



#InvestEUresearch

# Horizon 2020 Work Programme for Research & Innovation 2018-2020

**EMRS Event**

Warsaw, 19th September 2018

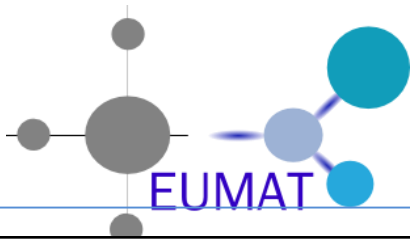
**Workshop:** Europe in Motion-EUMAT Session

**Time:** 13:45-16:10

**Proponent:** R. Nevshupa (CSIC) & A. Igartua (IK4-TEKNIKER)

**Proposal title:** Knowledge-based radical innovation towards **S**elf-healing nanostructured **I**ntelligent tribological Coatings for severe **E**nvironments

**Call:** FET OPEN. Deadline 24<sup>th</sup> January 2019



# Organisation / Company profile



IK4-TEKNIKER

## HISTORY



**28 YEARS**  
OF EXPERIENCE

## H2020



**4,6 M€**  
ANNUAL AVERAGE INCOME

## EUROPE IN FIGURES

## TECHNOLOGY TRANSFER



### PATENTS

Overall first filings	52
Total filings	119
First filings 2015	7
Exploited patents	11



### START-UP'S

Companies participated	29
Investee companies	6

## CURRENT PORTFOLIO OF COMPANIES



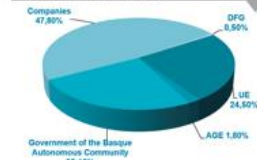
**TOTAL REVENUE**  
**24.000.000 €**



**PEOPLE**  
**278**

## IK4-TEKNIKER IN FIGURES

### SOURCES OF R&D&I REVENUE



## WHO WE ARE

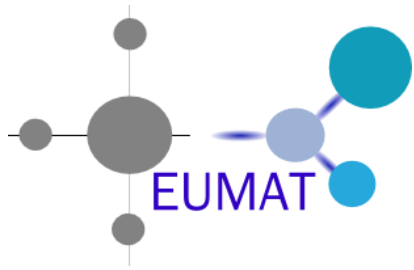
**R&D Centre, Eibar (The armouring city)**  
(not-for-profit Private Foundation)

**Applied research spanning 35 years.**

**Mission: To enhance the positioning and competitiveness of our clients through technology transfer.**

**Specialised in Manufacturing**

**Founder members of the IK4 Research Alliance.**



# SINCE Project Idea

## Problematic to be solved

### a-C:H tribological coatings

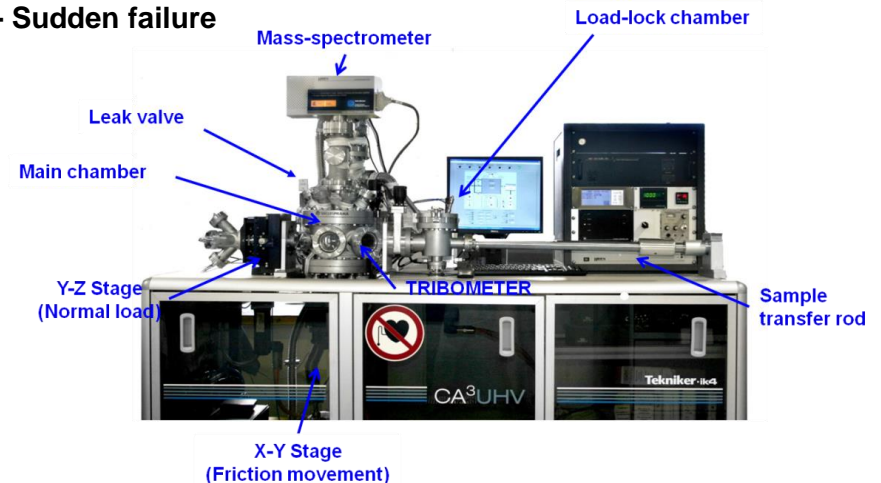
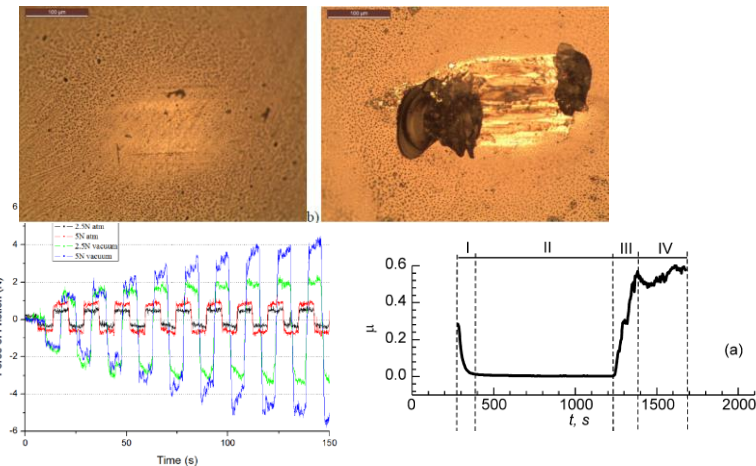
- + super low friction (SLF) in vacuum and inert environment
- + SLF can be restored by hydrogen refilling

