

AVECC 2004



**Breakthrough Ce/Zr oxides
as precious metal supports**

**in ultra low loaded precious metal
catalysts technologies**

O.Touret, E. Rohart, O. Larcher, M. Allain, P. Macaudière



Issues in Three-Way Catalysis

- | | | |
|--------------------------|---|--|
| Cost saving | → | Low PGM loading |
| High durability | → | High surface area materials after very severe ageing |
| Low cold start emissions | → | High light off activity |

Agenda

- **Materials characteristics**
- **Model powder catalyst activity testing**
 - Test method
 - Fixed PGM loading
 - Decreasing PGM loading
- **Fully formulated catalyst SGB testing**



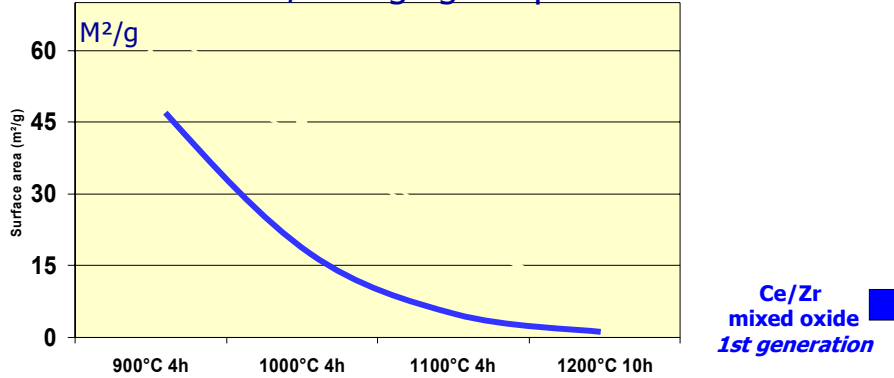
Agenda

- **Materials characteristics**
- **Model powder catalyst activity testing**
 - Test method
 - Fixed PGM loading
 - Decreasing PGM loading
- **Fully formulated catalyst SGB testing**



Highly thermostable OSC materials are key to achieve durability

Surface area / air aging temperature



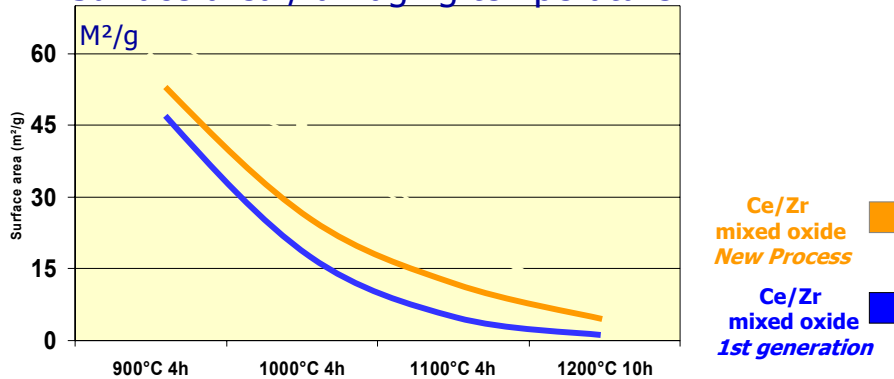
Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

5

Highly thermostable OSC materials are key to achieve durability

Surface area / air aging temperature



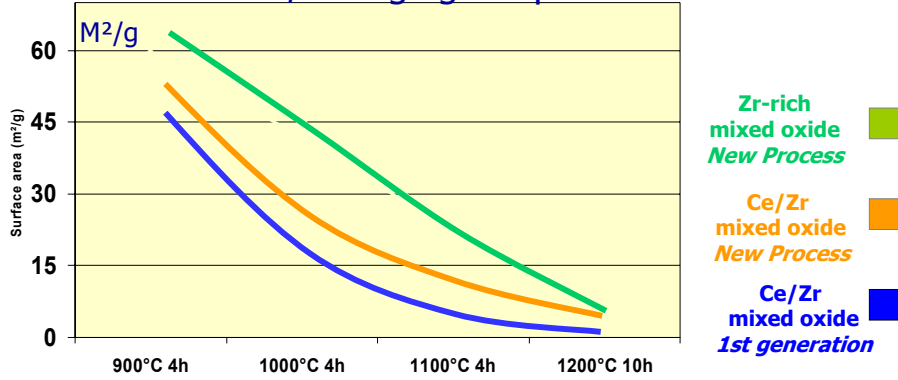
Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

