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Cirrus Hybrid™ Technology

An innovative coating system for light metal substrates

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Hybrid coating system

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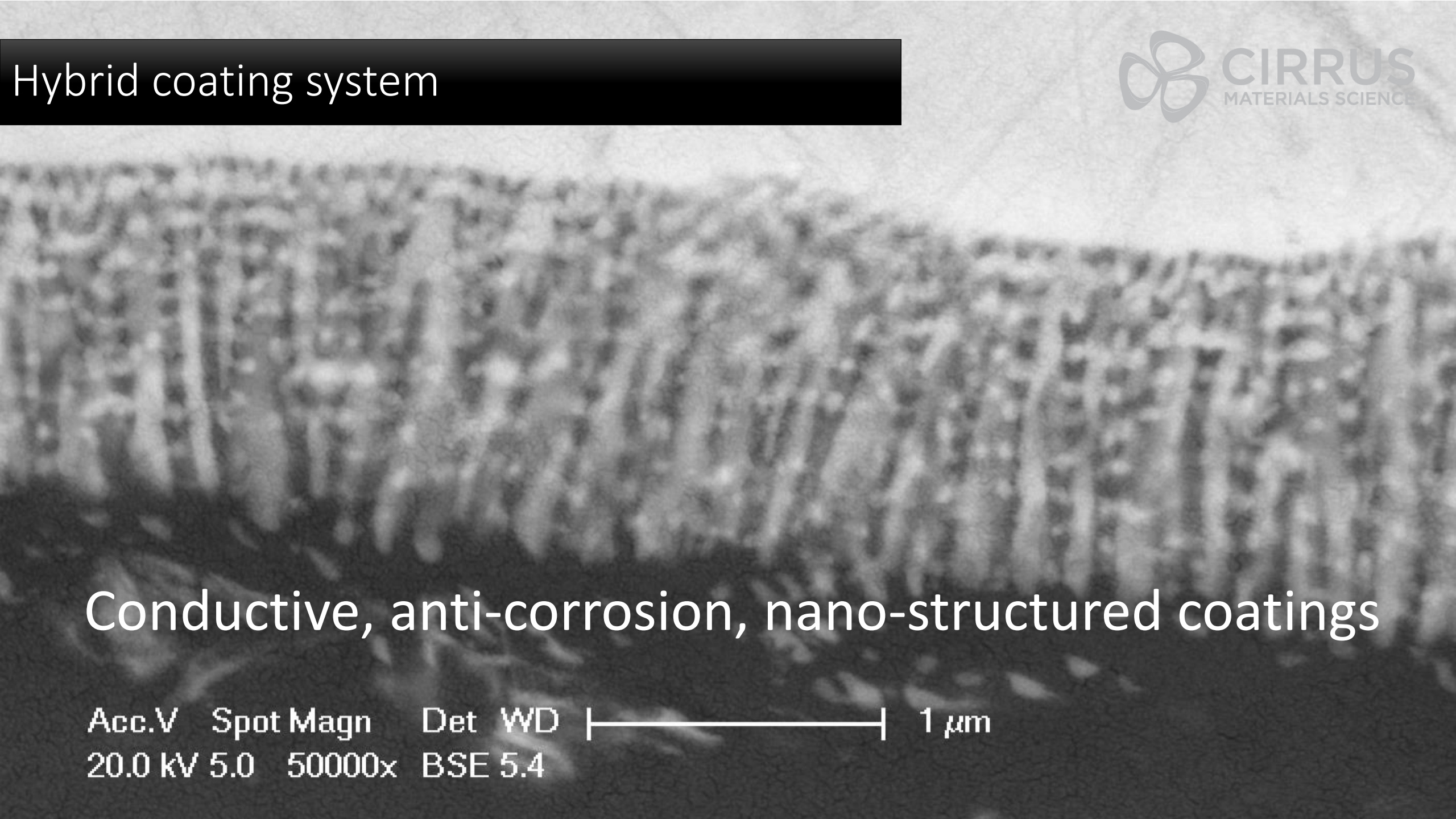


Conductive, anti-corrosion, nano-structured coatings

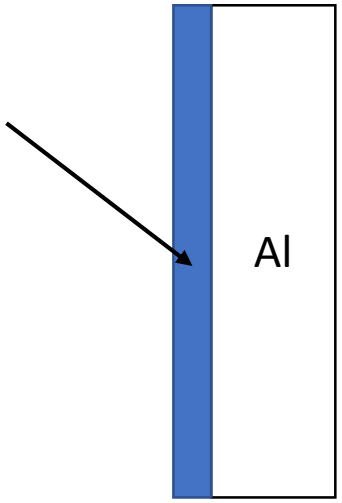
Why of Hybrid coating

Low cost, Non-toxic, non-hazardous!

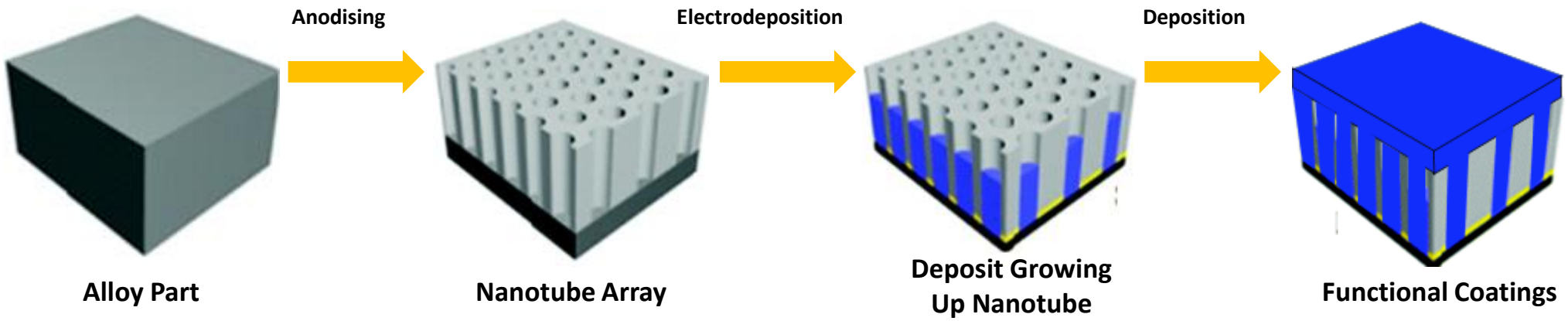
- Compared to traditional anodising
- Compared to electroless NiP
- Compared to primer and paint systems

Many Important Product Attributes are Controlled by the Coating System

- Wear resistance
- Tribology
- Magnetic Properties
- Solderability
- Weldability
- Hardness
- Thermal properties
- Corrosion Resistance
- Appearance

