



# Literature Report

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Article

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## **Pt@CeO<sub>2</sub> Multicore@Shell Self-Assembled Nanospheres: Clean Synthesis, Structure Optimization, and Catalytic Applications**

Xiao Wang, Dapeng Liu, Shuyan Song, and Hongjie Zhang\*

State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun, 130022 Jilin, China

***Reporter: Zhou Lin***  
***Advisor: Prof. Zhao***

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# About the author-Prof. Hongjie Zhang



## Education

- 1974-1978 B.S. Peking University
- 1982-1985 M.A. Changchun Institute of Applied Chemistry  
Chinese Academy of Sciences
- 1989 - 1993 Ph.D. Université Bordeaux1 Sciences et Technologie

## Awards

- 1997 Outstanding Young Investigator Award
- 2013 Candidate of academician of CAS



## *Background*

- Pt-CeO<sub>2</sub> systems have drawn continuous attention.
- **Challenge:** Work at relatively high temperature;
- **Problem:** Aggregation, leading to loss of catalytic active centers and catalytic degradation;
- **Solution:** Looking for thermally stable catalysts;

**Fabrication of complex Pt/metal oxide hybrids with well-designed and controlled secondary nanostructures.**



## *Efficient ways to improve high temperature stability*

- Two main structure modulations:

Embedding metal NPs into stable porous inorganic nanostructures( $\text{CeO}_2$ ,  $\text{TiO}_2$ ,  $\text{SiO}_2$ ,  $\text{ZrO}_2$ )

→ My project

Encapsulating metal NPs with metal oxides to form core@shell or yolk@shell nanostructures

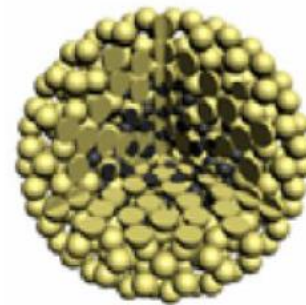
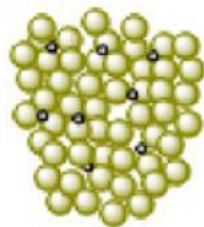
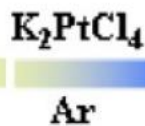
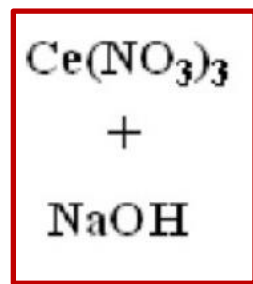
→ This work

Chen, C.; Nan, C.; Wang, D.; Su, Q.; Duan, H.; Liu, X.; Zhang, L.; Chu, D.; Song, W.; Peng, Q.; Li, Y. D. *Angew. Chem., Int. Ed.* **2011**, *50*, 3725.

Qi, J.; Chen, J.; Li, G. D.; Li, S. X.; Gao, Y.; Tang, Z. Y. *Energy Environ. Sci.* **2012**, *5*, 8937.

Lee, I.; Joo, J. B.; Yin, Y. D.; Zaera, F. *Angew. Chem., Int. Ed.* **2011**, *50*, 10208.

