1602 CD
DOI: 10.1017/S1431927606065834

Microsc Microanal 12(Supp 2), 2006

Metallographic Characterization of Thermal Spray Coating Microstructures

D. Puerta*, J. Sabine**, and A. Geary***

* IMR Test Labs, Failure Analysis & Metallurgical Engineering Department, Lansing, NY 13053
** Pratt & Whitney, Quality and Standards Laboratory, East Hartford, CT, 06108
*** Metallography Consulting Services, Meriden, CT, 06451

Within the past twenty years, there have been a number of significant advances in the area of metallographic preparation techniques. Traditional preparation methods which relied heavily on the use of silicon carbide (SiC) abrasive papers have been replaced by new methods which better utilize diamond as the abrasive for both grinding and polishing (see Table 1). As a result, microstructural features which were previously lost or masked during preparation are now readily visible [1].

Unfortunately, the slow adoption of these new techniques has led to confusion and mis-interpretation within the aerospace industry. Due to the sensitive nature of thermal spray coatings to metallographic preparation, different operators using different metallographic procedures can end up with varying results (see Figure 1). As a result, decisions affecting spray booth parameters are frequently made based on an inaccurate evaluation. This problem is compounded by the fact that the aerospace industry has long used photostandards for plasma spray coating analysis. Unfortunately, in many cases these photostandards were developed by engine manufacturers prior to the development of modern metallographic techniques.

In this presentation, plasma spray coatings including WCCo, Ni5Al, NiCoCrAly, and NiCrC will be examined to demonstrate the effects of metallographic preparation on coating features. Vacuum impregnation of low-viscosity epoxies containing fluorescent dyes will be used to highlight features inherent to each coating [2]. Scanning electron microscopy (SEM) will allow for analysis of cryogenic fracture surfaces (see Figure 2); from which voids and other microstructural features can be qualitatively observed [3]. Particular attention will be paid to the bonding of individual splat particles and the formation of linear detachments (voids) or oxides at these interfaces [4].

Due to the relationship between microstructural analysis and spray booth operation, metallographers must ensure that the laboratory coveys accurate results to the spray booth operator. This accuracy is directly dependent on improvements in specimen preparation for metallographic examination. Modern metallographic methods and automated sample preparation play a major role in this area.

References

[1] Puerta, D.G. Advances in the Metallographic Preparation of Thermal Spray Coatings, Proceedings of the Combustion Turbine Coatings Symposium, October 2005, Houston, TX.
[2] Street, K.W. and Leonhardt, T.A. Fluorescent Microscopy for the Characterization of Structural Integrity, NASA Technical Memorandum 105253, 1991.
[3] Geary, A.R. Metallographic Evaluation of Thermal Spray Coatings, Technical Meeting of the 24^{th} Annual Convention; International Metallographic Society, July 1991, Monterey, CA. pp 637.
[4] Herman, H. Plasma Sprayed Coatings, Scientific American, September 1998.
[5] The authors would like to thank Fred Anderson of IMR Test Labs for his assistance.

Table 1. Traditional versus modern metallographic preparation recipes.

Method	Paper/Cloth	Abrasive	Time
Traditional	SiC Paper	120-1200 grit	60 seconds/sheet
	Low nap cloth	1 micron diamond	4:00
Modern	SiC Paper	180 grit	Until planar
	Diamond griding disc	9 micron diamond	5:00
	Woven silk cloth	3 micron diamond	4:00
	Low nap cloth	1 micron diamond	4:00

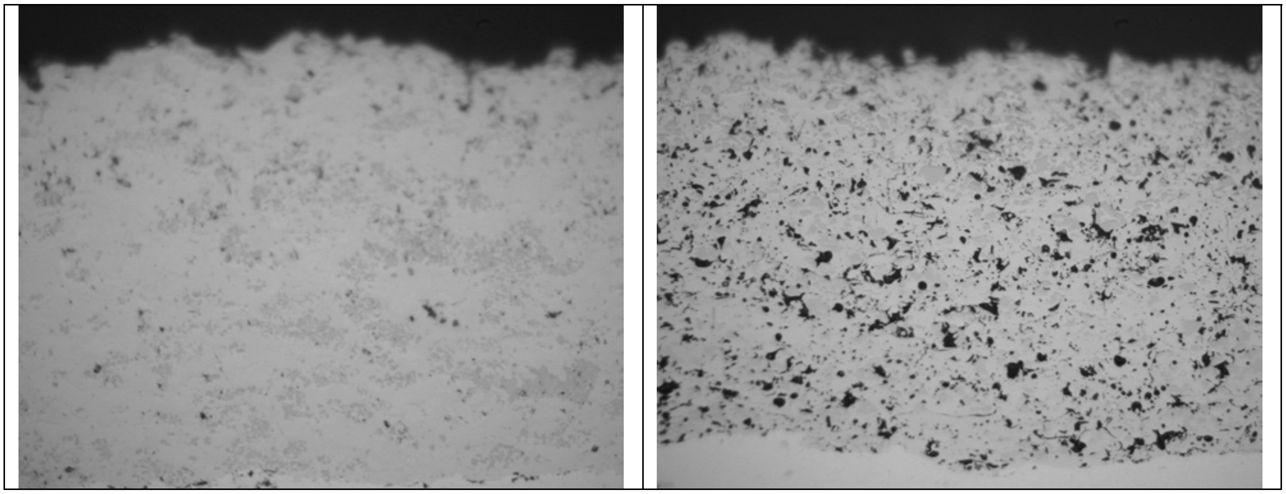

Fig. 1. Identical WCCo plasma spray samples, prepared using traditional (left) and modern (right) metallographic techniques.

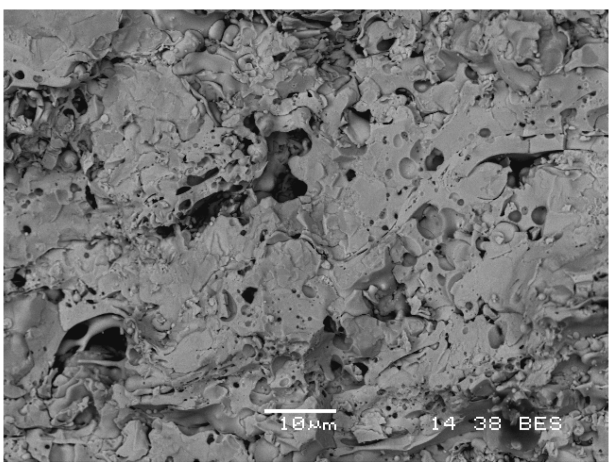

Fig. 2. SEM micrograph showing a cryogenic fracture surface of the WCCo sample shown previously in Fig. 1. From this surface, a qualitative measurement of the inherent porosity of this coating can be made.

https://doi.org/10.1017/S1431927606065834 Published online by Cambridge University Press