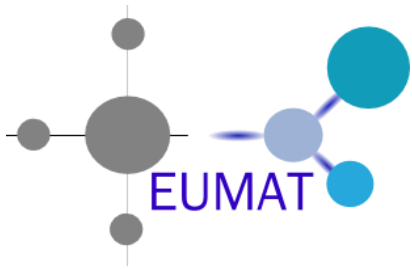
- Rapidly fails in presence of oxygen and water
- Sudden failure

### a-C tribological coatings

- + low friction in normal atmosphere

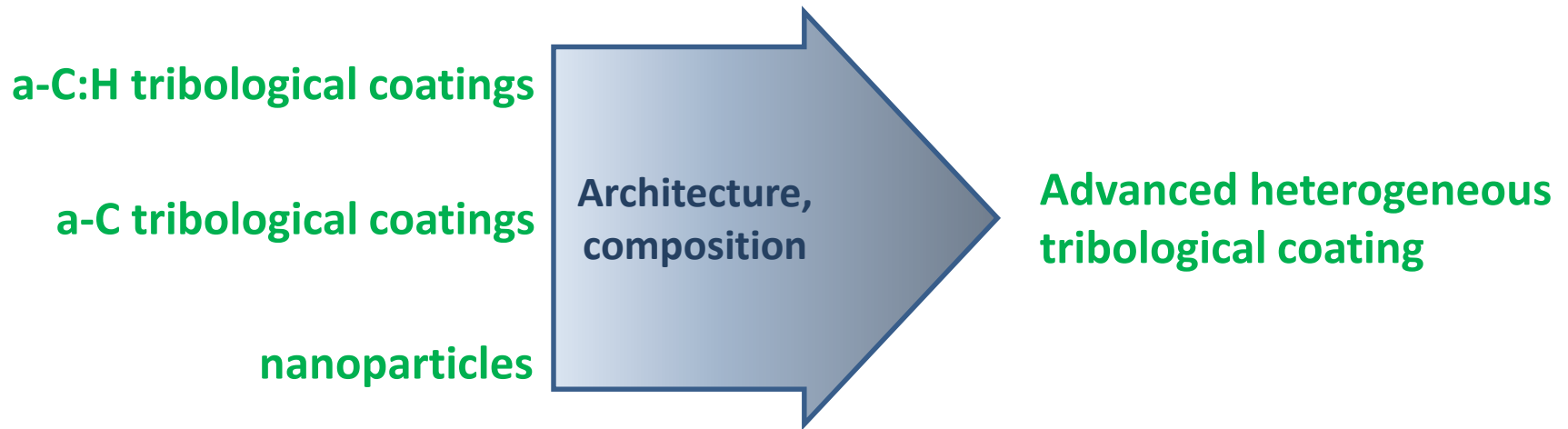
- Rapidly fails in under inert environment
- Sudden failure

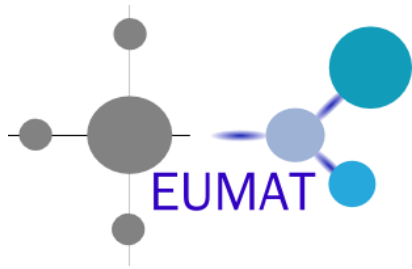




# SINCE Project Idea

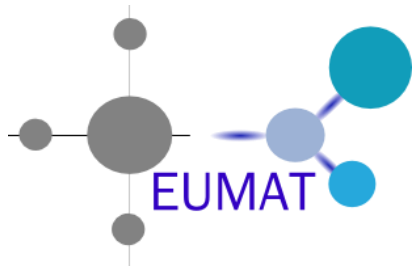
**Radical innovation: adaptive, self-healing and intelligent coating**