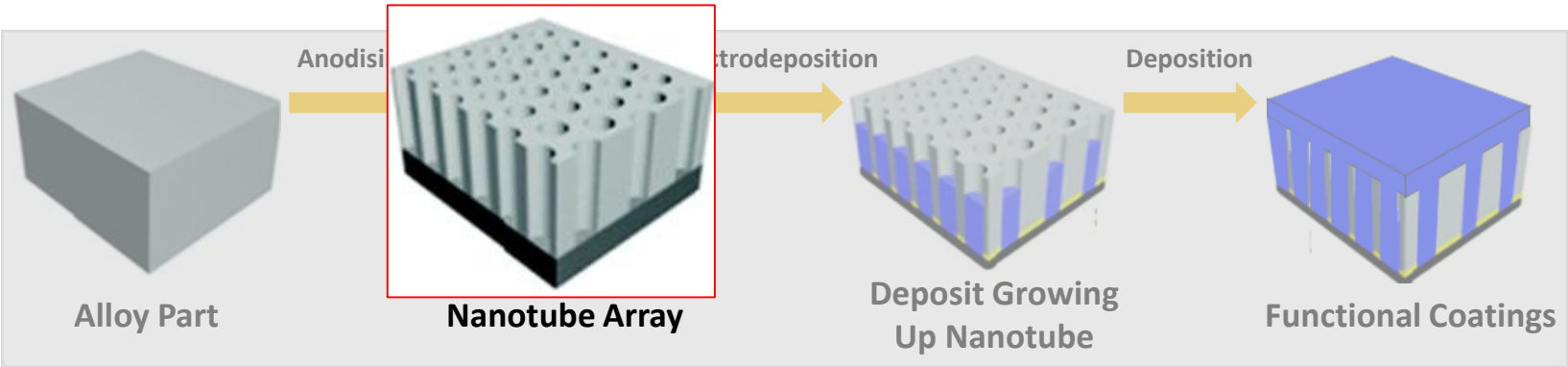


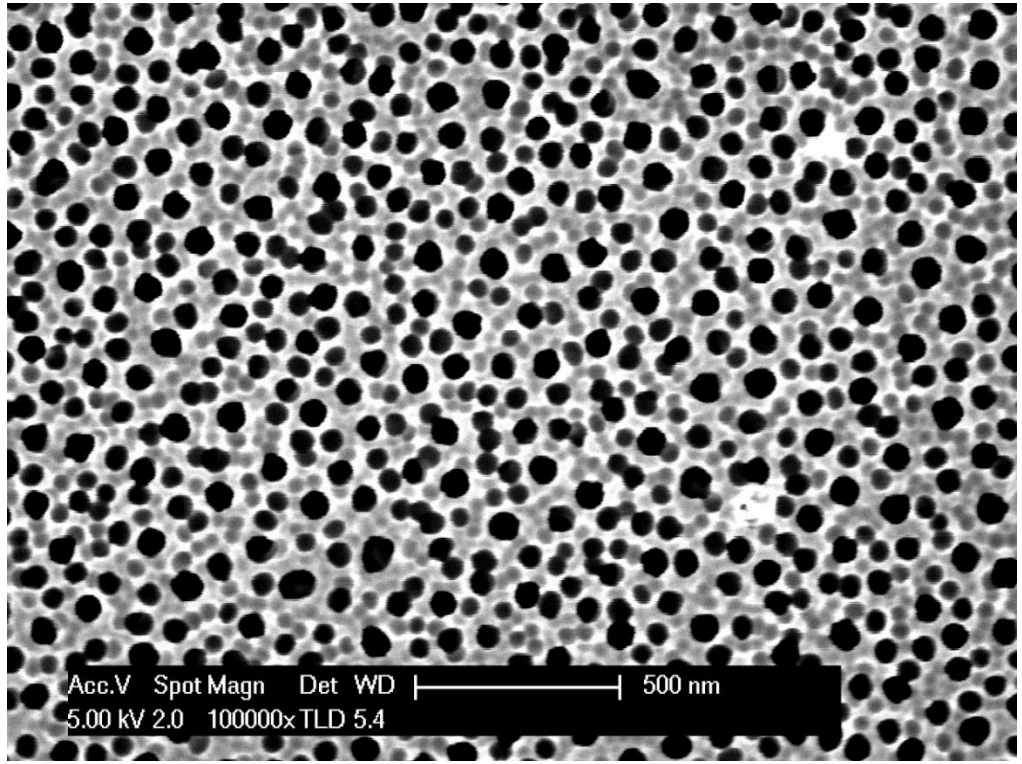
How does Hybrid coating work

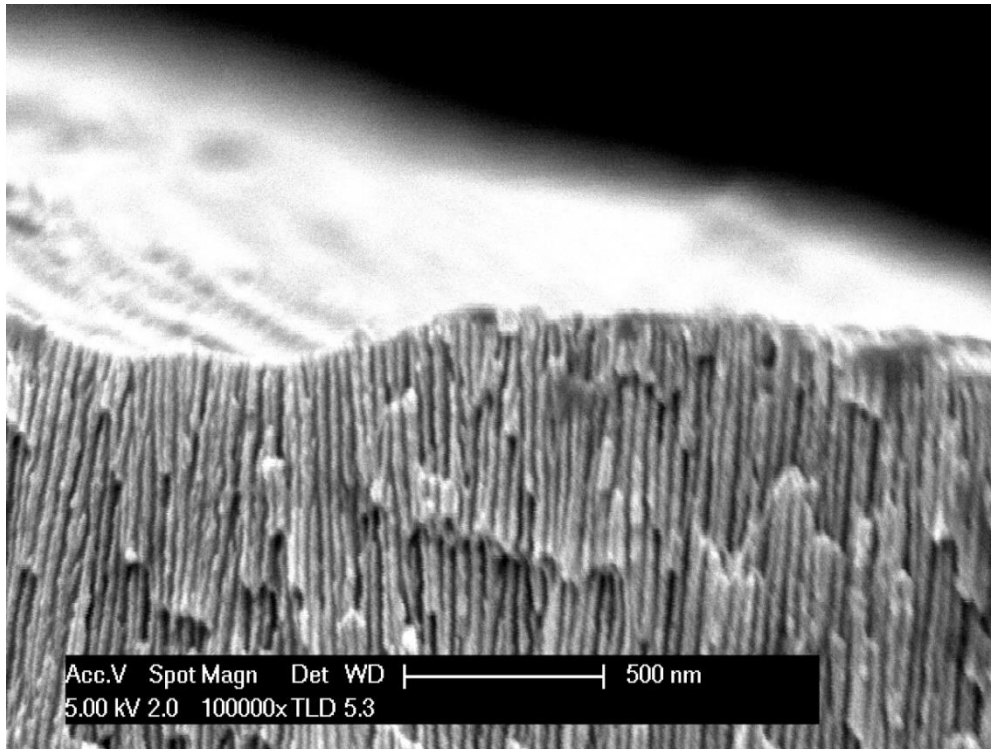


Cirrus Hybrid™ - patented coating process

How does Hybrid coating work







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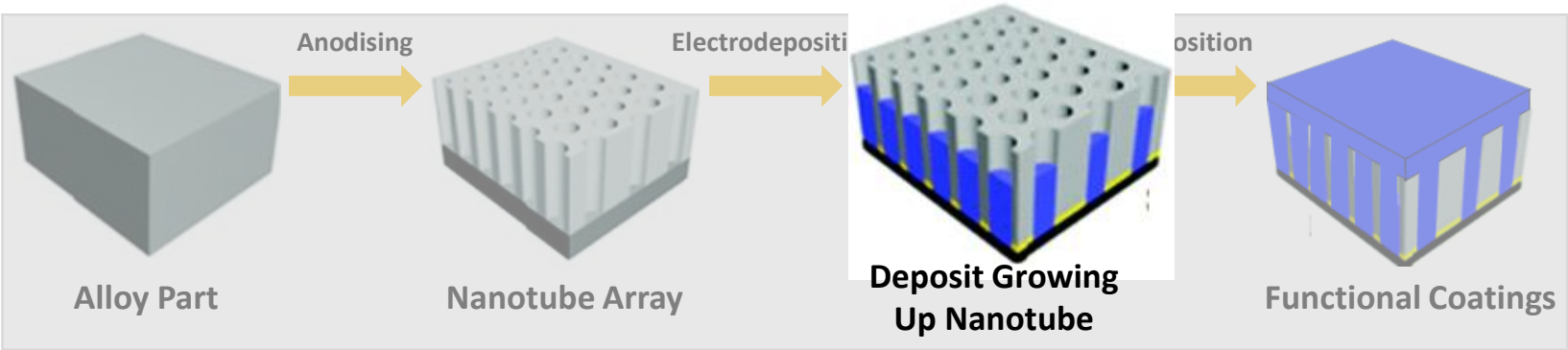
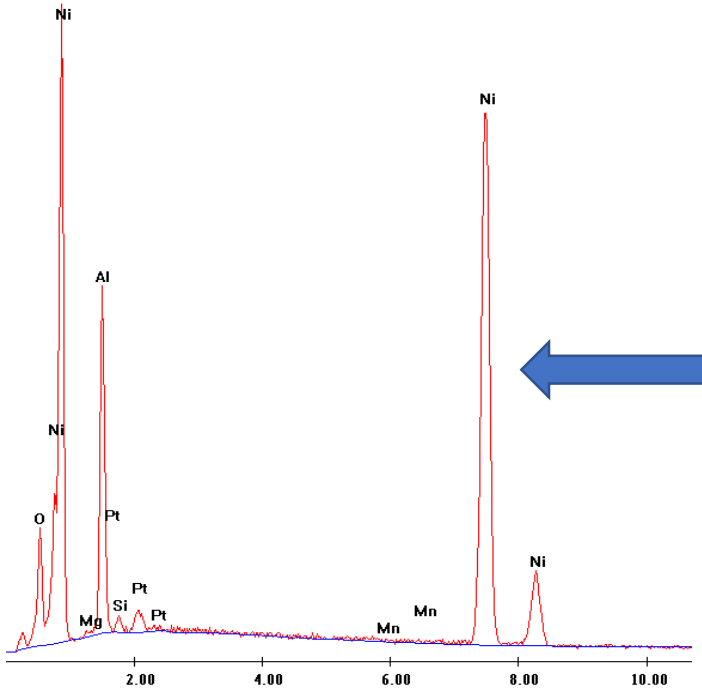
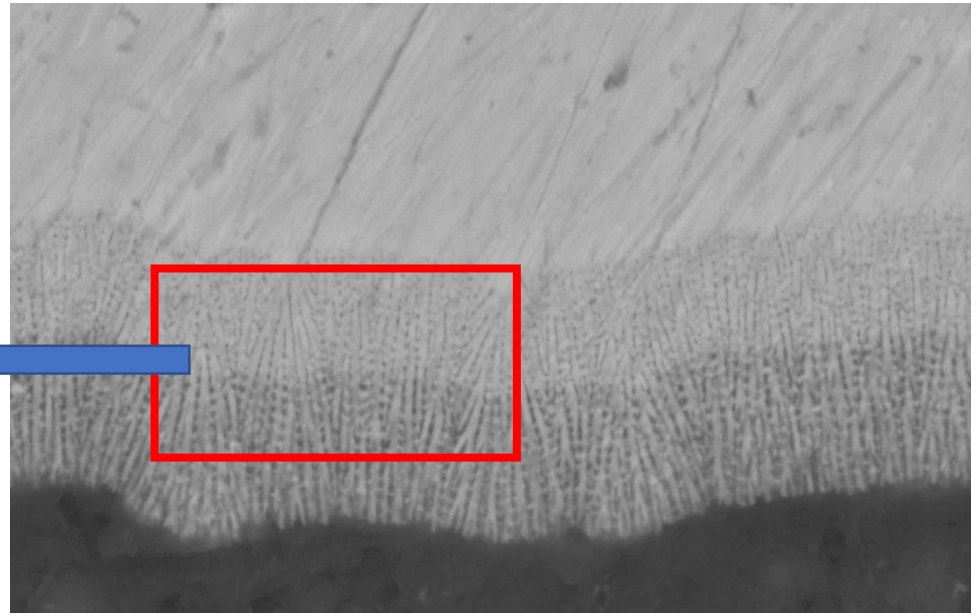
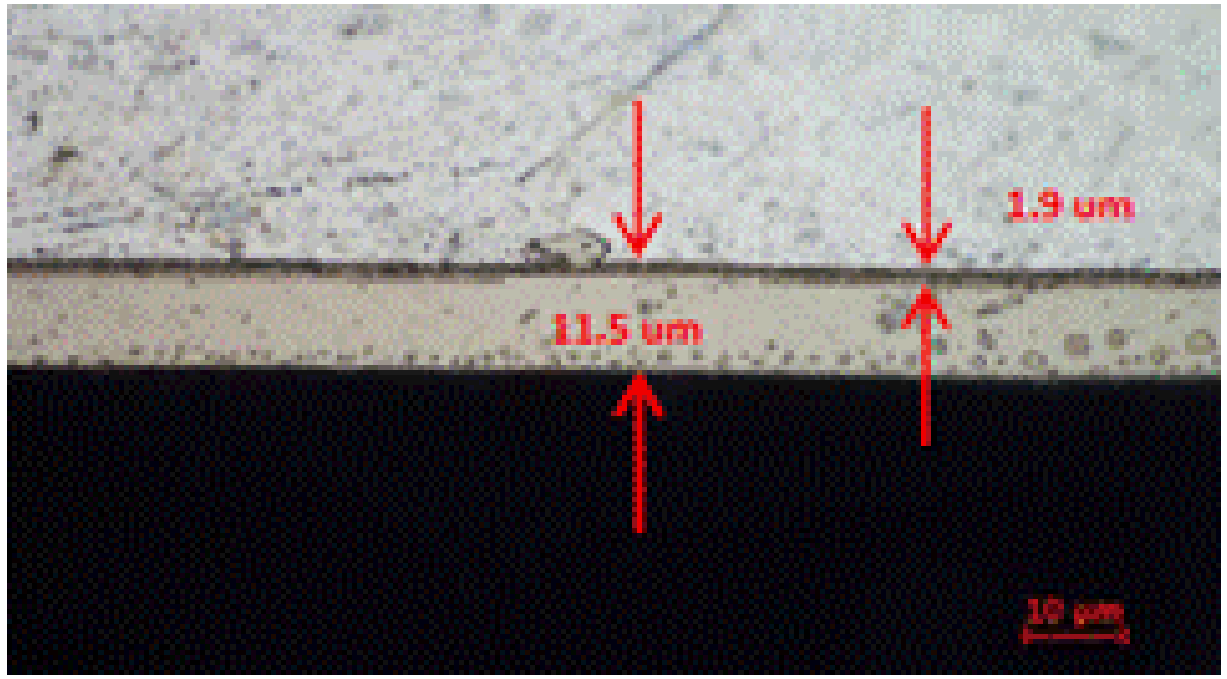






