Enhancing Quality of WC Coatings with Kinetic Metallization™

North American Cold Spray Conference
Session 2 - Characterization
Wednesday April 3, 2013 1:30 PM

Howard Gabel, President
Ralph Tapphorn, VP of Technology
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Deposition Processes

Gas	Liquid	Solution	Solid
Vapor Deposition	Thermal Spray	Electrochemical	Impact Consolidation
IVD	HVOF	Plating	KM
CVD	A/VPS	Anodize	CS
PVD	D-Gun	Chemical Conversion	

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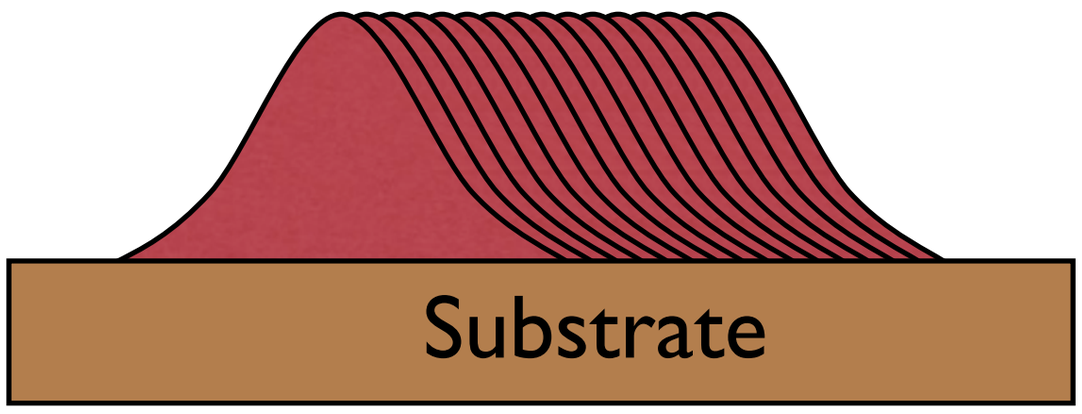
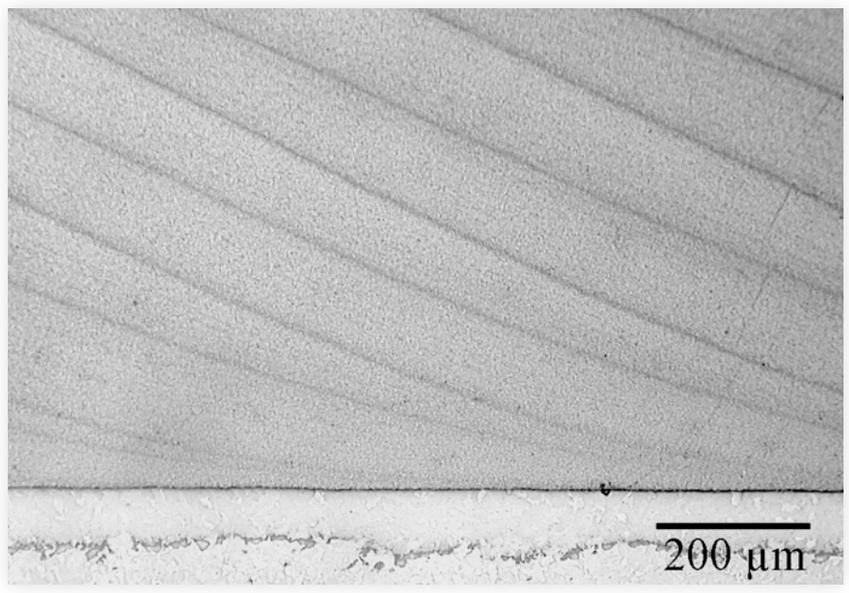
KM Basics

- 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





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Kinetic Metallization™ Process

Gas Storage System

Ultra-fine
Powder
Fluidizing
Unit

Sonic Deposition
Nozzle
with Powder
Preheater & Mixer

2.5 kW Thermal
Conditioning Unit
< 150 psig

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KM Systems

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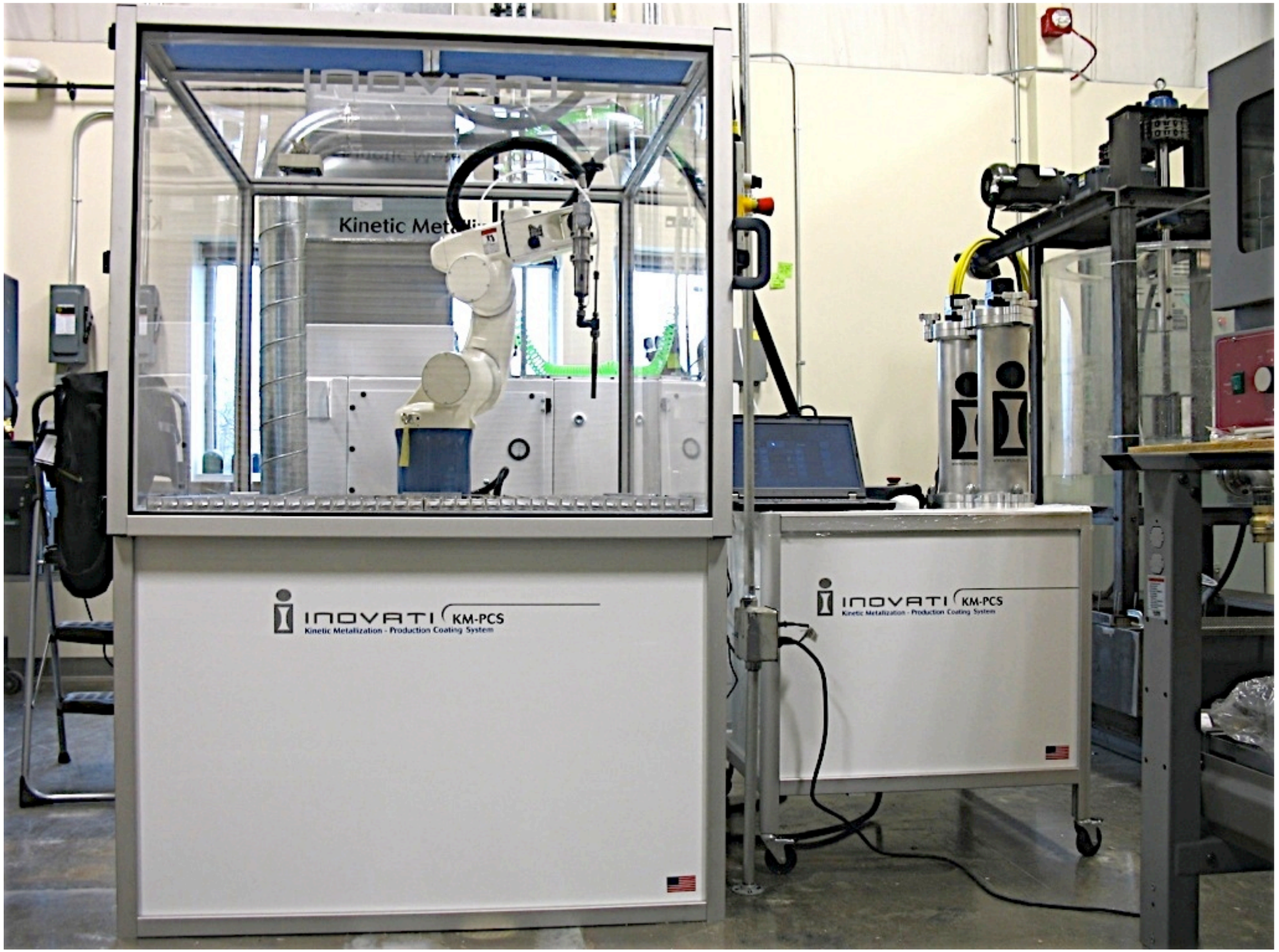
INOVATI KM-PCS
Kinetic Metallization - Production Coating System
INOVATI KM-PCS
Kinetic Metallization - Production Coating System

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KM-1373 System

- **Multiple Types Spray Guns**
  - Robotic, ID Gun, & Handheld
  - Gas blending (He & GN2)
- **Applicable Coatings**
  - 1100 °C Helium @ 60-90 psig
  - WC-Co, Ni alloys, Nb, Ta
  - GN2 (Al-Trans® , Cu, Zn, Ni)
  - Polymers (PEEK, PTFE)
- **Powder Loading**
  - ~100% gas mass flow