# Synthetic Scheme

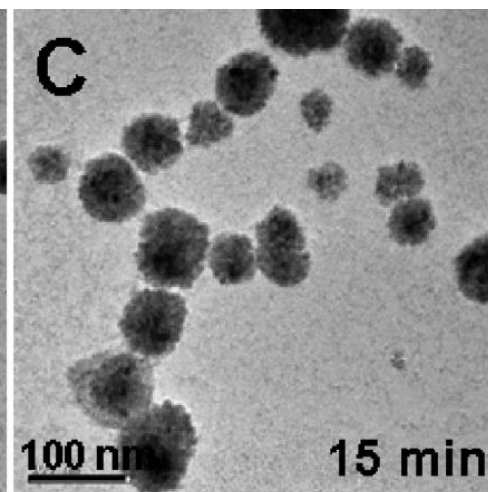
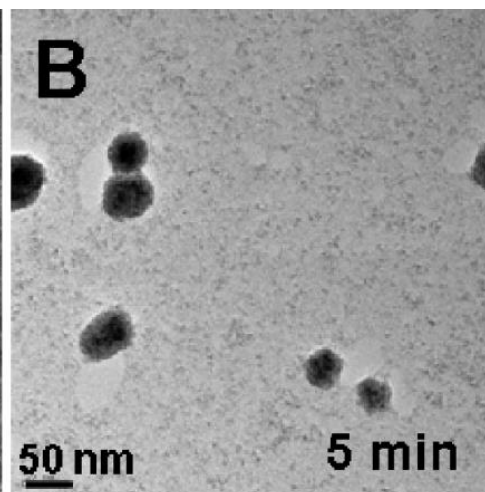
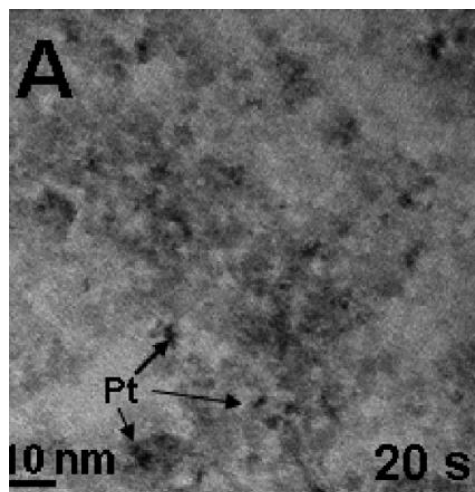


