



KINETIC METALLIZATION™ WC-CO WEAR RESISTANT COATINGS

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ITSC 2015 Presentation

Session — Engineering, Protection and Repair of Aircraft Structural Parts 4

INTRODUCTION
KINETIC METALLIZATION™
(KM)



Deposition Processes

Gas

Vapor Deposition

Liquid

Thermal Spray

Solution

Electrochemical

Solid

Impact Consolidation

IVD

HVOF

Plating

KM

CVD

AMPS

Anodize

CS

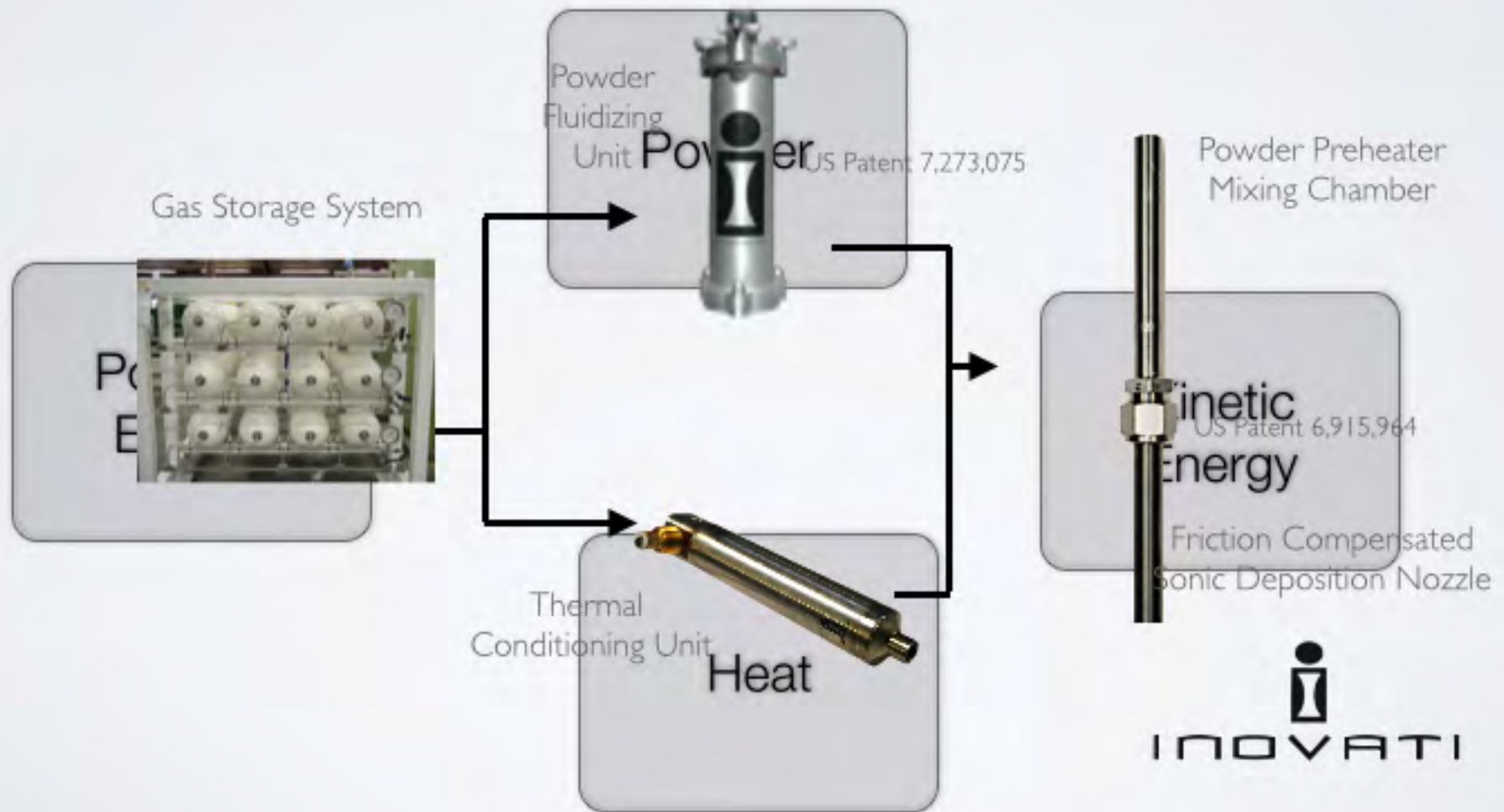
PVD

D-Gun

Chemical



KINETIC METALLIZATION™ PROCESS

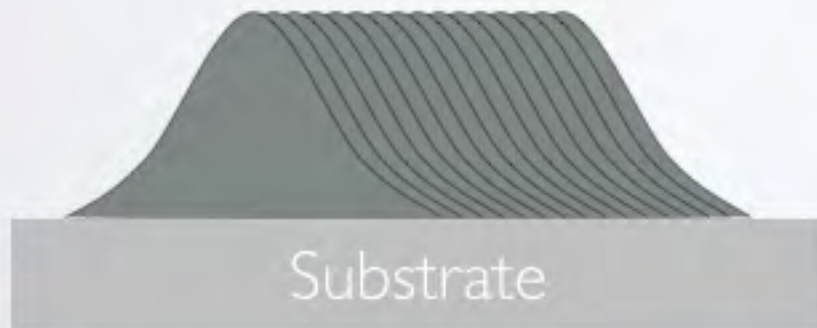


- Impact Consolidation Process

- Feed-stock: fine powder,
- Accelerant: inert light gas

- Solid-state Consolidation

- No Melting
- No Liquid Chemicals



- Environmentally Innocuous

- No Particle release
 - No Chromate formation
 - No Hazardous Gas Emission
- Enhanced worker safety





KM-PCS EQUIPMENT 
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POWDER FLUIDIZING UNITS

- Patented Brush-Sieve Design
- Light-weight pressure vessel
