PROJECT DETAILS

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PARTIAL-PGMs
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PARTIAL-PGMs

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MORE INFORMATION:

W W W . P A R T I A L - P G M S . E U

HORIZON 2020

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PARTIAL-PGMs

DEVELOPMENT OF NOVEL, HIGH PERFORMANCE HYBRID TWC/GPF AUTOMOTIVE AFTER TREATMENT SYSTEMS BY RATIONAL DESIGN:
SUBSTITUTION OF PGMS AND RARE EARTH MATERIALS

RATIONAL DESIGN OF CATALYSTS

with low critical raw materials content, for the development of novel automotive after treatment and the reduction of toxic and pollutant emissions from cars

HORIZON 2020

INTRODUCTION

PARTIAL-PGMs proposes an integrated approach for the coherent development of smart and innovative nanostructured automotive post-treatment systems by integrating TWCs on GPF, capable to meet future regulations, with reduced PGMs and REEs, leading to development of 2^{nd} generation GPFs.

S&T TARGETS

- Development of efficient hybrid TWC/GPF capable to meet future EC legislation (EU VII)
- Reduction of PGMs at least 35%.
- Decrease of REEs at about 20%

The workplan of the project involves the following general objectives:

- Rational design of nanocatalysts by Multi-scale modelling
- Synthesis of innovative nanostructured catalysts with enhanced activity.
- Full scale design and preparation of novel hybrid TWC/GPF
- Advanced characterisation techniques- Performance evaluation
- Life cycle analysis, Recyclability and environmental /health assessment studies
- Dissemination and exploitation of the results

MAIN IDEA

- Automotive catalysts were implemented in production in the US (1975)
- Japan and thereafter Europe (1986) adopted the use of automotive catalysts.
- The most common type of catalyst found on gasoline engines is the so called: Three-way catalyst (TWC) :

Carbon Monoxide (CO) → Carbon Dioxide (CO_2)
Hydrocarbons (HC) → Water (H_2O)
Oxides of Nitrogen (NOx) → Nitrogen (N_2)

- Platinum group metals (PGMs) mainly Pt, Pd and Rh have been the key component in automotive emissions control catalysts
- The national and international regulatory bodies enforce over more stringent emission rules so that the field of automotive catalysis is always at the very edge of technology.
- Continuous research to improve the catalyst performance and function, but also to reduce the amount of PGMs used to the catalyst
- Driven by ever tightening regulations Gasoline particulate filters (GPFs) are being developed to enable compliance with future particulate number (PN) limits for passenger cars equipped with gasoline direct injection (GDI) engines.

APPROACH

To date, three way catalytic converters (TWCs) have been established as the most effective engine exhaust after-treatment system. However, TWCs not only fail to address the issue of particulate matter (PM) emissions but are also the main industrial consumer of Critical Raw Materials (CRMs) mainly Platinum Group Metals (PGMs) and Rare Earth elements (REEs), with the automotive industry accounting for 65%-80% of total EU PGMs demand.

The enforcement of new limits on PM emissions (EURO 6c/7) will require higher TWC performance, hence leading to further increase the CRMs content in autocatalysts.
Addressing the necessity of CRMs reduction in catalysis, PARTIAL-PGMs proposes an integrated approach for the rational design of innovative nanostructured materials of low PGMs/REEs content for a hybrid TWC/Gasoline Particulate Filter (GPF) for after-treatment systems with continuous particulates combustion also focusing on identifying and fine-tuning the parameters involved in their preparation, characterization and performance evaluation under realistic conditions.

PARTIAL-PGMs approach is broad, covering multiscale modeling, synthesis and nanomaterials' characterization, performance evaluation under realistic conditions as well as recyclability, health impact analysis and LCA.

The rational synthesis of nanomaterials to be used in these hybrid systems will allow for a reduction of more than 35% in PGMs and 20% in REEs content, either by increasing performance or by their replacement with transition metals.

The compact nature of the new hybrid system not only will allow its accommodation in smaller cars but will also reduce cold start emissions and light-off times with performance aiming to anticipate both future emission control regulations and new advances in engines technology. Such R&D progress in autocatalysts is expected to pave the way to the widespread use of such low CRMs content materials in other catalytic applications.