$\text{Ce}(\text{OH})_3$

Nucleation

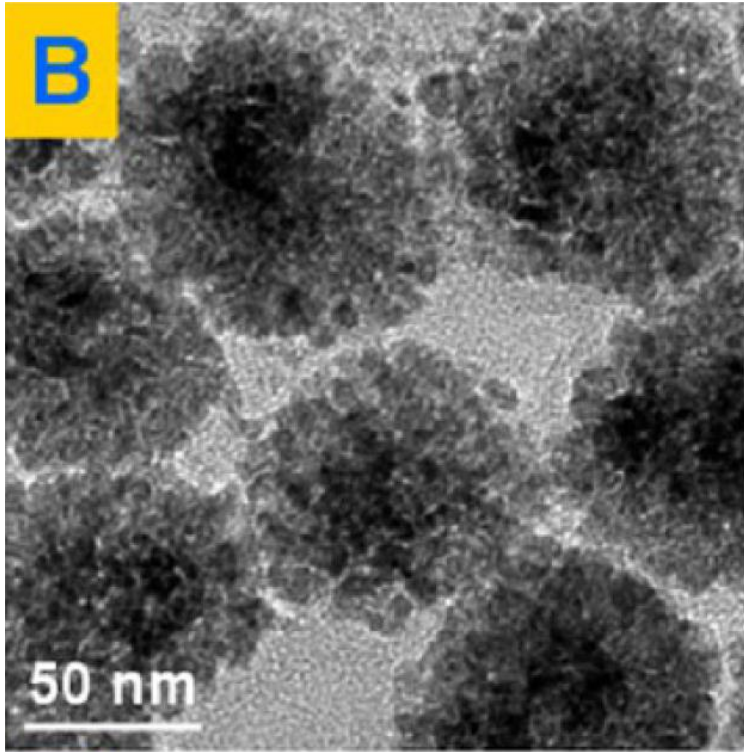
Self-assembly

● :  $\text{CeO}_2$   
○ : Pt



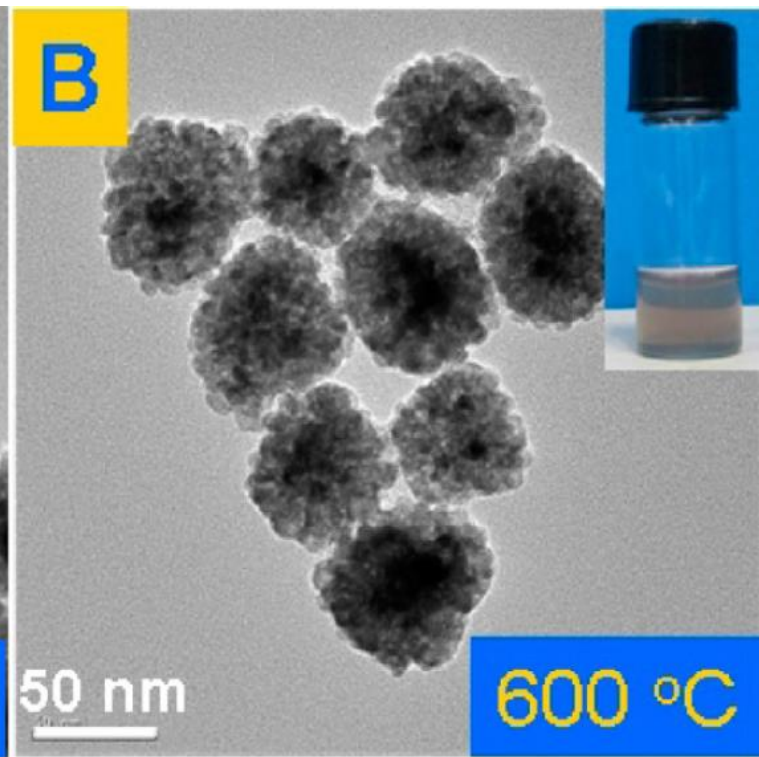
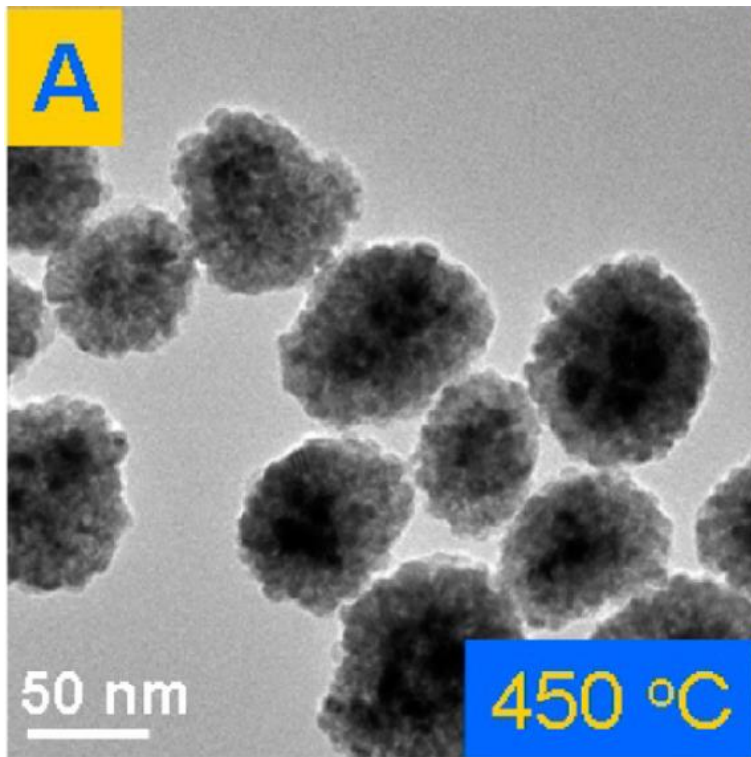