- Powder/ Gas flow rate independent
- Powder Size: 500nm - 50 μ m
- Feed Rate: 0-100g/min
- Large Capacity - 4 hour run time




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QUALITY ASSURANCE

- Automatic report generation
- Quickly view run overview
- Eliminates manual parameter logging
- Plotted parameters for quick evaluation
- Parameter statistics
- Configurable
- Detailed process history for QA purposes



KM QUALITY REPORT



Run Details

Operator	scoway	Customer	INOVATI
Date	3/16/15	Project	WC-Co Down
Time	12:36:03	Task	Sample Coupons

Substrate

Material Group	Steel	Bond Coat	none
Alloy	4130	Preheat Temp	0
Surface Prep	AODD1 Coil Blast	Thickness (in)	0.04
Surface Roughness	124		
Substrate Comment	3"Wx4"Lx0.04"		

Powder 1

Material Group	Tungsten	Drying Method	None
Alloy	KM118-10-10	Preblend?	No
Powder ID	0108-67	Set Point (%)	55
Sieve	35	Feed Rate (g/min)	30
Powder 1 Comment			

Powder 2

Material Group		Drying Method	
Alloy		Preblend?	
Powder ID		Set Point (%)	0
Sieve		Feed Rate (g/min)	0
Powder 2 Comment			