6

Highly thermostable OSC materials are key to achieve durability

Surface area / air aging temperature



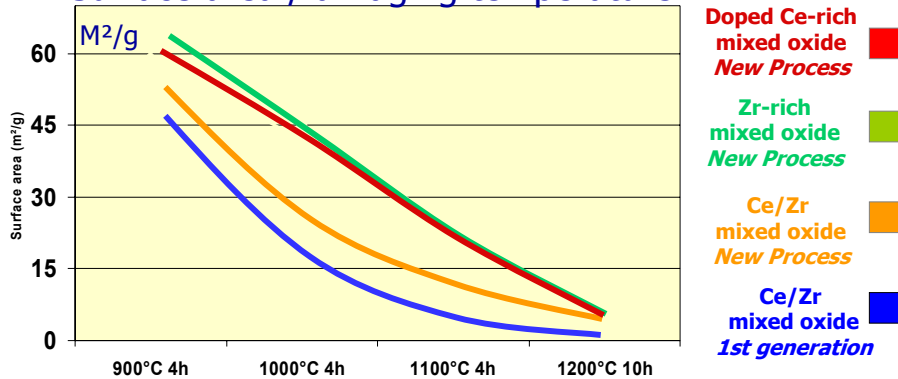
Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

7

Highly thermostable OSC materials are key to achieve durability

Surface area / air aging temperature



Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

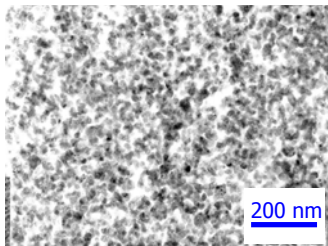
8

The control of the texture is key to improve reactivity and stability

Aged 900°C – 4h



Ce/Zr mixed oxide
1st generation



Ce/Zr
Mixed oxide ■
1st generation

Homogeneous
compact texture



Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports
in ultra low loaded precious metal catalysts technologies

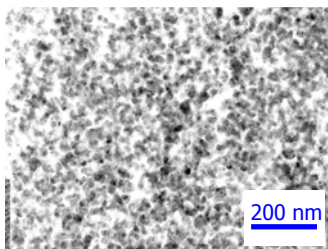
9

The control of the texture is key to improve reactivity and stability

Aged 900°C – 4h

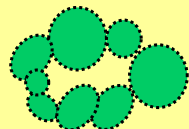


Ce/Zr mixed oxide
1st generation

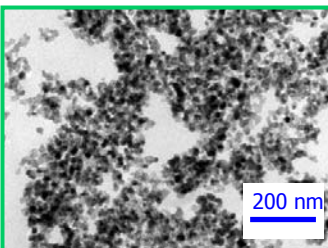


Ce/Zr
Mixed oxide ■
1st generation

Homogeneous
compact texture



Zr-rich mixed oxide
New Process



Zr-rich
Mixed oxide ■
New Process

Open pore texture

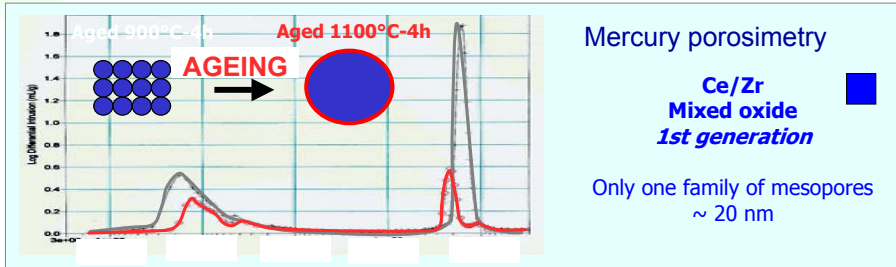


Electronics & Catalysis

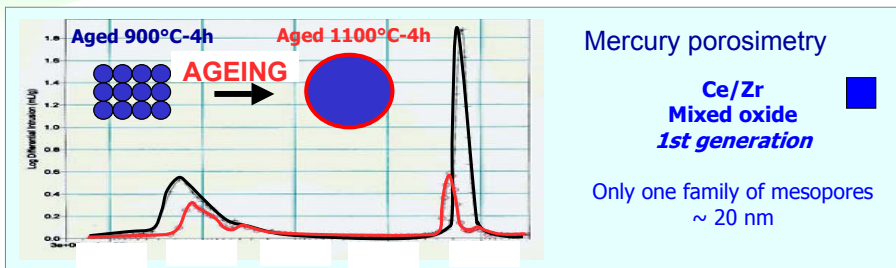
AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports
in ultra low loaded precious metal catalysts technologies