Advantages of Hybrid coating



- Low cost
- High performance from thin coating
- Simple process
- Uses existing production processes & equipment

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Hybrid™ Properties

Early performance data

Corrosion Properties of Hybrid coating

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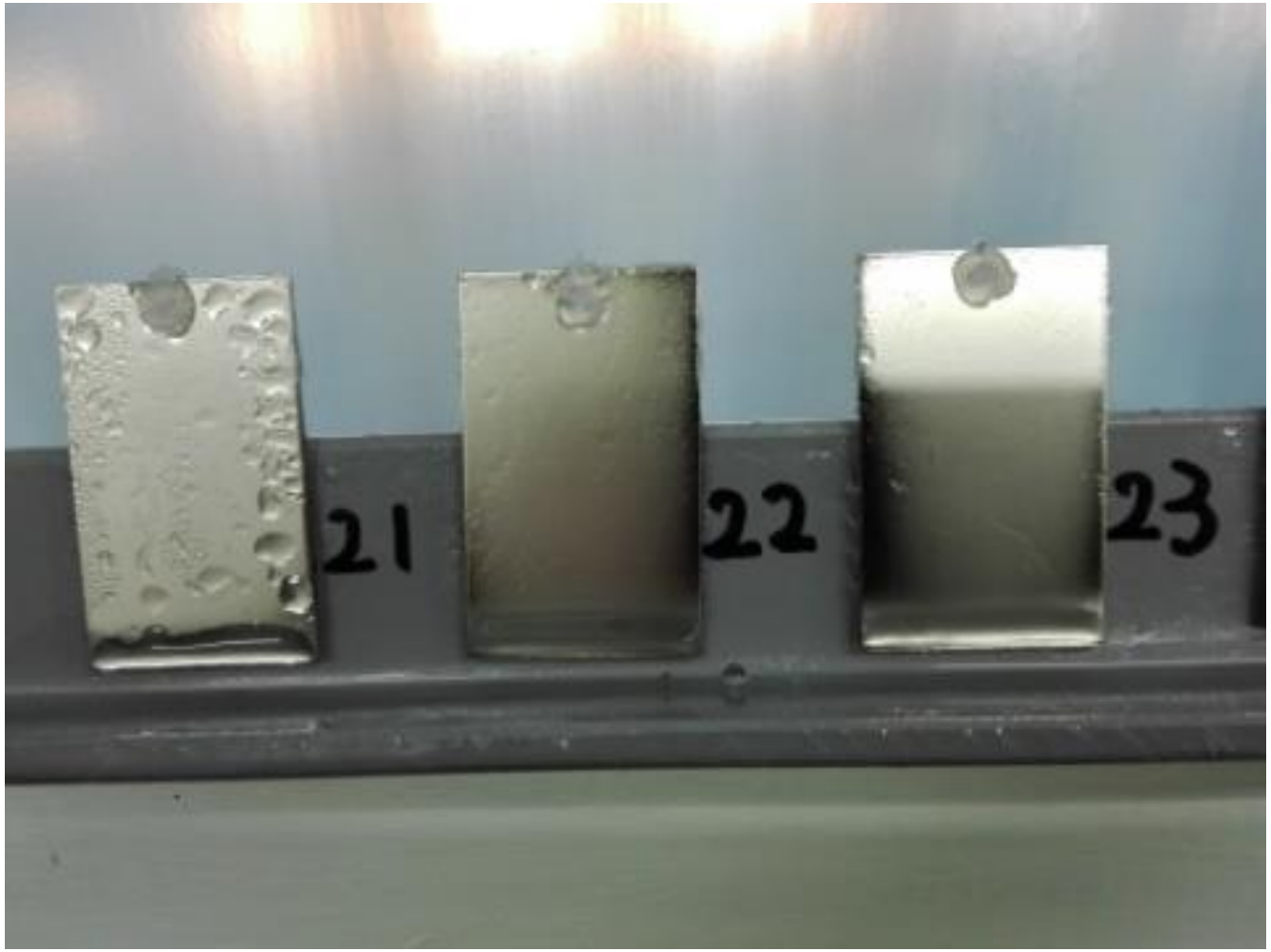
Neutral Salt Spray - ASTM B117



6 micron duplex Hybrid Ni

- Anodising 2 microns
- Columnar nickel 4.5 microns
- Laminar nickel 1.5 microns

Time (hours)	Conductivity mΩ/in²	
	Pre	Post
> 120	0.3	0.9

10 micron duplex Hybrid Ni

- Anodising 2-3 microns
- Columnar nickel 7 microns
- Laminar Nickel 3 microns

Time (hours)	Conductivity mΩ/in²	
	Pre	Post
> 500*	0.25	0.9

* > 75 hours CASS

Electrical Properties of Hybrid coating

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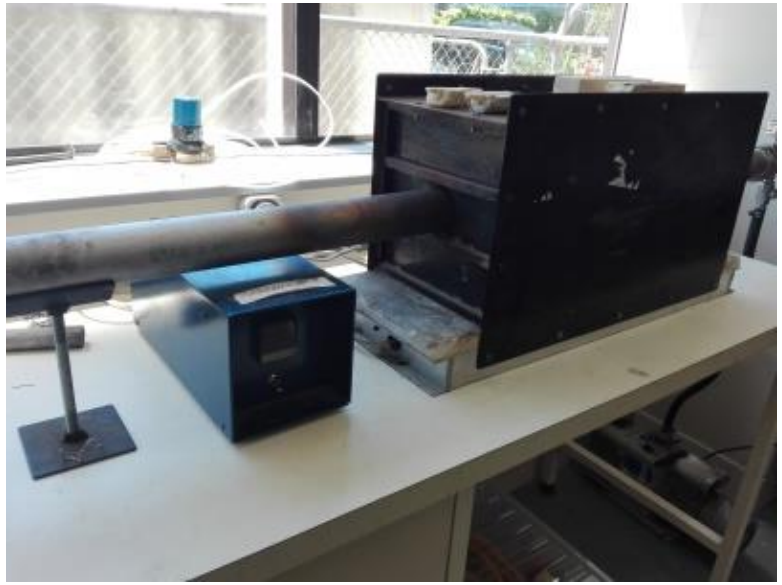
Thermal Cycling - Mil-Std-883 Method 1010 Condition F