Nozzle

Type	Straight	Serial Number	1501
Throat Diameter (in)	0.059		
Nozzle Comment			



Gas

PFU Gas	15-
TCU Gas	15-

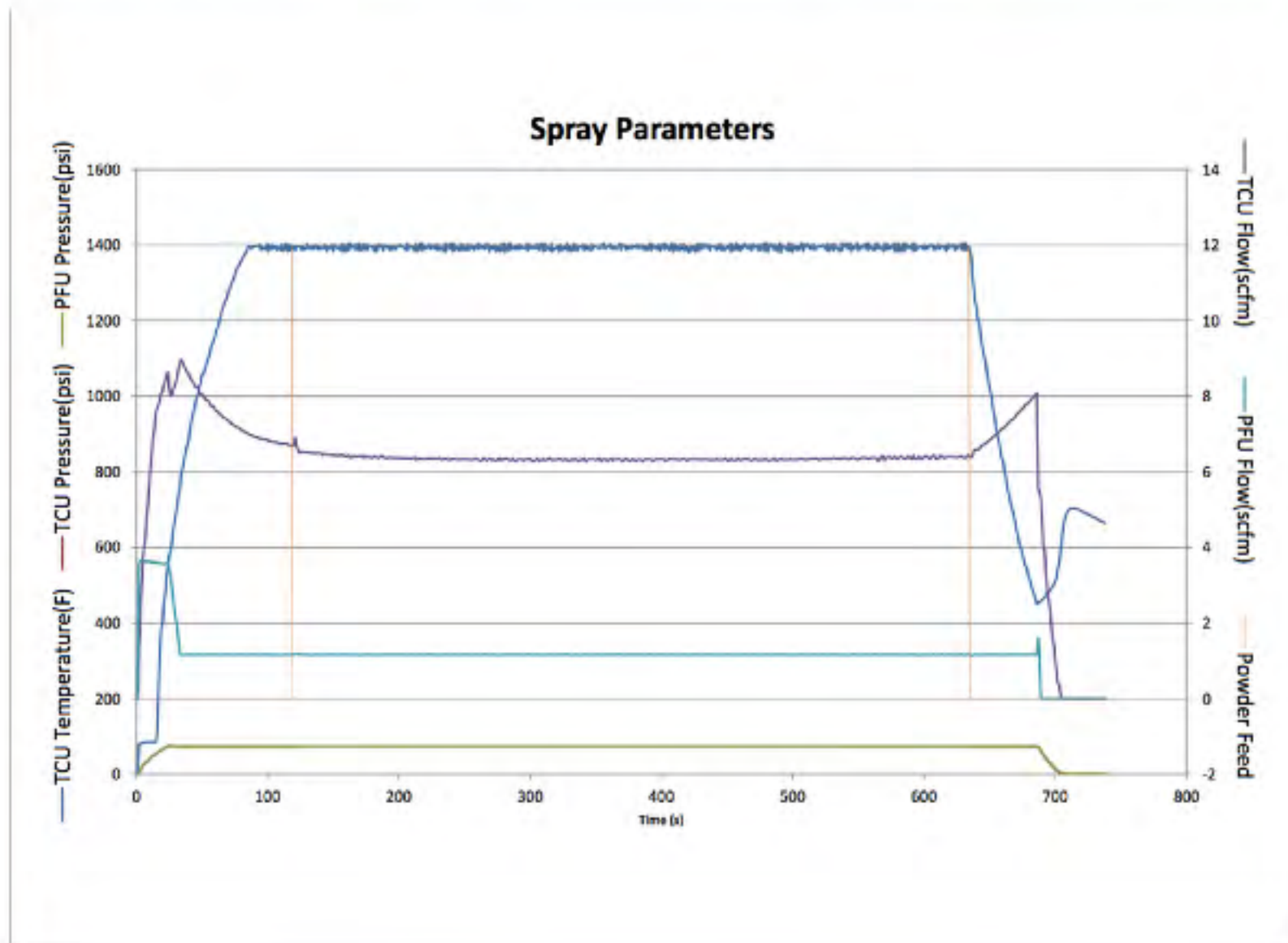
Spray Parameters

	Units	Set Point	Min	Max	Average	Standard Deviation
Temperature	°F	1400	1383.00	1403.00	1394.46	5.36
Pressure	psig	75	73.77	74.29	73.93	0.07
TCU Flow	SCFM	---	3.09	3.64	3.82	0.14
PFU Flow	SCFM	---	3.19	3.19	3.19	0.00
PFU Motor 1	%	55	0.00	59.00	54.69	0.60
PFU Motor 2	%	0	0.00	0.00	0.00	0.00

Robot Parameters

	Units	Set Point
Length	in	4.2
Width	in	1
Substrate Thickness	in	2.02
Standoff	in	0.49
Speed	in/sec	1
Step Size	in	0.00
Strokes	---	1
Layers	---	1
Turn Table Rotation Speed	rpm	0

