SAFE-BY-DESIGN IMPLEMENTATION APPROACH IN PRODUCTION SYSTEMS: CASE STUDY, PROTECTIVE COMPOSITE COATINGS BASED IN NANO-PARTICLES

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ABOUT ISQ

ISQ HEADQUARTERS

Founded in **1965**

headquarters in **Portugal**

WORLD OF SOLUTIONS

Mission:
Provide Scientific and Technological Support to Industry

ABOUT ISQ

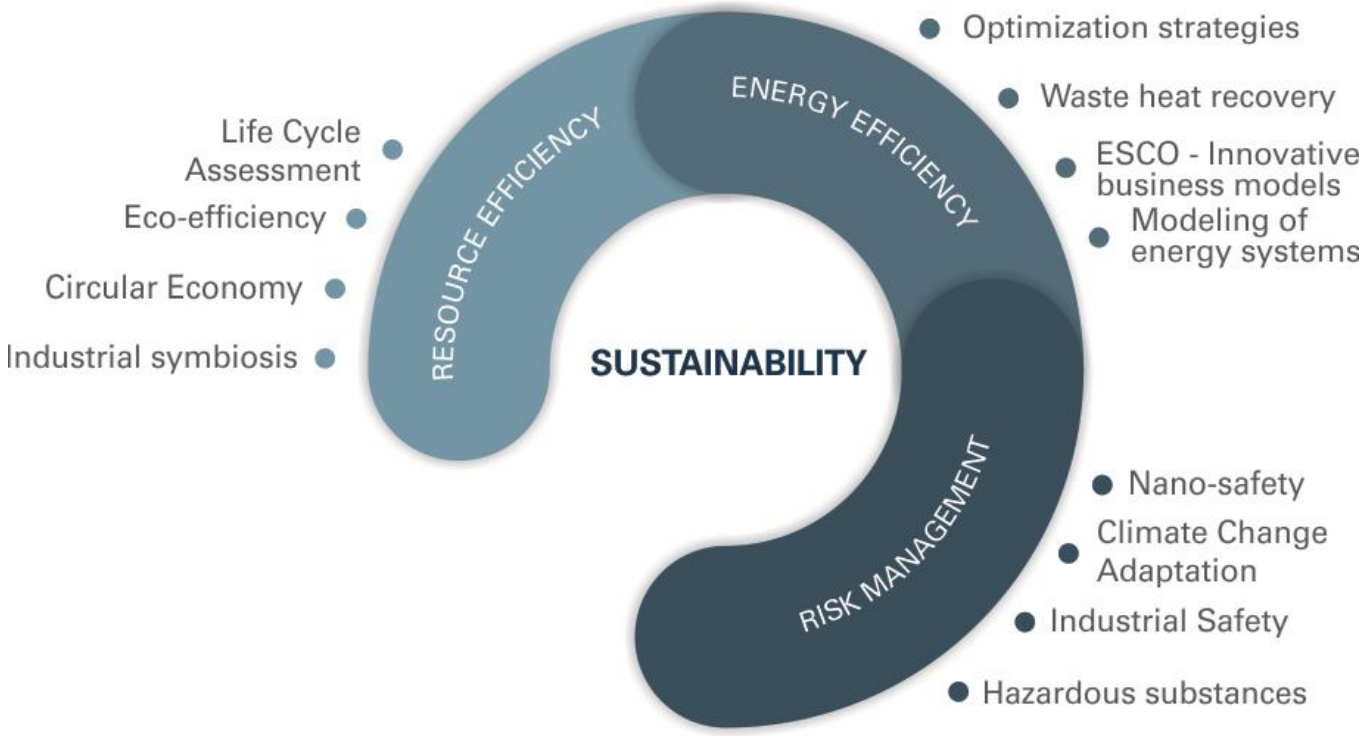
SUSTAINABLE INNOVATION CENTRE

CREATING VALUE

APPLIED RESEARCH

TECHNICAL EXCELLENCE

INDUSTRY PARTNER



PROJECT OVERVIEW

PROCETS is an European research project which started on January 1st, 2016, with an extent of 42 months, funded from Horizon 2020 (Nº 686135).

