MD-Vol. 94, Proceedings of the ASME Materials Division — 2000
Book of Abstracts
ASME 2000

Damage Mechanisms in Plasma-Sprayed Alumina Coatings

Rodney W. Trice*, David. W. Prine#, and Katherine T. Faber*
*Department of Materials Science and Engineering
Robert R. McCormick School of Engineering and Applied Sciences
Northwestern University
Evanston, IL 60208

#Infrastructure Technology Institute
Northwestern University
Evanston, IL 60208

Abstract

Al_2O_3 coatings produced by plasma spray have been considered for wear resistance and corrosion protection. Mechanical investigations of these coatings are often performed when the coating is still on the metallic substrate, hiding the intrinsic response of the coatings and the lamellae that make up their microstructure. The development of a compression test for stand-alone coatings will be described. Cyclic compression loading with monotonically increased peak stresses was employed to study the deformation and damage of the coatings. Transmission electron microscopy and acoustic emission were also used to identify damage mechanisms that ultimately lead to failure. It is proposed that numerous defects that exist in plasma-sprayed coatings, including porosity and microcracks, serve as sites for crack nucleation and/or propagation. As these small cracks extend subcritically under an applied stress that ultimately propagate parallel to the loading direction along inter-lamella boundaries. With increasing stress, these cracks ultimately link resulting in catastrophic failure.