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KM ID Gun

Internal Diamter
Down to 50 mm ID
Bore Lengths> 1 meter

Low Temperature WC-Co

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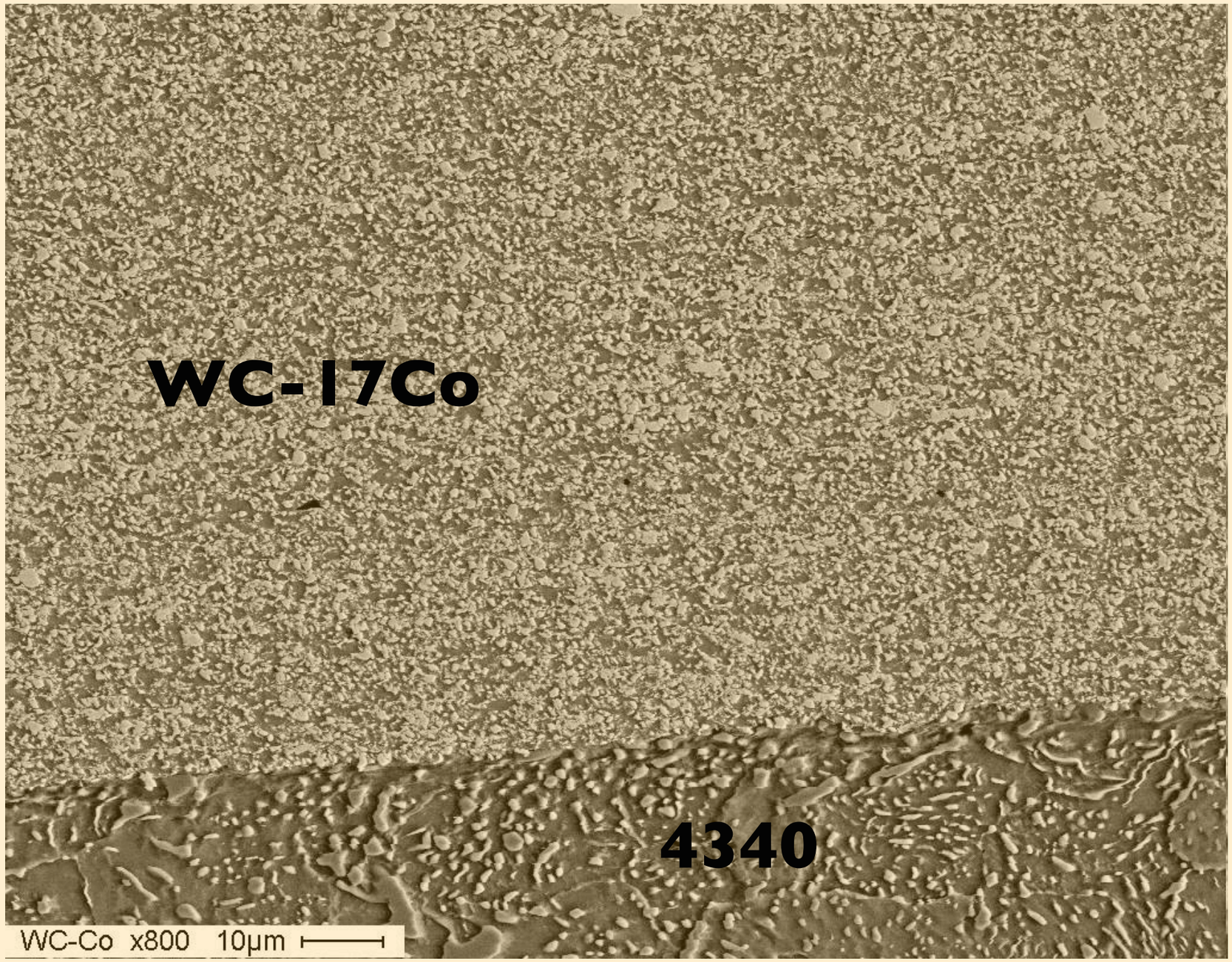
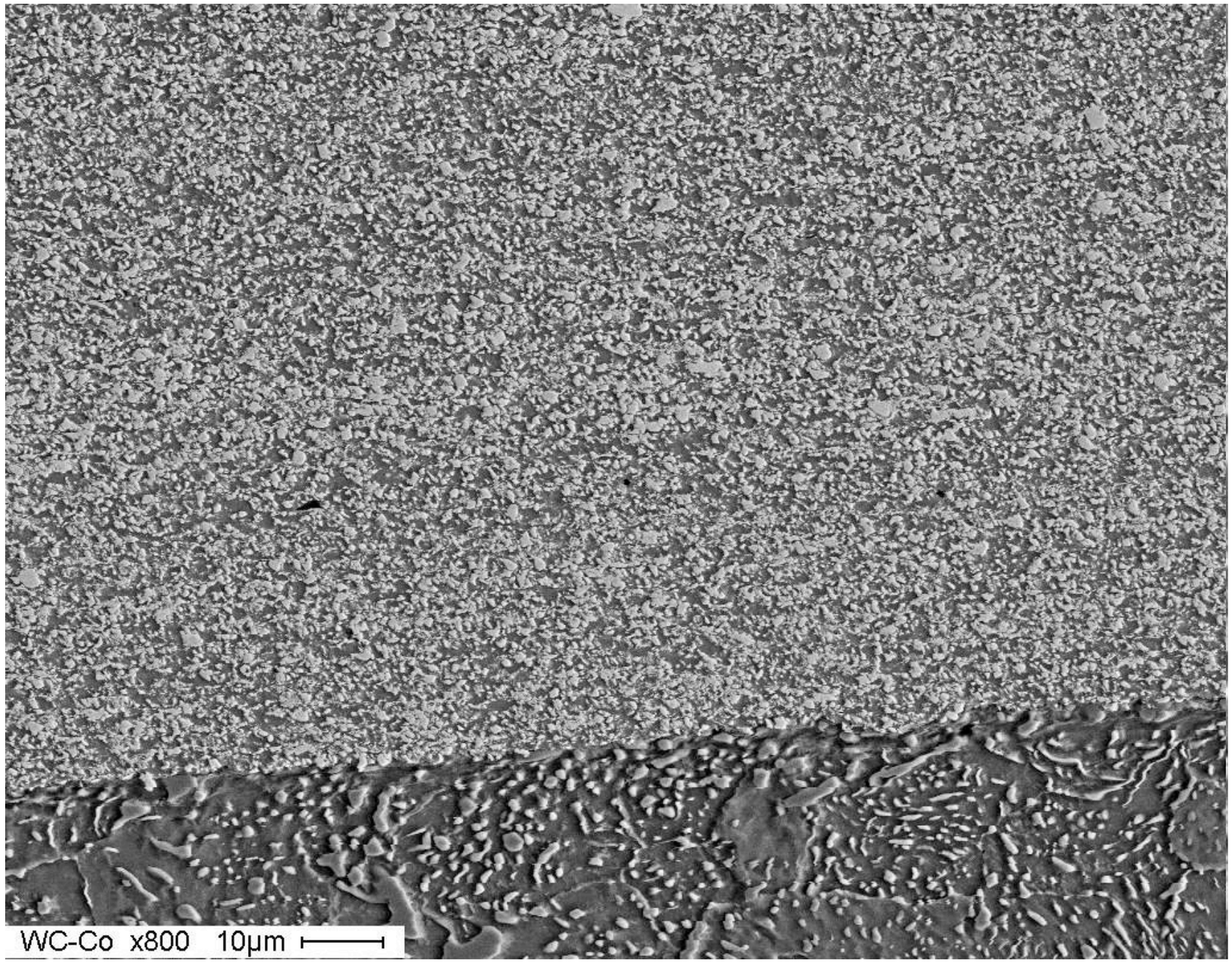