5 Cycles

-65°C	30 minutes
+25°C	2 Minutes
+175°C	30 Minutes
+25°C	2 Minutes



Hybrid Coating Thickness	Conductivity		Crack or Peel
	Pre	Post	
6 micron	0.3 mΩ/in^2	1.2 mΩ/in^2	No
10 micron	0.3 mΩ/in^2	0.9 mΩ/in^2	No

Mechanical Properties of Hybrid coating

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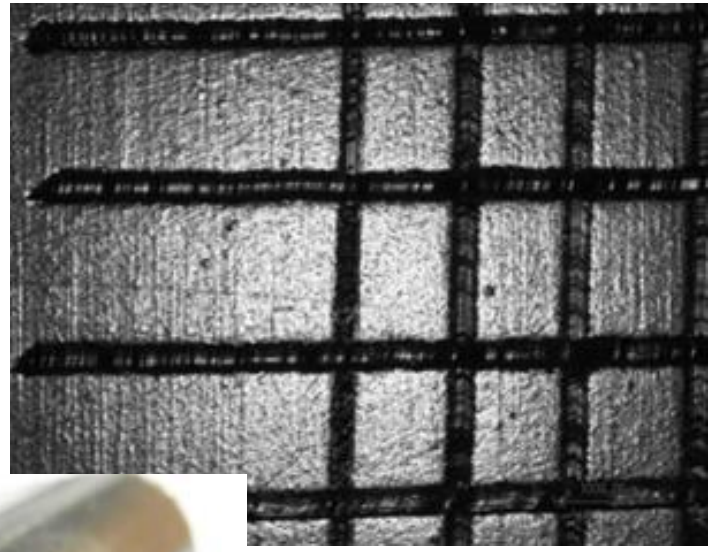
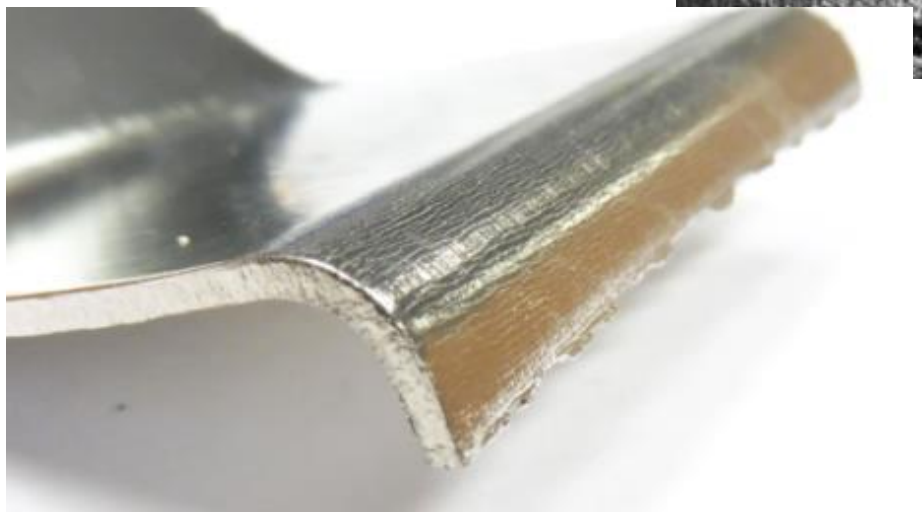
Adhesion - ASTM B571

- Samples tested:
  - As coated
  - After Thermal Shock Testing
  - After NSS testing
- Tests Performed
  - Scribe grid test
  - Mandrel bend test

-





Aesthetic Properties of Hybrid coating

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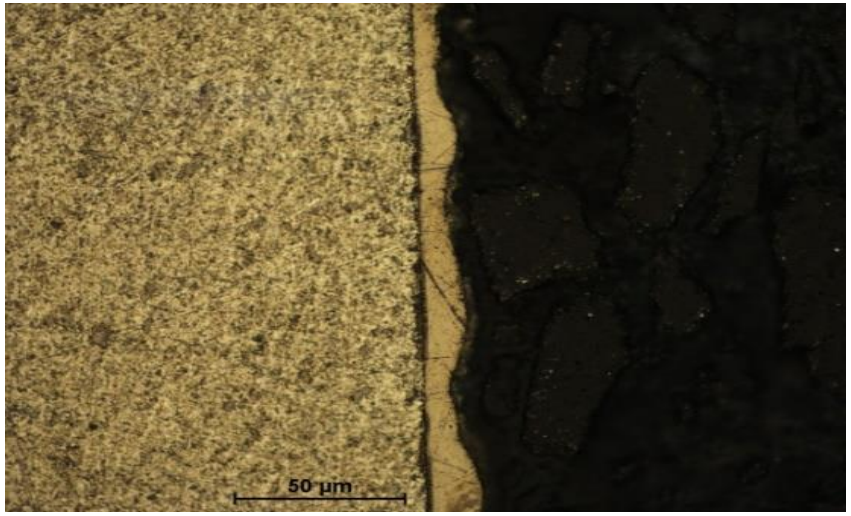
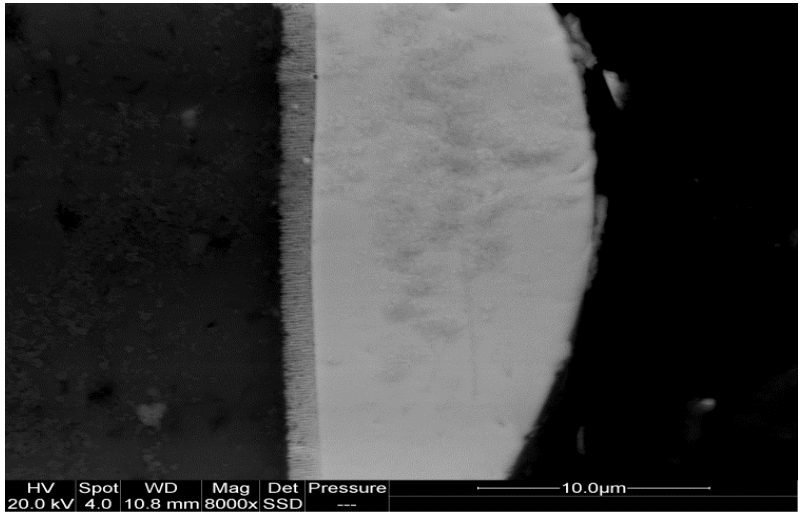
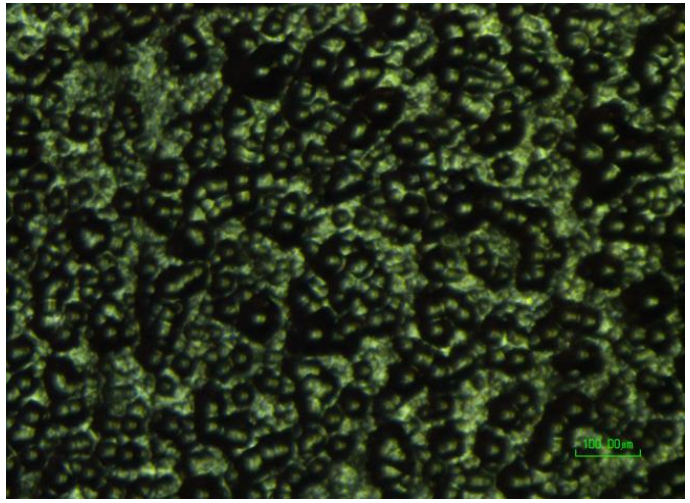
Can produce an hemispherical Surface Morphology







Tune-able surface morphology allows creation of hydrophilic, hydrophobic, or unique surface aesthetic.

