IBC Materials & Technologies

IBC Technology Overview: NCMS - SET

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EAGLE Registrations Inc.
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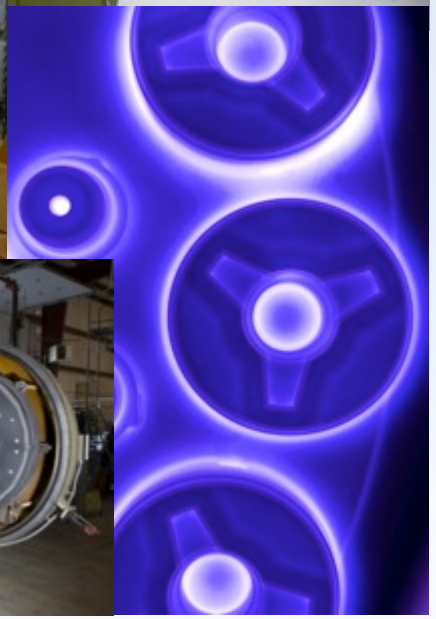
ANAB ACCREDITED
ISO/IEC 17021
MANAGEMENT SYSTEMS CERTIFICATION BODY

Profile: IBC Capabilities



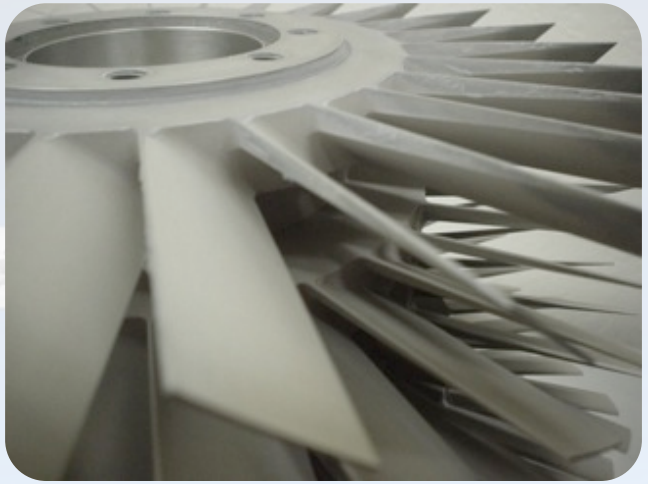
Company Profile

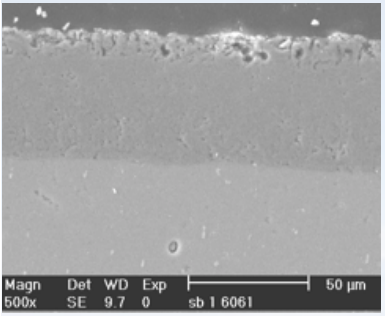
- IBC consists of three companies: IBC Coatings Technologies INC, IBC Materials and Technologies INC, and IBC- Sputtek INC
- IBC is a privately owned surface engineering company established in 1996, with manufacturing and R&D capabilities located in Lebanon, Indiana, U.S.A. and Toronto Canada
- IBC has about 65 employees and occupies about 70,000 sq feet
- IBC serves variety of industries – Aerospace, Gas Turbines, Oil, Automotive, Metal Forming, Die Casting, Forgings and others by providing advanced surface treatment solutions in USA , Canada, Mexico, Europe
- IBC develops and applies proprietary surface treatments to improve wear, corrosion, fatigue and lubricity properties of components
- IBC provides AM processes such as laser cladding in conjunction with its surface treatments and finishing processes to provide new repair solutions
- IBC surface treatments are used in a wide variety of applications with excellent results

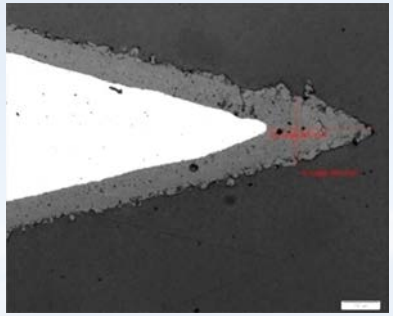
Plasma Electrolytic Oxidation (PEO) Coating Properties

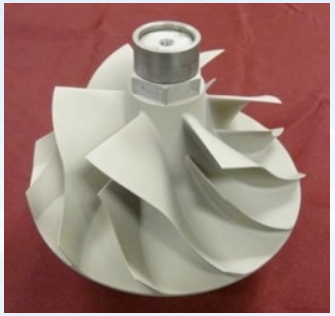
Nano-ceramic coating for Al, Ti and Mg alloys

- Diffusion coating with excellent adhesion – oxidation of the substrate
- Conformal diffusion and growth
- Excellent corrosion resistance outperforming all types of anodizing
- High hardness (800-2000HV)
- 10X+ wear performance compared to Type III anodize
- **GREEN** process (water based) – no acids or harsh chemicals
- Low-temperature, non Line-of-Sight process