Project Co-ordinator: Patrik Karlsson (CERTH)

Project Website: www.procets.eu

PROJECT PARTNERS

CENTER FOR RESEARCH & TECHNOLOGY HELLAS

TENNECO

POLITECNICO DI MILANO

avanzare

Universitat de Barcelona

iSQ

TEKNISKA HÖGSKOLAN
HÖGSKOLAN I JÖNKÖPING

FALEX TRIBOLOGY NV

Husqvarna

MBN nanomaterialia

CROMOMED S.A.

Nano Engineering & Consulting

MATRES
material research & design

CETRI
Center for Technology Research & Innovation

SEA
SURFACE ENGINEERING ASSOCIATION

Wienerberger

PROJECT OVERVIEW

The scope

The main target is to deliver protective coatings (PC) covering a wide range of applications (automotive, aerospace, metal-working, oil and gas and cutting tools industries) via thermal spray and electroplating methods by utilizing more environmental friendly materials, compared to the currently used (Replacement of the hazardous process of hard chromium plating and WC-Co coatings via thermal spray).

The need

- Wear and corrosion of materials causes losses of 3-4% of GDP in developed countries;
- billions of Euros are spent annually on capital replacement and control methods for wear and corrosion infrastructure.

as a result

many important industries are dependent on surface engineering of PC, making it one of the main critical technologies underpinning the competitiveness of EU industry.

PROJECT OVERVIEW

There are two main techniques that dominate the protective coatings sector:

1) hard chromium (HC) plating and → Negative health and environmental impact → Restriction of this method for using Cr^{+6} by the end of 2017

2) thermal spray (TS). → Toxicity of Co-WC particles in a dose/time dependente manner

The project idea

The PROCETS will take advantage of the use of **nano-particles for production of composite coatings** with superior properties compared to those of HC produced by electroplating or to Co-WC produced by thermal spray. These novel **nano-particles will be incorporated into existing production lines** after appropriate modifications. The new procedures will:

- ✓ be easily transferred by minor adaption to the present electroplating and TS facilities,
- ✓ combine flexibility and mass customization abilities
- ✓ restrict environmental and health hazards and
- ✓ be available at acceptable cost

PROJECT OVERVIEW - TECHNICAL OBJECTIVES

Objectives related to the electroplating process and coatings:

1) Selection of hard (e.g. SiC, Al_2O_3, B_4C) and self-lubricant (e.g. BN, nano-graphite) nano-particles (NPs) to be integrated in a Cr^{+6} free electrolytic bath (e.g. Ni-P, Ni-W-P, Cr+3), based on the mechanical performance of the composite coatings.

2) Integration of NPs in the electrolytic baths and formulation of stable electrolytic baths with excellent dispersion and prolonged lifetime by using appropriate mixture of additives and ultrasonication method.

3) Development of a direct current (DC) electroplating method in pilot lines for applying PROCETS composite coatings with thickness up to 250μm following the requirements of the respective end users. The method will be 3 times faster than conventional hard.

4) Delivery of pilot PC plating lines for applying PROCETS composite coatings with thickness up to 300μm, exhibiting current eficiente70% and superior functional properties by a factor of 20% compared to coatings produced by DC.

PROJECT OVERVIEW - TECHNICAL OBJECTIVES

Objectives related to the thermal spray process and coatings:

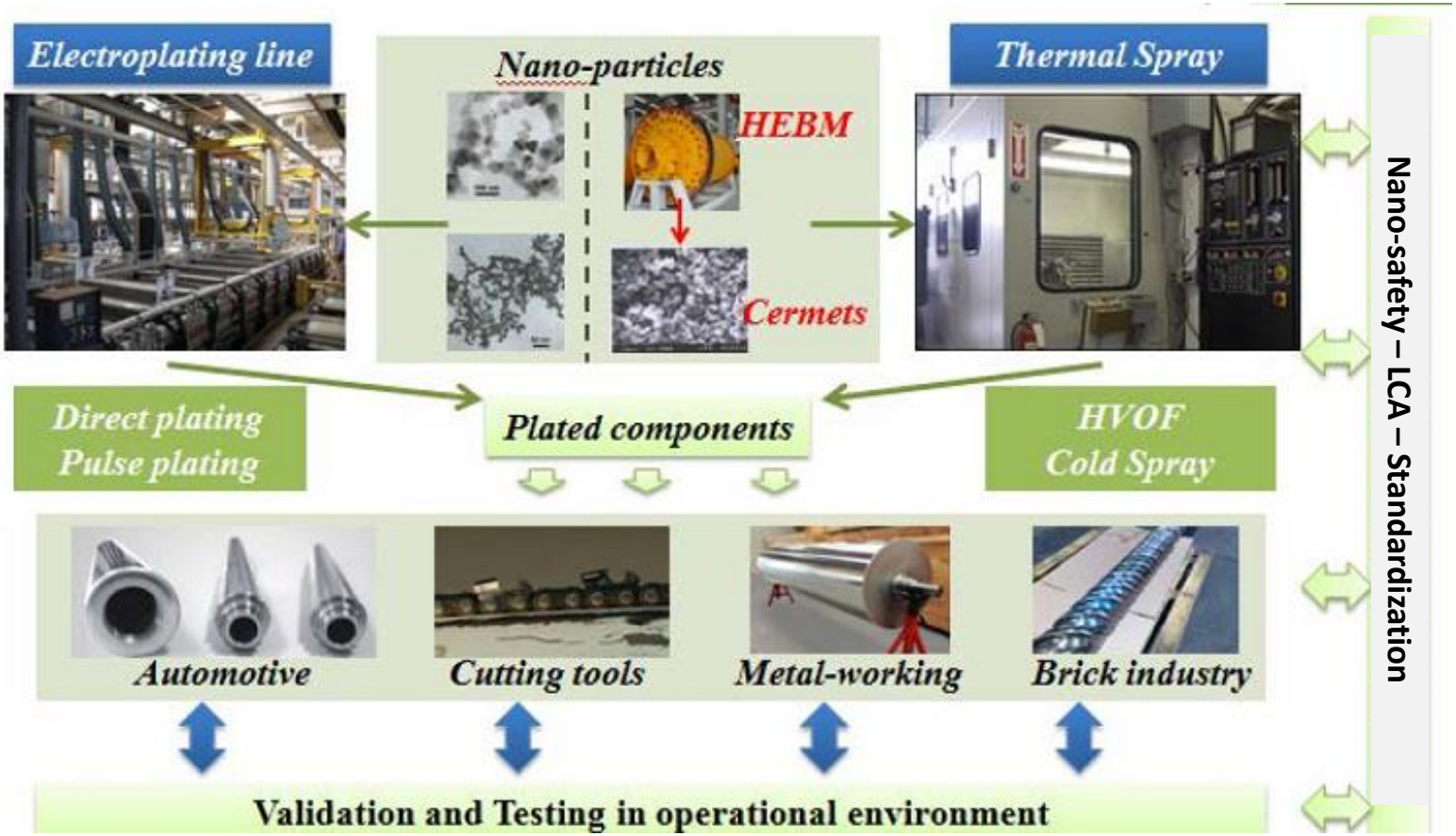
1) Development of green carbide powders by efficient mechanical alloying procedure to be used as feedstock for thermal spraying.

2) Development of a controlled and reproducible enhanced process based on TS to optimize green carbide coatings able to be used to replace WC-Co coatings at industrial level.

3) Development of coatings produced with the developed green carbides materials having controlled and reproducible features/properties.

4) Evaluation and fulfillment of the application requirements.

SCHEMATIC CONCEPT OF THE PROCETS PROJECT



PROJECT OVERVIEW - SCIENTIFIC OBJECTIVES

1) Set-up and integration of NPs and operation of the electroplating pilot lines for the application of PROCETS composite coatings at specific components to be tested in operational environment.

2) TS process integration in an industrial pilot-line and evaluation of the coated components.