# *Structure Characterization*

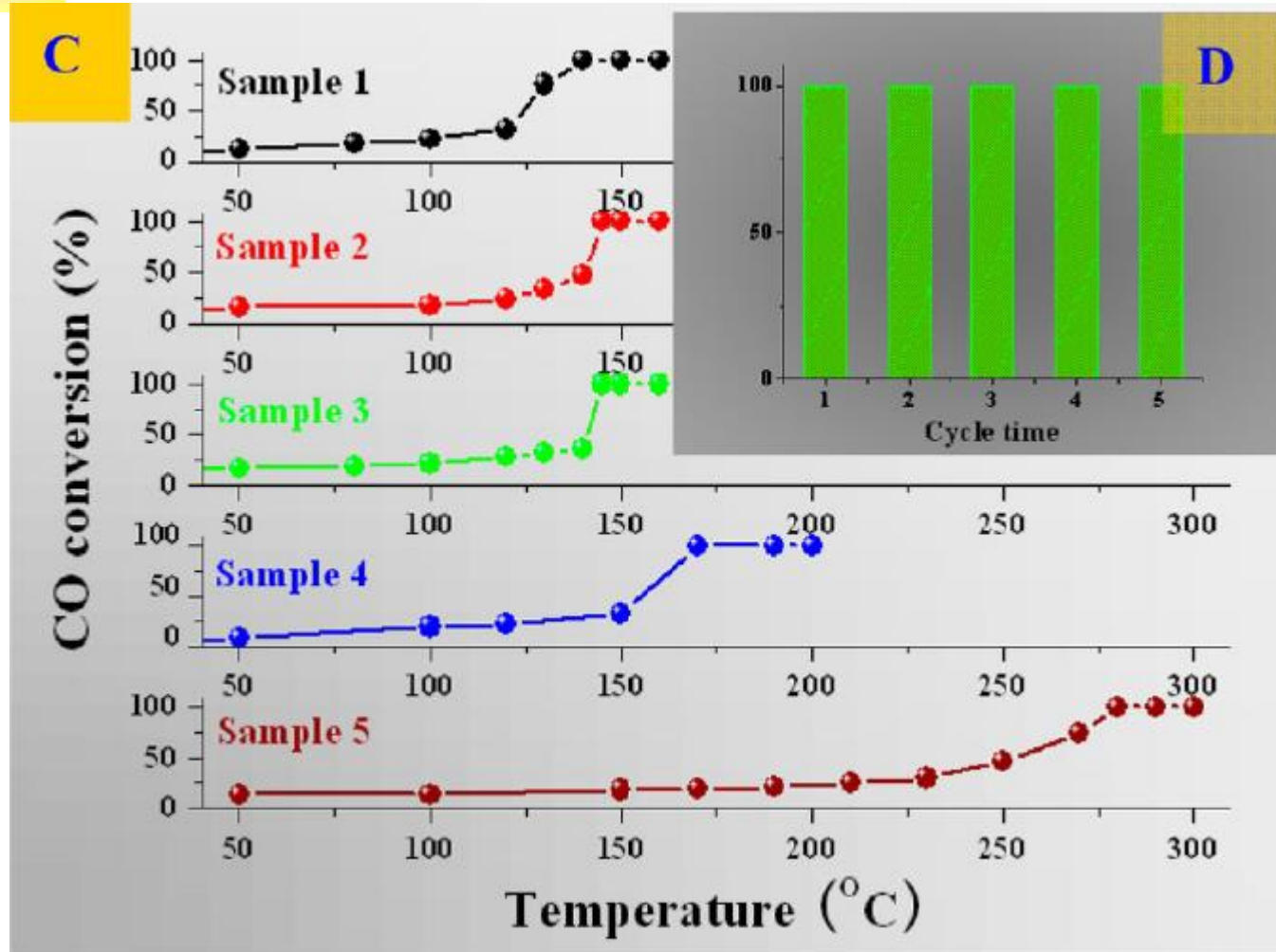




# *Thermal Stability*



# CO Catalytic Oxidation







# *Structure Optimization*

- **Limitations of Pt@CeO<sub>2</sub> nanospheres:**

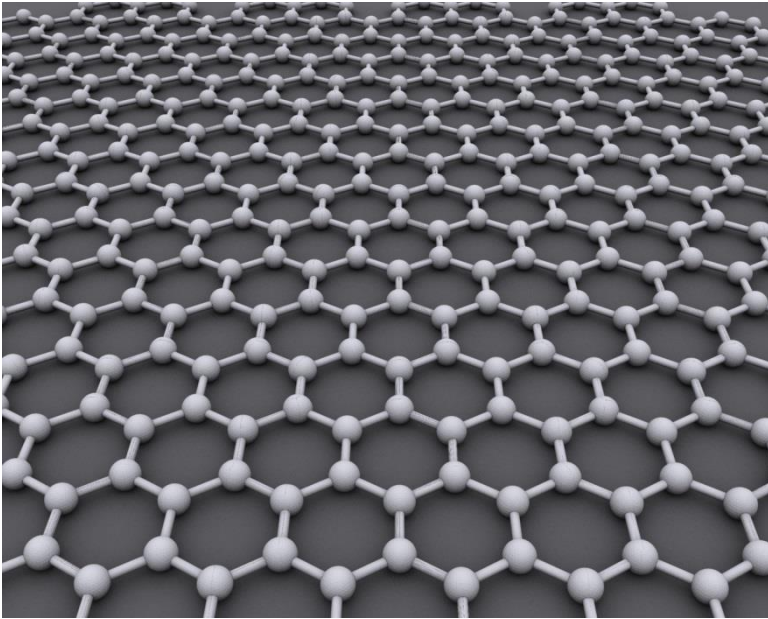
Hard to separate the catalysts due to their extremely good colloidal stability in water.

- **Solution:**