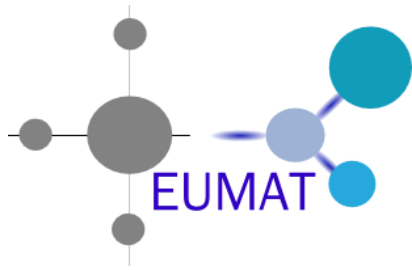
# SINCE Overview

NAME	TYPE	COUNTRY	CAPACITIES	ROLES, ACTIVITIES
IK4-TEKNIKER	RTD	ES	Testing friction, tribodesorption and wear mechanism, gas desorption	Coordination. Coating development incorporating nanoparticles. Testing of coatings for tribological properties under vacuum and ultrahigh vacuum (high low, low speed), bearing testing
CSIC	RTD	ES	Development of intelligent tribological coating with controlled gas release	Intelligent tribological coatings, testing (low load, high speed) gas release, new research, modelling of relationship between triboemission and coating configuration.
<b>AERONAUTIC SPACE APPLICATION</b>	BIG	IT	Applicability of the intelligent tribological coating to second applications	Target second application (eg.space) with selfhealing and self diagnosis capacity due to gas control release.
Janssen Precision Engineering	SME	NL	Applicability of the intelligent tribological coating to vacuum and cryogenic applications	Target implications in Vacuum and cryogenic components with selfhealing and self diagnosis capacity due to control of gas released.
Univ. Autónoma	UNI	ES	Materials for hydrogen storage	kinetic and thermodynamic properties of hydrides, to understand the in situ deposition of hydride nanoparticles.



# Project Overview

- It is a **bottom up research project** (TRL 2-3) that intends to study during a period of **36<sup>th</sup> months**, the feasibility of developing **breakthrough intelligent (self diagnostics), self-healing and adaptive tribological coatings**, able to have a good behaviour under atmospheric, vacuum and ultrahigh vacuum conditions
- The proposed project is focused on the **Materials technology of multi-layer hybrid amorphous carbon (a-C:H) coatings with incorporated nanoparticles** which have super low friction (SLF) in vacuum, low wear rate (both in atmosphere and in vacuum) and very low gas emission.
- **Background:** Two decades of investigation into the phenomenon of Mechanically Stimulated Gas Emission allowed to formulate basic principles of the technology (TRL 1)
- **The proof of concept:** Laboratory tests on deposition of nano-particles, tailoring tribological behaviour of carbon coatings and controlling gas emission on individual components will be performed. (TRL 2-3)



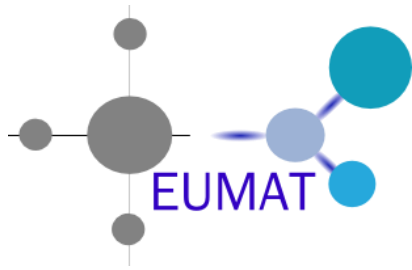
# Challenges & Activities

## Principal challenges: Optimal combination and properties of three principle components (a-C:H, a-C and nanoparticles)

1. Development of **adaptive coatings**: To enhance the tribological properties of the coatings in the air while optimizing their SLF from atmosphere to vacuum conditions
2. Development of **self-healing coatings**: to enhance the service life of the coatings in atmosphere and vacuum conditions
3. Development of **intelligent coatings with self-diagnosing properties**: to reduce the severity of the consequences related to the coatings failure.

## Activities to be performed:

1. Development of **tailored a-C:H coatings** with incorporated metal nano-particles.
2. Characterization of **tribological and tribodesorption properties** of the coatings in vacuum and in atmosphere, **studying the gas release** during time.
3. Optimization of **hybrid tribological coatings on surfaces** relevant to **aerospace, cryogenic and vacuum applications** (experimental modelling on laboratory scale).
4. Evaluation of the **potential of the hybrid coating deposition** technology for future scale-up



# Project Outcomes & Partners sought

## Expected Outcomes

- *This proposed project seeks to physically **validate the** radically **new technological concept based on cross-disciplinary approach and the use of principally new phenomena for development of self-healing, adaptive and intelligent nanostructured tribological coatings suitable for inert atmosphere, vacuum and space applications.** This disruptive technology addresses the challenges in various sectors related to advanced coatings and deposition methods including space, cryogenic, vacuum, electronic manufacturing systems, etc.*
- *Understanding of the technology for **co-deposition of amorphous carbon and metal nanoparticles and desorption of Hydrogen for lubrication purposes.***

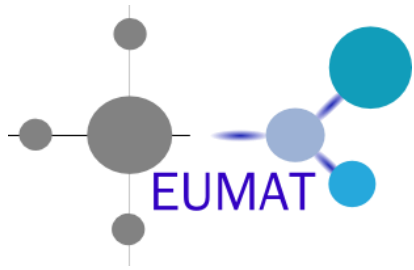
## Expertise sought

*Advanced techniques for physico-chemical characterization at nanoscale:*

- *XPS*
- *TEM (Transmission electron Microscopy),*
- *TERS (Tip enhanced Raman Spectroscopy),*
- *AFM Raman*

*A second application in Aerospace, Vacuum*





# Contact details

## *Contact details*

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**Dr. Roman Nevshupa:** [r.nevshupa@csic.es](mailto:r.nevshupa@csic.es)