

# TRIBONANO SOLUTIONS



Nanocermet  
micropowder materials  
and innovative spray  
coating technology for  
metal parts with improved  
wear resistance



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 686165.

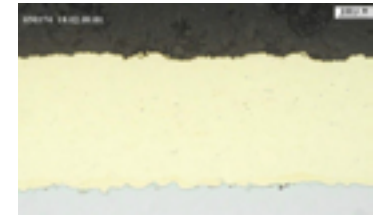
This brochure has been developed in the framework of IZADI-NANO<sub>2</sub>INDUSTRY project (H2020, G.A. no.686165). It is aimed at presenting the main results achieved by TRIBONANO PILOT partners, whose activities have been focused on the development of innovative materials and processes to produce metallic components of hydraulic motors with improved durability and increased efficiency.

*This publication reflects only the authors' view and the European Commission is not responsible for any use that may be made of the information it contains.*

## Nanostructured coatings

### OUR ACHIEVEMENTS

Micrometer sized powders with nanocrystalline microstructure for improved tribological performance components.



Bronze base alloys

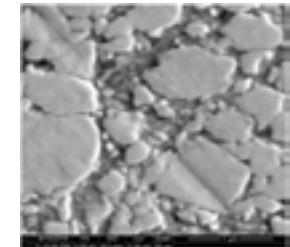
### WHAT WE OFFER

#### Formulation and delivery of tailor-made nanocermet

- Technical consultancy services for the definition of:
  1. different metallic substrates and coating materials that respond to the specifications defined by the customer;
  2. the best working parameters for the cold spray deposition of the micropowders on the selected metallic substrates.
- Large scale production of micropowders with nanocrystalline microstructure.



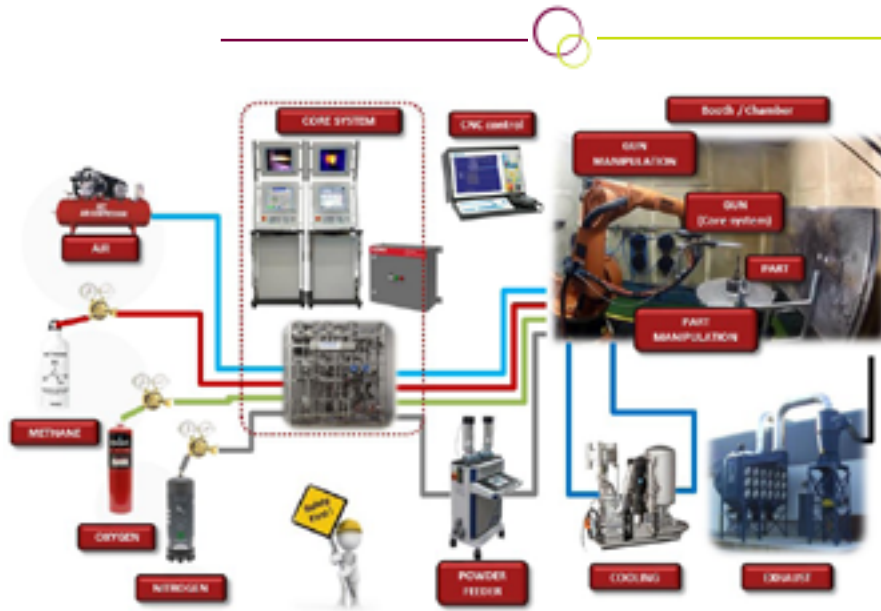
Nanostructured WCCoCr Cermets



#### Advantages of IZADI-NANO<sub>2</sub>INDUSTRY nanostructured coatings

- Ductility and toughness enhancement
- Improved sinterability
- Increased resistance to tribological and environmentally assisted damage
- Increasing strength and/or ductility with increasing strain rate
- Potential for enhanced superplastic deformation at lower temperatures
- Faster strain rates

# Solid-state deposition process through cold spray technique



## Modules to be integrated in the design of the deposition equipment include:

- Spray gun and barrels
- Gas heater
- Gas panel and gas control
- Powder feeder equipment and powder heater
- Cooling system
- Control console and human interface
- Process monitoring for the own pilot unit purpose

## Infrastructures required for the deposition process:

- Gases and compressed air supply
- Water availability
- Electrical power
- Exhaust and filtering equipment
- Manipulation devices and their programming (XY plates, turntables, robot,...)
- Deposition area or chamber adequately isolated for noise.