Surface Properties of Hybrid coating

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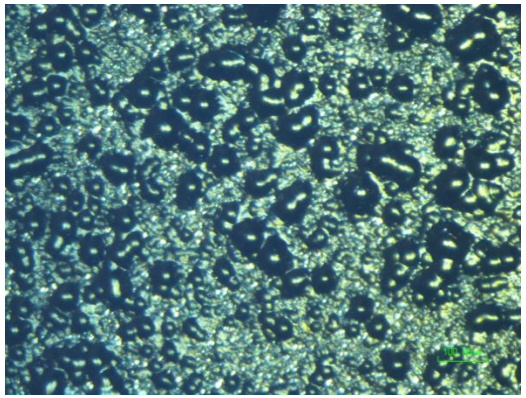
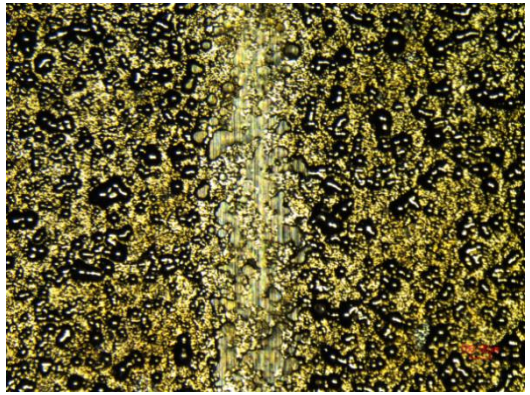
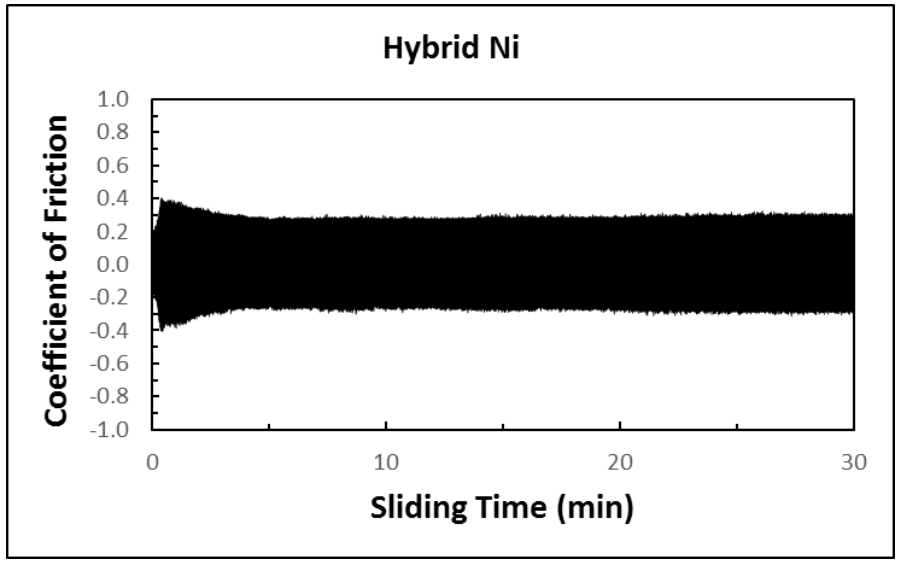
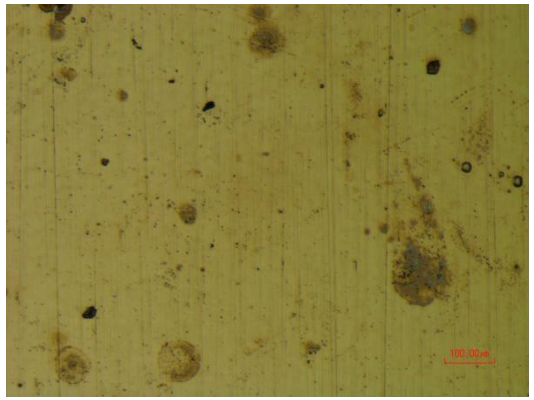
Cirrus Hybrid™ HMSC

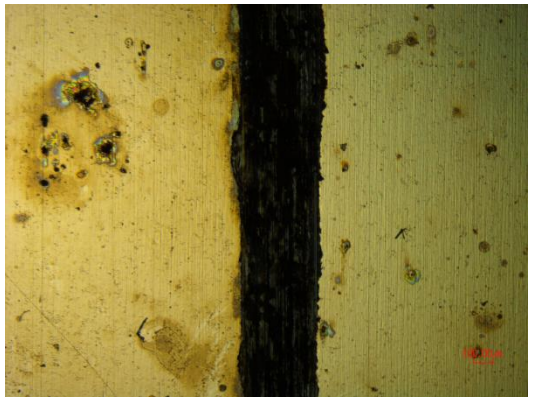


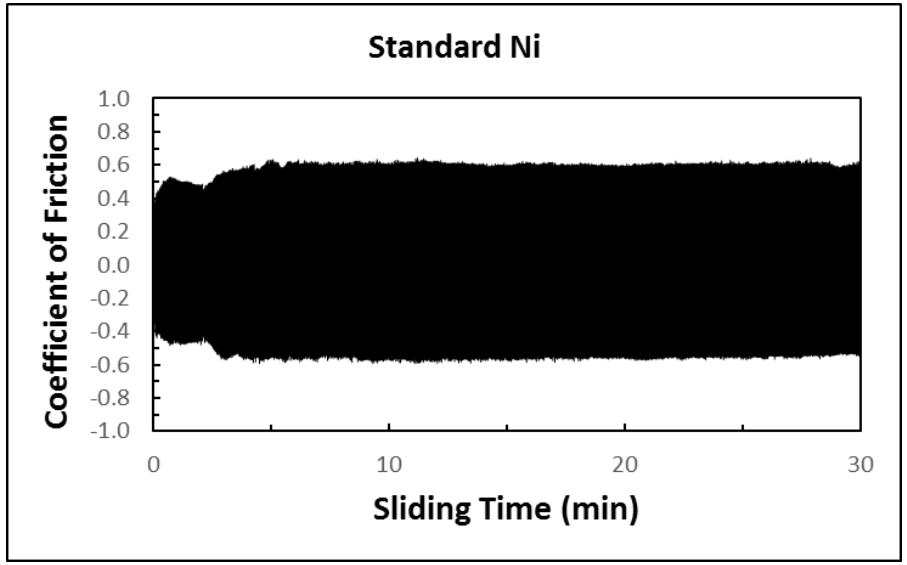




Typical Bright Nickel Coating on Aluminium







Optical Properties of Hybrid coating

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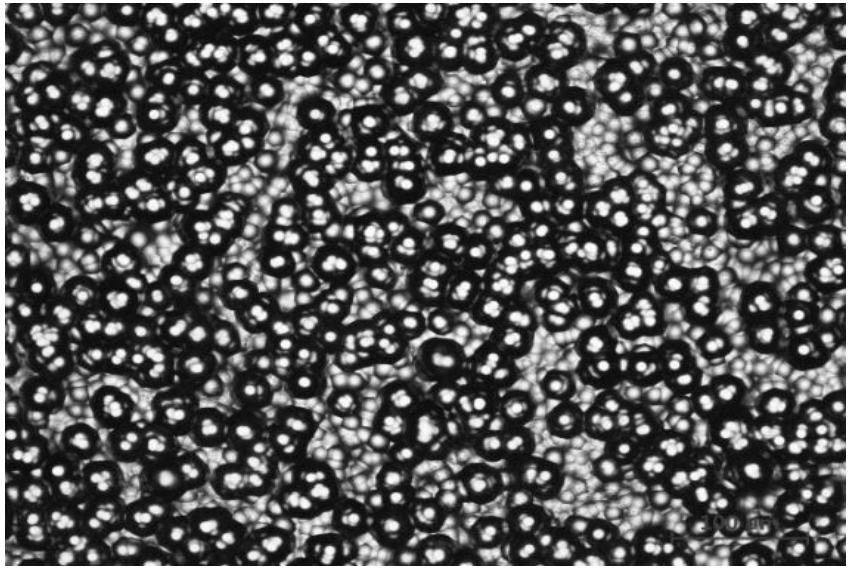
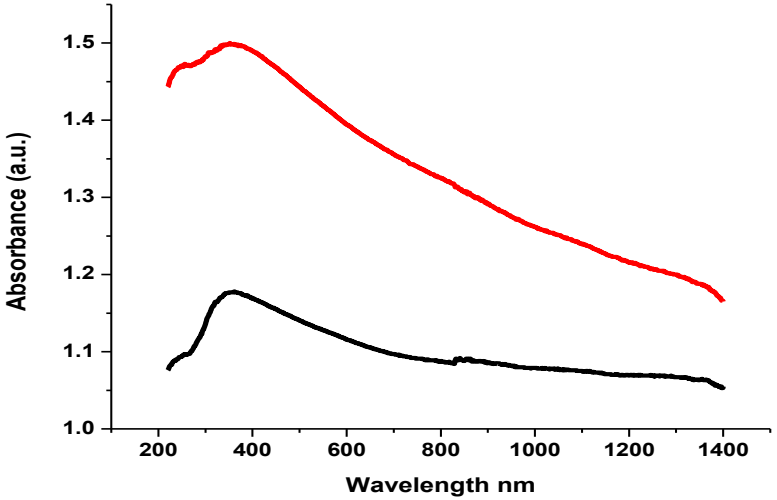
UV-Vis-infrared light absorption properties