WC-17Co
4340
WC-Co x800 10µm



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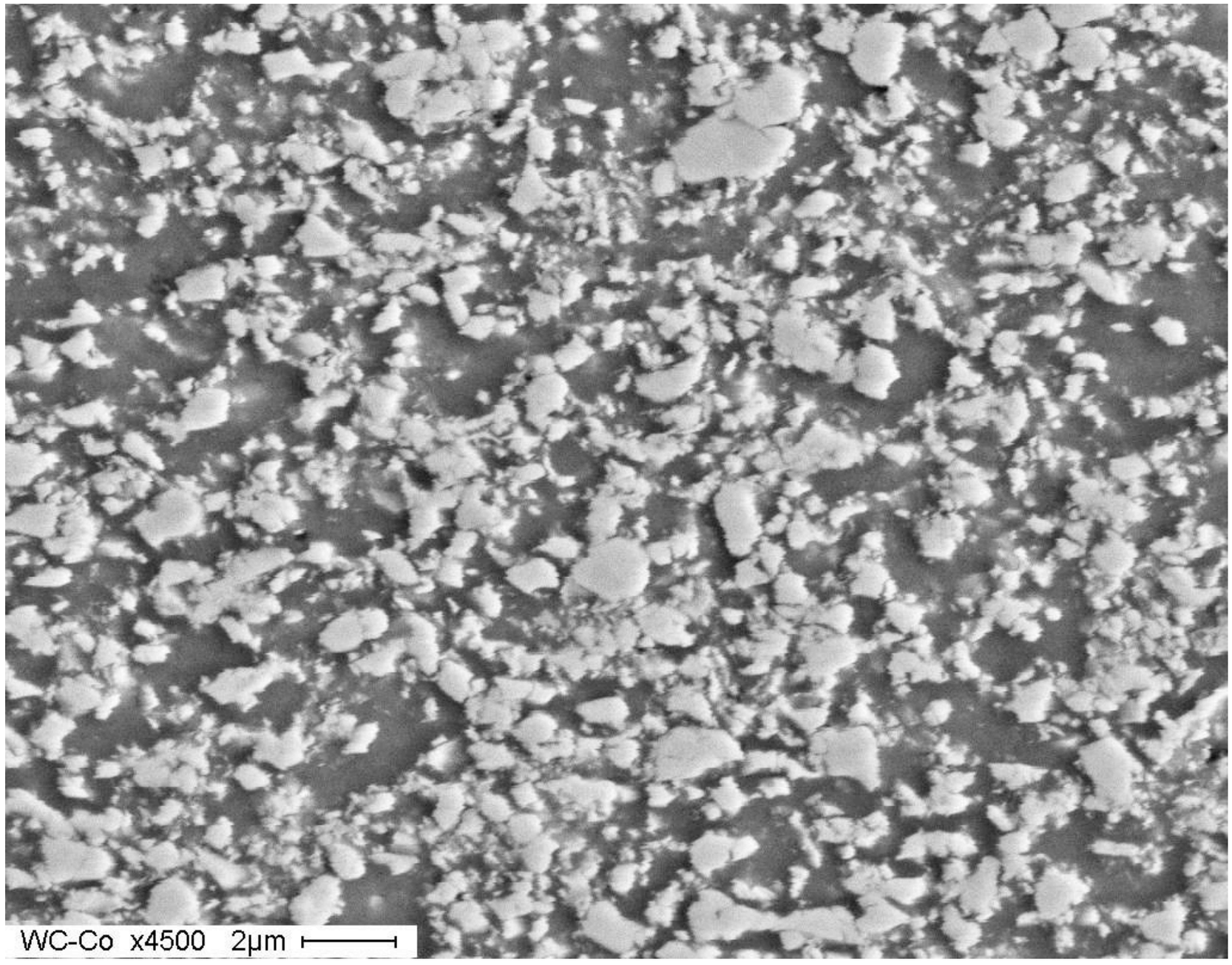
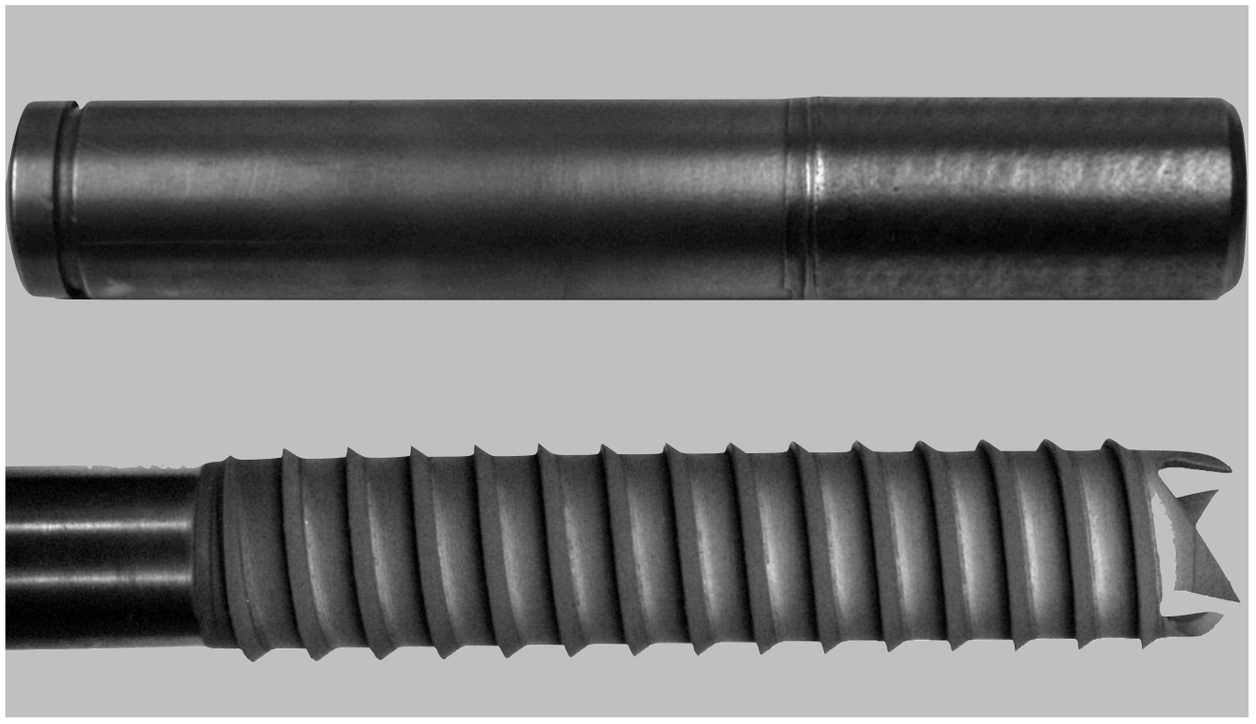