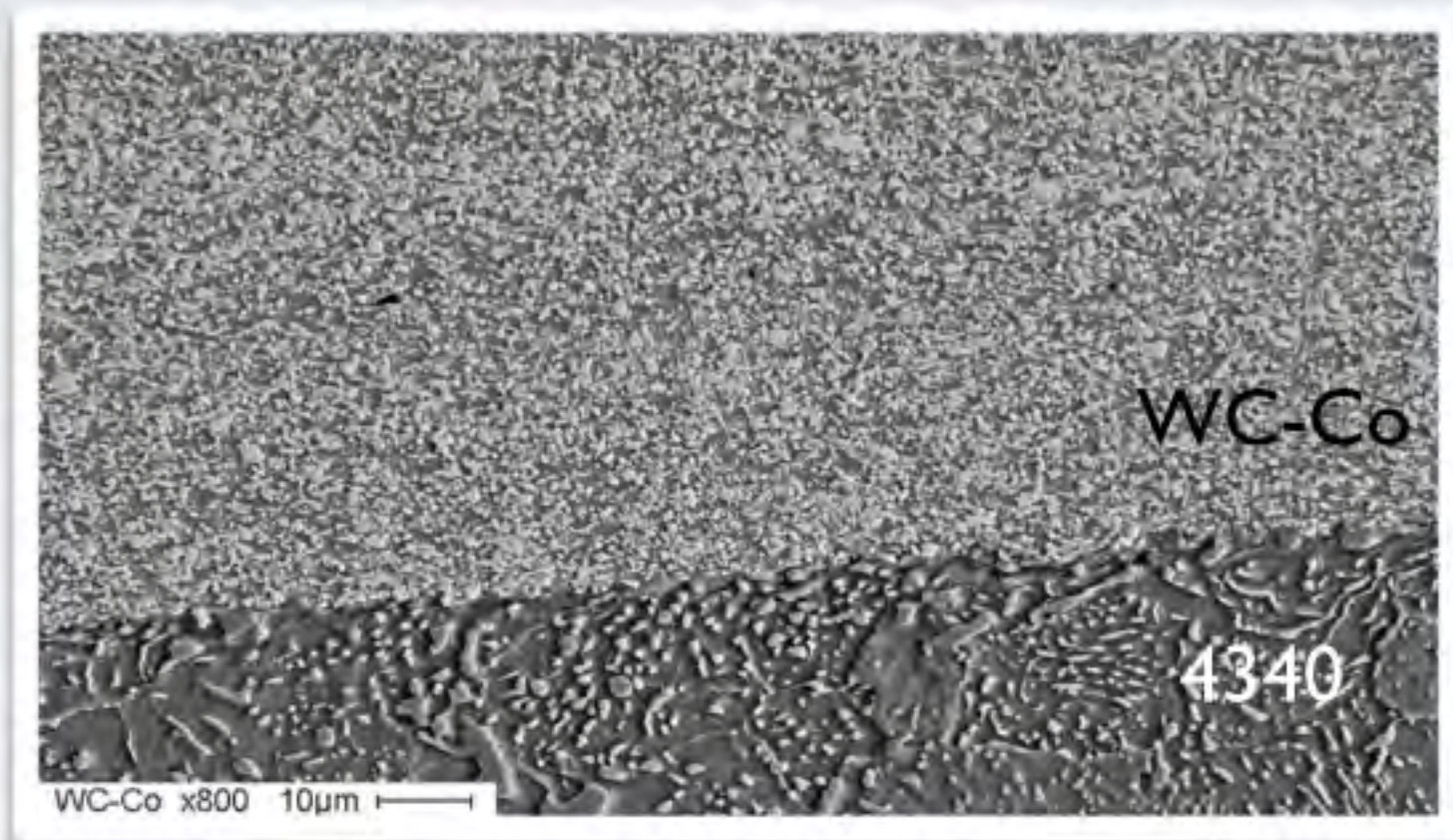
KM QUALITY CHART



KINETIC METALLIZATION™ WC-CO

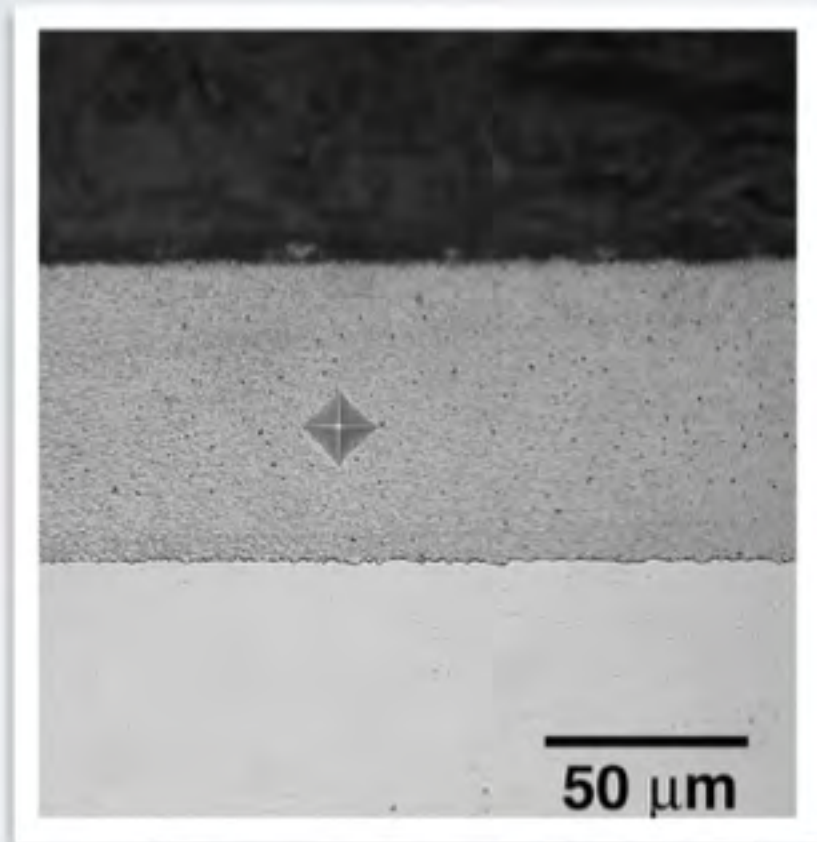