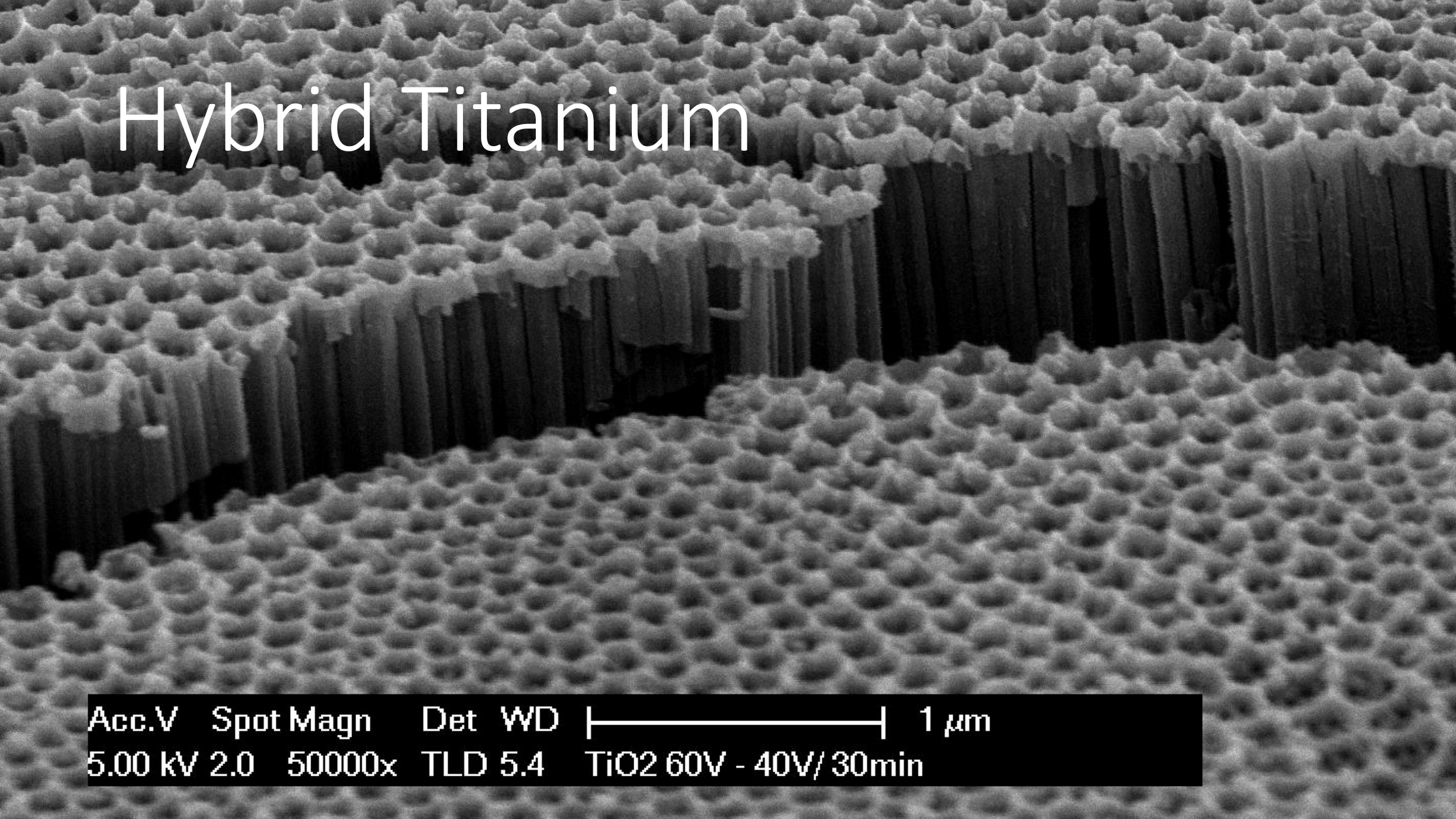


The Surface Morphology of the Hybrid Black Nickel Coating



UV-Vis-infrared light absorption properties Hybrid™ Black Ni (red) versus standard Black Ni.

Hybrid Titanium



Hybrid Ti: deposit of Cu Nano-particles

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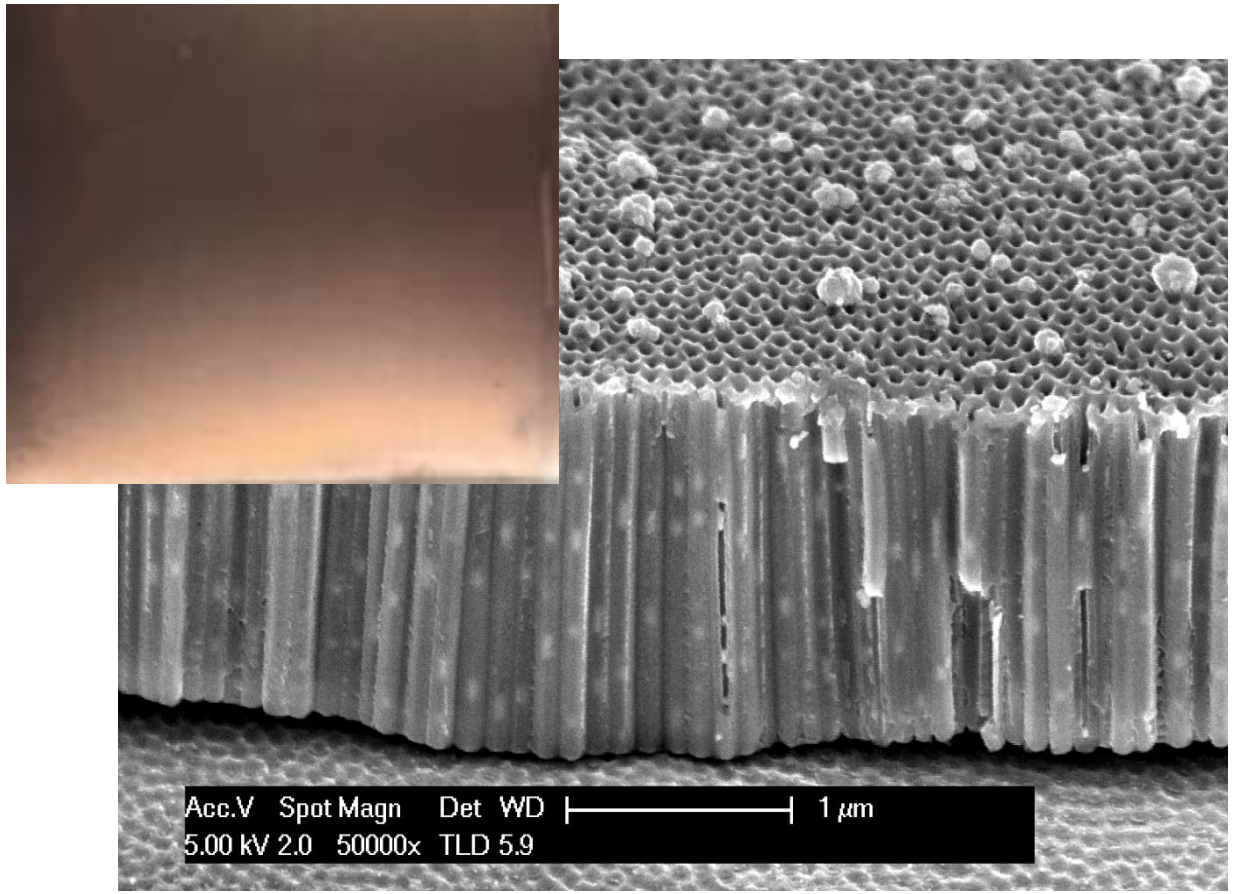
Electro-polishing → Anodizing → Post-treatment → Electroplating

Ethanol washing & HF activation

Copper Pyrophosphate



- Short plating time supports formation of coper nanoparticles with interesting bacteriological properties
- Nano particles can facilitate plating of other metals
- Low adhesion between substrate and anodized layer
- Longer plating produces uniform copper with poor adhesion