10

Open texture changes sintering mechanism and delays sintering at high temperature

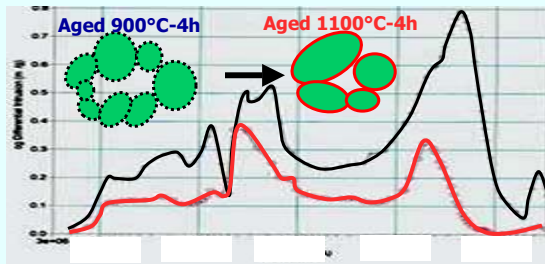


Open texture changes sintering mechanism and delays sintering at high temperature



**Zr-rich
Mixed oxide
New Process**

A continuous
distribution of pore size
from 10 nm to 10 μ m
that resist to sintering



Texture and structure

- **New CeZr Mixed oxides show high thermal stability on the whole composition range : from Zr-rich to Ce-rich**
- **Open pore texture delays sintering at high temperature**
- **The control of the structure gives pure solid solution up to 1100°C**

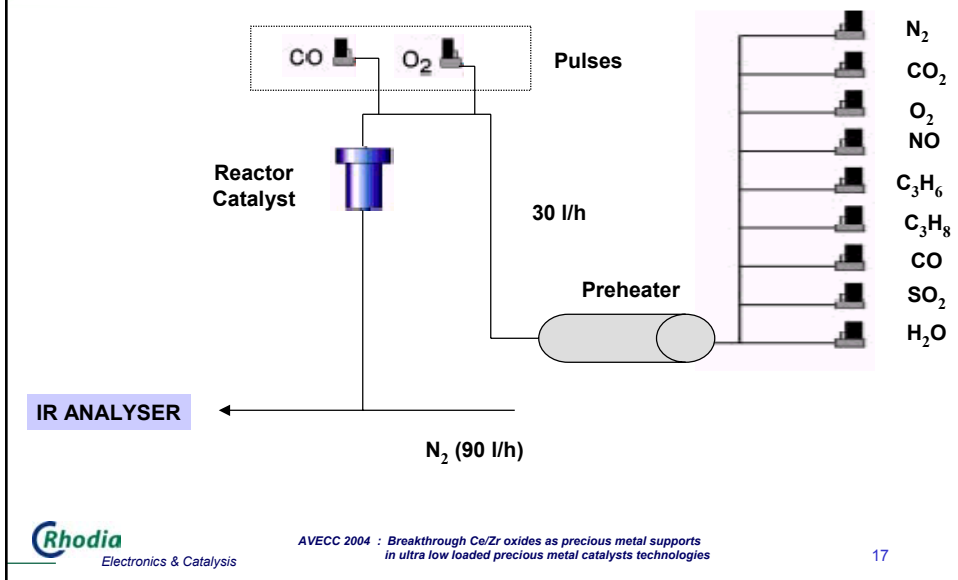


Agenda

- **Materials characteristics**
- **Model powder catalyst activity testing**
 - Test method
 - Fixed PGM loading
 - Decreasing PGM loading
- **Fully formulated catalyst SGB testing**

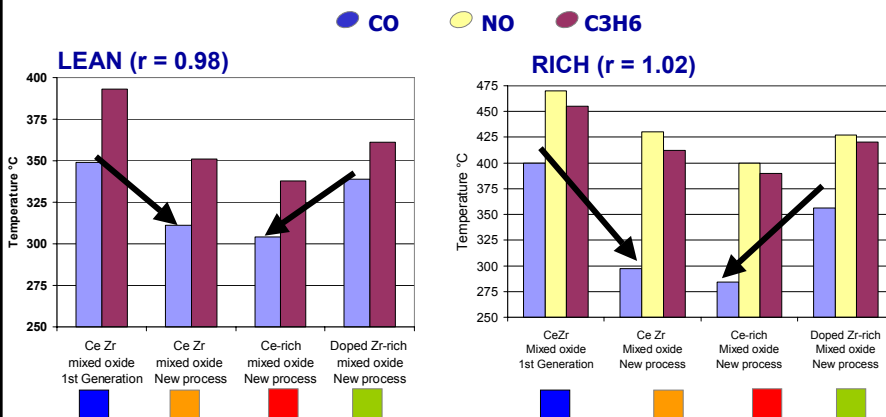


Light-off activity and COP performance are measured on model powder catalysts after Redox aging 6 hours at 1100°C