WC-Co x4500 2µm



KM1000
WC-Co Coatings

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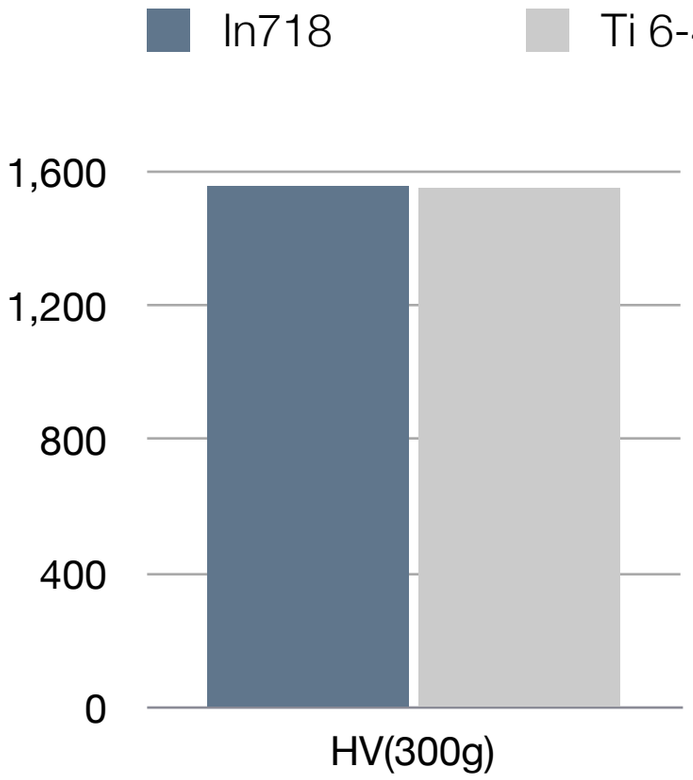
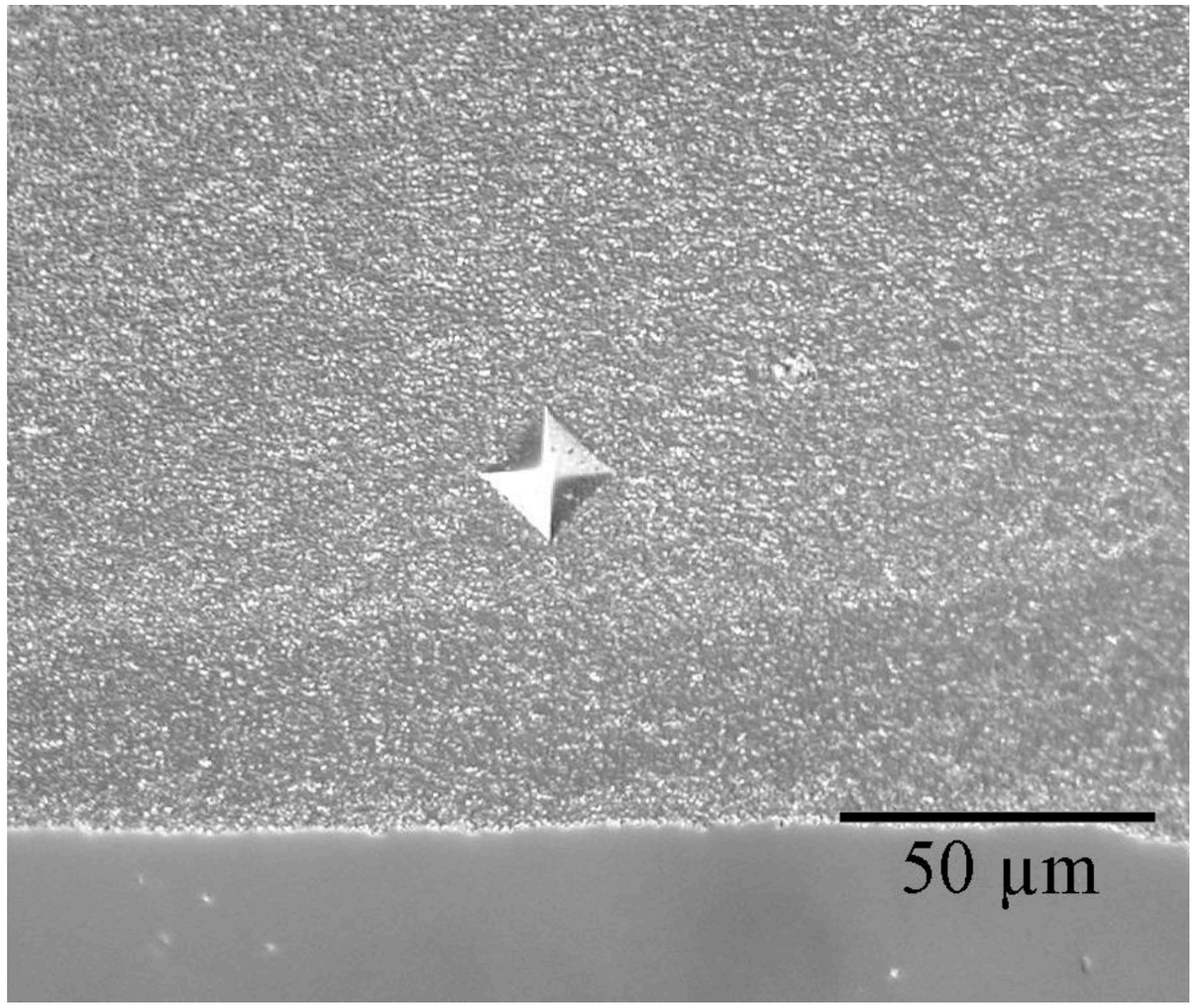
WC-NiCrCo Microhardness





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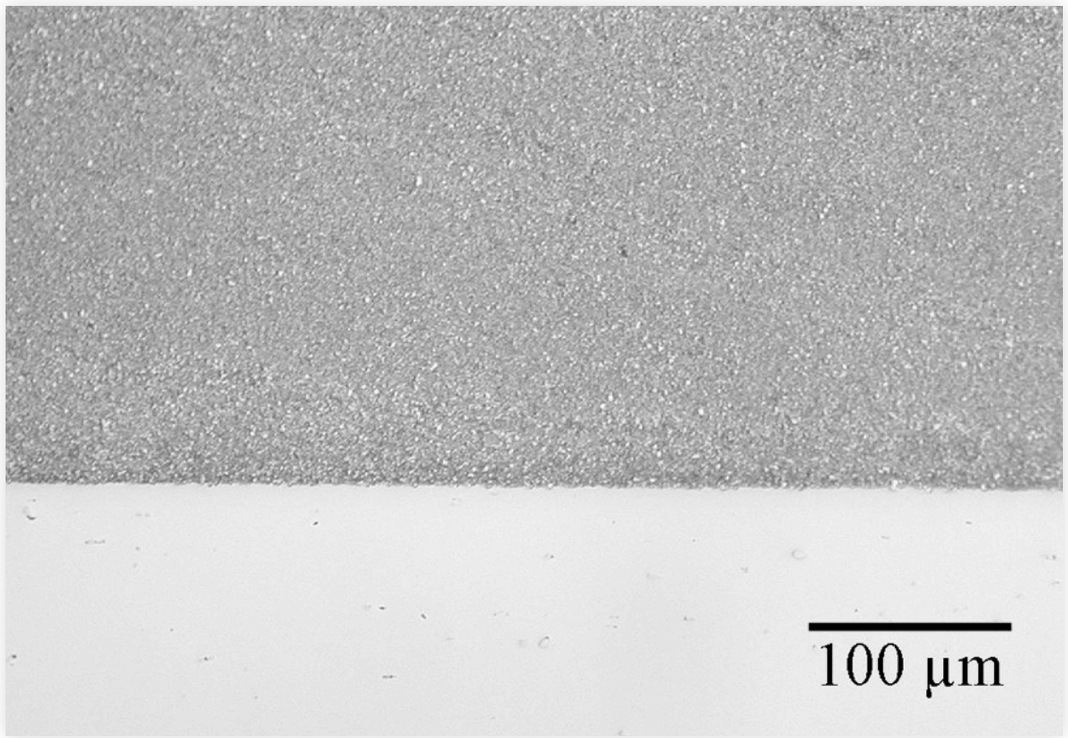
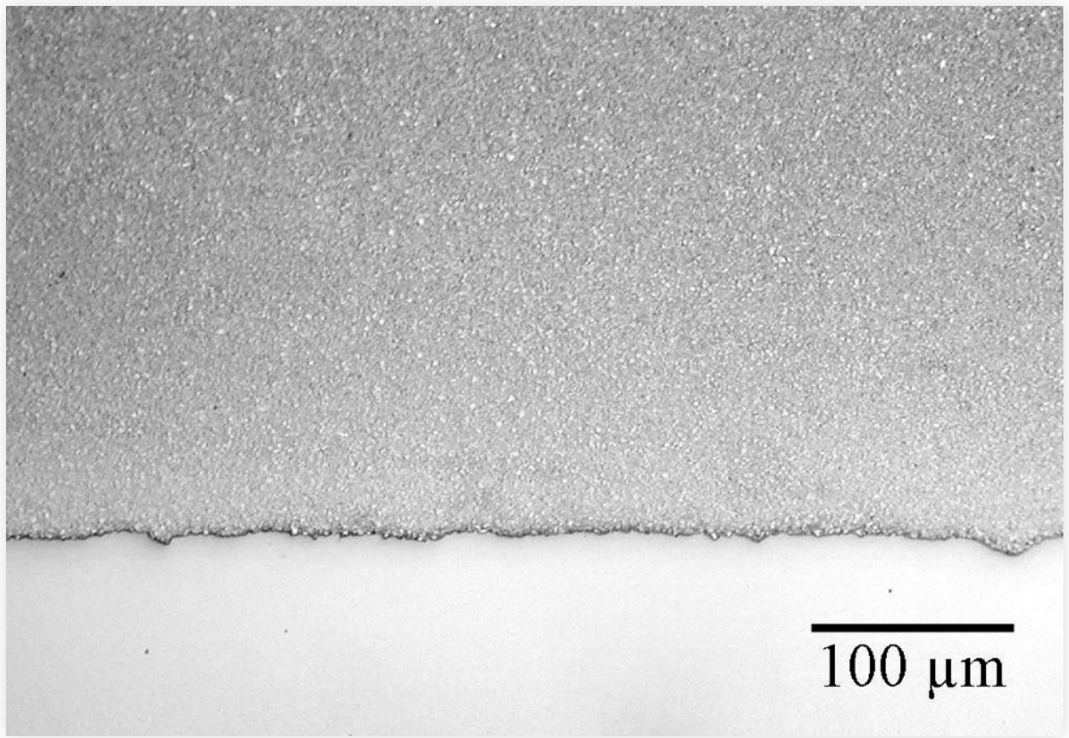
Microstructural Characterization