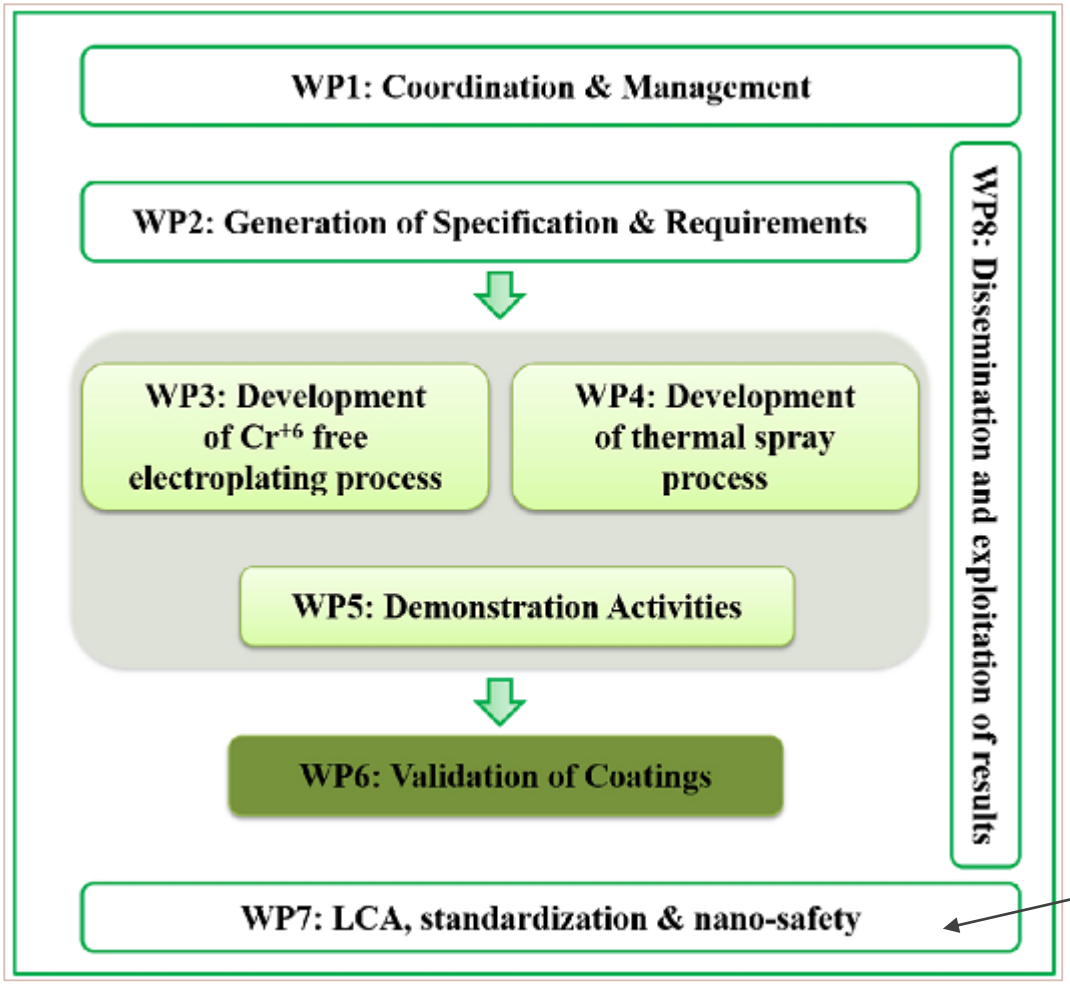
3) Tenneco test case: Applying the new developed protective coatings by DC and PC electroplating methods at rods to be integrated in shock absorbers.

4) Husqvarna test case: Applying the new developed protective coatings by DC and PC electroplating methods at cutting edges of links to be integrated in chain saws.

5) Cromomed test case – Laminating roller for steel industry: Applying the new TS coatings in rollers to be integrated in laminating machines.

6) Wienerberger test case: applying TS and electro-plating coatings at scraper and mixer components of clay manufacturing industry machines.