# Advantages of IZADI-NANO2INDUSTRY Solid-state deposition process

- Spray of thermally sensitive materials (eg. nanomaterials)
- Limited oxidation and interaction with environment
- Spray of fine cut size powder < 10 micron
- Avoid grit blasting preparation of substrate
- No barrel build-up
- Retain properties of initial powder materials
- Dense, hard, cold worked microstructure
- High thermal and electrical conductivity
- Reduced thermal heating and residual stresses

## SSD applications:

- **Cermets**
  - Avoid transformations & increase kinetic energy
  - Eg. Fine powders, nanostructured carbides
- **Metals and alloys**
  - Avoid oxidation or transformations
  - Eg. Al alloys, Cu alloys, MCrAlYs, Steels, Ni alloys, Ti alloys

Comparative Advantages			
Specified characteristics	HVOAF IZADI-NANO2INDUSTRY	HVOAF M3	HVOAF JP5000
Equivalent Power, kW	150	350	250
Max Spray rate, kg/hr	10	30	12
Fuel Flow rate, SLPM	Methane 100-300	Propane 240	Kerosene 32 l/h
Powder carrier gas	Nitrogen	Air	Nitrogen
Cooling	Water 15/kW	Air	Water 100kW
Max air flow rate, SLPM	1500	13,500	/
Max flow of O <sub>2</sub> SLPM	500	/	1100
Carrier gas flow rate, SLPM	20-80	70	18
Powder injection	RADIAL&AXIAL	AXIAL	RADIAL



# Main application Areas

## Metal Industry

- Higher process productivity
- Reduction of post processing steps

## Hydro Turbine Industry

Best erosion resistant coating to longer life-time of hydro components

## Paper Industry

Improved production of paper with long lasting doctor blades coated with nanocarbide layer

## Petrochemical Industry

Best wear resistance for improved durability

## Aeronautical Industry

- Durability of flaps with harder wear resistant coatings
- Improved fretting fatigue resistance of coated component



## Early adopter: CONSTRUCTION AND AGRICULTURAL MACHINERY SECTOR

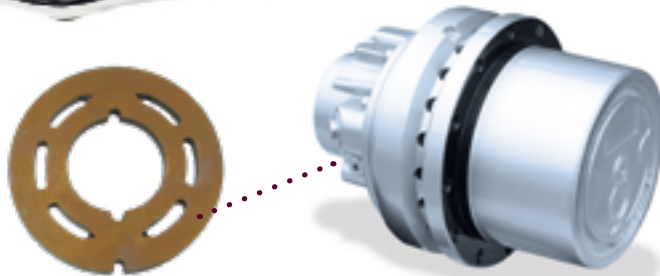
### Need:

Improved  
**DURABILITY**  
(6000 h, i.e. 5000 h  
+20% of target)  
and Increased  
**EFFICIENCY**



### Selected Component:

Valve plate of  
hydraulic motor



In a hydraulic motor the valve plate acts as a bearing surface upon which the cylinder block slides upon and seals against it.

Dimension:  $\Phi 102 \times \Phi 47 \times 5$  mm. | Iron (SAE1010 Low-carbon steel) is used as base metal with a thin layer of bronze (CuPb10Sn10) on the sliding face.

## Results Achieved: INCREASE OF THE MECHANICAL EFFICIENCY OF THE MACHINE TRANSMISSION

From comparison test the IZADI valve plate demonstrated an overall increase of mechanical efficiency. Considering the standard working points (evidenced below in purple) the efficiency increase is around 3%.

Increase of mechanical efficiency with  
IZADI-NANO<sub>2</sub>INDUSTRY PLATE  
(motor at max displacement)

Mech Eff. (%)	500 rpm	1000 rpm	1500 rpm	2000 rpm
50 bar	6,5	7,6	6,3	5,4
100 bar	2,9	3,4	3,3	2,2
150 bar	2,3	2,2	1,7	1,2
200 bar	2,0	2,3	2,8	2,3
250 bar	1,3	1,4	1,3	1,0
300 bar	1,2	1,3	1,3	1,0
350 bar	1,1	1,1	0,7	0,7

Increase of mechanical efficiency with  
IZADI-NANO<sub>2</sub>INDUSTRY PLATE  
(motor at min displacement)

Mech Eff. (%)	500 rpm	1000 rpm	1500 rpm	2000 rpm	2500 rpm	3000 rpm
50 bar	12,8	11,6	11,3	9,4	14,0	10,0
100 bar	5,2	5,9	7,2	4,7	5,2	2,9
150 bar	2,9	3,0	3,6	2,8	2,4	3,6
200 bar	1,8	1,8	1,9	2,2	1,5	2,0
250 bar	1,1	1,1	2,0	1,8	1,4	1,6
300 bar	0,8	0,8	0,1	0,9	1,2	0,5
350 bar	/	/	/	/	/	/

The increase of motor efficiency gives as Diesel Power reduction a value of 2,3 kW.

-2,3  
kW



-500 lt/year of  
Diesel Fuel  
consumption

Based on 1000 hours/  
year as working hours  
and a fuel consumption of  
16900 lt/year



-700 euro/year  
for Diesel fuel  
cost



-1,3 tons/year  
of  
CO<sub>2</sub> emission

# Contacts

## Early Adopter

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## Nanostructured Powders Producer

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**IZADI-NANO<sub>2</sub>INDUSTRY** (H2020, G.A. no.686165) aims at contributing to overcome the barriers that nano-materials are currently facing to get introduced in the market. During the project, technologies and strategies based on nano-reinforced materials, nanotextured surfaces and nanostructured-coatings have been implemented in three innovative PILOTS that are proposing new added-value products to OEMs and solutions to the European Automotive, Construction and Agricultural Machinery sectors.

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