PROTECTIVE COMPOSITE COATINGS VIA ELECTRODEPOSITION AND THERMAL SPRAYING

PROCETS – EC funded Pilot Line project

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INTRODUCTION

- Wear and corrosion of materials cause losses of 3-4% of GDP
- Billions of Euros are spent annually on capital replacement and control methods for wear and corrosion infrastructure
- Industries are dependent on surface engineering of protective coatings
- Two main techniques that dominate the protective coatings sector for large components
  - hard chromium electroplating
  - thermal spray WC-Co cermet coatings
**Hard chromium electroplating**

- Hard wear and corrosion resistant coatings at competitive cost.
- Issues: extremely negative environmental impact of the hard chromium plating process due to the use of the *carcinogenic hexavalent chromium*, has led to a number of directives and legislations by the EC related to the *restriction* of this method.
- Deadline for using hexavalent chromium (Cr$^{+6}$) in Europe: **Sept. 21, 2017**.
- Further production only after authorization
THERMAL SPRAY

- **WC-Co cermet coatings** are widely used to improve wear resistance of a majority of machine components, applied by thermal spraying.
- Recently toxicity studies of WC-Co cermet have revealed that **WC-Co particles are toxic** in a dose- and time-dependent manner.
- These findings support the hypothesis that WC-Co particle internalization contributes to cellular toxicity.
PROCETS CONCEPT

Electroplating line

Nano-particles

HEBM

Cermets

Thermal Spray

Direct plating
Pulse plating

Plated components

HVOF Cold Spray

Automotive
Cutting tools
Metal-working
Brick industry

Validation and Testing in operational environment
WHO ARE THE COMPANIES
Test Case Applications
Electroplating
Tenneco OE Ride Performance

Suspension Systems for
Superior Driving Experience
OE markets served globally

### Passenger cars
- Shocks, struts, modules, systems

### Commercial vehicles
- Axle, cabin and seat dampers and modules

### Agricultural vehicles
- Cabin and seat dampers and modules

### Two-wheelers
- Forks and rear suspension
Thermal Spray
Grinding, Electric Discharge Texturing and Chrome Plating
SUMMARY OF THE INDUSTRIAL REQUIREMENTS

- The 5 end user applications cover a large range of applications from small, accurate parts to larger lower specified parts up to a very large part with tight specifications.
- Every application has its special challenges for the development of the new coatings.
Pilot Lines
WHAT COMPOSITE COATINGS ARE WE DEVELOPING FOR PILOT LINE PRODUCTION

Electroplating Process
- Nano-particles: Boron Carbide (B4C), Silicon Carbide (SiC), Graphene
- Electrolytic bath: Nickel-phosphorous (NiP), Trivalent chromium (Cr(III)), Iron-phosphorous Fe(II)P
- Direct current and pulse plating processes

Thermal Spray Process
- Green carbide powders to replace WC-Co coatings
- High Velocity Oxygen Fuel (HVOF) and cold spray coating process
Pilot Line for DC plating

AVANZARE
Pilot Line for Pulse plating

ARTIA
PILOT LINES FOR THERMAL SPRAY

MBN
Powder production by HEBM and post processing

UB-CPT
Coating deposition on components by thermal spray

Matres
Powder engineering and characterization

Falex
Tribological tests on coating
HOW TO TRANSITION FROM PILOT LINE PRODUCTION TO END-USERS
The number one question in industry:

**How long will it last?**

- What ‘new’ coatings are better than old ones?
- What happens to my coating when conditions change?
- There are so many new coatings on the market, which one is better?
50 Stations
20 km sliding => 10 days of testing
40 km sliding => 20 days of testing

- 50 samples at one station, condensed into 2

Cost per data point
- Single station machine: 6000 Euro
- Multistation machine: 180 Euro

Results availability
- Single station machine: 1000 days
- Multistation machine: 20 days

The time and cost efficient solution: Multistation wear testing
THANK YOU!

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