

Industry Solutions

Turbine Airfoil - Ni SuperAlloy

Prepare High Quality Turbine Airfoil Mounts in Minutes Using the Planarmet™ 300 Planar Grinder



Turbine Airfoil

Background

Turbine airfoils are typically made out of Ni-based superalloys as the application demands excellent mechanical strength, resistance to corrosion and resistance to creep deformation. However, these same characteristics make the material difficult to prepare. When planar grinding is performed on a high speed planar grinder, the high daily volumes and high material removal requirements can be easily met.

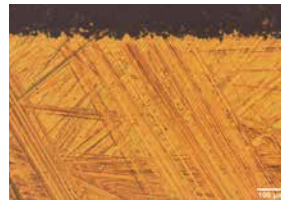
Preparation



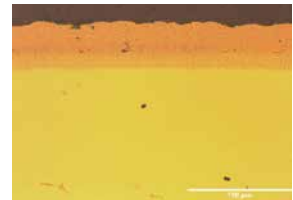
Sectioned Airfoil.



Airfoil mounted in EpoMet™ G.



Surface finish after Planarmet 300 at 5X.



Surface finish after MasterMet™ colloidal silica polishing on ChemoMet™ at 20X.

Sectioning

Equipment: IsoMet™ 4000 or 5000
Consumable: IsoCut™ Precision Blade CBN HC

Best practice for sectioning airfoils is to use a precision cutter when possible to minimize deformation. Cutting should be performed in the direction of the sample bulk so that the coating is in compression, reducing the chances of breaking the coating off the substrate. If the size of the airfoil is too large for a precision saw, then an abrasive saw can be used with a superalloy wheel.



Mounting

Equipment: SimpliMet™ XPS1
Consumable: EpoMet G

The airfoil was mounted in EpoMet G mounting media using the SimpliMet XPS1 mounting press.



Grinding & Polishing

Equipment: Planarmet™ 300

The Planarmet 300 was used to grind the airfoils specimens plane with the following parameters:

Parameters:

Grinding setting:
Load: 10 lbs [45N] (six samples)
Cycle time: 1:10 Minutes
Head RPM: 150
Platen: Complimentary
Wheel Type: Aluminium oxide wheel, 120grit [P120]



The initial grinding step with a 120 [P120] grit alumina stone yields high material removal in a shorter period of time compared to using traditional SiC abrasive papers. Grinding time was reduced from 10 minutes to just over one minute.





Equipment: EcoMet™/AutoMet™ 300



The Ecomet/AutoMet 300 was used to polish the specimens using a 12in [305mm] platen. The mounted specimens were polished in central force mode with only three steps.



Preparation (cont'd)

4-Step Method for Ni-based SuperAlloys using the PlanarMet™ 300 and EcoMet™/AutoMet™ 300

Surface	Abrasive / Size	Load - lbs [N] / Specimen	Platen Speed [rpm]	Head Speed [rpm]	Relative Rotation	Time [min:sec]
Alumina Grinding Stone	120 [P120] grit	10 [50]	Fixed	150		1:10
UltraPad™	9µm MetaDi™ Supreme Diamond	10 [50]	150	60		5:00
TriDent™	3µm MetaDi Supreme Diamond	10 [50]	150	60		5:00
ChemoMet™	0.02 - 0.06µm MasterMet™ Colloidal Silica	10 [50]	150	60		2:00

 = Platen
  = Specimen Holder
 *Plus MetaDi Fluid Extender as desired

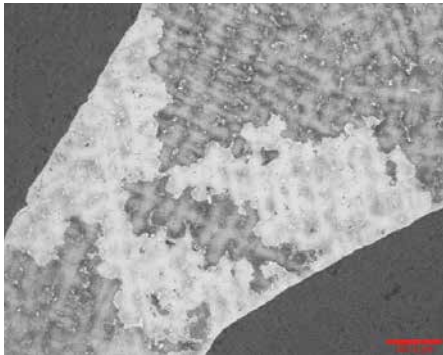
Analysis

Imaging & Analysis

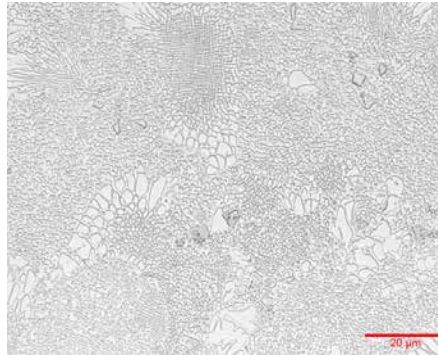
Equipment: Nikon Eclipse MA200 Inverted Microscope
Routines: Coating Thickness, OmniMet™ Object Analysis



The prepared specimens were inspected using a Nikon Eclipse MA200 inverted microscope equipped with a 3.1 MP uEye digital microscopy camera using bright field illumination (BF).



Airfoil etched with Molybdic Acid Reagent at 5X.



Airfoil etched with Molybdic Acid Reagent at 50X.

Conclusion:

A true representation of Ni-based superalloys can be achieved in a quick and economical matter using the PlanarMet 300 Planar Grinder and modern preparation methods.

Benefits:

Overall processing time was reduced by 41% over traditional methods which uses multiple steps of SiC grinding paper.

Sectioning

AbrasiMet • AbrasiMatic • IsoMet

Mounting

SimpliMet

Grinding & Polishing

EcoMet • AutoMet • MetaServ

Imaging & Analysis

OmniMet

Hardness Testing

Wilson® Hardness



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