- Inconel 718
- Ti-6-4

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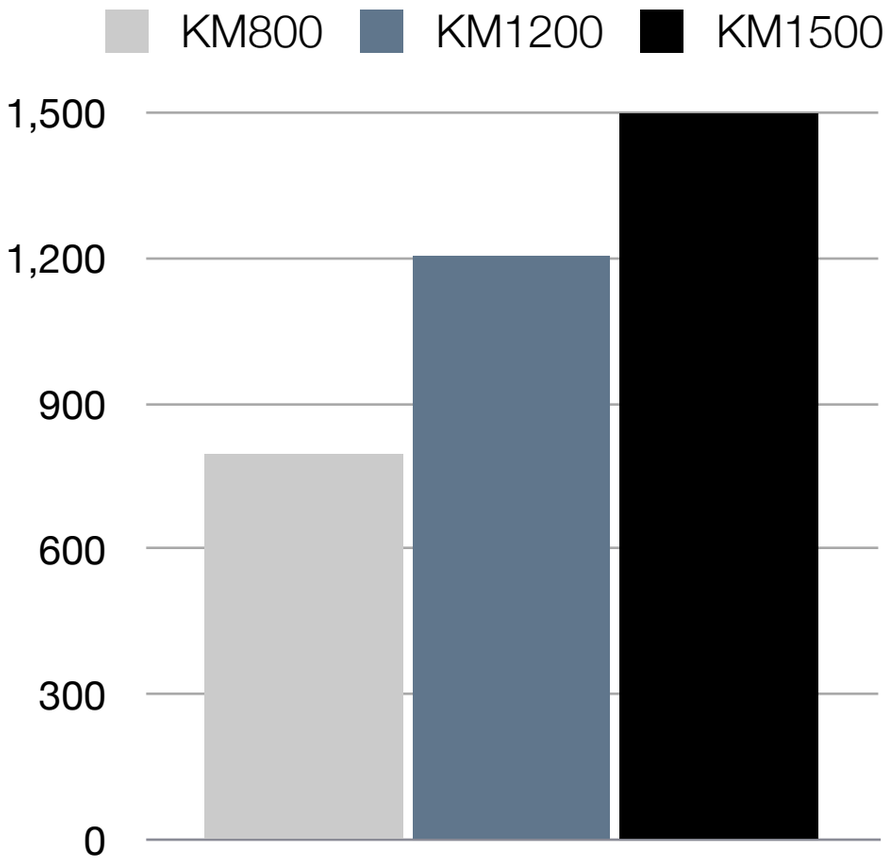
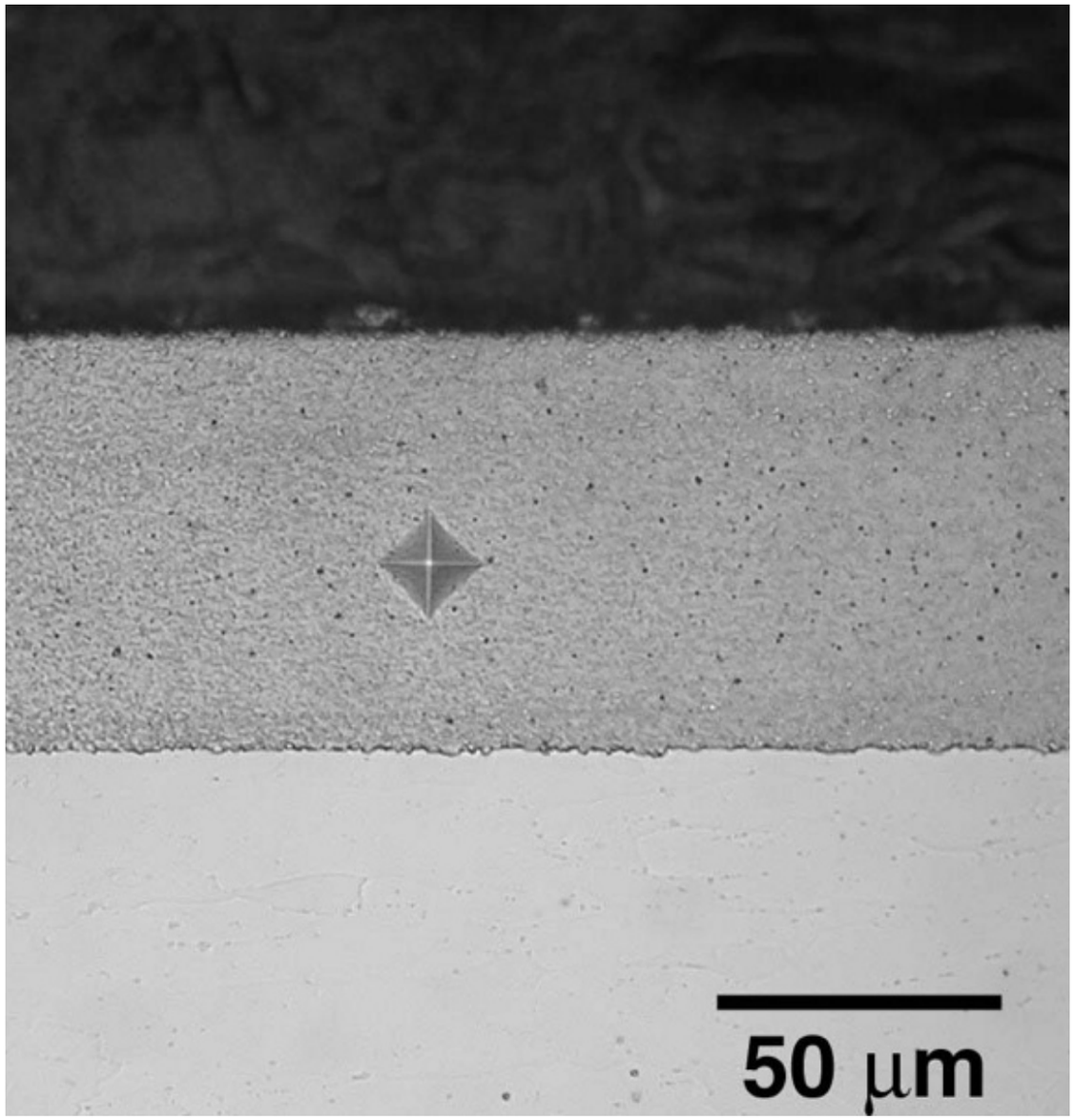
Tunable Hardness KM WC-Co





HV (300g) = 1495 kg/mm2

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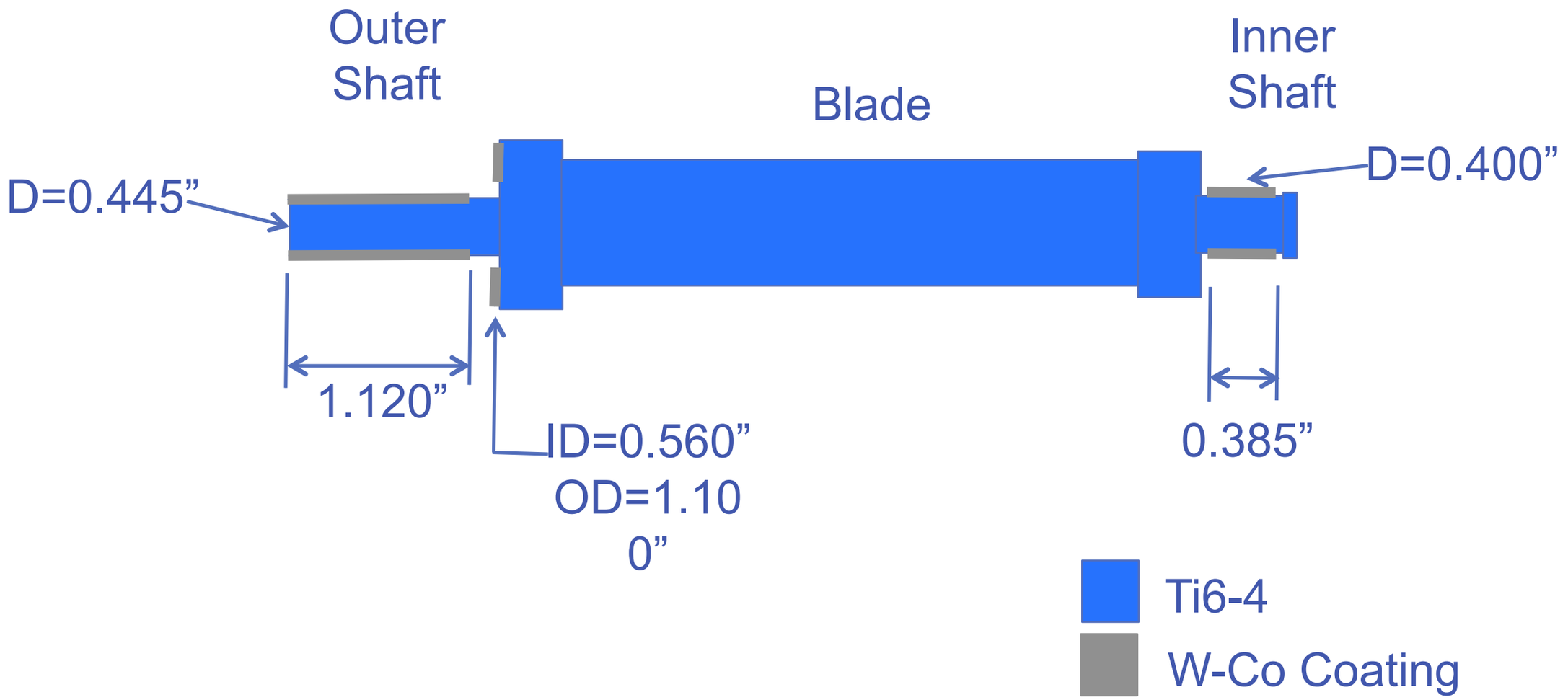
Stator Coated Surfaces



