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Prometheus: A Copper Based Polymetallic Catalyst for Automotive Applications

Part I: Synthesis and Characterization

This project has received funding from the European Union’s Horizon 2020 Research and Innovation Program under Grant Agreement N° 778893

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

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)

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

Due to high cost and supply risk of PGMs, Pd and Rh should be substituted by abundant non-precious (transition) metals like Copper, without compromising efficiency and performance.

Physicochemical characterization

Elemental Analysis: ICP

<table>
<thead>
<tr>
<th>Elements</th>
<th>Results (ppm)</th>
<th>Deviation (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>14,740</td>
<td>500</td>
</tr>
<tr>
<td>Palladium</td>
<td>5,042</td>
<td>200</td>
</tr>
<tr>
<td>Rhodium</td>
<td>977</td>
<td>40</td>
</tr>
</tbody>
</table>

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

Dry at 100-120°C
Calcination at 500-700°C/2hrs
Milling
Sieving <350um

Steering RT
Heating 60-80°C

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Platinum Group Metals and Cu synergy
Nanoparticles catalyst synthesis
Wet Impregnation Method

M1 is dissolved in water (stirring)
M2 is added in the aqueous solution (stirring)
M3 is added in the aqueous solution (stirring)
Carrier is added in the aqueous solution (stirring)
Stirring RT
Heating 60-80°C

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

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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)

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