KM WC-CO

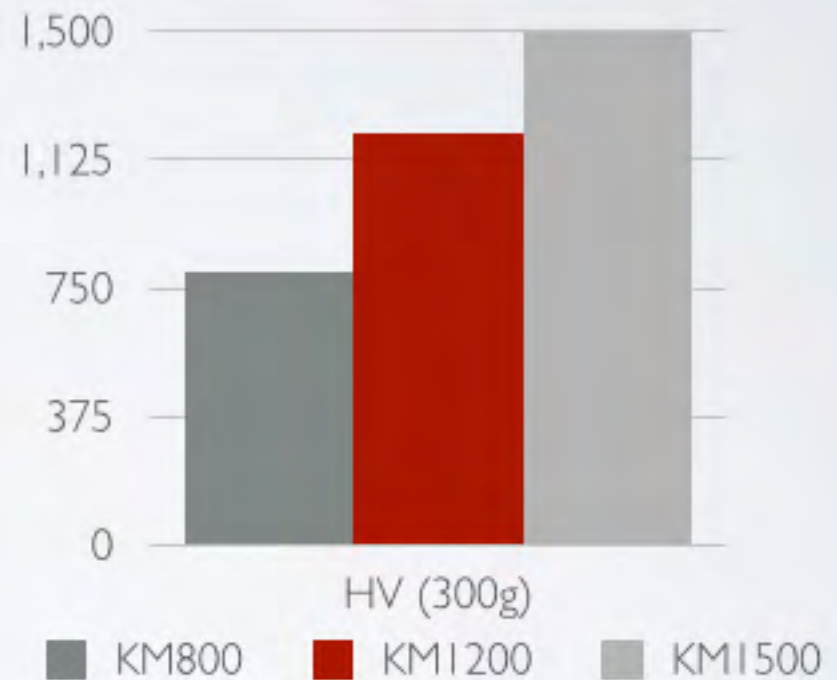


- Fine grain structure
- 99.9% Dense