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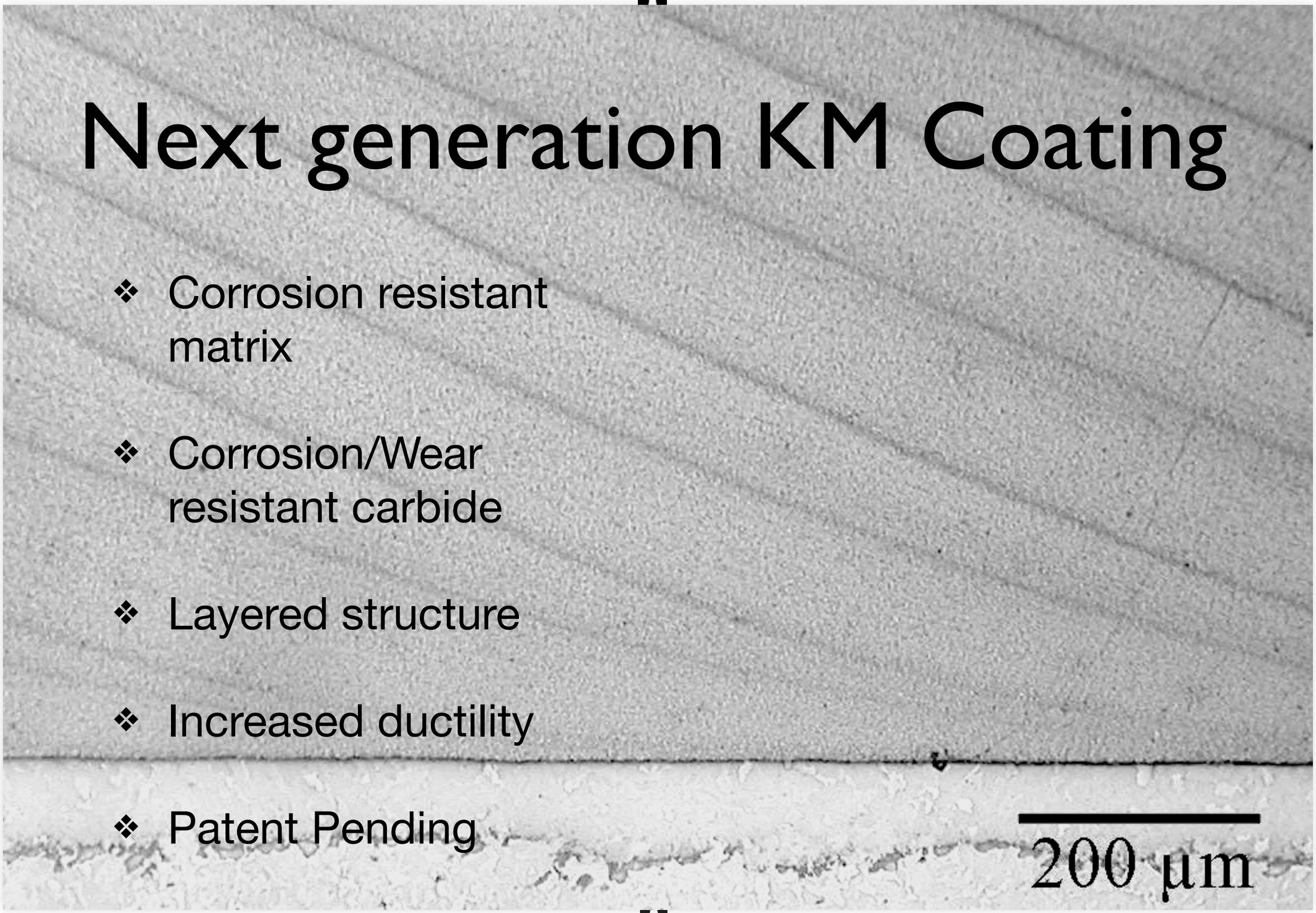
Next generation KM Coating

- Corrosion resistant matrix
- Corrosion/Wear resistant carbide
- Layered structure
- Increased ductility
- Patent Pending