Graphene was chosen as the second substrate.



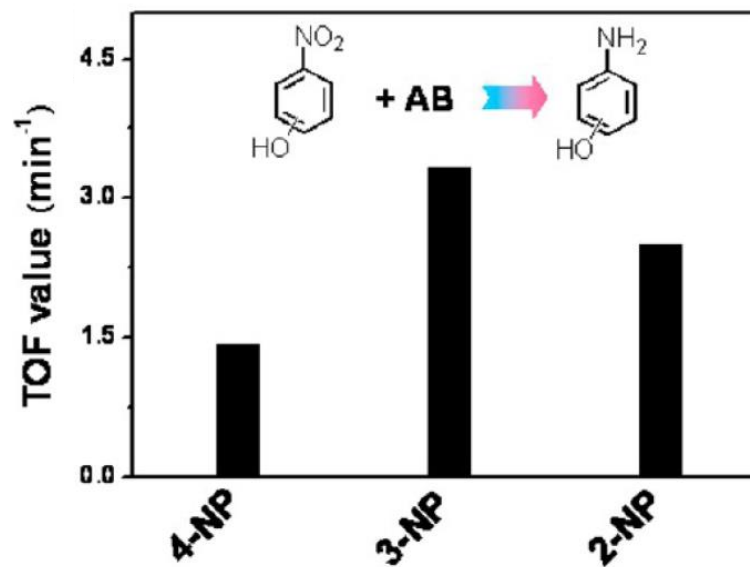
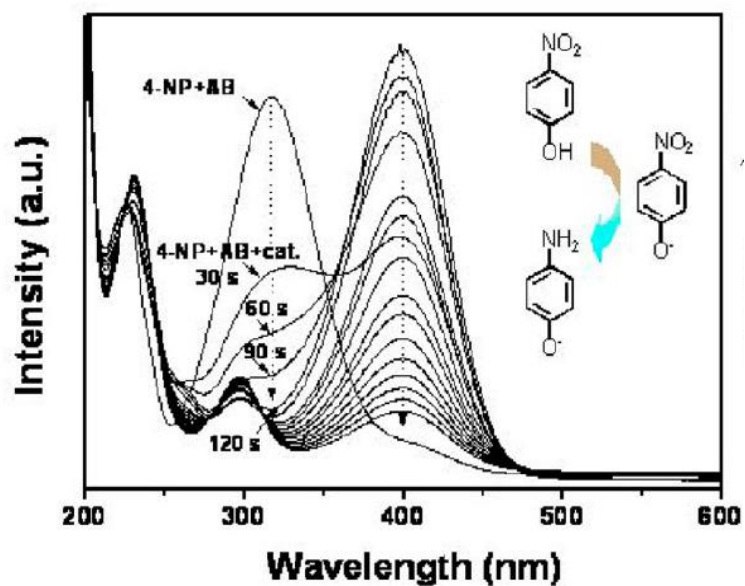
# *Graphene*



## Three important factors:

- Large surface areas: Fix and separate the active components from each other;
- Restriction of the Brownian motions of small particles;
- Collection of metal nanoparticles;

# Pt@CeO<sub>2</sub>/RGO





*Thanks for your listening!*