- Tunable hardness

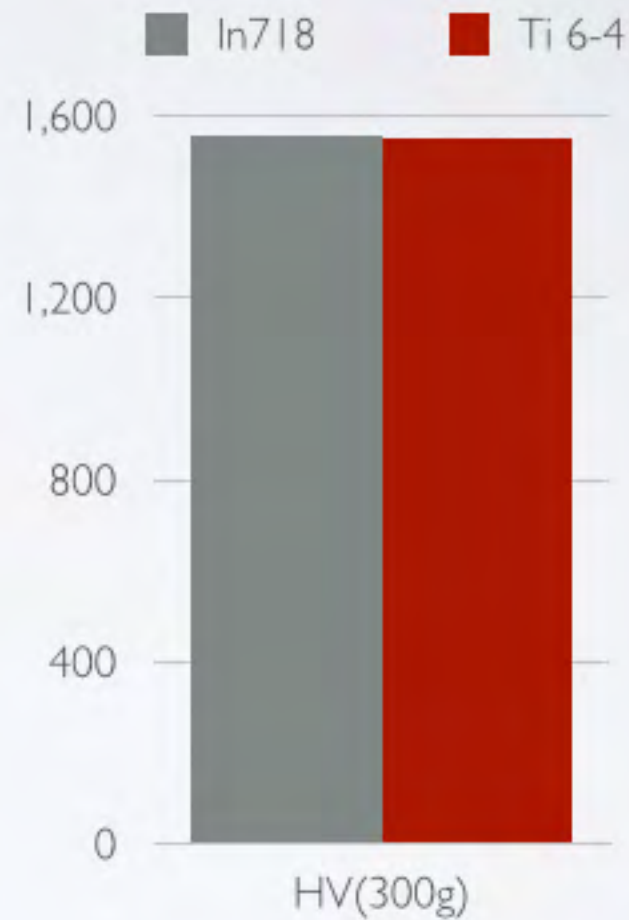
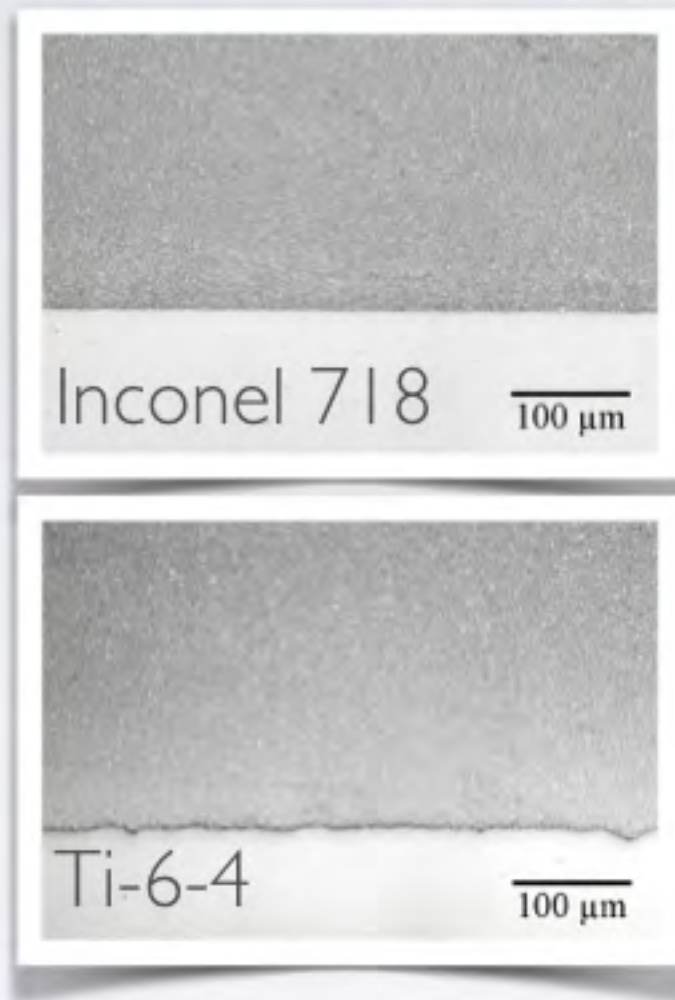
TUNABLE HARDNESS