PROJECT OVERVIEW – WORK PACKAGES



Leader of the task: ISQ

WP7: LCA, STANDARDIZATION & NANO-SAFETY

Safe-by-Design concept has gained interest over recent years as it aims to **reduce potential health and environmental risks at an early phase in the innovation process.**

To achieve this goal, will be:

1) Characterization of the innovative process (detail of the inputs, outputs)
2) verify the compliance with standards of all project results, namely REACH, and defining the specific actions to direct the development activities toward the standards;
3) performed a risk management process following the principles and guidelines of the standard ISO 31000 and 31010 (will start in the pilot phase in order to allow evaluating all the risk for the process and for the workers in a previous phase;

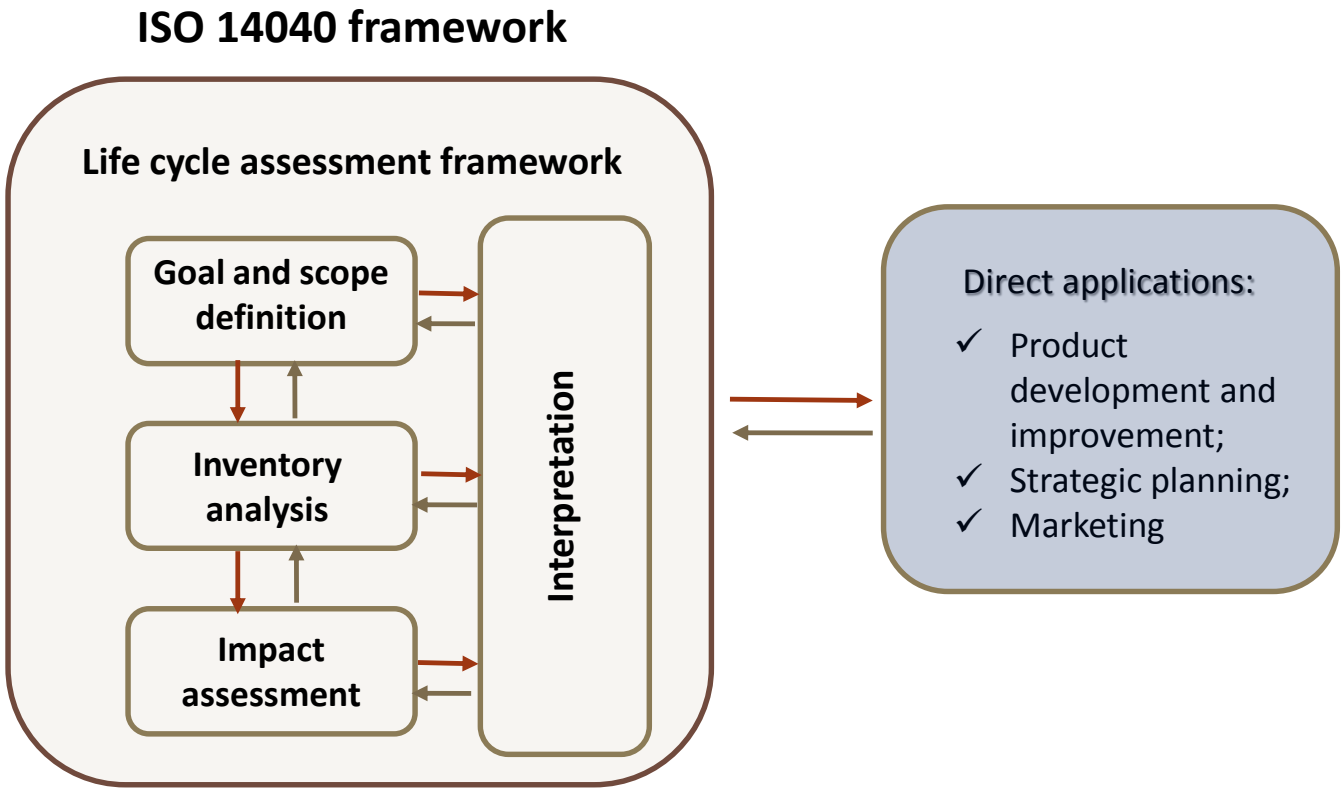
WP7: LCA, STANDARDIZATION & NANO-SAFETY

4) performed a completed Life Cycle Assessment (LCA) analysis to define the energy and environmental profile of the new processes;

5) promote safe practices, based on the available information and literature (good practice guides, projects results, standards, etc.) during electroplating and thermal spray coatings production (industrial scale), and identify the safer final products according to chemical and physical characterizations performed across the duration of the project;

WP7: LCA, STANDARDIZATION & NANO-SAFETY

WP7: LCA, standardization & nano-safety



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Thanks for your attention

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