Inside a PEO cell

DoD applications in process

Uniform coatings for complex geometries

Plasma Electrolytic Polishing

- Non-line of sight process
- Non-hazardous water-based electrolyte
- Does not affect the substrate
- Typical Processing time:
  - 3-7 min

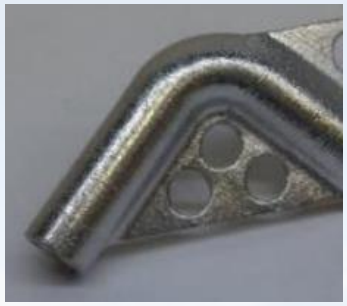
Surface Roughness Example:

Ra: Before 1.6 um -> After 0.1um

Rz: Before 7.9 um -> After 1.8 um

Example of PEP on 15-5ph AM component:

Ra = 8.5 μm



Ra = 0.10 μm

Example of PEP on Inconel 600 sample:

Ra = 3.2 – 4.5 μm
Rz = 10.1 – 11.1 μm

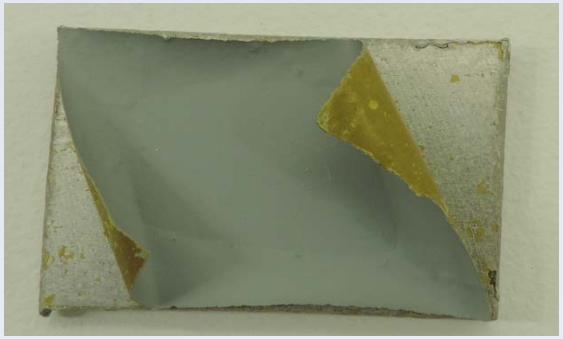
Ra = 0.13 – 0.18 μm
Rz = 2.0 – 2.5 μm

Ti, Al, Stainless Steel, and Ni Alloys

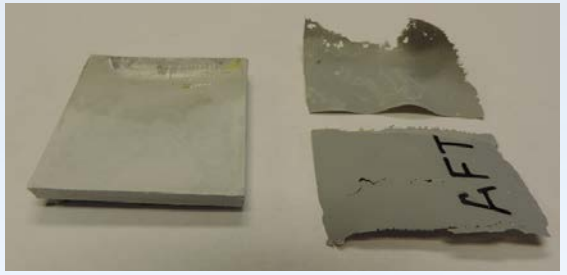
Plasma Electrolytic De-painting (PEDP)

- No pre-treatment is necessary
- Non-hazardous byproducts – weak water-based electrolyte
- Processing time is in between 3 and 7 min as a single process.
- Does not affect the substrate – SEM / EDS confirmation

Depainted Fragments:



During PEDP Treatment
(3 minutes)

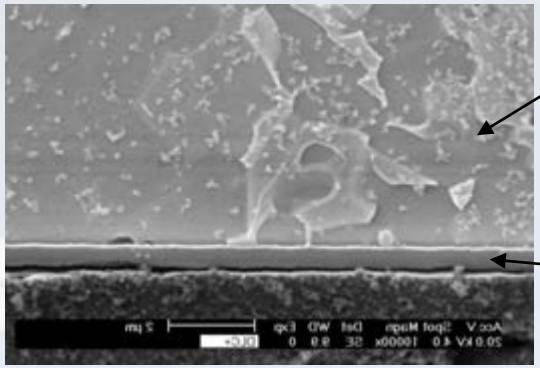


Sheet Removal

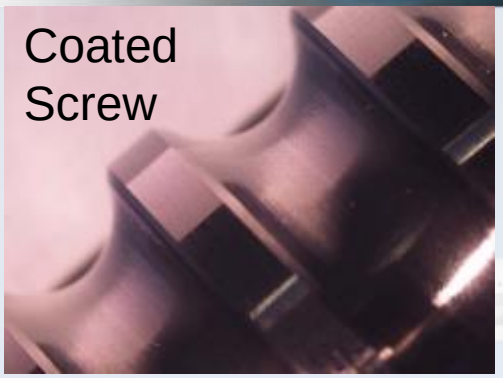
Target application:
De-painting of aircraft wheels

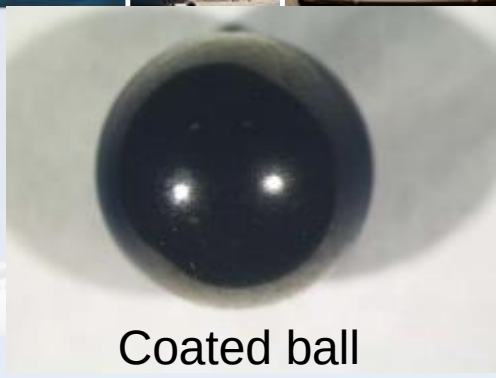
CeraTough-D™ (DLC) Coating

- DLC (Diamond-Like Carbon) nanocomposite coating has unique properties of low friction, high hardness, and high corrosion resistance
- CeraTough-D™ DLC coatings have the following characteristics:
  - High hardness
  - Low coefficient of friction (0.02-0.15)
  - High corrosion resistance
  - Great adhesion to substrate material
  - Fretting resistance; Abrasive wear resistance
  - Self lubrication in dry wear conditions
  - Excellent release properties
  - Electrical insulation
- IBC's DLC processes include:
  - Cathodic Arc Physical Vapor Deposition (CA-PVD)
  - Plasma Assisted Chemical Vapor Deposition (PA-CVD)