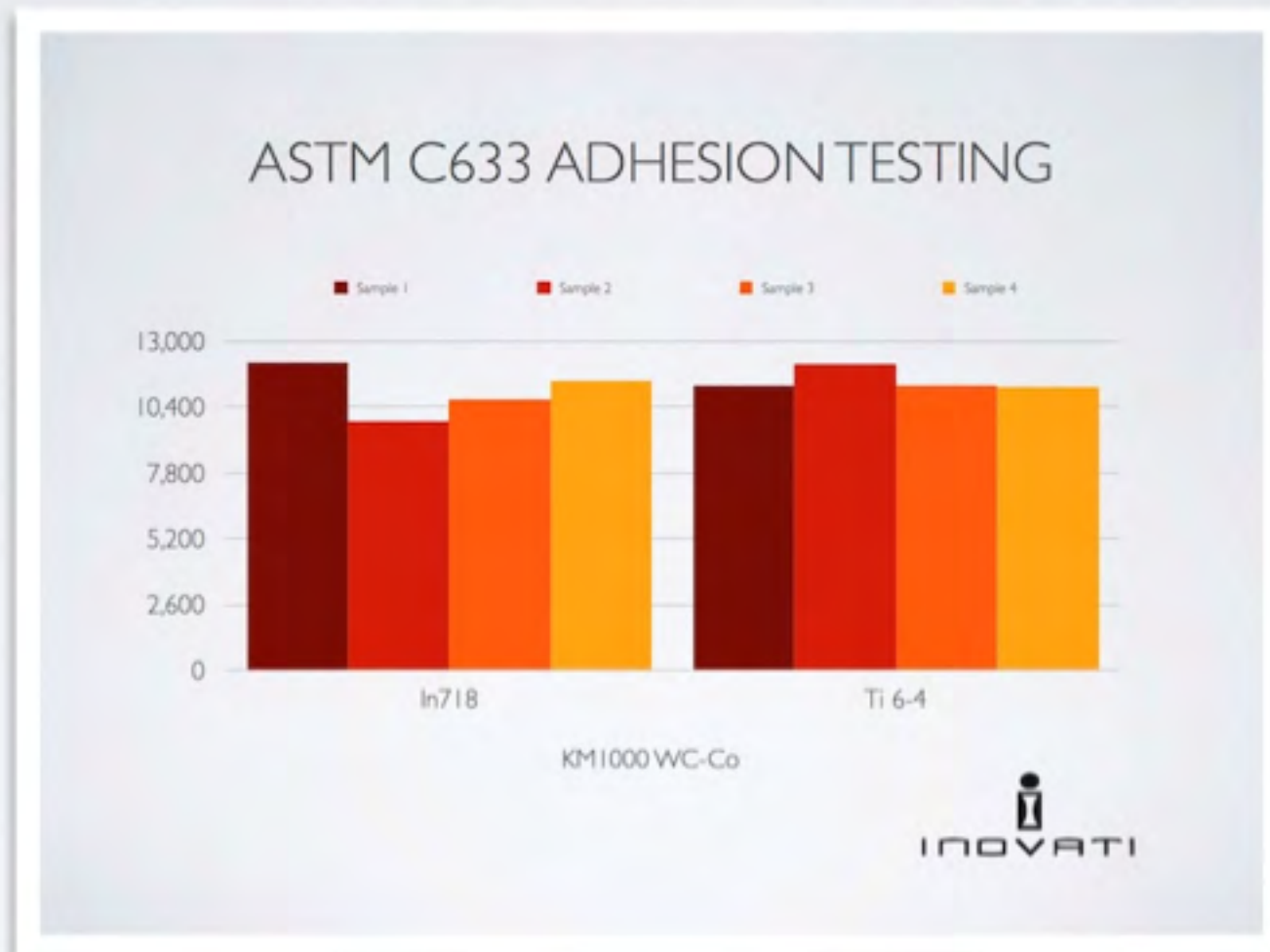
HV (300g) = 1495 kg/mm²



WC-CO ON BLADE ALLOYS

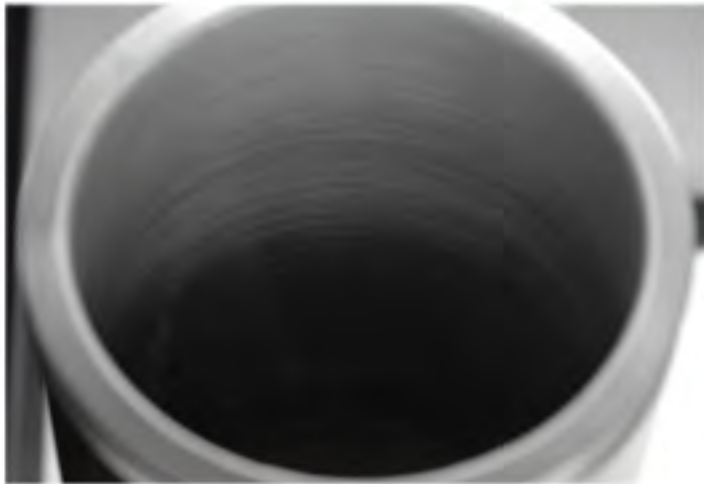


WC-CO ON BLADE ALLOYS



KM APPLICATIONS
WC-CO
WEAR RESISTANT COATINGS





KM WC-CO

- ID & OD
- LARGE & SMALL
- SMOOTH & SHARP


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T16-4 KNIFE EDGE WC-CO

Longitudinal X-section



X-section



F/A-18 (AMAD) HYDRAULIC GEAR SHAFT REPAIR

AMAD - Aircraft Mounted Accessory Drive



REPAIR OVERVIEW

Hydraulic Pump Spur Gear

- Wear at sealing surface (AMS 6265)
- High Cost
- Low Part Availability

Current Repair

- Hard Chrome Plating
- Human Health & Environmental Issues

KM Repair

- No Toxic Chemicals
- Better Performance Than Original Part



DAMAGED HYDRAULIC GEAR



- 0.005" deep wear groove



- Detail




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KM Repair F/A-18E/F Hydraulic Pump Gear Shaft