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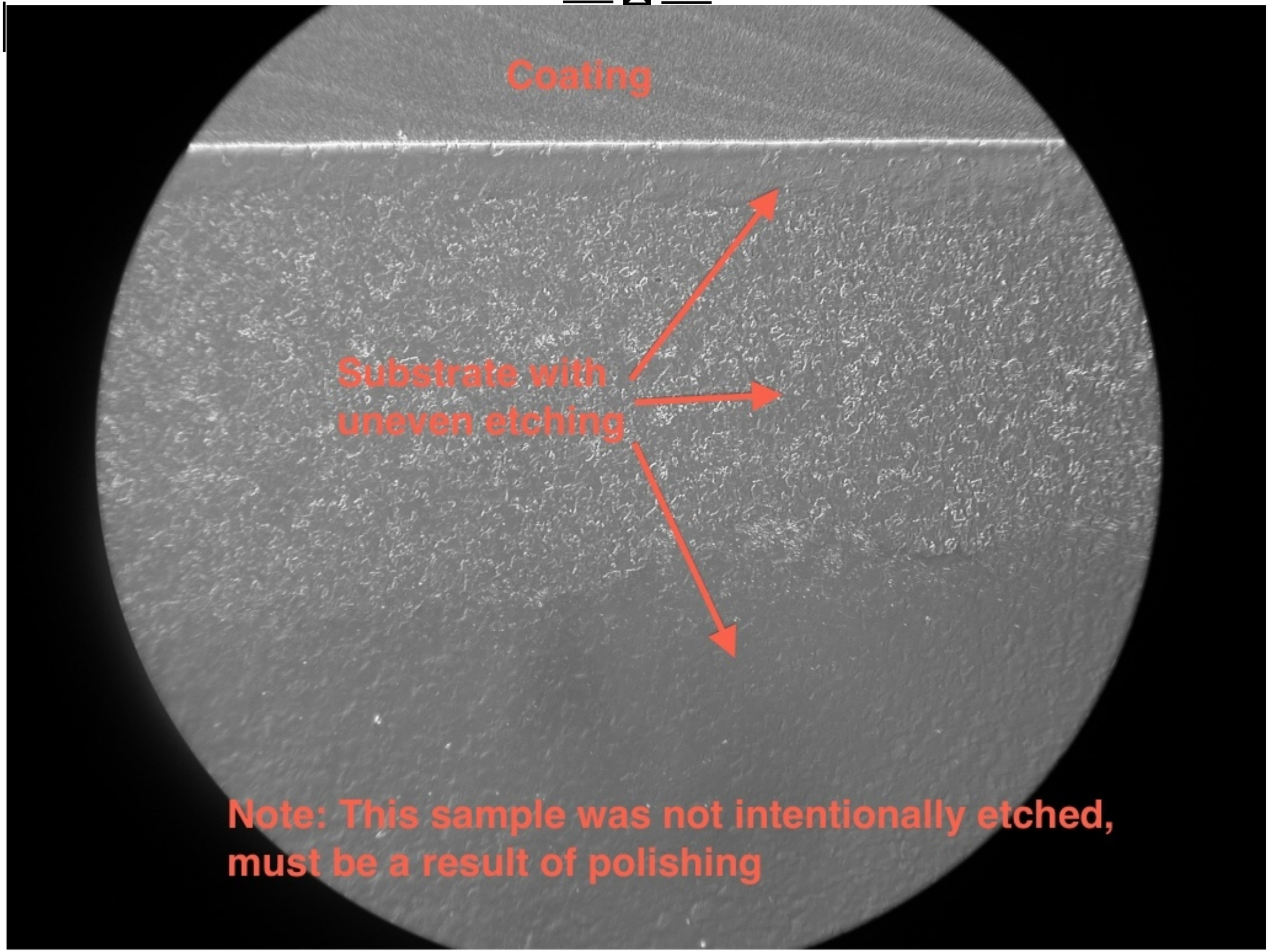
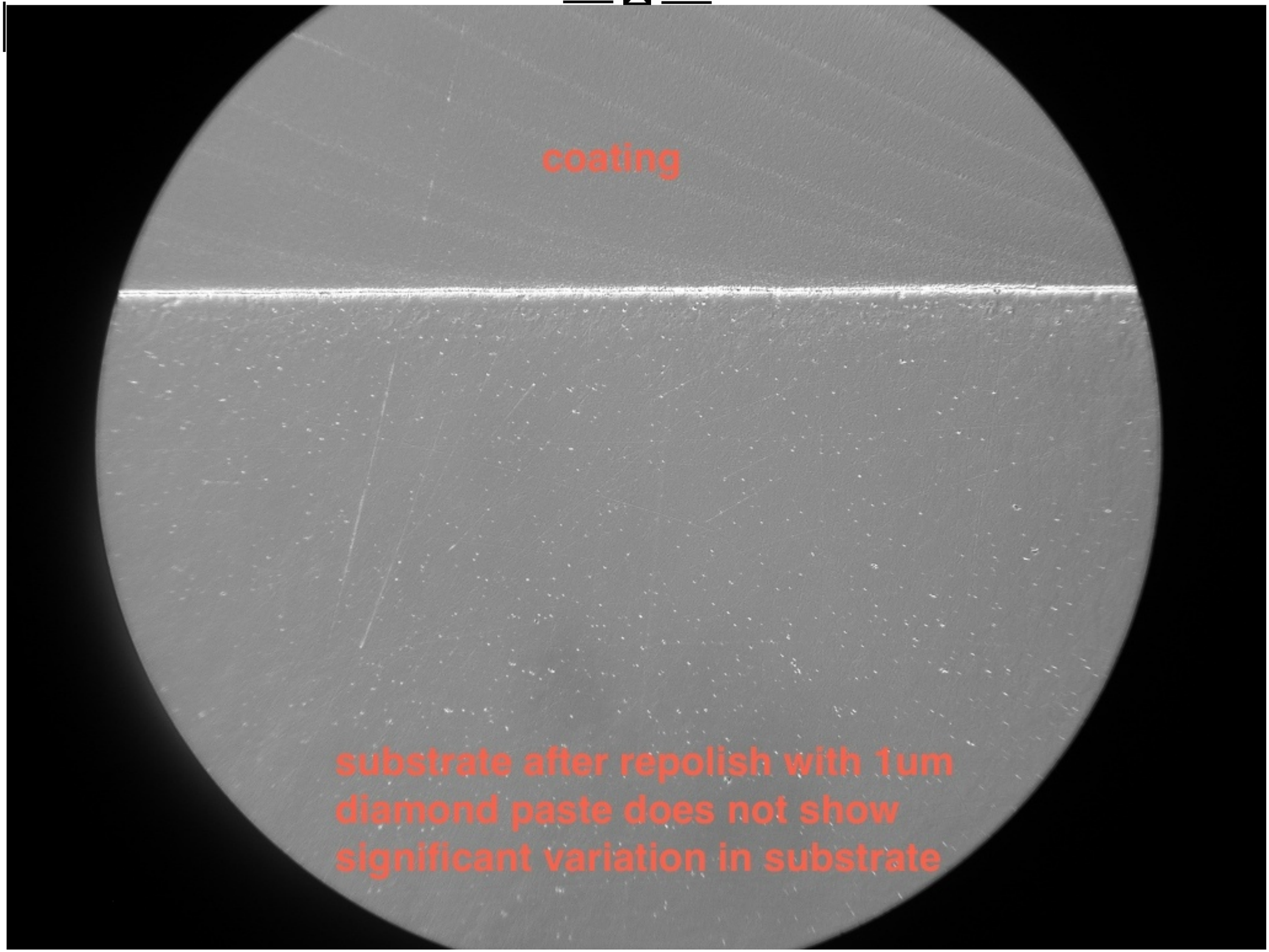
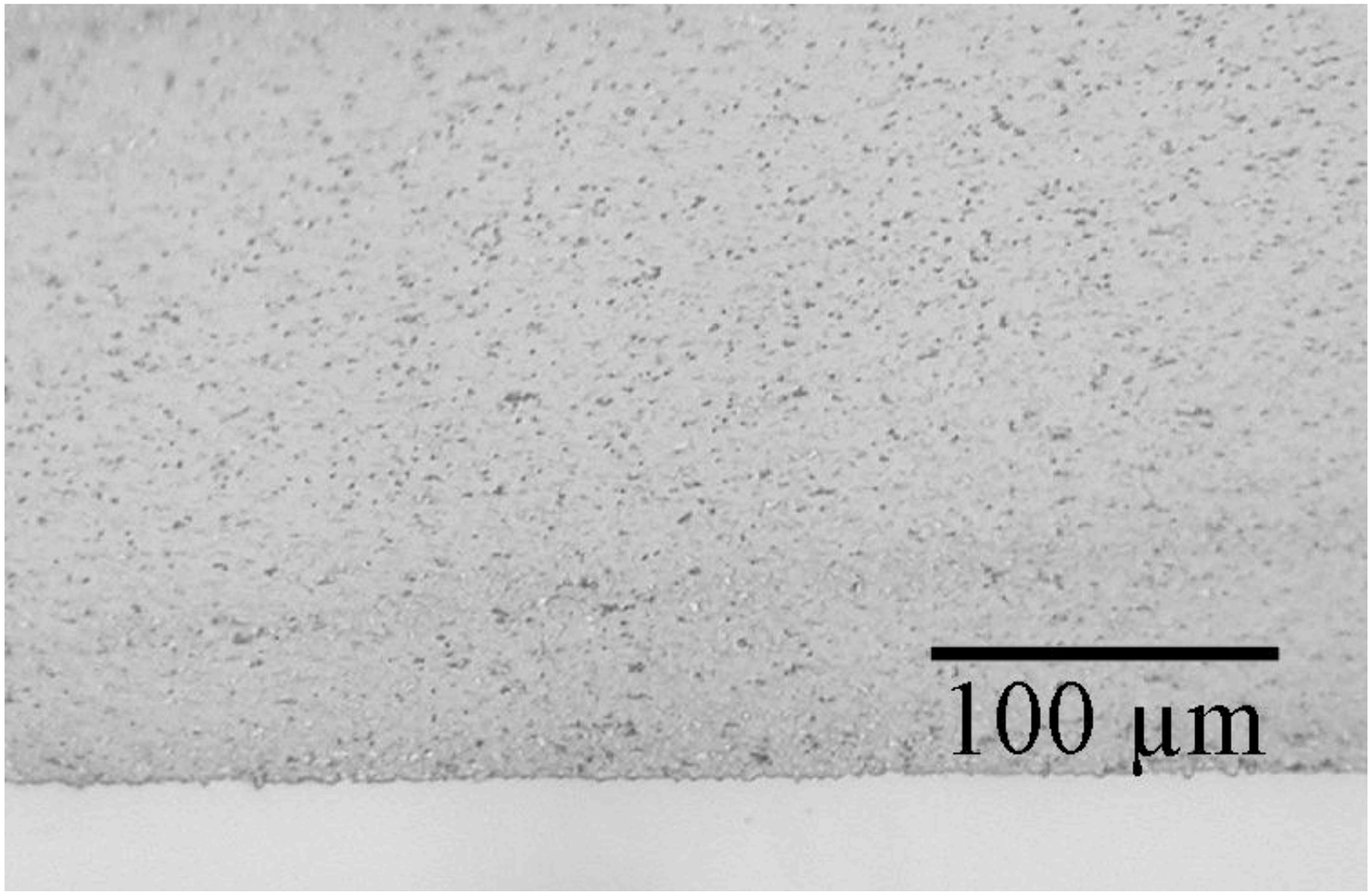

