**What is an automotive catalyst?**

The **automotive catalyst** is used in the exhaust system of vehicles to control the emission of harmful gases, such as HC, CO, NOx, into the atmosphere.

\[
\begin{align*}
2 \text{NO} + \frac{1}{2} \text{O}_2 &\rightarrow \text{N}_2 + \text{O}_2 \\
2 \text{CO} + \text{O}_2 &\rightarrow 2 \text{CO}_2
\end{align*}
\]

High cost critical raw materials Pt, Pd, and Rh are used in automotive catalysts.

**For the first time, a trimetallic (Cu, Pd, Rh) nano-catalyst has been synthesized and characterized in large scale, by substituting up to 85% of PGMs!**

**Synthesis of PROMETHEUS catalyst**

Corderite impregnation

| Process                  | Description                             |
|--------------------------|-----------------------------------------|
| Catalyst is dissolved    | in water solution                        |
| Binder is added          | in the solution                          |
| Cordierite monoliths     | are dried at 80-100°C (1-2 hrs)          |
| Cordierite is merged     | into the beaker                          |
| Cordierite to the oven   | (100-120°C)                              |
| Dry                      | Heating at 400-600°C                     |
| Cooling                  | Mass measurement                         |

**Physicochemical characterization**

**Catalytic Powder:** 2% w/w Cu/Pd/Rh on Ce0.68Zr0.32O after calcination, 500-700°C/2hrs

| Elements | Results (ppm) | Deviation (ppm) |
|----------|---------------|-----------------|
| Copper   | 14,740        | 500             |
| Palladium| 5,042         | 200             |
| Rhodium  | 977           | 40              |

- ICP: Confirmation of metal ratio Cu/Pd/Rh = 21/7/1
- XRD: Confirmation of the 2/1 Ce/Zr molar ratio and the cubic phase of the support

**Lean-burn conditions (λ=0.99)**

- Activation at T > 190°C
- CO oxidation efficiency - 100%
- CH₄ oxidation efficiency - 87%
- Increased NO reduction activity due to Rh presence

**Rich-burn conditions (λ=1.03)**

- Activation at T > 190°C
- CO oxidation efficiency - 100%
- CH₄ oxidation efficiency - 100%
- NO reduction efficiency - 6%, possibly due to oxidation of Rh nanoparticles

**European Patent has been granted on November 2019 (EP3569309)**

**Part I: Synthesis and Characterization**

**Platinum Group Metals and Cu synergy**

**Nanoparticles catalyst synthesis**

**Wet Impregnation Method**

1. M1 is dissolved in water (stirring)
2. M2 is added in the aqueous solution (stirring)
3. M3 is added in the aqueous solution (stirring)
4. Carrier is added in the aqueous solution (stirring)
5. Stirring RT
6. Heating 60-80°C
7. Slurry is formed
8. Dry at 100-120°C
9. Calcination at 500-700°C/2hrs
10. Milling
11. Sieving <350μm

**Catalytic activity**

**Elemental Analysis: ICP**

- ICP: Confirmation of metal ratio Cu/Pd/Rh = 21/7/1
- XRD: Confirmation of the 2/1 Ce/Zr molar ratio and the cubic phase of the support

**Prometheus: A Copper Based Polymetallic Catalyst for Automotive Applications**

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