Hybrid Ti: Nickel coating

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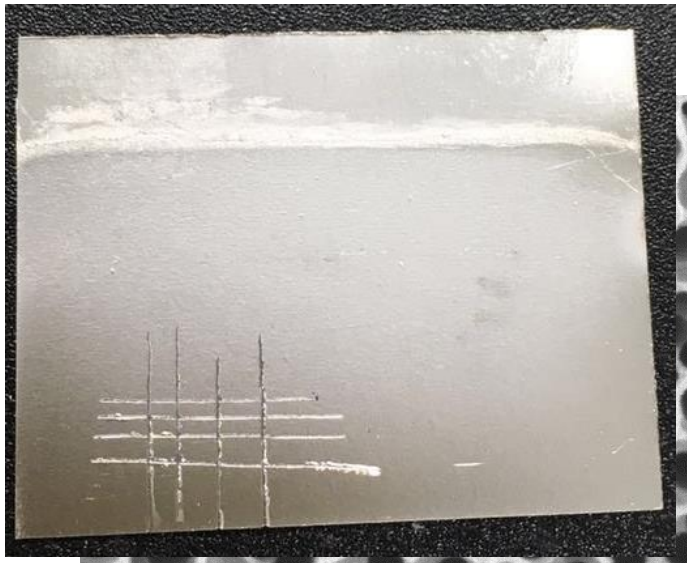
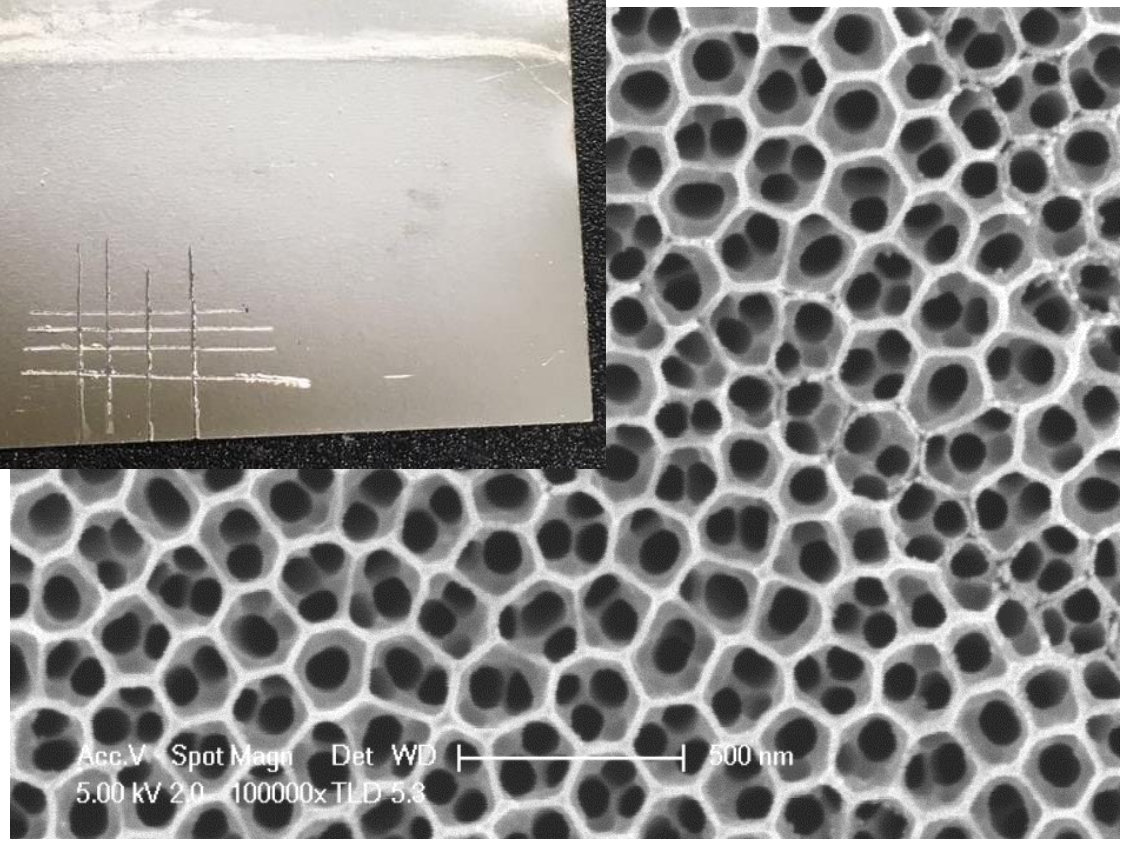
Anodizing → Oxide removal → Anodizing → Post treatment → Annealing → Plating





- Duplex nickel plating provides best results
- Annealing increases wettability and improves pore filling
- Adhesion between anodising film and plated coating excellent
- Adhesion of annealed film to substrate excellent
- Problems exist with bending adhesion after plating

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Functional Top Layer

Hardened & nano-structured multi-layer coating

Use of Cirrus Dopant™ with Hybrid coating

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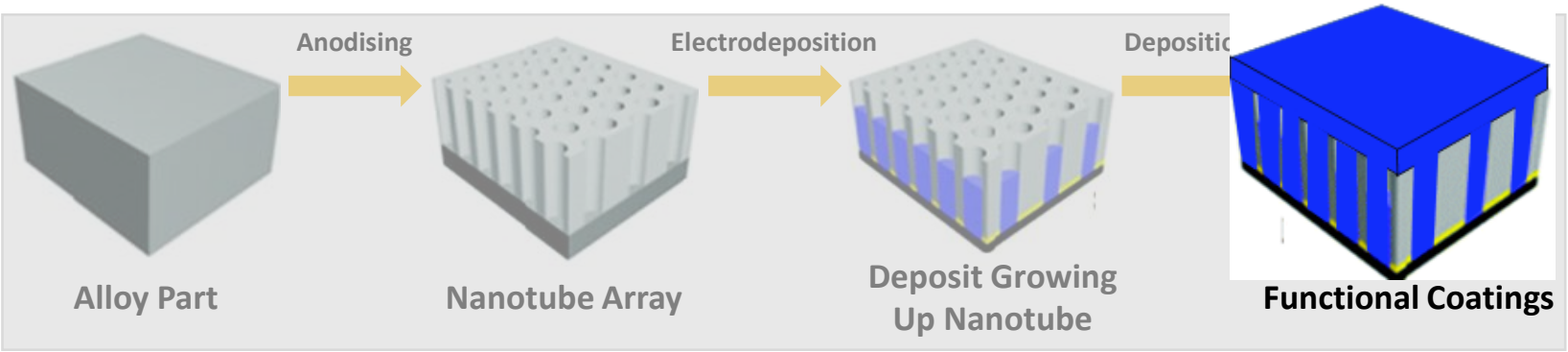

Hard surfaces: Cirrus Hybrid™ + Cirrus Dopant™

Functional upper layer can be any material, plated or coated directly onto the protected light metal substrate.

Gold, Silver, Nickel (NiB, NiCo, NiP), Cobalt (CoP, CoW), Cr, Cu, Zn, Sn …

Or combined with a Cirrus Dopant™ to created a nano-structured, hardened composite functional upper layer.

Cirrus Dopant - nano-composite coatings

- Liquid to liquid – forms sub 20nm particles which do not agglomerate
- Designed to be stable and highly dispersed in the bath
- Safe to handle