AMS 6265
Hv = 384

WC-Co
Hv = 1000

Wear damage removed and replaced
with Tungsten Carbide-Cobalt using
Kinetic Metallization™


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ACCELERATED WEAR TESTING

	Hours of Accelerated Wear	Surface Roughness (Ra) (μ -in) Before	Surface Roughness (Ra) (μ -in) After
OEM Gear AMS 6265	22	18-20	>200
Chrome Plate	21	4-5	>200
KM WC-Co	61	2-3	16-17



KM – HVOF COATING PERFORMANCE COMPARISON



LCF TESTING

Key Finding for High Loads

- 220ksi, R = -0.33
- 0.005" KM coating integrity equaled 0.003" HVOF
- More ductile coating & uniform thickness provided improved grind performance over HVOF



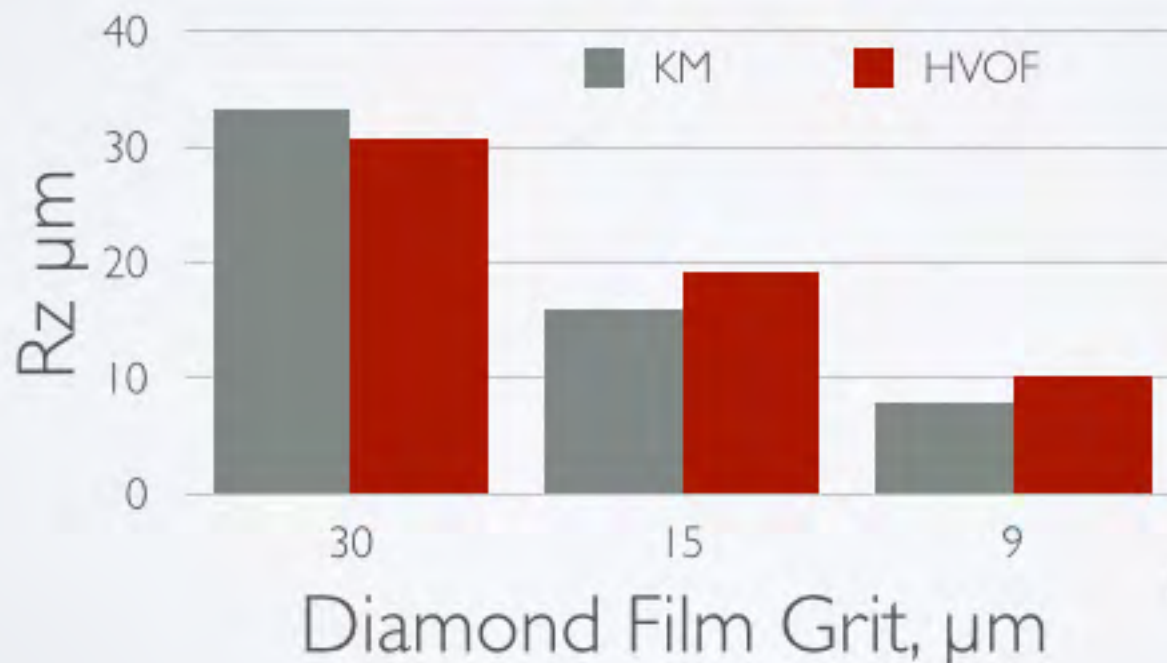
0.003" KM coating at 160ksi, R = -1

KM – HVOF SUPERFINISHING COMPARISON



WC-CO SUPERFINISHING

- Surface finishes
- WC-17Co – Kinetic Metallization™
- WC-86Co-4Cr – High Velocity Oxygen Fuel (HVOF)



Conclusions

- KM WC-Co Applications
 - Restoring wear damage to F/A-18 components
 - Extended life of hydraulic spur gears (AMAD)
 - Applicable to journal bearing surfaces
 - Permits sustainable seal/bearing wear surfaces
 - Tunable hardness range $H_v = 800$ to 1500
 - Ultra-fine microstructure eliminates seal degradation
 - Adhesion strengths of >10 -ksi





VISIT BOOTH 1064

KM-SAM Process & Equipment