Failure Analysis and Prevention of Thermal Spray Coatings: Failure Mechanisms, Characterization, and Case Studies

Abstract: Thermal spray coatings are widely used in aerospace, automotive, energy, and industrial applications to enhance component performance and provide resistance to wear, corrosion, oxidation, and elevated-temperature exposure. Despite their proven reliability, premature coating failures can occur when coating design, substrate condition, processing variables, and service environment are not appropriately considered. Such failures may result in loss of coating functionality, substrate degradation, reduced component life, and unexpected maintenance or replacement costs. This paper examines common failure modes in thermal spray coating systems from a failure analysis and prevention perspective. Failure mechanisms including adhesion loss, cohesive failure, cracking, delamination, excessive porosity, erosion, wear, corrosion, and environmentally assisted degradation are discussed in relation to coating architecture, substrate condition, surface preparation, deposition parameters, and service conditions. Emphasis is placed on systematic failure investigation, including visual and microscopic examination, metallographic analysis, coating thickness and microstructure evaluation, adhesion and cohesion assessment, and identification of coating/substrate interactions. Some case studies are presented and the methodologies and case studies presented provide practical guidance for identifying root causes and implementing corrective actions to improve the reliability, durability, and service performance of thermal spray coating systems.

Biography: Dr. Satish Dixit is the Director of Engineering/R&D at Plasma Technology Inc., (PTI). He leads a team of scientist and engineers in new development programs as well as is also involved in new materials development, thin film PVD coatings and thick film thermal spray coating process development programs for various aerospace and automotive industries. He is also working on several governments funded programs. He is also very actively involved in ASM LA chapter for past 15 years and is the chapter chair and Education Chair. He is actively involved in various capacities such as Thermal Spray Society, ASMu board member as well as Chair of the Advanced Manufacturing division at IMAT Conference. He is also Executive member of the Advanced Surface Engineering Division (ASED) of the American Vacuum Society (AVS) for past 20 years and engaged in various capacities for running the ICMCTF conference.