DLC / Multilayer System for Actuators





787 EM Spoiler Actuator Testing at 502 ksi Dynamic Load: Life Summary

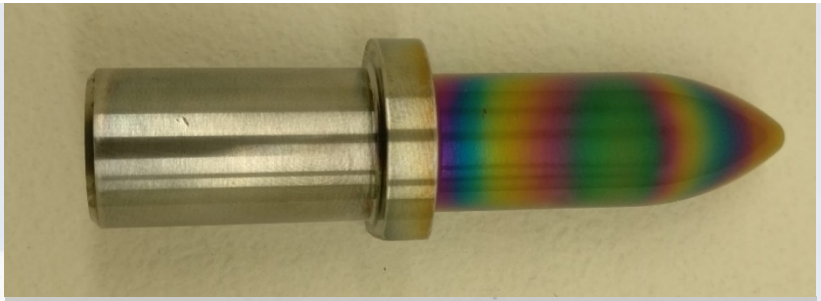
Test #	Actuator Configuration	Ballscrew Inches of Travel	Ballscrew Rev's	Comparison
1	Uncoated balls and screw, without lubrication	4244.8	9432.9	Baseline
2	DLC coated balls with uncoated screw, without lubrication	28090.7	62423.8	6.6x
3	DLC coated balls and screw, without lubrication	65976.9	146615.4	15.5X

1) Actuator and image courtesy of MOOG Inc.

Rainbow DLC

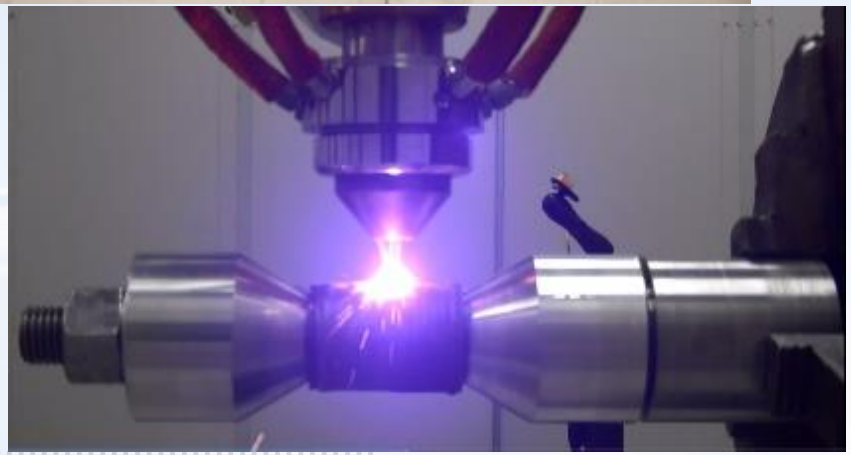
Properties

- Low Thickness – 0.5 µm
- High Hardness – 3000-5000 HV
- Low Coefficient of Friction – 0.05
- Hydrophobic Properties
- Currently undergoing anti-icing testing by a DOD supplier



LASER CLADDING

- IBC Laser Cell has a 4kW IPG fiber laser with a head tail stock positioner that can hold part up to 2000 kg and 12’ length
- Cell has a wide production window to clad a variety of metals



Thank you from IBC

- **Thin Film Coating**
  - CeraTough-D™ Diamond Like Carbon (DLC) coatings
  - High Energy PVD coatings (TiN, TiALN, CRN, CRC, TIC, VC, Al_2O_3, SiO_2, ZrO_2, SiN)
- **Nitriding**
  - Ion Plasma Nitriding (DHIN)
  - Ion Plasma Ferritic Nitrocarburizing (DH-FNC)
  - Post-DHIN and FNC Oxidation (equivalent to Plasox)
  - Salt Bath Nitriding (DHN) (equivalent to QPQ, Melonite, Tufftride, etc.)
- **Laser Cladding**
- **Micro-laser welding and repair**
- **Electro-spark deposition**

- **Plasma Electrolytic treatments and coatings**
  - PEO – plasma electrolytic coatings of Al, Mg, Ti alloys
  - PED – plasma electrolytic diffusion coatings
  - PEP- plasma electrolytic polishing
- **Heat treating**
  - Vacuum Heat Treat with up to 12 Bar Gas Quench
  - Annealing
  - Stress Relief
  - Aging
  - Carburizing
  - Solution Nitriding
- **Thermal Diffusion Surface treatments**
  - Boriding (DHB)
  - Tantalizing (DHTa)
  - Chromizing (DHC)
  - Aluminizing (DHA)
  - Vanadium Carbide (TDH)

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