Light-off temperatures of Pt powder catalysts are significantly lowered

T20% Light-off Temperatures
Pt loading is constant : 0.5% wt



Pt (0.5% wt) powder catalysts – Aged 1100°C – 6h, under cycling conditions

Agenda

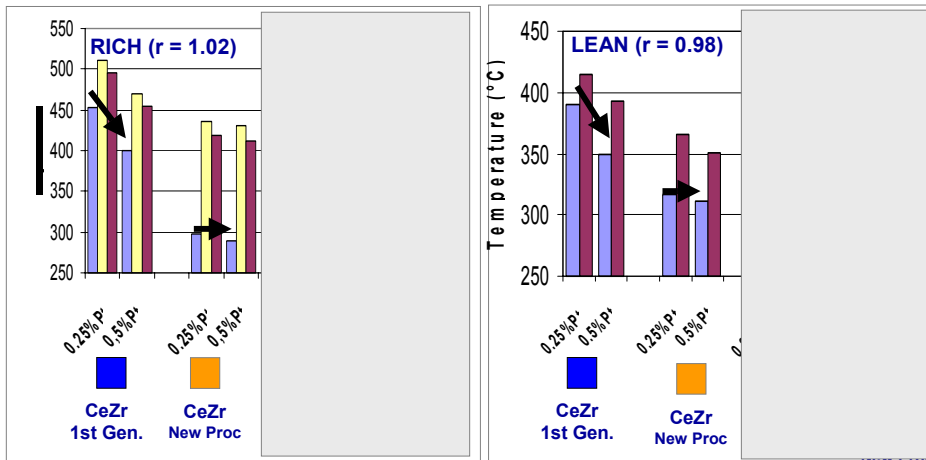
- Materials characteristics
- **Model powder catalyst activity testing**
 - Test method
 - Fixed PGM loading
 - Decreasing PGM loading
- Fully formulated catalyst SGB testing



New Ce-rich mixed oxides are preferred carriers for low loading Pt catalysts

Pt loading ranges from 0.5 wt % to 0.25 wt%

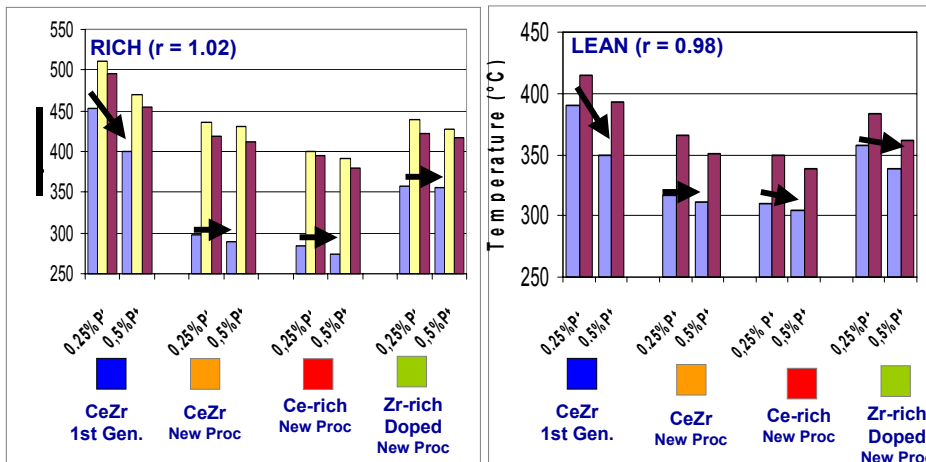
● T 20% CO
 ● T20% NO
 ● T20% C3H6



New Ce-rich mixed oxides are preferred carriers for low loading Pt catalysts

Pt loading ranges from 0.5 wt % to 0.25 wt%

T 20% CO (blue circle) T20% NO (yellow circle) T20% C3H6 (purple circle)