Cirrus Hybrid™ plus Cirrus Dopant™

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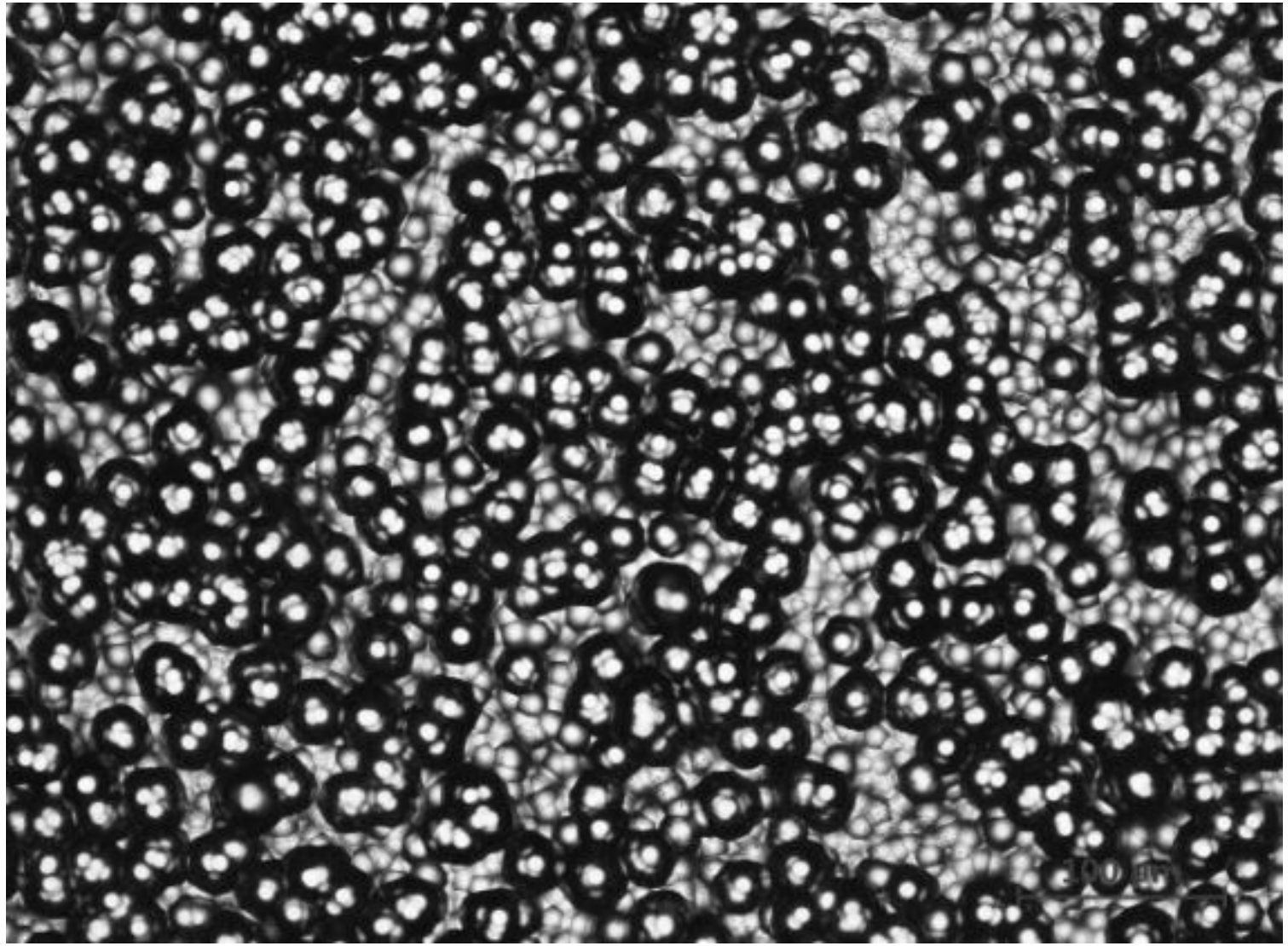
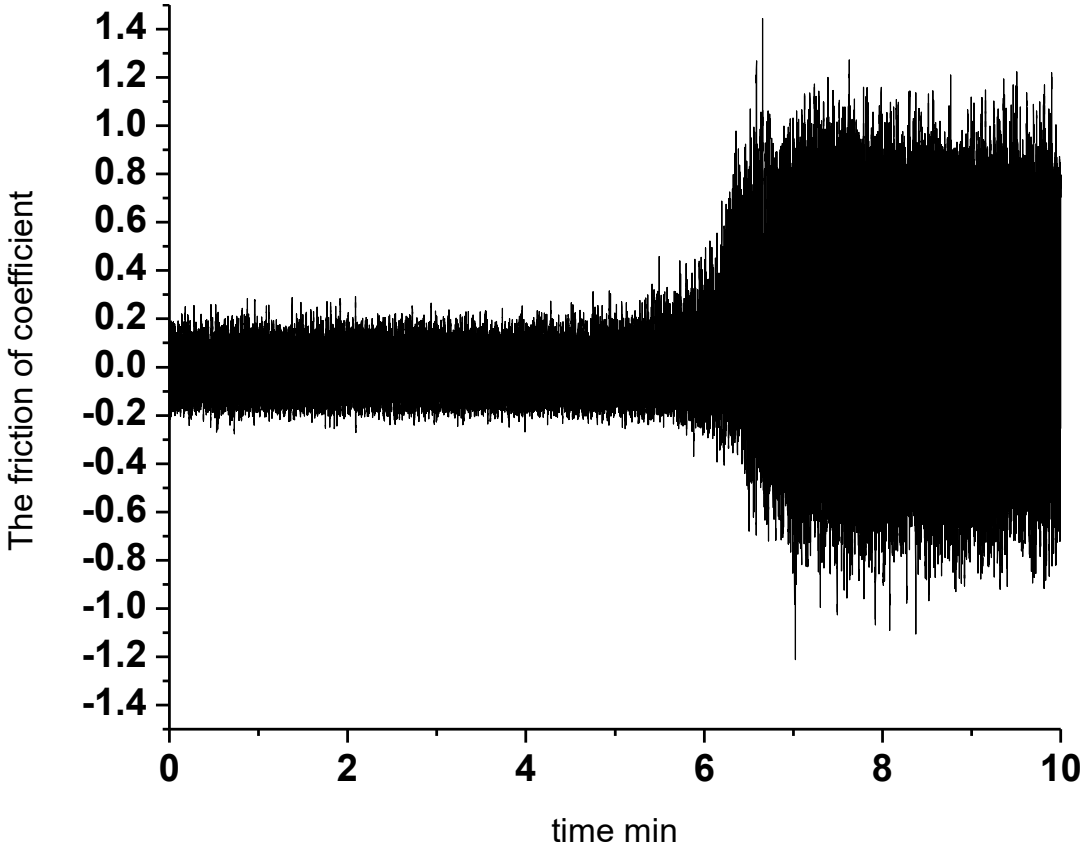
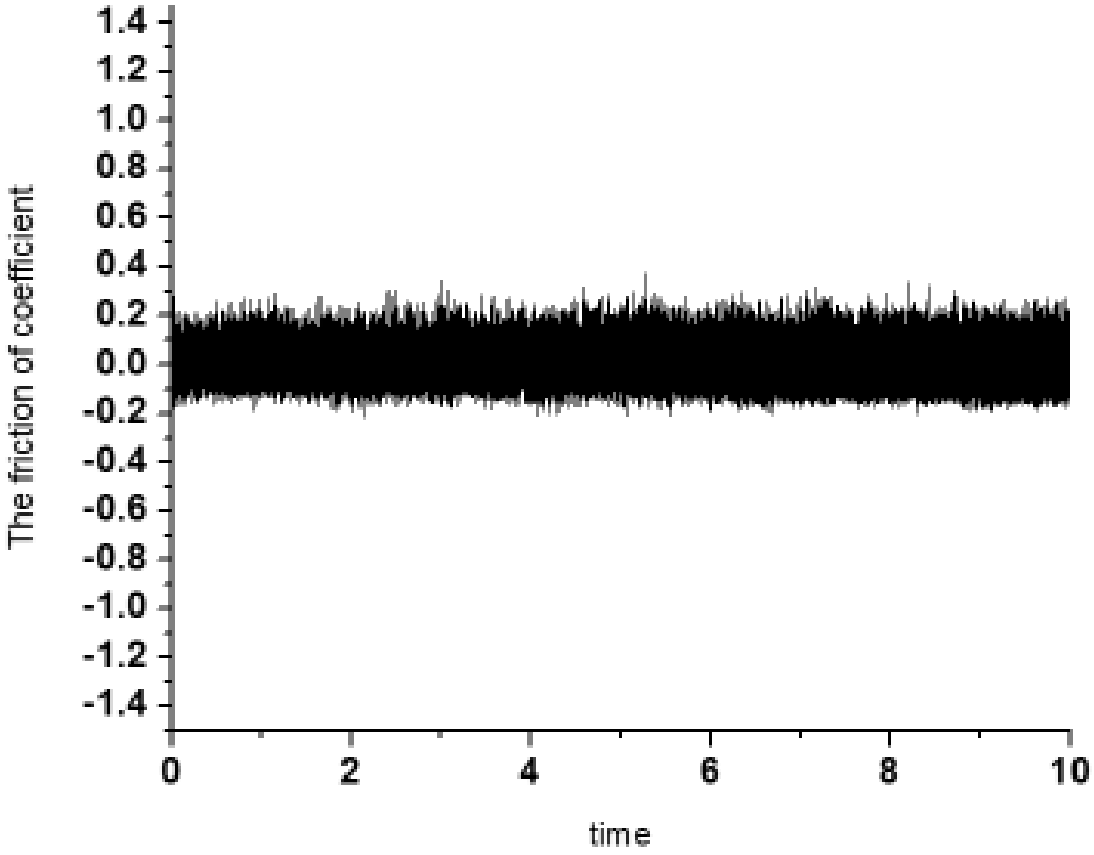


Co-efficient of Friction



Cirrus Hybrid Black Ni



Cirrus Hybrid Black Ni with Cirrus Dopant™

Cirrus Hybrid™ coating system for light metals

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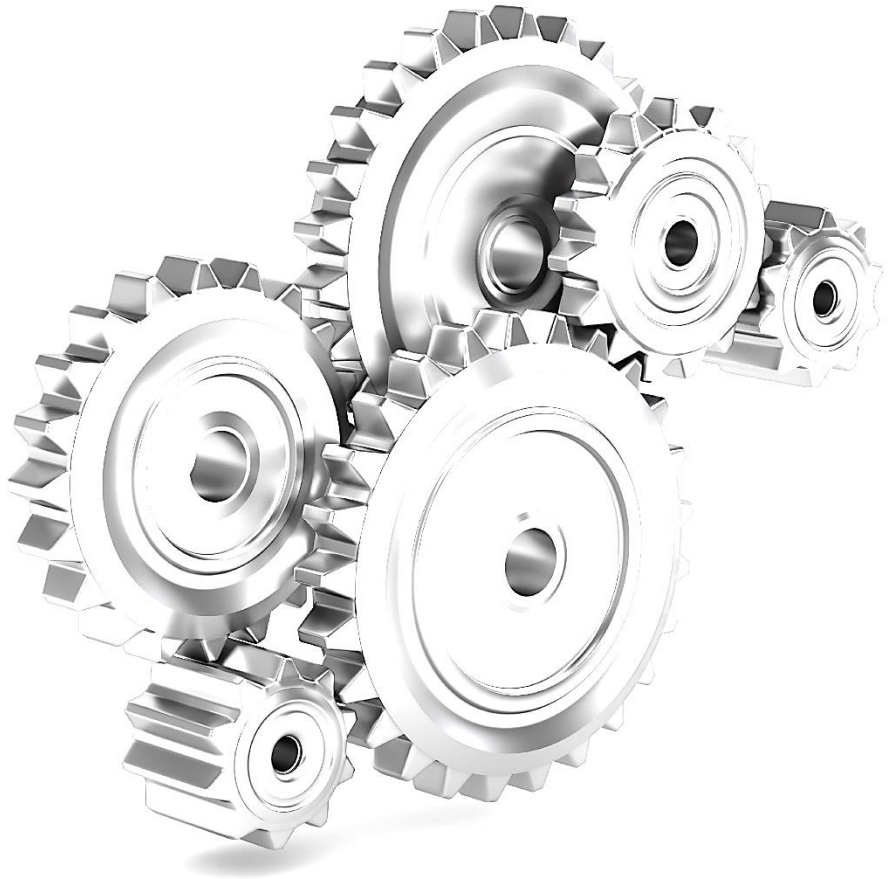

Low cost, high efficiency coating system that utilises existing production processes

Excellent conductivity, corrosion resistance, adhesion, thermal stability..

Hemispherical functional coatings creates aesthetic, mechanical & optical properties.

Can be combined with nano-structured and hardened composites, or ultra black upper layers.

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