Coating
Substrate with
uneven etching
Note: This sample was not intentionally etched,
must be a result of polishing


coating
substrate after repolish with 1um
diamond paste does not show
significant variation in substrate



WC-NiCoCr on 718

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F18 Hydraulic Gear Repair

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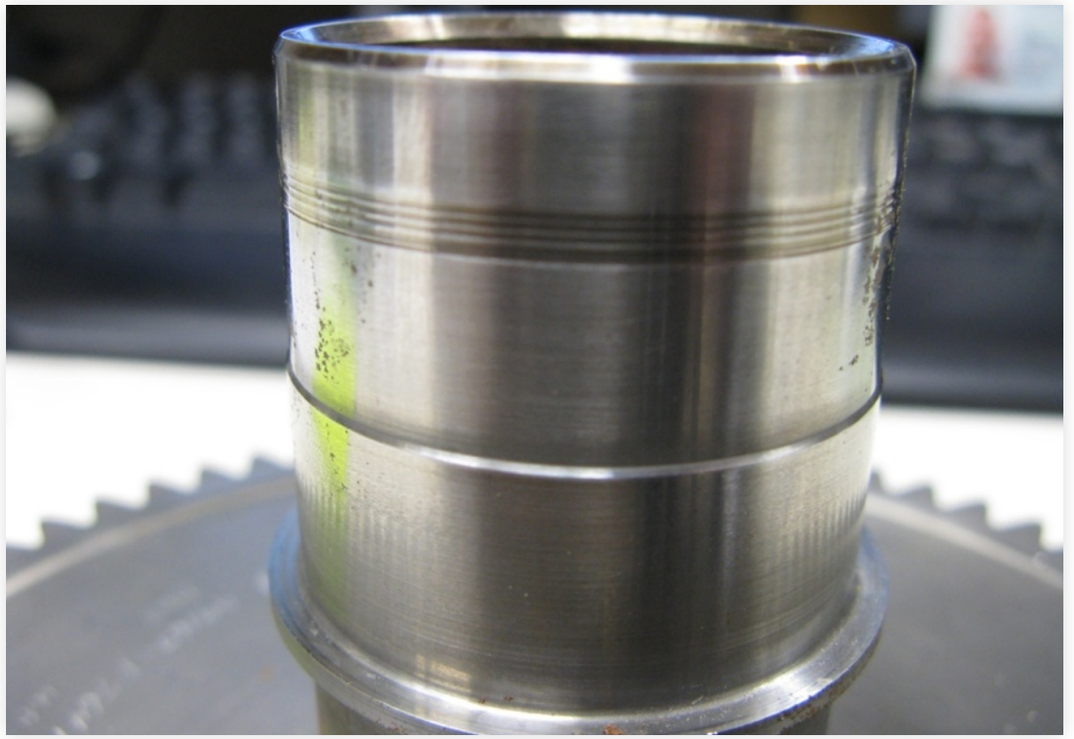
Wear Groove



- 0.005” deep
- Detail

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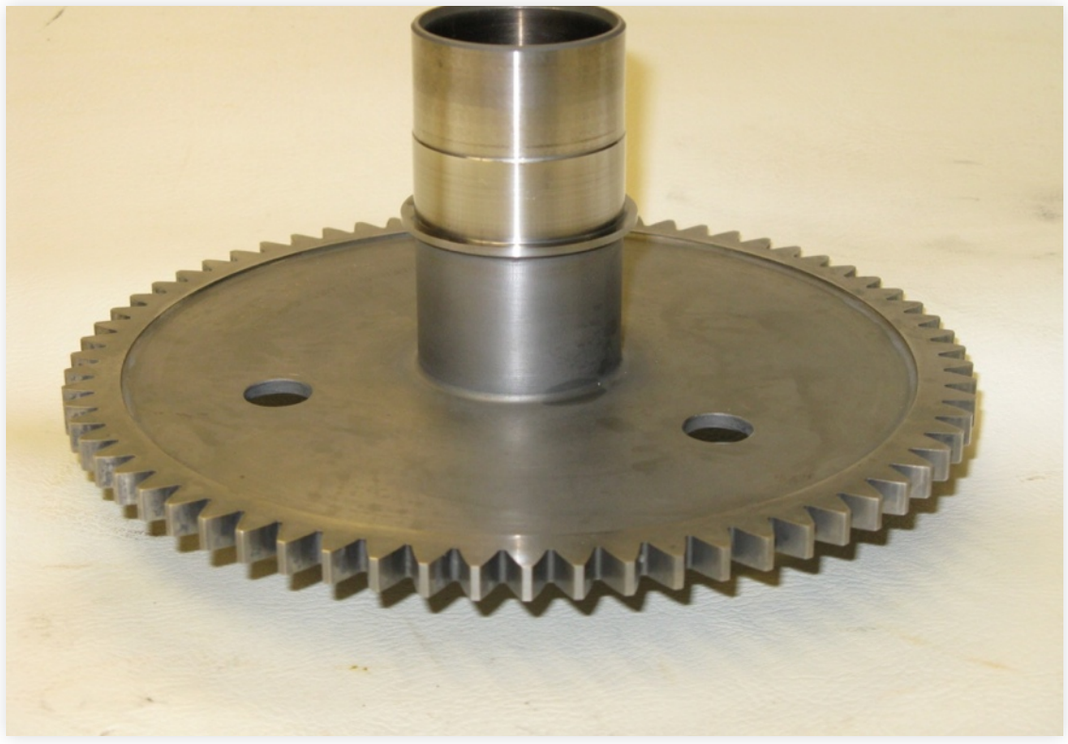
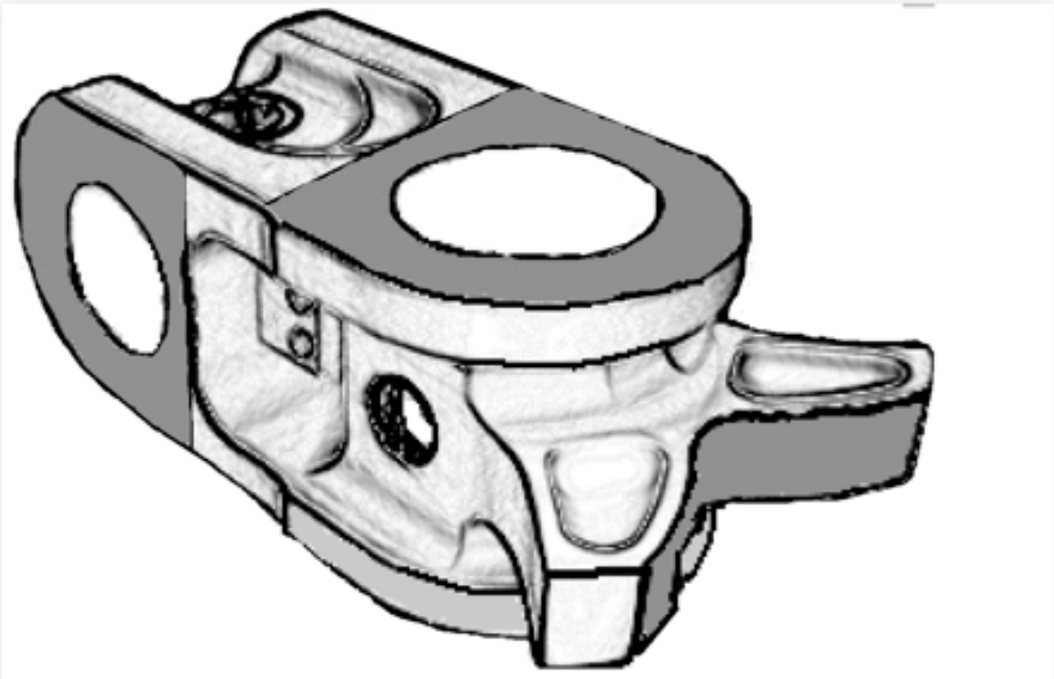
Repair and Finished



- 0.10” sprayed
- WC-Co, Hv = 1,000

F-18 Tailhook Arresting Gear Pivot



- WC-Co Coating (shaded)
- Photo of Arresting Gear Pivot

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KM Carbide Coatings

- Flying on F18 Superhornet
- Aero Engine Applications
- Automotive Brake Rotors
- Upstream Oil and Gas

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