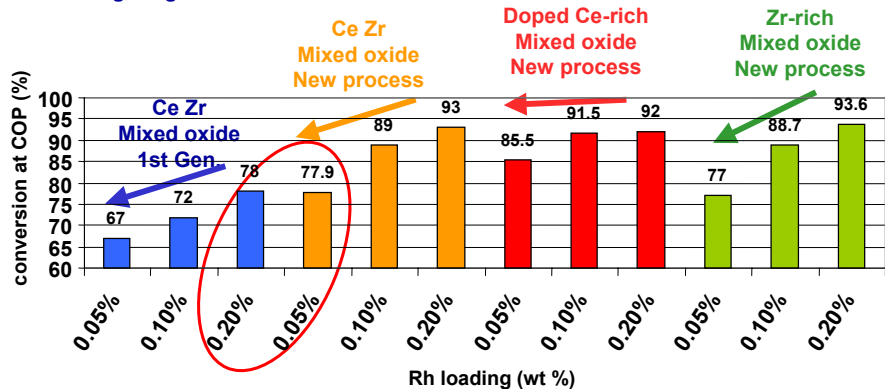
Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

29

New Ce-rich mixed oxides keep Rh available after severe aging

Rh loading ranges from 0.2 wt % to 0.05 wt%



Rh powder catalysts – Aged at 1100°C / 6h under cycling conditions
COP test is performed at 470°C



Electronics & Catalysis

AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal supports in ultra low loaded precious metal catalysts technologies

31

Powder model catalysts testing

- **New process materials :**
- **Used as Pt carriers, they show improved light-off performance**
- **Used as Rh carriers, they show improved activity at COP**
- **Activity shows very small impact when decreasing PGM loading**

Agenda

- **Materials characteristics**
- **Model powder catalyst activity testing**
 - Test method
 - Fixed PGM loading
 - Decreasing PGM loading
- **Fully formulated catalyst SGB testing**

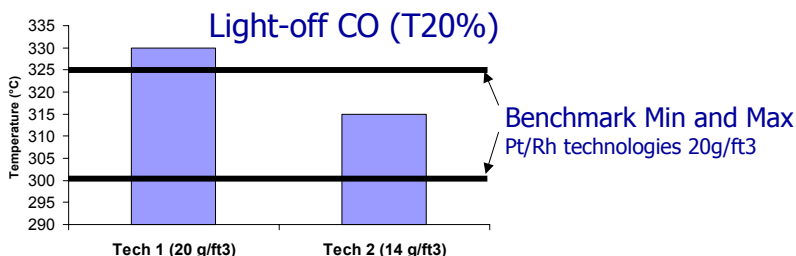
Investigation of two Pt/Rh technologies

- Washcoat is coated on cordierite ceramic cores with 1" diameter and 2" length . Cell density is 600/3 cpsi
- Rhodia Tech 1 : **20 g/ft³ Pt/Rh 2/1** including first generation mixed oxides from Rhodia
- Rhodia Tech 2 : **14 g/ft³ Pt/Rh 1.8/1** including "New Process" mixed oxides from Rhodia
- FAURECIA has performed SGB testing after ageing 20 hours at 1080°C, and has provided the Min and Max values of a BGS **benchmark of Pt/Rh 20g/ft³** technologies.
- These 2002 technologies target Euro3, and meet Euro 4 limits for NO_x and CO



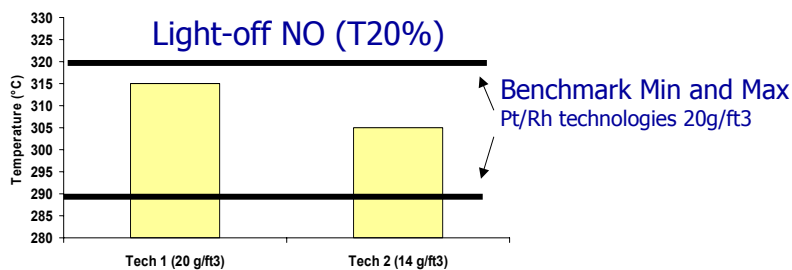
New process OSC materials enable low loaded Pt/Rh technologies

- Low loaded PGM technology, Tech 2, including new OSC materials, shows better light-off activity than high loaded PGM Tech 1 catalyst :
- Tech 2 is within technology benchmark range



New process OSC materials enable low loaded Pt/Rh technologies

- Low loaded PGM technology, Tech 2, including new OSC materials, shows better light-off activity than high loaded PGM Tech 1 catalyst :
- Tech 2 is within technology benchmark range



- **These new process materials are preferred Oxygen Storage Components for low loaded PGM technologies**

Thank you for your attention



**Rhodia is certified to highest
automotive quality standard**

**ISO 9001 : 1994
ISO/TS 16949 : 1999**

Rhodia
Electronics & Catalysis

*AVECC 2004 : Breakthrough Ce/Zr oxides as precious metal sup
in ultra low loaded precious metal catalysts techn.*