability of thermal barrier coatings (TBCs) for gas turbine components operating at temperatures exceeding 1200 °C in presence of water vapor is a key issue for TBC systems. Their lifetime is limited by high temperatures and water vapor, which induce severe interfacial damage mechanisms.

This study evaluates the durability of suspension-sprayed single layer YSZ and double layer gadolinium zirconate (GZ) on YSZ on Ni-superalloy substrates, emphasizing the roles of bondcoat and topcoat architectures. Plasma sprayed and laser DED NiCoCrAlY layer along with Pt-rich diffusion layer were employed as bondcoats. Microstructural features and damage were characterized via SEM; isothermal cyclic oxidation at 1200 °C was used to assess lifetimes. Furthermore, thermal exposure at 1200°C under water vapor conditions was performed using DLR's innovative facility, which is designed to re-produce conditions relevant to hydrogen combustion. Interfacial phenomena, including TGO growth and potential delamination leading to degradation of TBC systems are evaluated. The influence of bondcoat selection on TBC stability under thermal oxidation is highlighted.

This study applies the LAser Shock for DAMage Monitoring (LASDAM) methodology to TBCs in severe environments for the first time. The LASDAM method relies on the controlled introduction of calibrated interfacial defects via the LAser Shock Adhesion Test (LASAT) and tracks their evolution non-destructively via infrared thermography. This method quantifies damage by measuring changes in apparent thermal conductivity caused by cracks and air gaps. The results show that LASDAM is highly sensitive, enabling the detection and quantification of defect growth in both dry and vapor-rich environments. The evolution of damage depends on the topcoat architecture, the deposition route and the atmosphere.

**Biography:**

With more than 25 years of R&D experience in thermal coating, Dr. Toma works closely with academia and industry partners, ensuring support from the development of the advanced, multifunctional and environmental friendly coating solutions and products up to the technology transfer, endorsing novel thermal coating solutions to industrial and environmental challenges. She has been contributed to JTST and TSS events for over 15 years. 2025 she was awarded the TSS President's Award for Meritorious Service.